CHEMTECH

The Innovator's Magazine **MAY 1976**

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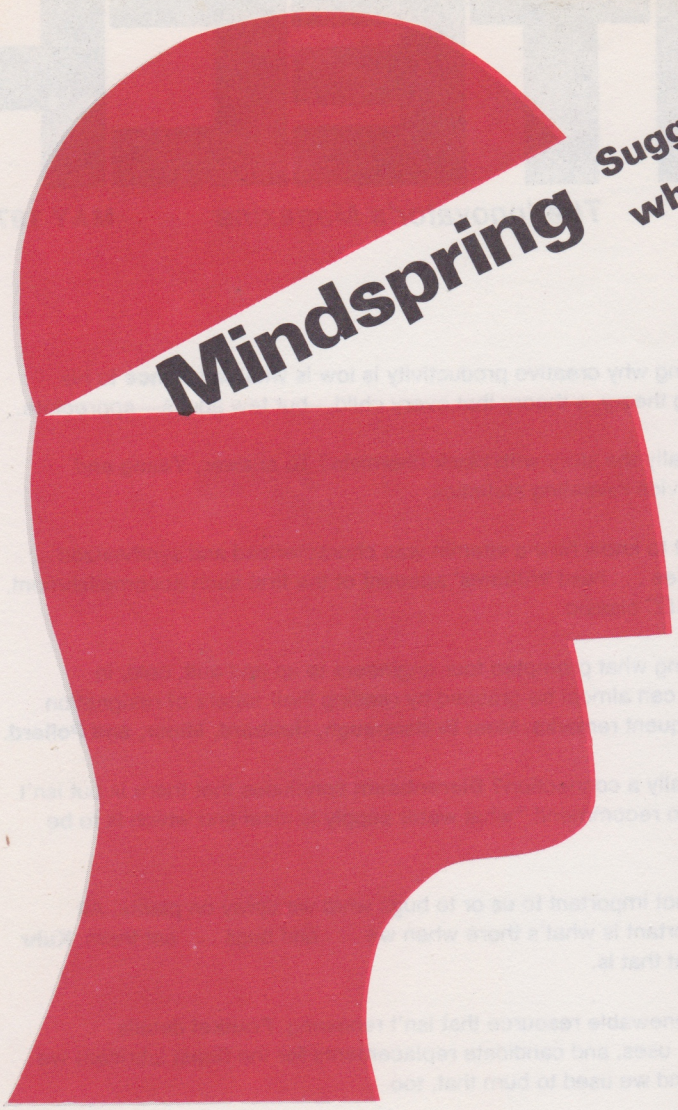


Suggesting answers to why productivity is low

Ever since managers were invented, they have been puzzled by their subordinates' lack of creative thinking. Managers want new ideas and fresh approaches; they exhort their people to produce them; they believe their people are capable of delivering more—yet production of creative ideas remains low. Now there is new information that can help us understand this dilemma. And perhaps even resolve it.

First we will look at the dynamics of the creative process, using the clarifying power of a new insight called Mindspring. Then we will look at the realities of communication in groups, using the clarifying research of Mehrabian, Rosenthal, and Lozanov.

In our company we have a unique laboratory to study the creative process. The laboratory consists of a continuous parade of small groups of people who have problems that require innovative solutions. We provide them with comfortable work spaces and with "facilitators" to help as they create solutions to their own problems. They provide us with data on how people think and act while solving problems. We have been collecting these data (using audio and videotape) and examining them since 1960. By now, several thousand problem solvers have contributed to our body of knowledge. Here's what we've learned.

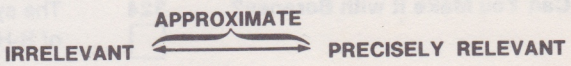
Pretend that you have been employed by the Thermos Company to invent a new closure for a wide-mouth thermos flask. This new closure is to replace the present screw-in stopper. The chief improvement being sought is that the new closure should be loss proof. Thermos has experimented with chains, strings, and hinges but these devices were not appealing to the consumer.

Think about closures for a moment.

