

# PROBLEM SOLVING & CREATIVITY

## CHAPTER 10

- **Problem solving:** the processes used when we want to reach a particular goal and that goal cannot be easily reached.
- "You face a **problem** whenever a \_\_\_\_\_ exists between where you are now and where you want to be -- \_\_\_\_\_."
- (Matlin, 1994, p. 331)
- **Think of problems you solved yesterday:**
  - essay exam required comparison of two theories that didn't seem to have any relationship
  - wanted to make something interesting for dinner, but nothing in the kitchen to fix
  - sat down to read a mystery, or watched a mystery on TV, or solved a crossword problem in the newspaper.

### Every Problem Contains 3 Features

- **Initial State:**
  - You wanted to make something interesting for dinner, but nothing in the kitchen to fix.
- **Goal State:**
  - You borrow some ingredients from a neighbor and create a fabulous dinner.
- **Obstacles:**

### UNDERSTANDING THE PROBLEM

- **UNDERSTANDING THE PROBLEM** involves creating an \_\_\_\_\_ of the problem.

#### Example

- Farmers were having problems harvesting their tomato crops by machine. The tomatoes are getting bruised in the process.

#### Example

- A grocery store is losing customers because they are annoyed at how long it takes to check out. If you were hired as a consultant to this company what would you suggest?

## 2 IMPORTANT STEPS TO UNDERSTANDING A PROBLEM

- The **first step** is deciding which information is \_\_\_\_\_ and which is \_\_\_\_\_.
- The **second step** is \_\_\_\_\_.

### THE FIVE- HANDED- MONSTER PROBLEM

- Three five-handed extraterrestrial monsters were holding three crystal globes.
- Because of the quantum-chemical peculiarities of their neighborhood, both monsters and globes come in exactly three sizes with no others permitted: small, medium, and large.
- The medium-sized monster was holding the small globe; the small monster was holding the large globe; and the large monster was holding the medium-sized globe.
- Since this situation offended their keenly developed sense of symmetry, they proceeded to transfer globes from one monster to another so that each monster would have a globe proportionate to his own size.
- Monster etiquette complicated the solution of the problem since it requires: that only one globe may be transferred at a time; that if a monster is holding two globes, only the larger of the two may be transferred; and that a globe may not be transferred to a monster that is holding a larger globe.
- By what sequence of transfers could the monsters have solved this problem?

### UNDERSTANDING THE PROBLEM

- **Divided attention:** this can hinder your ability to sort out what is \_\_\_\_\_.
- **Paying attention to important information**

### TWO IMPORTANT STEPS TO UNDERSTANDING A PROBLEM

- The **second step** is \_\_\_\_\_.
- **Methods of Representing the Problem:**

### MARY PROBLEM

- **Symbols:**
- Mary is ten years younger than twice Susan's age. Five years from now, Mary will be eight years older than Susan's age at that time. How old are Mary and Susan?

#### Problems Arise in Use of Symbols

- Linguistic interpretation of the words
- Schema consistent processing of previous misconceptions?
- Problem solver sometimes \_\_\_\_\_ and in so doing misrepresents the information.
  - Can't solve 5-Handed-Monster with algebra or symbols
- **What to use?**

### GRAPHS

#### BUDDHIST MONK PROBLEM

Exactly at sunrise one morning, a Buddhist monk set out to climb a tall mountain. The narrow path was not more than a foot or two wide, and it wound around the mountain to a beautiful, glittering temple at the mountain peak. The monk climbed the path at varying rates of speed. He stopped many times along the way to rest and to eat the fruit he carried with him. He reached the temple just before sunset. At the temple, he fasted and meditated for several days. Then he began his journey back along the same path, starting at sunrise and walking, as before, at variable speeds with many stops along the way. However, his average speed going down the hill was greater than his average climbing speed. Prove that there must be a spot along the path that the monk will pass on both trips at exactly the same time of day.

BUDDHIST MONK PROBLEM

#### IMAGERY

Images have the advantages of

- Can be \_\_\_\_\_ allowing us to escape \_\_\_\_\_
  - Monk meets himself coming down the hill.
- They are somewhat \_\_\_\_\_ – symbol for a theory that is not thoroughly

developed.

## WHICH METHOD IS BEST?

### PROBLEM SOLVING APPROACHES

- **ALGORITHM:** method that will always produce a solution to a problem, sooner or later.
  - **Exhaustive Search:**
    - **Mary & Susan's age problem** could start with  $m=0$  &  $s=0$ , then  $m=1$  &  $s=0$  and try out all possible values.
  - **Problem:** Algorithms are time consuming.
- **Heuristics:**
  - You explore only those alternatives that are most likely to produce a solution.

### THE HILL-CLIMBING HEURISTIC

- **The Hill-Climbing Heuristic:** Select the alternative that seems to
- **Problems:**

### MEANS-ENDS HEURISTIC

- **Means-Ends:**
  - 1<sup>ST</sup> you divide the problem up into \_\_\_\_\_.
  - 2<sup>ND</sup> you solve each sub-problem by detecting the differences between the \_\_\_\_\_ and the \_\_\_\_\_ and then reducing the differences between these two states.
- You are in the library when you remember that you must miss class at 11:00 AM. You have an Exam the next class meeting. You need Susan's meticulous notes.

**Research on the Mean-Ends Heuristic:**

- **Greeno (1974)** found that
  - People do not move ahead at steady rate –
  - People took a long time before \_\_\_\_\_.
  - Hobbits & Orcs requires some moves away from the goal.
  - The Problem:
  
- **Computer Simulation:** Researcher writes a program that will perform a task the “same” way that a human would.

