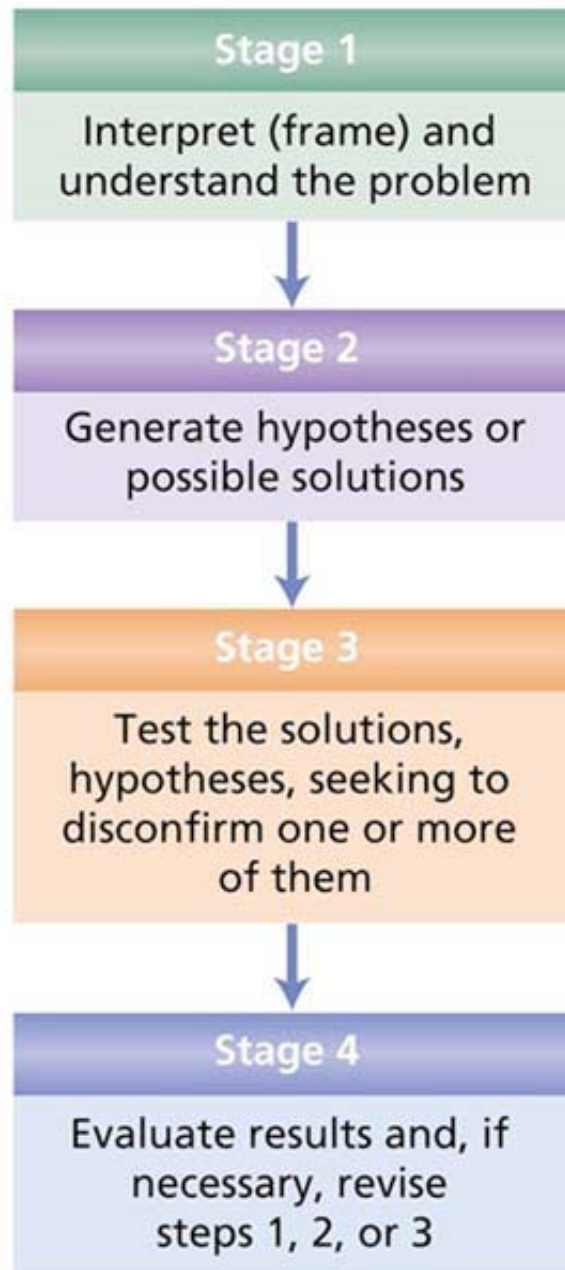


Figure 8.15: The Stages of Problem Solving

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Stage 0: Identify and Notice a Problem

Before you can solve a problem, you must be able to identify a problem to be solved. In the following examples, the users of the technology noticed problems in their practical implementation.

Allied Radar versus German Radar

In his study of innovation during and immediately after WWII, J.F.O McAllister contrasted British and Nazi science efforts. “German war science was hierarchical and compartmentalized, discouraged free-wheeling interchange between scientists and soldier (the user). Hence while German radar was beautifully engineered, achieving signal stability “that was better than that of the best instruments that Britain had available”, the German method of displaying the aircraft position was awkward for air defense controllers to use. (From *When Sparks Fly, Igniting Creativity in Groups*, page 30).

Tanks, Telephones and the Foot Soldier

During WWII, the way you got a tank to fire at a target would be to bang the butt of your rifle on the tank to get the tank commander's attention. He might pop his head out if it was safe. When he did, you would shout to the commander where you wanted him to fire. He might not hear you and you would have to repeat it, and he would look to see where you wanted him to fire. Now this doesn't seem so bad, but all this time, your enemy (the Germans or Italians) sees the tank commander and start shooting at him.

One way they solved this problem is to put telephones on the back of tanks so that soldiers outside could communicate with the tank commander. Where did this idea come from? The soldiers. None of the engineers thought of this, none of them noticed this problem, or the opportunity to solve the problem.

Rubbermaid with No Ideas?

When the Sundberg-Ferar product development firm was helping Rubbermaid develop a new walker for adults with limited mobility, they convened in nursing homes focus groups of people using walkers. “What could we do to improve your walkers?” The participants shook their heads. They liked their walkers as they were. Nope, they couldn’t suggest any improvements if the walker could be redesigned from scratch. The researchers gave up and excused the group members.

