

## Problem Solving Strategies

### **IDEAL**

- I Identify the problem
- D Define and represent the problem
- E Explore possible strategies or solutions
- A Act on a selected strategy or solution
- L Look back and evaluate

**Trial and error:** A strategy that involve 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.

**Heuristics:** A general rule of thumb.

1. **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.

**Insight:** A sudden realization or intuition on how to solve a problem. Different representations can lead to different insights.

## **Creativity, Innovation and Problem Solving**

Would you consider the following people to be creative and innovative when they invented the respective technologies?

- Thomas Edison (light bulb, phonograph)
  - James Watt (steam engine)
  - Alexander Graham Bell (telephone)
  - Johan Gutenberg (printing press)
  - Henry Ford (automobile production line)
- (see Connections I video series)

Some people consider inventors to be creative and innovative. However, many of these inventors built their work on of others—combined different ideas in a new way. Which of the following inventions were considered “worthless” at the time they were introduced to the public?

Color television  
Submarine  
Microwave oven  
Typewriter  
Telephone  
Xerox machine

Being creative requires persistence and having a lot of ideas. When we have a creative idea, we don't realize all of the non-creative ideas, making it difficult to see the creative process.

## Barriers to solving problems and creativity

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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).
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. There is an “urge to merge”. A norm needs to be established that constructive disagreement is acceptable to spark creativity.

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## Strategies to gain insight into solving problems

- Reframe the problem
- Observe and identify problems
- Observe the users of the technologies

## **Functional Fixedness**

In high school I stayed at a friend's house the night before a class trip. Our bus left very early in the morning and we were running late. It was time to go and she still had wet hair. She said, "No problem, I'll dry it in the car." I didn't understand but rushed around to get ready. Once in the car, she turned the heater on high and dried her hair as I drove us to catch the bus. I would have never thought of using the car heater as a hair dryer.

I bought frozen orange juice. When I got home, Nicole told me we didn't have a pitcher to put it in. I simply went over and grabbed an empty 2 liter bottle from ginger ale and used that.

Have you ever spent a lot of time looking for a flat-headed screwdriver when a dime would have worked just as well?

I have a kitchen hammer that I saw kitchen chefs use to crush garlic with (observational learning). However, it is packed away somewhere, and I don't want to take the effort to go find it. Instead, I take a can of chili (the glass jars are too risky) and use it to crush the garlic.

## **Mental Sets**

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

“Oil change service”

“When something breaks, throw it away and buy a new one versus fixing it”

## **Normative influence and institutional barriers**

### **When Sparks Fly: Igniting Creativity in Groups**

“Surprise me,” the CEO said to John, who had just assumed the newly created title of Director of Business Development. “You can hire six new people. Get some young blood in here and find us some new products—ones we can bring to market in, say three or four years. Let’s see what possibilities a creative group of people can identify in eighteen months.” John was thrilled; what an opportunity at age thirty-four! He recruited three of the best financially minded, calculator-wielding MBAs he could find and set them to work sifting through the hundreds of possibilities in the research pipeline. With three job openings left, he pawed through dozens of impressive resumes before selecting three highly qualified young engineers. Eighteen months passed in a whirl of financial and technical analyses. To John’s delight, the group members worked well together and became good friends. However, at the end, John was the one surprised—and out of a job. The group had rejected every idea in the pipeline on the basis of either financial or technical unfeasibility; they had identified not a single new idea worth pursuing. As John moved on to a different company, he was baffled: How could such a smart, well-qualified bunch of people have failed? (Source: From When Sparks Fly, Igniting Creativity in Groups, page19)

Why couldn’t John’s team of highly qualified engineers and MBAs come up with any new ideas?

## **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 too 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.

## **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).

## Chapter 3

### Generating Creative Options

“I don’t need to tell you how important this distance learning contract is,” said Hazel as she opened the meeting. “If we get to design the ad campaign, we’ll have a whole new line of business. That’s why I’ve put our very best people on this team—including Fred from Sales and Tom—even though he’s moved to our financial services account. I know some of you were a bit surprised at my bringing them in, but we needed a variety of backgrounds and knowledge to be creative. I was really pleased with yesterday’s brainstorming session—we came up with a lot of cool ideas. Given our schedule and resource constraints, I’ve gone ahead and selected one to work on. The parody of university professors concept was funny—but I don’t think we know enough about university teaching to pull it off. And I liked the notion of outreach to kids in developing nations, but we could offend some people with that one. So I suggest we go with the puppy training idea. If your dog can be trained to sit up and beg through the Internet, then for sure your kids can be taught calculus the same way. People like animals in ads; it won’t offend anyone; we can make it funny and it’s a low budget approach. I’ve divided you up into three subgroups; each group needs to get going on slogans, storyboards, budgets. We’ll get together next Friday to see what you’ve come up with and select the best treatment. Any questions? No? Okay, let’s move.

