

Introduction to Creative Thinking

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Much of the thinking done in formal education emphasizes the skills of analysis--teaching students how to understand claims, follow or create a logical argument, figure out the answer, eliminate the incorrect paths and focus on the correct one. However, there is another kind of thinking, one that focuses on exploring ideas, generating possibilities, looking for many right answers rather than just one. Both of these kinds of thinking are vital to a successful working life, yet the latter one tends to be ignored until after college. We might differentiate these two kinds of thinking like this:

Critical Thinking	Creative Thinking
analytic	generative
convergent	divergent
vertical	lateral
probability	possibility
judgment	suspended judgment
focused	diffuse
objective	subjective
answer	an answer
left brain	right brain
verbal	visual
linear	associative
reasoning	richness, novelty
yes but	yes and

In an activity like problem solving, both kinds of thinking are important to us. First, we must analyze the problem; then we must generate possible solutions; next we must choose and implement the best solution; and finally, we must evaluate the effectiveness of the solution. As you can see, this process reveals an alternation between the two kinds of thinking, critical and creative. In practice, both kinds of thinking operate together much of the time and are not really independent of each other.

What is Creativity?

An Ability. A simple definition is that creativity is the ability to imagine or invent something new. As we will see below, creativity is not the ability to create out of nothing (only God can do that), but the ability to generate new ideas by combining, changing, or reapplying existing ideas. Some creative ideas are astonishing and brilliant, while others are just simple, good, practical ideas that no one seems to have thought of yet.

Believe it or not, everyone has substantial creative ability. Just look at how creative children are. In adults, creativity has too often been suppressed through education, but it is still there and can be reawakened. Often all that's needed to be creative is to make a commitment to creativity and to take the time for it.

An Attitude. Creativity is also an attitude: the ability to accept change and newness, a willingness to play with ideas and possibilities, a flexibility of outlook, the habit of enjoying the good, while looking for ways to improve it. We are socialized into accepting only a small number of permitted or normal things, like chocolate-covered strawberries, for example. The creative person realizes that there are other possibilities, like peanut butter and banana sandwiches, or chocolate-covered prunes.

A Process. Creative people work hard and continually to improve ideas and solutions, by making gradual alterations and refinements to their works. Contrary to the mythology surrounding creativity, very, very few works of creative excellence are produced with a single stroke of brilliance or in a frenzy of rapid activity. Much closer to the real truth are the stories of companies who had to take the invention away from the inventor in order to market it because the inventor would have kept on tweaking it and fiddling with it, always trying to make it a little better.

The creative person knows that there is always room for improvement.

Creative Methods

Several methods have been identified for producing creative results. Here are the five classic ones:

Evolution. This is the method of incremental improvement. New ideas stem from other ideas, new solutions from previous ones, the new ones slightly improved over the old ones. Many of the very sophisticated things we enjoy today developed through a long period of constant incrementation. Making something a little better here, a little better there gradually makes it something a lot better--even entirely different from the original.

For example, look at the history of the automobile or any product of technological progress. With each new model, improvements are made. Each new model builds upon the collective creativity of previous models, so that over time, improvements in economy, comfort, and durability take place. Here the creativity lies in the refinement, the step-by-step improvement, rather than in something completely new. Another example would be the improvement of the common wood screw by what are now commonly called drywall screws. They have sharper threads which are angled more steeply for faster penetration and better holding. The points are self tapping. The shanks are now threaded all the way up on lengths up to two inches. The screws are so much better that they can often be driven in without pilot holes, using a power drill.

The evolutionary method of creativity also reminds us of that critical principle: **Every problem that has been solved can be solved again in a better way.** Creative thinkers do not subscribe to the idea that once a problem has been solved, it can be forgotten, or to the notion that "if it ain't broke, don't fix it." A creative thinker's philosophy is that "there is no such thing as an insignificant improvement."