You may have thought of a spice can closure, or a roll-top desk, or a slide like a window, or the iris of a camera—all good starting ideas. Now I want to identify the Mindspring-thinking operations. First there is a *wish*. I wish to invent a new closure. Next is *retrieve*. I retrieve from my vast (and unique) storehouse of experience the iris of a camera. I look this iris over in my mind's eye—we call that *imaging*, a thinking operation that goes on all the time. It is my display system—the way I keep track of my thoughts. Next I *compare* the iris with my needed closure—the specifications. Compare is another thinking operation. I *transform* the iris—I make it large enough to fit the neck of the thermos. I compare its function with the specifications. Easy to clean—I transform the leaves into plastic. And so on until I have a new closure that fits the specs. Then I *store* this new piece of information.

Hypothesis #1 of Mindspring Theory holds that there are six discrete thinking operations: wish, retrieve, image, compare, transform, and store.

Hypothesis #2: All thinking operations are purposeful. The product, for example, a retrieval—will fall somewhere on the spectrum



This spectrum is a convenient way to test how much of my potential for creative thinking I am using. For instance when I was working on the thermos problem, I might retrieve a window as a form of closure. If I am feeling precise I may reject it as irrelevant to my problem or too approximate to be useful. If I am tolerant, I keep the window in my mind's eye and transform it to thermos size, make it solid of foam material, put slides on the thermos, and I have a closure that no longer resembles a window yet was derived from that approximate retrieval.

The purpose of most thinking is to move toward precision, and in the process it is appropriate to use approximations. A characteristic shared by the great discoverers is the ability to make the seemingly irrelevant, useful. Archimedes and his bath, Newton and his apple, Pasteur and the anthrax-bearing worm droppings, Goodyear and the spilled latex, Fleming and the spoiled culture. To rephrase Pasteur's "chance favors the prepared mind"—the prepared mind makes its own chances by using the seemingly irrelevant.

Hypothesis #3: Learning employs the same thinking operations as problem solving. When I learn something new I use transforming differently but it is the same operation. Let us say I am giving you directions for getting to my office and Cambridge is strange to you. "You will be coming out Storrow Drive", I say, "When you see some brick

buildings on your left—that is the Harvard Business School—take the next exit and cross the bridge".

As you listen, you image. You retrieve a stereotype brick building from your experience. Also you retrieve a stereotype exit and bridge. You hold these approximations in your mind. They are your interim learning of the way to my office. As you make the journey and see the actual buildings, exit, and bridge, you transform the approximate stereotypes into the precise realities. This hypothesis has some interesting implications for learning/teaching. For example, it suggests that an efficient first step in learning is to guess. Armed with that approximation, I am in a better position to transform to precision than if I am simply blank. (I am so long as I recognize my guess as just that, and don't become irrevocably defensive about it.)

Hypothesis #4: Certain of the thinking operations tend to be repressed. This decreases learning and problem-solving efficiency. We believe that this repression happens something like this: When I am young, I wish a lot. I wish I had a birthday every day, I wish I had the candy in the window, the bike of the kid next door; I wish my little brother would get run over, and so on. My parents socialize me by making it clear that certain wishes are not to be made. I don't really differentiate and so I repress all wishes.

A similar thing happens to transforming. I transform a pencil into a truck. Somebody soon makes it clear that a truck has four wheels, a body, and so forth, and transforming gets to be wrong in my head.

Imaging suffers too. As someone tells me something, my images speed far ahead of the speaker. As he supplies added data, my images prove to be wrong. Being wrong hurts, so I learn not to let images form until I am certain I am not going to be wrong.

Being wrong is painful because from early childhood we are punished for any wrongness. Our parents start this; our friends and teachers reinforce it with ridicule, low marks, and even ostracism. By the time we are seven or eight, most of us experience serious anxiety when we are wrong. Wishing, transforming, and imaging become associated with wrongness. When I use them I suffer anxiety. To avoid this, I simply stop being aware of it when I use these operations. This is a well-known psychological strategy called selective attention (*1*). What this does for me is to let me continue to use these operations without anxiety. The price I pay is that these valuable learning and problem-solving operations are not under my control. I cannot use them whenever I want.