From When Sparks Fly, Igniting Creativity in Groups



## “Real-world” Examples about Innovation, Creativity and Problem Solving

World War II: American tanks and telephones  
(communication of ideas with the user is important for innovation)

World War II: German radar (institutional barriers to innovation)

Anthropologists and copier paper jams.

Rubbermaid and walkers.

Fischer-Price and action toys

Velcro

Raising Arizona (Nicholas Cage and Holly Hunt)

**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.

## 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?

## Grading Problem

A fellow instructor has 8 homework assignments. She uses the best 7, and drops the lowest, to calculate the students' average homework grade. Many instructors use a spreadsheet like EXCEL to keep track of grades, which contains many mathematical functions (sum, average, count, max, min, standard deviation, sine, cosine, tangent, etc.) How can you tell EXCEL what the average of the student's highest 7 scores are?

Bob	<b>75</b>	<b>65</b>	<b>96</b>	<b>84</b>	<b>95</b>	<b>99</b>	<b>89</b>	<b>87</b>
Albert	<b>88</b>	<b>96</b>	<b>86</b>	<b>78</b>	<b>92</b>	<b>95</b>	<b>86</b>	<b>71</b>
Doris	<b>84</b>	<b>95</b>	<b>70</b>	<b>85</b>	<b>73</b>	<b>96</b>	<b>84</b>	<b>94</b>

### Examples of the functions

=Sum (a1:a8)

=Average (a1:a8)

Answer: Reframe the problem as dropping the lowest score

Calculate the minimum score

Calculate the total score

Subtract the minimum score from the total

Divide the total by 7

What does this illustrate about problem solving? Sometimes you need to change the representation to solve the problem.

## **Xerox, Paper Jams and Anthropologists**

How about mixing anthropologists in with computer scientists? Introducing social scientists into a laboratory of “hard science” where physics and mathematics have traditionally ruled is not an intuitive way to encourage creativity. However, observations by anthropologists have deeply affected the design of copier machines. The traditional inclination of Xerox engineers was to make the machines “idiot-proof”, that is, to try to anticipate everything that could possibly go wrong and design such problems out of the system. The anthropological approach was to observe and deeply understand the interaction of people with the machine, beyond ergonomic factors. The anthropologists filmed a couple of leading computer scientists trying to use a new machine to do their copying. The footage of some very smart people becoming increasingly frustrated led to an important insight. Some trouble in using the machines was inevitable because of the increasing scope of tasks covered. The solution was to help users manage troubleshooting through customized instructions in the display panel, linked to particular procedures, and visuals depicting the location of the problem. Clearing paper jams now took 20 seconds, compared to 28 minutes before the redesign. (From When Sparks Fly, Igniting Creativity in Groups, page 25, 26).

## **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)

## Action-Heroes and Fisher-Price

Consider the following dilemma at Mattel's Fisher-Price division. The action figure market for little boys is a *big* one—and Fisher-Price is in the toy business (among others). But the company values, reflecting a dedication to pleasing primary purchaser Mom as well as child, include a strong prohibition against violent toys. So how could they pursue this important market segment without producing shoot-'em-up Rambo figures? Marilyn Wilson-Hadid, vice president of marketing (the dominant function at Fisher-Price), and Peter Pook, vice president of product development, argued long and hard. Pook insisted that the action figure market segment was critical. Wilson-Hadid steadfastly maintained that no Fisher-Price toy could present violence in a favorable light. Every product concept Pook offered, Wilson-Hadid countered with: "How are we going to talk to the mothers about this?"

For those of you without children or haven't had the benefit of playing with these toys, how do you think they could have resolve the problem?

### Possible option:

Options included ideas such as "equip-men" with super power tools that were a kind of "un-gun," but would appeal to the same desire for combat as action figures, with their oversized weapons.

The final positioning? Rescue Heroes— “cool guys that are good guys”: Billy Blazes, Fire Fighter; Rocky Canyon, Mountain Ranger; Gil Gripper, Scuba Diver; and Jack Hammer, “Construction Expert.” Each figure is equipped with a special tool that does something dramatic when a trigger is pulled, pushed, or released. The policeman has a noisy bullhorn and siren, the (female) Fire Fighter has a chopping axe, the Scuba Diver has a clamp, and the Construction Expert has a jackhammer. The toys have been a huge success because they please both little boys’ desire for action and Mom’s preference that it be more positive than violence against others. In fact (somewhat to the surprise of the designers), children are observed to engage in “helpful behavior,” such as using the toys to “rescue” other figures in imaginary straits. The product thus protects what Fisher-Price teams value as a distinctive advantage: the “Mom benefit.” (From When Sparks Fly, Igniting Creativity in Groups, page 105)



## **Velcro**

Sometimes solving a problem requires insight, looking at the problem in a different way (reframing the problem), or reframing the question.

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”.