Synthesis. With this method, two or more existing ideas are combined into a third, new idea. Combining the ideas of a magazine and an audio tape gives the idea of a magazine you can listen to, one useful for blind people or freeway commuters.

For example, someone noticed that a lot of people on dates went first to dinner and then to the theater. Why not combine these two events into one? Thus, the dinner theater, where people go first to eat and then to see a play or other entertainment.

Revolution. Sometimes the best new idea is a completely different one, an marked change from the previous ones. While an evolutionary improvement philosophy might cause a professor to ask, "How can I make my lectures better and better?" a revolutionary idea might be, "Why not stop lecturing and have the students teach each other, working as teams or presenting reports?"

For example, the evolutionary technology in fighting termites eating away at houses has been to develop safer and faster pesticides and gasses to kill them. A somewhat revolutionary change has been to abandon gasses altogether in favor of liquid nitrogen, which freezes them to death or microwaves, which bake them. A truly revolutionary creative idea would be to ask, "How can we prevent them from eating houses in the first place?" A new termite bait that is placed in the ground in a perimeter around a house provides one answer to this question.

Reapplication. Look at something old in a new way. Go beyond labels. Unfixate, remove prejudices, expectations and assumptions and discover how something can be reapplied. One creative person might go to the junkyard and see art in an old model T transmission. He paints it up and puts it in his living room. Another creative person might see in the same transmission the necessary gears for a multi-speed hot walker for his horse. He hooks it to some poles and a motor and puts it in his corral. The key is to see beyond the previous or stated applications for some idea, solution, or thing and to see what other application is possible.

For example, a paperclip can be used as a tiny screwdriver if filed down; paint can be used as a kind of glue to prevent screws from loosening in machinery; dishwashing detergents can be used to remove the DNA from bacteria in a lab; general purpose spray cleaners can be used to kill ants.

Changing Direction. Many creative breakthroughs occur when attention is shifted from one angle of a problem to another. This is sometimes called creative insight.

A classic example is that of the highway department trying to keep kids from skateboarding in a concrete-lined drainage ditch. The highway department put up a fence to keep the kids out; the kids went around it. The department then put up a longer fence; the kids cut a hole in it. The department then put up a stronger fence; it, too, was cut. The department then put a threatening sign on the fence; it was ignored. Finally, someone decided to change direction, and asked, "What really is the problem here? It's not that the kids keep getting through the barrier, but that they want to skateboard in the ditch. So how can we keep them from skateboarding in the ditch?" The solution was to remove their desire by pouring some concrete in the bottom of the ditch to remove the smooth curve. The sharp angle created by the concrete made skateboarding impossible and the activity stopped. No more skateboarding problems, no more fence problems.

This example reveals a critical truth in problem solving: **the goal is to solve the problem, not to implement a particular solution.** When one solution path is not working, shift to another. There is no commitment to a particular path, only to a particular goal. Path fixation can sometimes be a problem for those who do not understand this; they become overcommitted to a path that does not work and only frustration results.

Negative Attitudes That Block Creativity

1. Oh no, a problem! The reaction to a problem is often a bigger problem than the problem itself. Many people avoid or deny problems until it's too late, largely because these people have never learned the appropriate emotional, psychological, and practical responses. A problem is an opportunity. The happiest people welcome

and even seek out problems, meeting them as challenges and opportunities to improve things. Definition: a problem is (1) seeing the difference between what you have and what you want or (2) recognizing or believing that there is something better than the current situation or (3) an opportunity for a positive act. Seeking problems aggressively will build confidence, increase happiness, and give you a better sense of control over your life.

2. It can't be done. This attitude is, in effect, surrendering before the battle. By assuming that something cannot be done or a problem cannot be solved, a person gives the problem a power or strength it didn't have before. And giving up before starting is, of course, self fulfilling. But look at the history of solutions and the accompanying skeptics: man will never fly, diseases will never be conquered, rockets will never leave the atmosphere. Again, the appropriate attitude is summed up by the statement, "The difficult we do immediately; the impossible takes a little longer."