Let us briefly examine what this repression is costing me. Wishing is an efficient form of goal setting. It is also a problem-spotting technique: "I wish this situation were different." Further, it is the natural first step in affecting change—the opposite of passivity. In addition, wishing is one of our powerful motivators—the first step in involving or committing ourselves to solving a problem or learning something.

Transforming is at the very heart of learning. As I transform my stereotype into a more precise reality—this is learning's moment of truth. Without transforming there can be no change, no learning.

Imaging is our display. When I see something with my mind's eye, I can understand it, manipulate it, make it real and memorable for myself. A picture is worth a thousand words. With a little courage and a little less repres-

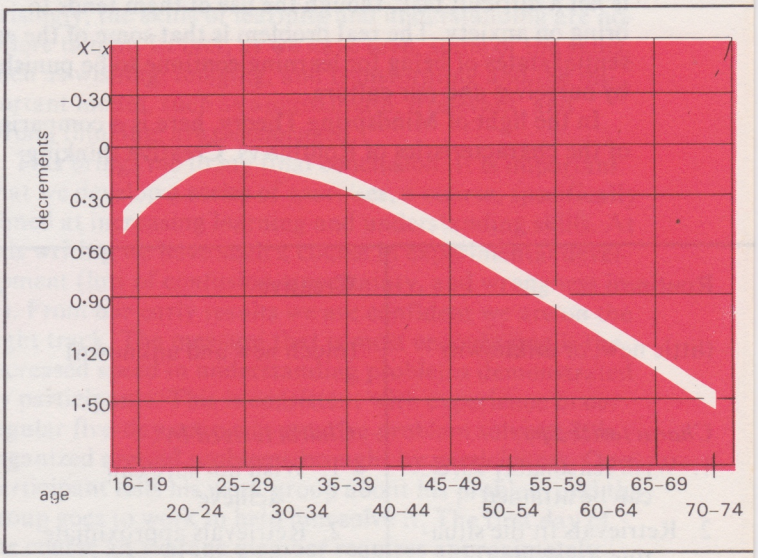
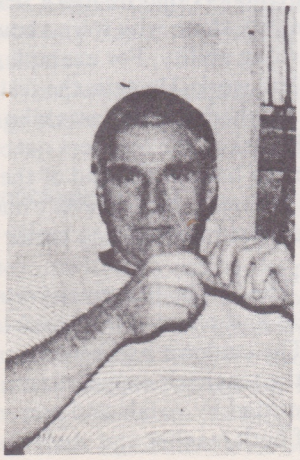


Figure 1. Learning and age. Curve of average decline of mental ability with age. Ages 16 to 75 (*2*)

Editor's Note: Some of us "over thirty" dispute this. Shortly CHEMTECH will publish a viewpoint that older people learn differently, but not necessarily "worse".



George M. Prince is Chairman of Synectics, Inc. His responsibilities include research, training, and consulting, as well as developing processes for increasing innovation and learning.

He was graduated from Williams with a degree in geology and, after serving in destroyers in World War II, worked for the advertising firm of Rumrill-Hoyt. When he left in 1958 he was a Director and in charge of creative services. He joined Arthur D. Little in that year and became General Manager of their Invention Design Group. Its mission was to invent new products and process for ADL clients.

In addition to being an active inventor, he has been studying groups and individuals as they solve invention and implementation problems. His work has involved experiments with some 4000 people, mainly in top and middle management. In nearly all these cases the task was to identify what was impeding creative productivity, and then to devise procedures to overcome these impediments. This research into the innovative process and later into interactions and their effect on productivity led to "The Practice of Creativity" (Harper & Row, 1970) and to numerous articles. He has lectured at the Harvard Business School, MIT Sloan School, and The NYU and Columbia Graduate Schools of Business.

