

Problem Solving

Chapter 11

1

What is a problem?

Problem can generally be defined as an **obstacle**, that remains perplexing until solved.

2

Reactions to a Problem

1. Problem exists, but the individual is not cognizant of it.
2. Problem exists and the individual is aware of it, however lacks the motivation to solve it.
3. The individual is aware of the problem, however does not know how to solve it or is in the process of solving it, and perhaps shows distress.
4. The individual has solved the problem and shows satisfaction.

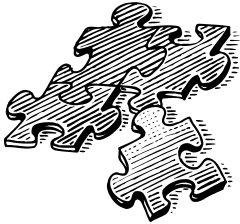
3

Kinds of Problems

4

Arrangement Problems

Jig-saw Puzzles



Requires recognition and transformation to solve

5

Arrangement Problems

Rearrange the letters to make words.

RWAET
KEROJ
MSROPBLE
AYXW

6

Solution

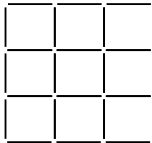
Requires recognition and transformation to solve.

Water
Joker
Problems
Waxy

7

Arrangement Problems

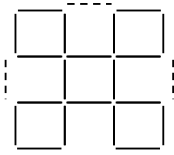
Remove four lines so that you end up with 5 equal sized squares.



8

Solution

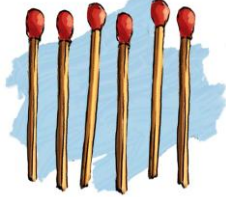
Requires trial and error and transformation to solve.



9

Arrangement Problems

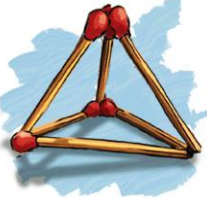
How would you arrange six matches to form four equilateral triangles?



10

Solution

Requires trial and error and transformation to solve.



11

Arrangement Problems

Using these materials, how would you mount the candle on a bulletin board?

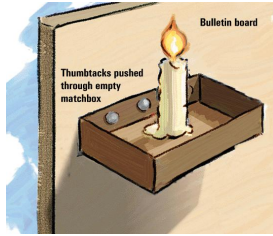


(Duncker, 1945)

12

Solution

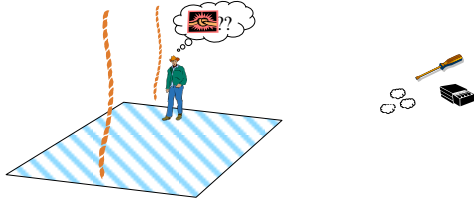
Requires trial and error and transformation to solve.



13

Arrangement Problems

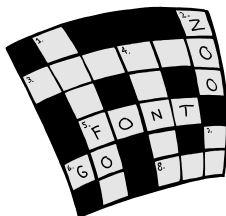
Join two ends of the ropes hanging from the ceiling with a knot. Materials provided: cotton balls, screw driver and match box.



Requires trial and error and transformation to solve. 14

Arrangement Problems

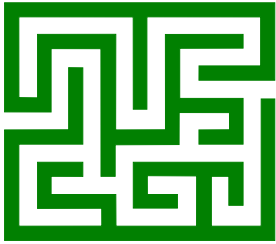
Cross-word Puzzles



Requires recall and transformation to solve 15

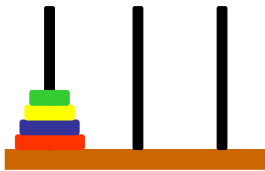
Transformation Problems

Maze Problems



Requires trial and error and sequential steps to solve. 16

Transformation Problems



Tower of Hanoi

Requires trial and error and sequential steps to solve. 17

Structure Problems

Problems with word, symbols, e.g., Series problems in math. Requires sequence/transformation.

A. 1 2 8 3 4 6 5 6 __

B. A B M C D M __

Requires recognition, mental and cognitive processes. 18

Kinds of Problems

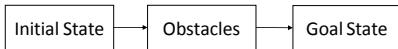
Problems can be of many kinds but they require both mental and manual activity for solution.

Solving a jigsaw puzzle is manual in nature but requires active mental acumen to place the pieces of puzzles in the correct place. Solving a math problem requires mental activity but the solver presents the solution on paper using hands and fingers.

19

Solution to Problems

1. **Initial State:** Describes the situation at the beginning of the problem.
2. **Obstacles:** Describes the restrictions that make it difficult to reach the goal state.
3. **Goal State:** Reaching the solution to the problem.



20

Steps to Solution

Steps	Condition
Initial State	I need to go to the library to study. Dorm is noisy and is far away from the library.
Obstacles	Cannot walk to the library. Don't have a car. My friends don't want me to go.
Goal State	Asked one of my friends to drive me down to the library. I am in the library studying.

21

Understanding Problem

Understanding is the key to solving problem.

1. Attention in problem solving.
2. Methods of representing problem.
3. The role of context in solving problem.

22

Attention

Attention must be given to relevant information in the problem.

