# Noesis

The Journal of the Hoeflin Research Group
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## Editorial

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Members for the coming year: Eleven of our seventeen members will be continuing with us for the coming year:

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Three of our four non-member subscribers also renewed. We may pick up several new members toward the end of the year when and if my new Titan Test is published by Omni magazine.

The July 4 weekend: Keith Raniere has located a free meeting room for us for the weekend of July 2, 3, and 4. The address is 342 Madison Avenue, Suite 2001. I believe this is between 52nd and 53rd Streets. I currently expect 6 or 7 members to attend the gathering. James Majicek sent me the following clipping concerning inexpensive accommodations in the New York area and asked for my comment. It might be worth a try, but I personally would choose an inexpensive furnished room in Manhattan to keep transportation short and simple.

AN ALTERNATIVE to midtown Manhattan's high hotel rates is 10 minutes away in Hoboken, N.J. Accommodations at the residence halls of Stevens Institute of Technology now are available and are within sight of the New York skyline. Hoboken is served around the clock by air-conditioned subway trains to the World Trade Center and to midtown. The fare is $1.

From late May through late August, dormitory-style rooms cost $30 per night single or $22 per person for two in a room. Air-conditioned rooms with private baths are $50 per night single, $30 per person for twin accommodations. Visitors staying at Stevens are welcome to use campus recreational facilities.

Accommodations also are available for slightly higher rates during the rest of the year. For more information, write to Campus Holidays USA, 242 Bellevue Ave., Upper Montclair, N.J. 07043, or call (800) 526-2913.

# Bayesian Regression

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Once we have abandoned the search for certainty, we are left with rational assessments of probability in leading our lives. The mathematical laws of probability allow us to compute the odds of various events, given the odds of other events. This is commonly called Bayesian inference, which is a fancy name for a tautology. For example, if I prepare an urn with 100 balls, fifty white and fifty black, then I select a ball at random from the urn, the odds are even that the selected ball will be white. Similarly, the odds are one in four that two balls selected with replacement will both be white, one in eight that three balls selected with replacement will all be white, etc. If I did not start with fifty of each color, these odds would be different. We can calculate all of these odds by simply counting cases, which is all there really is to Bayesian inference.

However, suppose I do not know how many of each color I started with. What are the odds in this case? It is tempting to still try to apply Bayesian inference, but this time to consider all possible combinations of colors of balls. However, this reasoning is faulty. It is trying to get something for nothing. It is trying to get knowledge from ignorance. The answer depends upon arbitrary definitions. What do we mean that all combinations are equally likely? Do we mean that each color is equally likely, which leads to a binomial distribution? Or do we mean that each possible mix is equally likely, which leads to a flat distribution?

Once we accept that we simply do not know the odds of picking a white ball if we do not know the distribution of the colors of the balls, then we are faced with a problem I will call "Bayesian regression." In order to know the outcome of any experiment, we must know the probabilities of the experimental setup. How do we know that the needle on the gauge did not just happen to repeatedly indicate the same reading? We know this because the odds against this happening are astronomical. But in order to know these probabilities, we need to know other probabilities, etc. At some point, we need to simply ASSUME that things are pretty much the way we think they are.

We can only assume that we are not brains in the vat of some diabolical scientist: we can never claim that this is very unlikely, because we have no evidence that contradicts this hypothesis. Considerations other than evidence cause us to reject this hypothesis: things like Occam's Razor. It would be nice to have some firmer basis for this conclusion, but unfortunately I do not see one.

# Puzzle Solutions

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Switch? (Issue Number 15, June 1987)

Generalize the problem from three marbles to n marbles. If there are n marbles, your odds of having selected the red one are 1/n. After the other person selected a black one at random, your odds go up to 1/(n-1). There are n-2 marbles left in the bag, so your odds of selecting the red one by switching are 1/(n-2) times the odds that you did not already select it (n-2)/(n-1) or 1/(n-1), the same as the odds of already selecting it. Therefore there is no advantage to switching.

If the person looked into the bag and selected a black one on purpose, then your odds of having selected the red one are not improved, so the odds of selecting the red one by switching are 1/(n-2) times (n-1)/n or (n-1)/n(n-2). This is (n-1)/(n-2) times better than the odds without switching, so you should switch.