3. I can't do it. Or There's nothing I can do. Some people think, well maybe the problem can be solved by some expert, but not by me because I'm not (a) smart enough, (b) an engineer, or (c) a blank (whether educated, expert, etc.) Again, though, look at the history of problem solving.

Who were the Wright brothers that they could invent an airplane? Aviation engineers? No, they were bicycle mechanics. The ball point pen was invented by a printer's proofreader, Ladislao Biro, not a mechanical engineer. Major advances in submarine design were made by English clergyman G. W. Garrett and by Irish schoolmaster John P. Holland. The cotton gin was invented by that well known attorney and tutor, Eli Whitney. The fire extinguisher was invented by a captain of militia, George Manby.

And so on. In fact, a major point made by recent writers about corporate excellence is that innovations in industry almost always come from individuals (not research groups) outside of the area of the invention. General Motors invented Freon, the refrigeration chemical, and tetraethyl lead, the gasoline additive. Kodachrome was invented by two musicians. The continuous steel casting process was invented by a watchmaker (fooling around with brass casting). Soap making chemists turned down the problem of inventing synthetic detergents: those detergents were invented by dye making chemists.

In a nutshell, a good mind with a positive attitude and some good problem solving skills will go far in solving any problem. Interest in and commitment to the problem are the keys. Motivation--a willingness to expend the effort--is more important than laboratory apparatus. And remember that you can always do something. Even if you cannot totally eradicate the problem from the face of the earth, you can always do something to make the situation better.

4. But I'm not creative. Everyone is creative to some extent. Most people are capable of very high levels of creativity; just look at young children when they play and imagine. The problem is that this creativity has been suppressed by education. All you need to do is let it come back to the surface. You will soon discover that you are surprisingly creative.

5. That's childish. In our effort to appear always mature and sophisticated, we often ridicule the creative, playful attitudes that marked our younger years. But if you solve a problem that saves your marriage or gets you promoted or keeps your friend from suicide, do you care whether other people describe your route to the solution as "childish?" Besides, isn't play a lot of fun? Remember that sometimes people laugh when something is actually funny, but often they laugh when they lack the imagination to understand the situation.

6. What will people think? There is strong social pressure to conform and to be ordinary and not creative.

Here are some overheard examples:

Creative Person: "I like to put water in my orange juice so it's less sweet."

Ordinary Person: "You're weird, you know?"

Ordinary Person: "What are you doing?"

Creative Person: "We're painting our mailbox."

Ordinary Person: "You're crazy."

Creative Person: "Why don't we add a little garlic?"

Ordinary Person: "Because the recipe doesn't call for garlic."

Ordinary Person: "Why are you going this way? It's longer."

Creative Person: "Because I like the drive."

Ordinary Person: "Did anyone ever tell you you're strange?"

The constant emphasis we see in society is toward the ruthlessly practical and conformist. Even the wild fashions, from those in Vogue to punk rock, are narrowly defined, and to deviate from them is considered wrong or ridiculous. Some peoples' herd instinct is so strong that they make sheep look like radical individualists.

So, what will people think? Well, they're already talking about you, saying that your nose is too big or your shoes are funny or you date weird people. So, since others are going to talk about you in unflattering ways anyway, you might as well relax and let your creativity and individualism flow.

Almost every famous contributor to the betterment of civilization was ridiculed and sometimes even jailed. Think about Galileo. And look what happened to Jesus. *Quotation: "Progress is made only by those who are strong enough to endure being laughed at."* Solutions are often new ideas, and new ideas, being strange, are usually greeted with laughter, contempt, or both. That's just a fact of life, so make up your mind not to let it bother you. Ridicule should be viewed as a badge of real innovative thinking.