He recently spoke on creativity and innovation to ACS and to industrial groups in London, Paris, and Finland. Mr. Prince is one of 12 creativity researchers, the only one from industry, asked to contribute to "Perspectives on Creativity" (Aldine Publishing Co., Chicago, 1975).

sion, if I have an approximate image I can transform as new data come in. I see the changes and thus learn with less confusion. Imaging makes it easy and fast to compare an idea with a need. It gives focus to my thinking.

The repression of these operations is clearly quite damaging. An unobvious consequence is that as I get older, I get more and more out of touch with these operations. Logically, as I accumulate experience and wisdom, I will become a better and better problem solver and learner. As you know, the opposite tends to be true. By the time I am eighty, I am a pathological nonlearner and nonproblem solver (Figure 1).

Hypothesis #5: These repressed operations can be restored to awareness, increasing learning and problem-solving efficiency. The implications here are quite exciting. If only we could recover the learning speed of children and still keep our experience bank built with age!

We could learn new languages in a few weeks, adapt to new situations with little stress, pick up a new sport in a few days, and become the professional learners we were at three with the added powers of age and experience.

The restoration of wishing, imaging, and transforming is not a difficult task, though the use of them tends to bring on anxiety. The real problem is that some of the essential states of being for learning continue to be punished by ourselves and our culture.

In the light of Mindspring Theory, here is a comparison of the characteristics of Routine vs. Creative thinking:

Routine	Creative
(little new, or unknown)	(much new and unknown)
Characterized by:	*Characterized by:*
1. Wish reasonably sure can be attained	1. Wish not sure can achieve
2. Retrievals fit the situation precisely	2. Retrievals approximate or don't fit situation
3. Little transforming	3. High transforming
4. Comparing leads to precise fits (solution)	4. Comparing leads to more wishes, transforming, to retrievals
5. Logical and precise	5. Nonlogical, approximate
6. Comfortable, certain	6. Confusion
7. Little or no learning	7. Uncertainty
8. High rightness	8. Wrongness
9. Little storing	9. Excitement/fear
	10. Learning storing

We see that three of the characteristics that *must* be present when we are learning or problem solving are not acceptable. Whenever I am confused, uncertain, or wrong I suffer anxiety, punish myself, and am punished by others.

We have not appreciated that confusion, uncertainty, and wrongness are not only appropriate but necessary at certain stages in learning and problem solving. Take wrongness. When I say I know from experience that a certain thing is true, what I am usually saying is: "I learned this by being wrong until I found out what was right." **If I insist on never being confused and uncertain, I must deny newness and the unknown and treat them as routine and known.** The punishment of apparent confusion, uncertainty, and wrongness is what makes restoration of wish, image, and transform difficult.

Transmission/receiving

The enforcers of repression are all around us and worse, inside us. Our only escape is in dreams—both night dreams and to some extent, daydreams.

In the dream state we put aside our judgmental selves and free our imaging, transforming, and wishing operations. We accept what happens as real and simply experience it. Let us examine the way this repression works on free adult men and women like us in face-to-face discourse. First, take a look at the three channels of communication:

Words
Vocals
Nonverbals

The meaning of words is clear. Vocals means tone, emphasis, hesitation, pitch, and so on. Nonverbals are expressions, gestures, and include such signals as dress or being late.