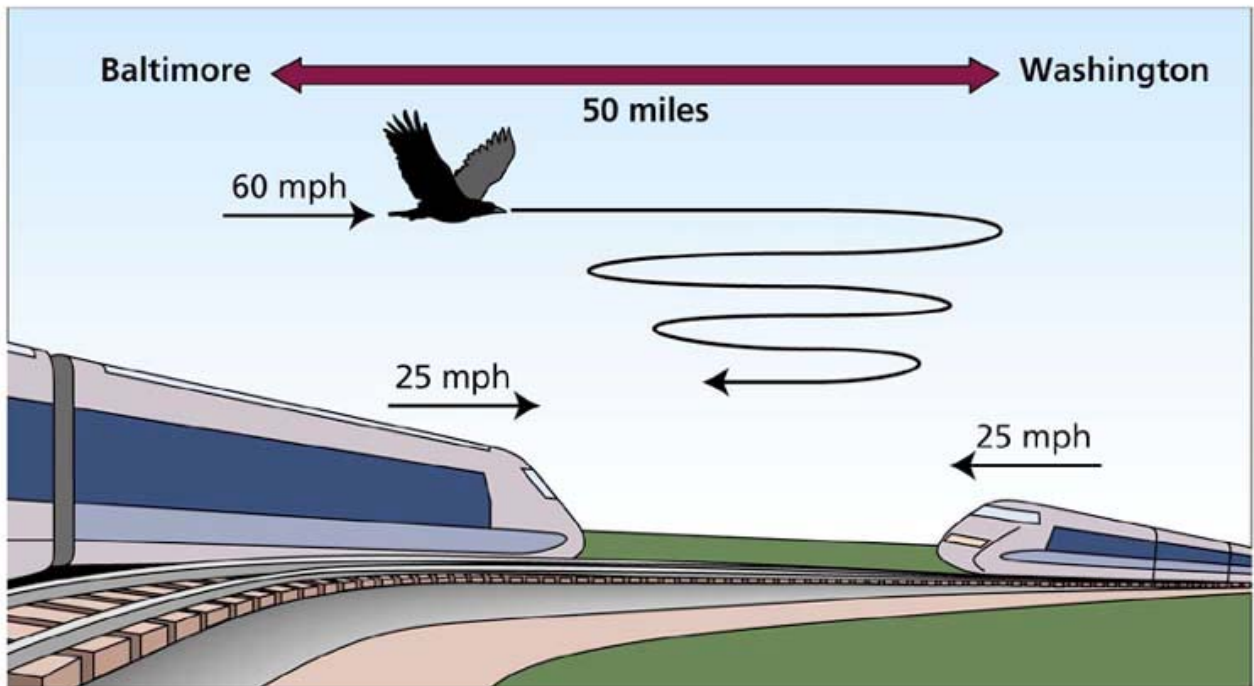
Only when the respondents got up and retrieved their walkers to exit the room did the researchers find that one woman had tied a bicycle basket to her walker with shoe strings; a man had fashioned a holder for his cordless phone out of duct tape; another had hung an aftermarket automotive cupholder on his walker!

These observations led Sundberg-Ferar to design a build-in flexible mesh pouch for walkers, providing what Rubbermaid called a CCA, a compelling competitive advantage. (From *When Sparks Fly Igniting Creativity in Groups*, page 85, 86)

Stage 1: Interpret (frame) and Understand the Problem

Train A leaves Baltimore for its 50 mile trip to Washington D.C. at a constant speed of 25 mph. At the same time, train B leaves Washington D.C. bound for Baltimore at the same speed of 25 mph.

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A crow that happened on a methamphetamine lab and sampled its product leaves Baltimore at the same time as train A, flying above the tracks toward Washington D.C. at a speed of 60 mph. When the crow encounters train B, it turns and flies toward train A, then instantly reverses its direction and flies back to train B. This supercharged bird continues this sequence until Train A and Train B meet midway between Baltimore and Washington D.C.

How far has the crow flown?

Mental Representations: Barriers for Insight

Horse problem

A man bought a horse for \$60 and sold it for \$70. Then he bought the same horse for \$80 and sold it again for \$90.

- Write down how much money was made in both transactions combined.

Techniques to solve the problem:

- Carry out a simulation with money to see what the actual results are.
- Add up the total amount of money paid out and compare it with the total amount of money paid in.
- Change the mental representation of the problem (see below).

The method you use should all lead to the same answer. When in doubt about an answer to a problem, try different techniques. If they come to different answers, there is a problem with one of your methods that need to be examined.