7. I might fail. Thomas Edison, in his search for the perfect filament for the incandescent lamp, tried anything he could think of, including whiskers from a friend's beard. In all, he tried about 1800 things. After about 1000 attempts, someone asked him if he was frustrated at his lack of success. He said something like, "I've gained a lot of knowledge--I now know a thousand things that won't work."

Fear of failure is one of the major obstacles to creativity and problem solving. The cure is to change your attitude about failure. Failures along the way should be expected and accepted; they are simply learning tools that help focus the way toward success. Not only is there nothing wrong with failing, but failing is a sign of action and struggle and attempt--much better than inaction. The go-with-the-flow types may never fail, but they are essentially useless to humanity, nor can they ever enjoy the feeling of accomplishment that comes after a long struggle.

Suppose you let your fear of failure guide your risk taking and your attempts. You try only three things in a year because you are sure of succeeding. At the end of the year the score is: Successes 3, Failures 0. Now suppose the next year you don't worry about failing, so you try a hundred things. You fail at 70 of them. At the end of the year the score is Successes 30, Failures 70. Which would you rather have--three successes or 30--ten times as many? And imagine what 70 failures will have taught you. Proverb: *Mistakes aren't fun, but they sure are educational.*

Myths about Creative Thinking and Problem Solving

1. Every problem has only one solution (or one right answer). The goal of problem solving is to solve the problem, and most problems can be solved in any number of ways. If you discover a solution that works, it is a good solution. There may be other solutions thought of by other people, but that doesn't make your solution wrong. What is THE solution to putting words on paper? Fountain pen, ball point, pencil, marker, typewriter, printer, Xerox machine, printing press?

2. The best answer/solution/method has already been found. Look at the history of any solution set and you'll see that improvements, new solutions, new right answers, are always being found. What is the solution to human transportation? The ox or horse, the cart, the wagon, the train, the car, the airplane, the jet, the SST? Is that the best and last? What about pneumatic tubes, hovercraft, even Star Trek type beams?

What is the best way to put words on paper? The word processor? Is that the last invention? How about voice recognition, or thought wave input?

On a more everyday level, many solutions now seen as best or at least entrenched were put in place hastily and without much thought--such as the use of drivers' licenses for ID cards or social security numbers for taxpayer ID numbers. Other solutions are entrenched simply for historical reasons: they've always been done that way. Why do shoe laces still exist, when technology has produced several other, better ways to attach shoes to feet (like velcro, elastic, snap buttons, and so on)?

3. Creative answers are complex technologically. Only a few problems require complex technological solutions. Most problems you'll meet with require only a thoughtful solution requiring personal action and perhaps a few simple tools. Even many problems that seem to require a technological solution can be addressed in other ways.

For example, what is the solution to the large percentage of packages ruined by the Post Office? Look at the Post Office package handling method. Packages are tossed in bins when you send them. For the solution, look at United Parcel. When you send a package, it is put on a shelf. The change from bin to shelf is not a complex or technological solution; it's just a good idea, using commonly available materials.

As another example, when hot dogs were first invented, they were served to customers with gloves to hold them. Unfortunately, the customers kept walking off with the gloves. The solution was not at all complex: serve the hot dog on a roll so that the customer's fingers were still insulated from the heat. The roll could be eaten along with the dog. No more worries about disappearing gloves. (Note by the way what a good example of changing direction this is. Instead of asking, "How can I keep the gloves from being taken?" the hot dog server stopped thinking about gloves altogether.)

4. Ideas either come or they don't. Nothing will help. There are many successful techniques for stimulating idea generation. We will be discussing and applying them.

Mental Blocks to Creative Thinking and Problem Solving

1. Prejudice. The older we get, the more preconceived ideas we have about things. These preconceptions often prevent us from seeing beyond what we already know or believe to be possible. They inhibit us from accepting change and progress.

Example problem: How to connect sections of airplanes with more ease and strength than using rivets. A modern solution is to use glue--glue the sections together. We probably wouldn't think of this solution because of our prejudice about the word and idea of glue. But there are many kinds of glue, and the kind used to stick plane parts together makes a bond stronger than the metal of the parts themselves.