USENET Letter Series Collection (Issue Number 21, December 1987)

1. T. If you say the sounds these letters make out loud, you will see that the next letter is T.

2. N, N, M, A. or N, S, M, A. Names of the chemical elements or first letters of their symbols.

3. J, V, H, T, P, T, F, P, B, L. Presidents.

4. M, N, O, P, U, W. Letters in the Hawaiian alphabet.

5. Z goes on the top line. The characters on the top line can be drawn with straight lines.

6. Army and Navy officer ranks, descending.

7. Army and Navy non-comm ranks, descending.

8. N, V, N, N, R. States in Constitution ratification order.

9. V or I. Colors.

10. V, L, S, S, C, A, P. Zodiacal signs.

11. U, N, P. Planets.

12. Q, R. Only letters with an inside as printed.

13. L, M, N, O, S, U. Letters whose English names start with vowels.

NEWSDAY, SUNDAY, MAY 15, 1988

# Creativity — Say, There's a Good Idea

## *You can foster it — but not with rewards, coercion or competition.*

**By Teresa M. Amabile**

THE chemist who had just arrived for his appointment looked no different from the others I'd been interviewing all day at a major R&D laboratory in a large chemical company. Over two dozen scientists had already answered my standard question: "Can you tell me about an example of high creativity from your work experience, as well as an example of low creativity?" I'd asked them to discuss any features of these events — the persons involved, the work environments — that seemed distinctive.

The stories I'd been hearing were full of rich and intriguing detail. But I was completely unprepared for this man's startling remarks.

"One thing I've done to stay creative is to cut my salary down, so management doesn't worry about what I'm doing every moment. Once a salary gets up there, management is forced to get involved in every-

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thing you do, because every moment of your time costs the company money. So I avoid this by turning down the raises. I'm here to have a good time. I have the joy of thinking . . . I love just thinking things over, just circling a problem. I am interested in things that don't work, and I even seek them out. When I see conceptual contradictions, I go get them. Just let me play. Give me a big enough playpen, and I'll go from there."

Not surprisingly, I would later learn that this man's colleagues and supervisors considered him eccentric and difficult to manage. At the same time, though, they agreed that he consistently produced the laboratory's most creative work.

Although he was the only one of the 120 scientists my colleagues and I interviewed who said he refused salary increases, this man merely presented an extreme form of an attitude that we found quite prevalent among the most creative participants: They are in it for the fun and the personal sense of satisfaction they get from meeting an intriguing challenge. If anything gets in the way of that fun and satisfaction — particularly constraints placed on them by their work environment — their level of creative productivity suffers.

We can ask two questions about this revelation:

What does it tell us about the special characteristics of creative people — "the creative personality"?

What does it tell us about the special characteristics of creative thinking — "the personality of creativity?"

When psychologists first started studying creativity about 35 years ago, they tackled the first question. For example, psychologists at the Institute for Personality Assessment and Research in Berkeley, Calif., identified a number of traits that described their creative subjects (architects, mathematicians and writers). Among those traits were independence, nonconformity and a propensity toward risk-taking. And all researchers during this time acknowledged the importance of special talents in the highest levels of creative work.

But extraordinary talent and personality and cognitive ability seem not to be enough. Arthur Schawlow, a Nobel laureate in physics, said this about his own creativity and that of his colleagues: "The labor of love aspect is important. The successful scientists often are not the most talented, but the ones who are just impelled by curiosity . . . They've got to know what the answer is."

That extra something that determines creativity, that "labor of love aspect," is what my students, my colleagues and I have studied over the past 10 years. Our research can be summarized in the Intrinsic Motivation Principle of Creativity: People will be most creative when they are motivated by intrinsically interesting aspects of the work itself — interest, enjoyment, satisfaction and challenge — and not by extrinsic motivations — supervisory restrictions, deadlines, or reward structures.

We are not alone in this belief. Albert Einstein saw intrinsic motivation as conducive to creativity and extrinsic motivation as detrimental. As he said, "It is a very grave mistake to think that the enjoyment of seeing and searching can be promoted by means of coercion and a sense of duty."

The observations of outstandingly creative people such as Einstein, Schawlow and other scientists, writers, artists and musicians constitute our first source of evidence on the Intrinsic Motivation Principle of Creativity.

*'We know six ways to kill creativity — and so do many teachers, business managers and parents.'*

The second source comes from controlled experiments that we have conducted in our laboratory with young children, college students, creative writers and business managers. By systematically varying the presence or absence of extrinsic constraints in the work environment (factors such as restricted choice, expected evaluation, competition or surveillance of work), we have examined the effects of each of these factors on artistic, verbal and problem-solving creativity.

The third source of evidence comes from the interview study of R&D scientists which I conducted with Dr. Stan Gryskiewicz of the Center for Creative Leadership. Through a detailed analysis of our scientists' descriptions of creative and uncreative events, we found that this nonexperimental study provided striking confirmation of the laboratory experiments.

In all, we have discovered six methods for killing creativity — six factors that, when imposed on someone who is doing an interesting and potentially creative task, can undermine both the interest and the creativity. They are:

- *Expected evaluation*. People who are concentrating on how their work will be evaluated are less creative than people who are not made to worry about evaluation.
- *Surveillance*. People who are conscious of being watched as they are working will be less creative than people who are not conscious of being watched.
- *Reward*. People who see themselves as doing

something primarily for a tangible reward will be less creative than those who are not working primarily for reward.