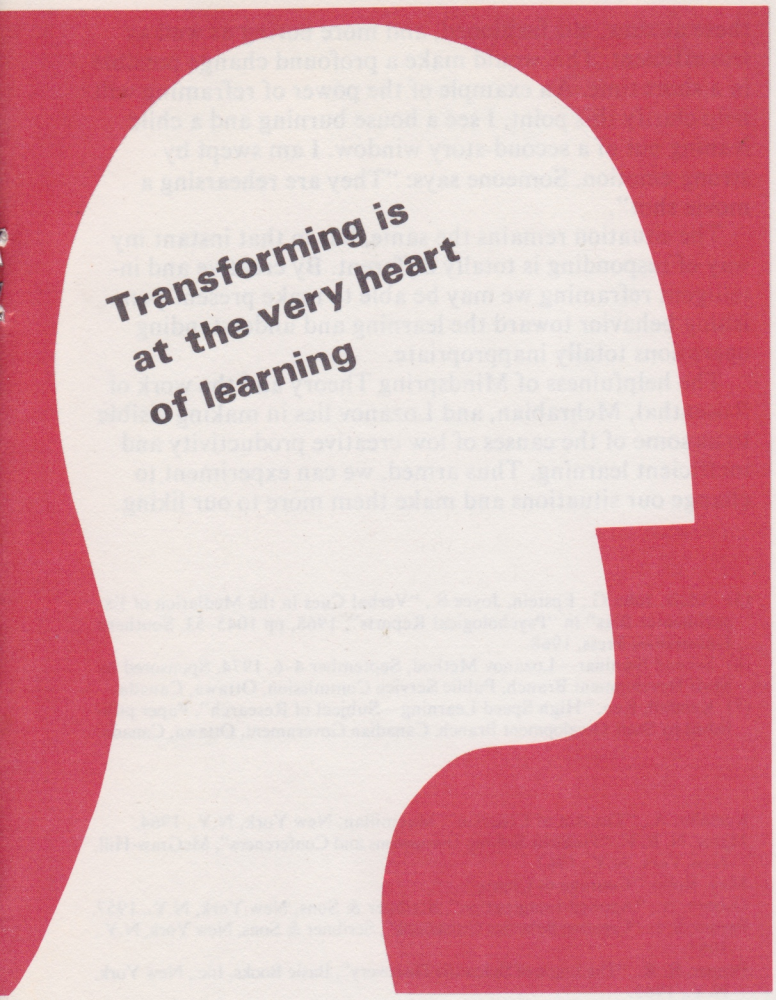
Albert Mehrabian (*3*) has done some splendid research to determine the impact of each of these channels in face-to-face communication. When you and I are talking together, my message to you depends upon words, on vocals, and on nonverbals. Most of us believe that words are by far the most important channel. I certainly did. So I was quite shocked at Mehrabian's values:

Impact depends on	
Words	7%
Vocals	38%
Nonverbals	55%

When I read his report I believed it and yet found it impossible to accept. For me words remained number one with 70–80% of the impact. I was made a little uncomfortable by the awareness that I could change meanings with vocals: "*That* is a good idea." Or with a nonverbal: "That is interesting!" and stifle a yawn.

My dependence on words was further shaken when I read about Robert Rosenthal's (*4*) experiment with teachers and students. He told some teachers that he had a new test for children that would identify those who were about to make a breakthrough in learning ability. For example, go from average work to excellent work. He gave the tests and then identified for several teachers the students who were going to break through. He asked the teachers not to tell the students. When he came back at the end of the term, he had been remarkably accurate. Nearly every one of the students he had identified was indeed doing better work.

Then he dropped the bomb. The test he had given was an ordinary intelligence test. *He had selected the breakthrough students at random.* The students had been influenced to do better work by the teacher's expectations. These expectations were transmitted by vocals and nonverbals out of the awareness of both teacher and student.



My faith in words as the number one communication channel was finally destroyed last year by two separate but related events. First, I read about some experiments (*5*) that demonstrated that expectations could be sent, received, and lived up to or down to with vocals alone (negative expectations breed bad performance). Then the final blow to my belief in the power of the word channel came when I attended a seminar in Ottawa (*6*). It was put on by the Canadian Government to report on their experiments using the Lozanov method to teach French. Georgi Lozanov (*7*), a Bulgarian, has developed a teaching method in which he makes deliberate use of vocals and nonverbals to suggest to students that they can learn much faster than they think they can. Using this method, which he calls Suggestology, he regularly speeds learning from four to twenty times. A two-year French course is completed in 20 days.

Now, with Mindspring Theory and the research findings above we have the data in place to draw some conclusions.

Conclusions

First, managers don't get creative productivity because they unwittingly (using the power of vocals and nonverbals) punish some of the necessary conditions for creative thinking: confusion, uncertainty, and wrongness. Subordinates cooperate fully. To avoid the risk of wrongness and punishment, we repress our wishing, transforming, and imaging operations. In fact, we have an unspoken, out of awareness agreement with our managers and each other to protect ourselves from the dangers of newness. If one of us, in an uncontrollable burst of spontaneity, proposes something new, we quickly save him. We point out the flaws and dangers and urge him back to the safety of the routine.