Another problem: How can we make lighter weight bullet proof windows? Thicker glass is too heavy. Answer: Use plastic. Again, we are prejudiced against plastic. But some plastics are not flimsy at all and are used in place of steel and in bullet proof windows.

Another problem: Make a ship's hull that won't rust or rot like steel or wood. Solution: Use concrete. Our prejudice is that concrete is too heavy. Why not make lightweight concrete? That's what's done.

Final example: How to divide a piece of cake equally between two kids so they won't complain that one kid is preferred over the other: "You gave him the bigger piece; you like him better! Waaaah!" Solution: Put the kids in charge of dividing the cake. Our prejudice is that immature, selfish kids can't do the job. But the solution, one cuts the cake, the other has first choice of pieces, works very well.

2. Functional fixation. Sometimes we begin to see an object only in terms of its name rather in terms of what it can do. Thus, we see a mop only as a device for cleaning a floor, and do not think that it might be useful for clearing cobwebs from the ceiling, washing the car, doing aerobic exercise, propping a door open or closed, and so on. (Later on in the semester, we will be doing "uses for" to break out of this fixation.)

There is also a functional fixation of businesses. In the late nineteenth and early twentieth centuries the railroads saw themselves as railroads. When automobiles and later airplanes began to come in, the railroads didn't adapt. "That's not our business," they said. But if they had seen themselves as in the people transportation business rather than in the railroad business, they could have capitalized on a great opportunity.

Similarly, when the telephone began its rise, some of the telegraph companies said, "That's not our business; we're telegraph companies." But if they had said, "Hey, we're in the communication business, and here's a new way to communicate," they would have grown rather than died. Compare Western Union to AT&T. And have you heard of those big calculator companies Dietzgen or Pickett? No? Well, they were among the biggest makers of slide rules. But when electronic calculators began to rise, they didn't know what business they were in. They thought they were in the slide rule business, when they were really in the calculator business. They didn't adapt, they didn't accept the challenge of change and opportunity, and they fell.

And there's a functional fixation of people, too. Think a minute how you react when you see your pastor mowing his lawn, or your auto mechanic on a television show promoting a book. Stereotyping can even be a form of functional fixation--how many people would laugh at a blonde quoting Aristotle? Too often we permit only a narrow range of attitudes and behaviors in other people, based on bias, prejudice, hasty generalization, or limited past experience. Think of those statements like, "I can't believe he said that," or "Imagine her doing that," and so on. But recall the proverb, "The goal of my life is not to live down to your expectations."

3. Learned helplessness. This is the feeling that you don't have the tools, knowledge, materials, ability, to do anything, so you might as well not try. We are trained to rely on other people for almost everything. We think small and limit ourselves. But the world can be interacted with.

If you are in need of information, there are libraries, bookstores, friends, professors, and, of course, the Internet. And there are also city, county, and state government agencies with addresses and phone numbers and web sites. There are thousands of government agencies that really exist and that will talk to you. Contact the EPA if you're working on air pollution or pesticides. Get some government publications. Call your state senator or federal congressman for help on bills, information, problems. Contact the manufacturer of a product to find out what you want to know about it.

If you are technologically poor, you can learn. Learn how to cook, use tools, make clothes, use a computer. You can learn to do anything you really want to do. All you need is the motivation and commitment. You can learn to fly an airplane, drive a truck, scuba dive, fix a car--name it.

4. Psychological blocks. Some solutions are not considered or are rejected simply because our reaction to them is "Yuck." But icky solutions themselves may be useful or good if they solve a problem well or save your life. Eating lizards and grasshoppers doesn't sound great, but if it keeps you alive in the wilderness, it's a good solution.

Perhaps more importantly, what at first seem to be icky ideas may lead to better solutions--de-ickyfied analogues of the original. When doctors noted that some unsophisticated natives were using giant ant heads to suture wounds, they imitated this pincer-closing technique by inventing the surgical staple.