Why? 1. Because attention is limited, 2. Attention given to irrelevant information distracts the individual from thinking about the problem.

23

Representing the Problem

Once the essential information in the problem is identified. The problem needs to be represented.

Representation means how do you state the problem. Clarification and representation of rules and regulations. Efficient representation leads to quick solutions of the problem.

24

Symbols

Problems can be translated into symbols (mathematical) that can help solve the problem. The difficulty arises, when problem is transferred into incorrect symbols; this leads to many mistakes made in the solution process.

Matrices

A matrix is a chart that shows all possible combinations of items and categories in a problem.

25

Diagrams

Diagrams and figures are yet another way that help us in solving problems. Diagrams can be of many kinds, e.g., hierarchical tree diagram, map-like diagrams, etc.

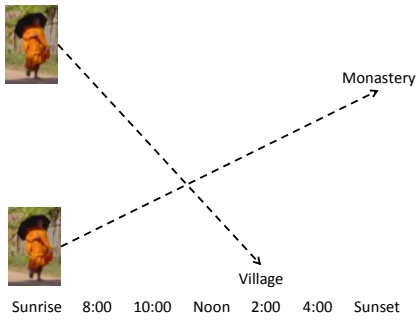
26

The Buddhist Monk Problem

Exactly at sunrise 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 rates of speed with many stops along the way. However his average speed going downhill was greater. Will there be a spot along the path that the monk will pass on both trips at exactly the same time of day? Why or why not?

27

Diagram for the monk problem



28

Visual Images

Imagery can also help us in solving problems. People who tend to high levels of imagery are better problem solvers than low imagery individuals.

Context

The ability to solve problems is tied to specific context and is termed as [situated-cognition approach](#). People are able to figure out a product is cheaper in the grocery store than on a paper and pencil test.

29

Strategies: Kinds of Heuristic

Hill-Climbing Heuristic: When choice point is reached in using a heuristic, one selects a route that leads directly to the goal.

Means-Ends Heuristic: Dividing the problem into sub-problems and reducing the difference between the initial and the goal state.

30

Hill-Climbing Heuristic

31

Means-Ends Heuristic

Getting articles from the library to write a paper, can be a means-ends heuristic. You spread your topic (problem) into many subtopics (sub-problems) and search for articles that discuss these subtopics. If your subtopics are adequately chosen reaching goal state is easy else you may need to go back to revise plans for new subtopics. Many computer programs are designed to use means-ends heuristics to solve problems. The [General Problem Solver \(GPS\)](#) is one such simulation, which mimics processes used by humans to solve problems.

32

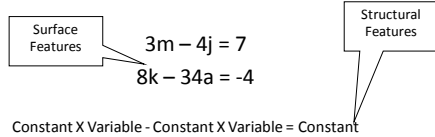
Analogy Approach

Problems can be solved by considering old solutions to previous problems. Thus using analogous procedures or principles to solve new problems.

33

Problem Isomorphs

Problems with same underlying structures but different specific details.



34

Analogy & Context

Failure to use analogy approach is usually context driven. New context can cloak the structural features of the problem. This can be overcome by giving hints.

35

Factors affecting Problem Solutions

Expertise: Is one big factor that differentiates people in their ability to solve problems.

1. **Knowledge Base:** Experts and novices differ in their knowledge base. Schemas.
2. **Memory:** Experts and novices differ in memory for specific expertise. Chess players.
3. **Representation:** Novices use simplistic representations for solving problems compared to experts.

36

Factors affecting Problem Solutions

4. **Problem-solving strategies:** Experts use means-ends heuristics generally to solve problems compared to novices.
5. **Speed and Accuracy:** Experts are faster and more accurate at solving problems. More parallel than serial processing.
6. **Metacognitive Skills:** Experts are better at monitoring their metacognitive processes than novices.

37

Mental Set

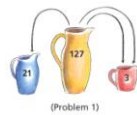
A tendency to approach a problem in a particular way especially a way that has been successful in the past but may or may not be helpful in solving a new problem.

A mental set predisposes our thinking in solving problems.

38

Mental Set

(Luchin, 1942)



Problem	Given jugs of these sizes			Measure out this much water
	A	B	C	
1	21	127	3	100
2	14	46	5	22
3	18	43	10	5
4	7	42	6	23
5	20	57	4	29
6	23	49	3	20
7	15	39	3	18



39

Mindlessness

Mindlessness, an entrapped mind, that is unable to use new information to solve problems, as opposed to mindfulness in which the individual is aware of new information helping in solving problems.

40

Functional Fixedness

Where mental set refers to our problem solving strategies, functional fixedness refers to the way we think about physical objects used in problems.

Putting candle on the bulletin board (Duncker, 1945). Rope tying problem.

41

Insight Problems

Problems that seem impossible to figure out, but then an alternative suddenly arises and the problem is solved.