A man bought a horse for \$60 and sold it for \$70.
Then he bought firewood for \$80 and sold it for \$90.
How much money did he make in both transactions combined?

Hotel Problem

A hotel detective was making his rounds through the corridors of the hotel. As he passed by a room, he heard a voice behind the closed door. The voice yelled, "Don't shoot John!" Immediately afterwards, the detective heard a gun discharge. He immediately broke into the room and encountered the following scene.

A dead woman was lying on the floor. Next to her was a gun. Three people were standing around her. They were a judge, a soldier, and a mail carrier. The detective immediately arrested the mail carrier for murder.

Based on the information provided, how did the hotel detective know to arrest the mail carrier?

If you know the answer, raise your hand, and I will tally how many people know the answer. **DO NOT** reveal how you know the answer. We may need to create a visual representation to help solve the problem.

How does the representation affect your ability to solve the problem?

Stage 2: Generate hypotheses or Possible Solutions

Problem Solving Strategies

- **Algorithms:** A strategy that involves following a specific rule, procedure or method that inevitably will produce a correct solution.
- **Heuristics:** A general rule of thumb.
 1. **Subgoal Analysis--Break the problem into smaller problems:** In the homework assignment to identify schedules of reinforcements and reinforcements/punishments, it is easier to break it into two smaller problems.
 2. **Means-end analysis:** The identification of differences between the present situation and the desired state or goal
- **Insight:** A sudden realization or intuition on how to solve a problem. Different representations can lead to different insights.
- **Trial and error:** A strategy that involves attempting different solutions and eliminating those that do not work.

Algorithms

A strategy that involves following a specific rule, procedure or method that inevitably will produce a correct solution.

Examples:

- Trying all possible combinations on a combination lock to unlock it.
 - Trying all keys on your key chain to unlock the door.
 - The movie Sneakers: SETEC ASTRONOMY
MY SOCRATES NOTE or TOO MANY SECRETS
 - Trying to find your friends house, except for instead of just driving around hoping you are going to find it, you go up and down each street in a systematic manner.
-
- What are the advantages of the algorithm strategy?
 - What are the disadvantages of the algorithm strategy?
-

Heuristics

A general rule of thumb.

Like trial and error, you can get accidentally reinforced for coming up with the solution. When this occurs, it is likely that you repeat this strategy (remember Thorndike, the law of effect, cats in puzzle boxes).

Examples:

- Means-Ends Analysis
 - Working backwards to solve a maze.
 - Sub-goal Analysis
 - Break a large problem into smaller ones.
 - Write a “to do list”
 - If you are trying to remember a person’s name, you can go through each letter of the alphabet as a retrieval cue. Does it start with an A, B, C....
 - Looking in the manual when a game, VCR, car doesn’t work like it is suppose to.
 - What works in the past might work now.
-
- What are the advantages of using heuristics to solve problems?
 - What are the disadvantages of using heuristics to solve problems?

Insight

A sudden realization or intuition on how to solve a problem. Different representations can lead to different insights. Prior experiences in solving similar problems increases the likelihood that you will be able to solve a particular class of problems.

People with *expertise* in a topic are better at insight and trial and error problem solving strategies

Examples:

- The circle problem.
- An unsuccessful attempt to sell a car called the Nova in Spanish speaking country (this is actually an urban legend).
- Discovering a strategy to remember the following sequence of 20 numbers
1 7 7 6 1 8 1 2 1 8 6 1 1 9 1 4 1 9 4 2.
- The murder problem (mail carrier, judge and soldier).
- Using insight to reorganize information (see previous chapter on memory)
- The inspiration for one of the first computers (called a tabulator) for the 1890 census came from the Jacquard loom.
- The inspiration for velcro (velvet crochet) came from nature (a cocklebur). “People have been removing burs since we were wearing saber-toothed tiger pelts, and no one else had thought to make a virtue (and millions of dollars) out of how tenaciously the burs cling”, (page 77, When Sparks Fly).

Trial and error

A strategy that involve attempting different solutions and eliminating those that do not work. Trial and error strategies can lead to superstitious behavior or heuristical thinking through accidental or coincidental reinforcement (see Chapter 6).