Psychological blocks prevent you from doing something just because it doesn't sound good or right, which is a pretty ridiculous thing. Overcoming such blocks can be really beneficial. Navy commandos in Vietnam overcame their blocks and put on women's panty hose when they marched through the swamps and jungle. The pantyhose cut down on the friction and rubbing from the plants and aided in removing the dozens of leeches after a mission. Overcoming the block to using your own blood to write a help note could save your life someday if you got kidnapped.

Positive Attitudes for Creativity

1. Curiosity. Creative people want to know things--all kinds of things-- just to know them. Knowledge does not require a reason. The question, "Why do you want to know that?" seems strange to the creative person, who is likely to respond, "Because I don't know the answer." Knowledge is enjoyable and often useful in strange and unexpected ways.

For example, I was once attempting to repair something, without apparent success, when an onlooker asked testily, "Do you know what you're doing?" I replied calmly, "No, that's why I'm doing it."

Next, knowledge, and especially wide ranging knowledge, is necessary for creativity to flourish to its fullest. Much creativity arises from variations of a known or combinations of two knowns. The best ideas flow from a well equipped mind. Nothing can come from nothing.

In addition to knowing, creative people want to know why. What are the reasons behind decisions, problems, solutions, events, facts, and so forth? Why this way and not another? And why not try this or that?

The curious person's questioning attitude toward life is a positive one, not a destructive one reflecting skepticism or negativism. It often seems threatening because too often there is no good reason behind many of the things that are taken for granted--there is no "why" behind the status quo.

So ask questions of everyone. Ask the same question of different people just to be able to compare the answers. Look into areas of knowledge you've never before explored, whether cloth dying, weather forecasting, food additives, ship building, the U.S. budget, or the toxicity of laundry detergents.

2. Challenge. Curious people like to identify and challenge the assumptions behind ideas, proposals, problems, beliefs, and statements. Many assumptions, of course, turn out to be quite necessary and solid, but many others have been assumed unnecessarily, and in breaking out of those assumptions often comes a new idea, a new path, a new solution.

For example, when we think of a college, we traditionally think of a physical campus with classrooms, a library, and some nice trees. But why must college be a place (with congregated students and faculty) at all? Thus, the electronic college now exists, where students "go" to college right at home, online. Correspondence courses have existed for years, too, beginning with the challenging of the school-as-centralized-place idea.

When we think of an electric motor, we *automatically* think of a rotating shaft machine. But why assume that? Why can't an electric motor have a linear output, moving in a straight line rather than a circle? With such a challenged assumption came the linear motor, able to power trains, elevators, slide locks, and so on.

Problem: We make brandy, and for this special edition of our finest kind, we want a fully-grown pear in one piece inside each bottle. The bottle is narrow necked. How can we do it? As you think, watch for the assumptions you are making. Possible solutions (assuming fully grown pear): close the neck or bottom after insertion, use a plastic bottle like heat-shrink tubing, change to a wide mouth bottle. If we do not assume a fully grown pear: grow the pear from a bud inside the bottle.

3. Constructive discontent. This is not a whining, griping kind of discontent, but the ability to see a need for improvement and to propose a method of making that improvement. Constructive discontent is a positive, enthusiastic discontent, reflecting the thought, "Hey, I know a way to make that better."

Constructive discontent is necessary for a creative problem solver, for if you are happy with everything the way it is, you won't want to change anything. Only when you become discontent with something, when you see a problem, will you want to solve the problem and improve the situation.

One of the hallmarks of the constructively discontented person is that of a problem seeking outlook. The more problems you find, the more solutions and therefore improvements you can make. Even previously solved

problems can often be solved again, in a better way. A constructively discontent person might think, "This is an excellent solution, but I wonder if there isn't another solution that works even better (or costs less, etc)."