**What can we gain from this?**

- Gives feedback on theories about \_\_\_\_\_.
- Computer language is much more \_\_\_\_\_ than human language -- forces theorist to be \_\_\_\_\_.
- If program works does not mean that it \_\_\_\_\_.

**MEANS-ENDS: Computer Simulation**

- Newell & Simon's **General Problem Solver (GPS):** Means-Ends analyses
  - **Ill-defined problems:** problems in which the goal is not obvious.
  - People can search for \_\_\_\_\_ – programs like GPS conduct a \_\_\_\_\_.

**ANALOGY AS A HEURISTIC**

- **Analogy Approach:**
- **Problem isomorphs** – problems that have the same \_\_\_\_\_ and \_\_\_\_\_, but different surface details

### ANALOGY AS A HEURISTIC

- Research portrays a pessimistic picture of people's ability to use analogy to solve problems (Novick, 1988)
  - Ss often fail to \_\_\_\_\_ the analogy or make \_\_\_\_\_ it.
  - Ss, especially novices, focus on salient \_\_\_\_\_.
  - These Ss fail to recognize the \_\_\_\_\_ -- the underlying core that must be understood.

### GENERAL STORY

#### Gick and Holyoak (1980,1983)

- If people are given this problem and simply asked to solve it \_\_\_\_\_

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- **Gick and Holyoak**

Gick and Holyoak (1980,1983)

### FACTORS THAT INFLUENCE PROBLEM SOLVING

- **MEMORY** - experts have different memory structure for their area of expertise.
- **DeGroot (1966)**: gave Ss brief presentation of chess board position and after the board was taken away he would ask them to reconstruct the positions.
- **Results**:
- **Results**:
- **Chase & Simon (1973)**: Hypothesized that expert chess players have a much better memory for various chess board positions because they can encode a larger size chunks of information than novices.

## FACTORS THAT INFLUENCE PROBLEM SOLVING

- **Knowledge Base/Expertise:** novices and experts differ in knowledge base or schemas.
  - It takes at least **10 years** of intense practice to gain expertise in an area (Ericsson & Charness, 1997).
  - Campitelli & Gobet (2011). *Current Directions in Psychological Science*, 20, 280–285
  - Hambrick & Meinz (2011). *Current Directions in Psychological Science*, 20, 275–279.
  - *Is a 16-year-old with a wide range of experiences a better problem-solver than a 16-year-old with a limited range of experiences? Is a 50-year-old always a better problem-solver than a 16-year-old?*
  - *If not, what other variable are involved?*
  - **Importance of specific knowledge:**
  - **Problem solving ability is an interaction of:**
  
- **Speed & Efficiency** - experts are much faster than novices & make fewer errors,
  
- Know other factors in your textbook
  
- **MENTAL SET:** Keep trying the \_\_\_\_\_ that has worked in the past.
  - Sort of \_\_\_\_\_ that sometimes blocks problem solving.

## FUNCTIONAL FIXEDNESS

- Duncker's (1945) candle problem
  - Imagine, you're led into a room that contains a table.
  - On the table there are 3 objects:
    - a candle
    - a box of matches
    - a box of thumbtacks
  
- Task: find a way to attach candle to the wall of the room so that it burns properly, using no other objects than those on the table.

### FUNCTIONAL FIXEDNESS

- **Functional Fixedness:** the \_\_\_\_\_ we assign to objects tend to stay fixed. People usually try to tack the candle to the wall or melt the candle to the wall somehow.
- **Key:** Representation of the problem space must include the \_\_\_\_\_ that holds the matches as a \_\_\_\_\_ as well as a container for the matches.

### INSIGHTFUL PROBLEM SOLVING

- **Behaviorist rejected the concept of insight**
- What appeared to be the use of insight could be explained by \_\_\_\_\_ of the animal.
- **Classic Experiment:** Wolfgang Kohler (1917): Sultan & the box and banana
- **Epstein et al. (1984):** Pigeon & the box and the banana

### STEREOTYPE THREAT

- **Stereotypes and Problem Solving**
  - our stereotypes can influence our beliefs about our own abilities
- **The Nature of Stereotype Threat**
  - struggling with a popular stereotype may cause additional \_\_\_\_\_ that may lead to less effective problem solving
  - **stereotype threat**—if you belong to a group that is hampered by a negative stereotype—and you think about your membership in that group—your performance may suffer
  - You don't have to believe in this stereotype for it to affect performance –
- **Potential Explanations**

### CREATIVITY

- Creativity is an area of problem solving that involves finding a solution that is both
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## FACTORS INFLUENCING CREATIVITY

- **Brainstorming Guidelines** (Osborn, 1957)
  - Evaluation of ideas must be held until later; thus criticism is ruled out.
  - The wilder the idea, the better. It is easier to tame an idea later than to think one up.
  - The greater the number of ideas, the better.
  - People can combine 2 or more ideas proposed by others.
  
- **Support for Brainstorming** = \_\_\_\_\_
  
- Research suggests that people are often \_\_\_\_\_ when they work alone.
  
- Brainstorming groups may produce \_\_\_\_\_ than groups encouraged to think critically, but they are of \_\_\_\_\_.
  
- **Incubation:** you are more likely to solve a problem if ...
  
- Incubation is \_\_\_\_\_ in well-controlled research.
  
- Need more \_\_\_\_\_ research w/ creative people solving real-world problems.
  
- **Hypotheses for mechanisms of incubation:**

## FACTORS INFLUENCING CREATIVITY SOCIAL FACTORS

- **Creativity will be reduced when:**