- *Competition*. People who feel themselves in direct, threatening competition with others in their work will be less creative than those not focusing on competition.
- *Restricted choice*. People whose choice in how to do a task is restricted will be less creative than people given a freer choice. This factor seems to be especially important for creativity in the scientists we studied. In the R&D interviews, freedom of choice in how to do one's work was the single most potent feature of environments supporting high creativity. Conversely, restricted choice was the single most potent feature of environments in the low creativity examples.
- *Extrinsic orientation*. People who are led to think about all the extrinsic reasons for doing what they are doing will be less creative than people who are thinking about all the intrinsic reasons.

This is not to suggest that extrinsic motivation is all bad. Indeed, in routine tasks that do not require any creativity, extrinsic motivation may be essential. Most of us don't want our bookkeepers to dream up new ways of playing with the accounts; in jobs such as bookkeeping, motivating an employee with rewards, evaluations, surveillance and so on may be perfectly appropriate for getting the work done, getting it done on time and getting it done accurately.

But if we are trying to get our scientists to produce innovative ideas, our advertisers to dream up novel campaigns, our graduate students to formulate elegant new hypotheses and our children to exercise their growing creative talents, then we had best find ways of supporting intrinsic motivation.

Intrinsic motivation is necessary for creativity, but it is by no means all that you need. The theory of creativity that I have been developing proposes three components that are necessary for creativity.

- *Domain-relevant skills*. These are abilities in specific areas (mathematics, music or literature, for example) learned through formal education and experience, for example.
- *Creativity-relevant skills*. These are ways of thinking and working that are conducive to creativity in any domain — for example, an independent, nonconfirming personality; a high energy level or a way of finding new perspectives on problems.
- *Task motivation*. An intrinsic motivation to do a particular task is more conducive to creativity in that task than an extrinsic motivation. This, of course, is the point that my own work has highlighted.

We know that the "personality of creativity" is such that it can be severely hindered by extrinsic motivators. We know six reliable ways to kill creativity — and so, apparently, do many teachers, business managers and parents.

How can we keep creativity alive? At this point, we can suggest three possibilities. First, it is important to have a high level of knowledge and experience. According to our theory, the overall level of creativity in an idea or a product is determined jointly by a person's level of domain-relevant skills, creativity relevant skills and task motivation.

If intrinsic motivation is somewhat low, that might be partially compensated for by high levels of skills. A person might be able to produce moderately creative work, even if somewhat more extrinsically than intrinsically motivated, if he or she is extremely skilled in the domain and experienced in thinking up new ideas.

The second method for keeping creativity alive is to take the focus off extrinsic goals and constraints. Ideally, we should be able to maintain our intrinsic motivation (and our creativity) by somehow shrugging off the strong extrinsic pressures under which we must work. But since this is difficult to do, it would help if our work environments did not impose unnecessarily strong systems of evaluation, reward, competition and other forms of extrinsic motivators.

Third, it should help if we can concentrate on intrinsic motives. This suggestion is a companion to the previous one. If we can somehow be really aware of our interest, enjoyment, personal challenge and internal satisfaction in our work, then we might be less subject to the ill effects of extrinsic constraints on our motivation and creativity.

We have just gathered some exciting new data on these last two points. My colleagues Beth Hennessey, Barbara Grossman and I tried to train children to focus on their intrinsic motives for doing various types of schoolwork and to minimize the importance of extrinsic constraints.

The children in the study watched videotapes in which other children served as models of intrinsically motivated individuals. When the adult on the videotape asked the models what they liked to do in school and why, they replied (according to a script we had written) with statements of interest, excitement and deep involvement in some aspect of their studies. When the adult asked how they felt about teacher approval and getting high marks, the models said that, although such things were nice, they were not as important as really trying to enjoy your work.

There was one dominant message throughout the training videotape and the accompanying discussion we had with the children in this study: It's nice to get rewards, approval and so on, but the most important factor is to be aware of the intrinsically interesting, satisfying and challenging aspects of whatever you are doing.

The training succeeded: Those children who were trained using the videotape showed higher levels of intrinsic motivation than children who had not been trained. More importantly, the trained children did not show less creativity even when they worked under extrinsic constraint.

In effect, what we have done is to show that children — and, we hypothesize, adults, too — can be *immunized* against the negative effects of extrinsic constraints on their intrinsic motivation and creativity.

If we can continue with this work, finding new ways to accommodate both persons and environments to the special "personality of creativity," we will have come a long way toward promoting what Einstein called "the enjoyment of seeing and searching."

The result will surely be *more* searching, *better* seeing — in short, greater creativity