Another mark of constructive discontent is the enjoyment of challenge. Creative people are eager to test their own limits and the limits of problems, willing to work hard, to persevere and not give up easily. Sometimes the discontent is almost artificial--they aren't really unhappy with the status quo of some area, but they want to find something better just for the challenge of it and the opportunity to improve their own lives and those of others.

4. A belief that most problems can be solved. By faith at first and by experience later on, the creative thinker believes that something can always be done to eliminate or help alleviate almost every problem. Problems are solved by a commitment of time and energy, and where this commitment is present, few things are impossible.

The belief in the solvability of problems is especially useful early on in attacking any problem, because many problems at first seem utterly impossible and scare off the fainter hearted. Those who take on the problem with confidence will be the ones most likely to think through or around the impossibility of the problem.

5. The ability to suspend judgment and criticism. Many new ideas, because they are new and unfamiliar, seem strange, odd, bizarre, even repulsive. Only later do they become "obviously" great. Other ideas, in their original incarnations, are indeed weird, but they lead to practical, beautiful, elegant things. Thus, it is important for the creative thinker to be able to suspend judgment when new ideas are arriving, to have an optimistic attitude toward ideas in general, and to avoid condemning them with the typical kinds of negative responses like, "That will never work; that's no good; what an idiotic idea; that's impossible," and so forth. Hospital sterilization and antiseptic procedures, television, radio, the Xerox machine, and stainless steel all met with ho-hums and even hostile rejection before their persevering inventors finally sold someone on the ideas.

Some of our everyday tools that we now love and use daily, were opposed when they were originally presented: Aluminum cookware? No one wants that. Teflon pans? They'll never sell. Erasers on pencils? That would only encourage carelessness. Computers? There's no market for more than a few, so why build them?

Remember then that (1) an idea may begin to look good only after it becomes a bit more familiar or is seen in a slightly different context or clothing or circumstance and (2) even a very wild idea can serve as a stepping stone to a practical, efficient idea. By too quickly bringing your judgment into play, these fragile early ideas and their source can be destroyed. The first rule of brainstorming is to suspend judgment so that your idea-generating powers will be free to create without the restraint of fear or criticism. You can always go back later and examine--as critically as you want--what you have thought of.

Proverb: "A crank is a genius whose idea hasn't yet caught on."

6. Seeing the good in the bad. Creative thinkers, when faced with poor solutions, don't cast them away. Instead, they ask, "What's good about it?" because there may be something useful even in the worst ideas. And however little that good may be, it might be turned to good effect or made greater.

Example problem: How can we get college students to learn grammar better? Solution: Spank their bottoms with a hickory stick. This isn't a good solution, partly because it's probably illegal. But should we just toss it out? Why not ask what's good about it? (1) it gives individual, attention to the poor performers, (2) it gives them public attention, (3) it motivates other students as well as the student being spanked, (4) it's easy and costs nothing. The next question is, Can we adapt or incorporate some of these good things into a more acceptable solution, whether derivative of the original or not?

We easily fall into either/or thinking and believe that a bad solution is bad through and through, in every aspect, when in fact, it may have some good parts we can borrow and use on a good solution, or it may do inappropriately something that's worth doing appropriately. And often, the bad solution has just one really glaring bad part, that when remedied, leaves quite a good solution. In the above example, changing the physical spanking to a verbal spanking changes the entire aspect of the solution while keeping all the good points we identified.

7. Problems lead to improvements. The attitude of constructive discontent searches for problems and possible areas of improvement, but many times problems arrive on their own. But such unexpected and perhaps unwanted problems are not necessarily bad, because they often permit solutions that leave the world better than before the problem arose.

For example, the first margarine was made from beef fat, milk, water, and chopped cow udder. It wasn't extremely tasty or healthy. Then about the turn of the century a shortage of beef fat created a problem. What to use? The margarine makers turned to vegetable fats from various plants and the soybean, corn, and sunflower oils they used are still used today. The margarine is healthier and tastes better.