My second conclusion is that creative productivity is extraordinary only because most of us discourage it in ourselves to avoid the punishment that seems to go with it. I believe that the whole idea of creativity—with its associations of weird behavior, irresponsibility, and the like—is an uncomfortable one. As a businessman, one part of me thinks of creativity as desirable and another thinks "Yes, but not really essential. Oh, maybe a little bit, now and then, when I ask for it."

This ambivalence is not uncommon. This attitude is tolerated because we have not realized that the thinking operations we use to be creative are exactly the same as those we use to learn and understand. To punish one is to punish the other. This can be an important insight. Where I might hesitate to commit myself to the fostering of wide-scale creativity, I can wholeheartedly support a program to increase learning and understanding efficiency. Surprisingly, the skills of learning and understanding are nowhere taught. In fact, as we have seen, some of the skills, such as wishing, imaging, and transforming and the important modes, such as approximate, irrelevant, and wrong thinking, are discouraged.

This brings me to my final conclusion. It is important that we develop a series of exercises, a course, specifically aimed at increasing learning and understanding skills. At this writing we have such a course in experimental development (lots of confusion, uncertainty, and wrongness in it). From our early results we are confident we are on the right track. The measure that is most encouraging is the increased speed in understanding problems demonstrated by participants. This is consistent with experience in our regular five-day course in creative problem solving. It is organized around problems brought by participants. One participant tells his work group about his problem and the group goes to work to help him solve it. The first day of the course an average member requires approximately 12–15 min discussion before he feels that he has learned (that is, understood) the problem. He would like longer but we are hurrying the group. Four days later, the average member feels he has learned enough about the problem to start working on it after approximately 1 min. After approximately 3 min, he feels he understands it. Some problems, of course, are simpler than others. My figures are approximate and are based on thousands of observations.

In our creativity course the improved learning skills are by-products. When we take deliberate aim at learning, we should do even better.

There are two parts to the problem of speeding learning. The first part has to do with relearning fluency in using the repressed thinking operations, welcoming approximate thinking, and developing comfort with confusion, uncertainty, and wrongness (I want to be clear that I do not advocate going through life always uncertain, confused, and wrong, just awareness that these states are appropriate and valuable at certain stages of learning). The second part has to do with creating a climate that encourages the behaviors necessary to speedy learning. There are at least two approaches to climate, one is to help individuals learn to intercept and reject transmissions that are punishing to their learning operations. For exam-

ple we have found that in many situations it is more efficient for the learner to invent (guess) the answer to his question and then check it out. When I do this without warning, I will expect the person I am with to send punishing transmissions to me for being wrong. He will probably not understand that my guess is a beginning approximation. I consciously decide how to respond to this punishment. In addition, we can develop strategies to get people to cooperate. For example, I might say to my partner, "I learn faster if I guess first and you can tell me where I must modify."

Another approach is to alert whole groups to the ways they discourage efficient learning and understanding. This could be easier and faster than we expect because it may be possible to reframe the punishing transmission habits—such things as insisting on early precision, punishing the approximate, using questions and the like—to reframe these as slow, old-fashioned, and more boring as well as less efficient. This would make a profound change possible in a short time. An example of the power of reframing will help clarify this point. I see a house burning and a child leaning out of a second-story window. I am swept by strong emotion. Someone says: "They are rehearsing a movie shot".

The situation remains the same, but in that instant my way of responding is totally different. By creative and intelligent reframing we may be able to make present punishing behavior toward the learning and understanding operations totally inappropriate.

The helpfulness of Mindspring Theory and the work of Rosenthal, Mehrabian, and Lozanov lies in making visible to us some of the causes of low creative productivity and inefficient learning. Thus armed, we can experiment to change our situations and make them more to our liking.

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Reading List

We often are asked for suggested reading material, and in response to the request, have compiled below a range of interesting and pertinent books in the field of creativity.

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