Examples:

- If this keystroke doesn't make the computer work, the next one might...
- Thomas Edison tried thousands of filaments for a light bulb before finding one that was appropriate.
- If you forgot where your friend lives, you can randomly try a variety of streets to see if you can find it.
- The cats in Thorndike's Puzzle Box

What are the advantages of the trial and error strategy?
What are the disadvantages of the trial and error strategy?

Drug treatments, public policies, oil drilling, crime prevention, and launching a space shuttle would be bad trial and error decisions.

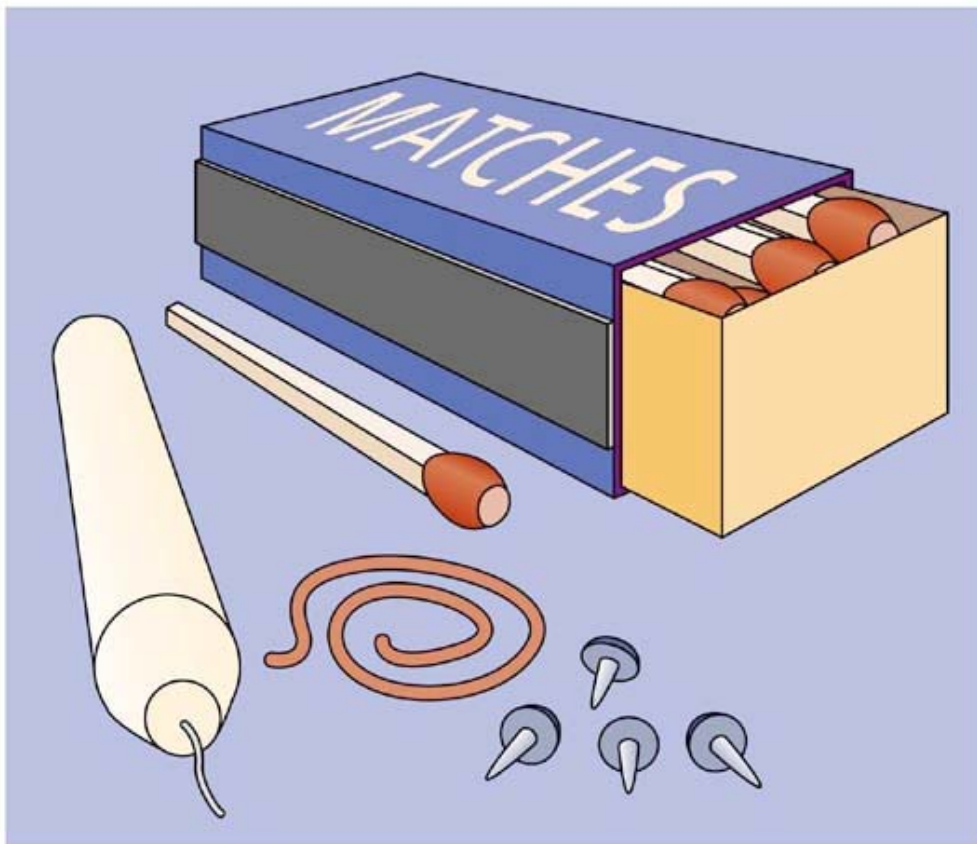
Barriers to solving problems and creativity

Functional fixedness	The tendency to view objects as functioning only in their usual or customary way.
Mental sets	The tendency to persist in solving a problem with solutions that have worked in the past (also see heuristics). This can keep you from noticing problems, novel ways of approaching it, or looking at the problem from a different perspective.
Mental representation	Sometimes, how you solve a problem is how you mentally represent it or frame the problem. Certain frames can make it easier, or more difficult to see “a solution”.
Selective exposure	The tendency to selectively associate with people who are similar to you.
Normative influence	The desire to be accepted by the group makes it difficult to express different ideas. A norm needs to be established that constructive disagreement is acceptable to spark creativity.

Functional Fixedness

Functional fixedness The tendency to view objects as functioning only in their usual or customary way.

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Using these objects, find a way to mount the candle on the wall so it functions like a lamp

Mental Sets

The tendency to persist in solving a problem with solutions that have worked in the past (also see heuristics).

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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

- “Oil change service”: How have they changed in the last 10 years?
- Raising Arizona with Nicholas Cage and Holly Hunt
- “When something breaks, throw it away and buy a new one versus fixing it”
- Rubbermaid with “No Ideas”: I list this example under noticing the problem as well as under mental sets. Why?
- Calculating averages or percentages