Or think about exams or papers. When you don't do as well as you want, you think, "Oh no!" But actually, you have a good insight into what you don't know and still need to learn. You are aware of the geography of your knowledge in a much more detailed form than before the errors showed up.

8. A problem can also be a solution. A fact that one person describes as a problem can sometimes be a solution for someone else. Above we noted that creative thinkers can find good ideas in bad solutions. Creative thinkers also look at problems and ask, "Is there something good about this problem?"

For example, soon after the advent of cyanoacrylate adhesives (super glue), it was noted that if you weren't careful, you could glue your fingers together with it. This problem--a permanent skin bond--was soon seen as a solution, also. Surgeons in Viet Nam began to use super glue to glue wounds together.

Another example, also involving glue: 3M chemists were experimenting with adhesives and accidentally came up with one that was so weak you could peel it right back off. Hold strength, shear strength, all were way below the minimum standards for any self-respecting adhesive. A glue that won't hold? Quite a problem. But this problem was also a solution, as you now see in Post-It Notes.

9. Problems are interesting and emotionally acceptable. Many people confront every problem with a shudder and a turn of the head. They don't even want to admit that a problem exists--with their car, their spouse, their child, their job, their house, whatever. As a result, often the problem persists and drives them crazy or rises to a crisis and drives them crazy.

Creative people see problems as interesting challenges worth tackling. Problems are not fearful beasts to be feared or loathed; they are worthy opponents to be jostled with and unhorsed. Problem solving is fun, educational, rewarding, ego building, helpful to society.

Miscellaneous Good Attitudes

1. Perseverance. Most people fail because they spend only nine minutes on a problem that requires ten minutes to solve. Creativity and problem solving are hard work and require fierce application of time and energy. There is no quick and easy secret. You need knowledge gained by study and research and you must put your knowledge to work by hard thinking and protracted experimentation. You've surely read of the difficulties and setbacks faced by most of the famous inventors--how many filaments Edison tried before he found a working one, how many aircraft designs failed in the attempt to break the sound barrier. But planning to persevere is planning to succeed.

2. A flexible imagination. Creative people are comfortable with imagination and with thinking so-called weird, wild, or unthinkable thoughts, just for the sake of stimulation. During brainstorming or just mental playfulness, all kinds of strange thoughts and ideas can be entertained. And the mind, pragmatist that it is, will probably find something useful in it all. We will look at several examples of this later on.

3. A belief that mistakes are welcome. Modern society has for some reason conceived the idea that the only unforgivable thing is to fail or make a mistake. Actually failure is an opportunity; mistakes show that something is being done. So creative people have come to realize and accept emotionally that making mistakes is no negative biggie. One chief executive of a big American corporation warns all his newly hired managers, "Make

sure you make a reasonable number of mistakes." Mistakes are educational and can lead to success--because they mean you are doing something.

Sir Francis Pettit Smith, one of the early developers of the screw propeller, tried one design in 1836. During the test, half of it broke off--what a failure--but then the boat increased in speed substantially, revealing the efficiency of a new design, formed from a mistake.

In sum, as Vergil once said, "They can who think they can." Having the proper positive attitude about generating new and useful ideas and solving problems is really a large part of the whole process.

A few years ago, the pipes in my mom's house had finally rusted through and I was faced with the task of finding a plumber to get a bid. Knowing how much they charge for small repairs, I knew that doing a whole house would cost a fortune. I thought, "You know, I'd really like to do this job myself, but I wonder if I can." My neighbor happened to be around once when I said this, and he said, "Oh, you can do it." Just that simple expression gave me the positive attitude I needed to do it. So I did.

Characteristics of the Creative Person

- curious
- seeks problems
- enjoys challenge
- optimistic
- able to suspend judgment
- comfortable with imagination
- sees problems as opportunities
- sees problems as interesting
- problems are emotionally acceptable
- challenges assumptions
- doesn't give up easily: perseveres, works hard

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