Gestalt psychologists believe that animals expressed insight in solving problems



Grande using boxes to obtain food 42

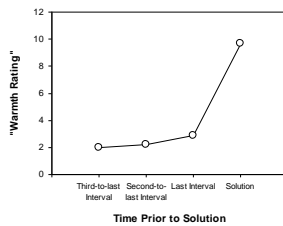
Non-insight Problems

Non-insight problems require a step-by-step, sequential effort in solving problems. Generally math questions require such an approach.

43

Metacognition during Solution

Metcalfe (1987) gave insight problems to subjects and asked them to rate their feeling of warmth every 10 seconds till the problem was solved. At solution subjects revealed high warmth ratings.



44

Creativity

Creativity is an area of problem solving with no real good definition. Being Creative generally means being novel or original.

Creativity requires one to be novel but at the same time it should be high quality and useful.

45

Who is Creative?

There are two schools of thought about creativity. One group believes that creativity results from ordinary thinking thus domain of common people. Others believe that creativity requires special expertise and only exceptional people have it.

46

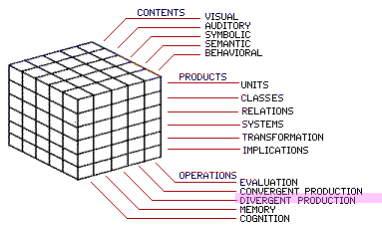
Approaches to Creativity

Two approaches have been taken to study creativity. One refers to *divergent production* (Guilford, 1967), and the other *multiple necessary components of creativity* (Sternberg & Lubart, 1995).

47

Structure of Intellect

Guilford proposed that creativity should be measured in terms of varied responses the individual can make on a test item.

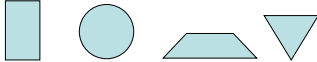


<http://tip.psychology.org>

48

Divergent Production

1. Many words begin with *L* and end with *N*. In one minute write as many words that have the form *L*____*N*. The words may have any number of letters between the *L* and the *N*.
2. Below are four shapes. In one minute combine them to make each of the following objects: a face, a lamp, a piece of playground equipment and a tree



49

Problems

1. Moderate correlation between items that measure divergent production and other measures of creativity.
2. Varied responses on these items do not guarantee novelty, high quality, and usefulness.

50

Investment Theory of Creativity

This theory proposes that a creative individual works like a proficient investor who buys for less and sells for more.

Creative idea is "introduced" when no one is interested in it ... over time it gains popularity ...and the creative individual moves forward to make more.

51

Creative People

1. Intelligence
2. Knowledge
3. Motivation
4. An encouraging environment
5. An appropriate thinking style
6. An appropriate personality

For creativity all six attributes must work. If the individual had five and not one (intelligence), creativity would not work.

52

Motivation & Creativity

It is believed that intrinsic motivation harbors creativity compared to extrinsic motivation. Intrinsic motivation is defined as working for a task for its own sake (Amabile, 1999).

53

Intrinsic Motivation

Rate Task	Do Task
Art	Art
Writing	Writing
Problem Solving	Problem Solving

Students were more creative in tasks they rated high in likeness (Ruscio et al, 1998).

54

American Haiku

Ocean
 Wavy, foamy
 Roll, rumble, crash
 All captured in this shell at my ear
 Ocean

55

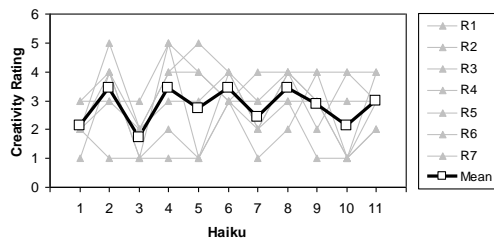
Spring

Spring Sunny, rainy Growth, renewal, brightens Flowers blossom all around Spring	Spring Life, Birth Warm, Sunny Green The rebirth of Nature's Art Spring
Spring Itchy, Sneezy Allergic, antihistamine, beautiful Allergy ridden beauty Spring	Spring Raw, cool Grow, birth, shine Just outside my window pane Spring
Spring New, Beautiful Growing, beginning, beautiful A new birth for the world to see Spring	Spring Rebirth, beautiful Playful children, Barbeque The most joyous season of the year Spring

Six out of 11 Haikus

56

Haiku: Spring



Low Creativity High Creativity
 ① ② ③ ④ ⑤

57

Extrinsic Motivation

Extrinsic motivation generally seems to be an obstacle in creativity.

In Ruscio et al., (1998) study when subjects were told that their poems will be judged by poets, their creativity declined.

58

Incubation & Creativity

Incubation is defined as a break that lies between unsuccessful attempts of solving a problem and successfully solving it.

Many scientists, artists, writers and craftsmen vouch for this period to be the basis of creativity. Research shows some relationship between creativity and incubation. Perhaps because of artificial nature lab research.

59

How does Incubation work?

When engaged in solving a problem, the individual may be blocked because of mental set and functional fixedness. Changing his environment or taking a break helps to overcome these obstacles rendering a creative solution.

60
