

The Systems Model of Creativity

Mihaly Csikszentmihalyi

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The Collected Works of Mihaly
Csikszentmihalyi

 Springer

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Introduction to Set “The Collected Works of Mihaly Csikszentmihalyi”

In looking over these volumes of *Collected Works*, there is no question that a few themes run through the four decades of their writing. For instance, the first report of my studies of creativity appeared in 1964 and, in 2010, *Newsweek* magazine reported on my latest investigations on this topic. Other topics that I have written about, off and on over the past 40 years, are cultural evolution, play, and adolescent development. Each of these themes is vital to the continuing prosperity, if not the survival, of the human race. I hope this rather ambitious collection will embolden other psychologists to take on the big issues of our time, and laypersons to think about how to find more creativity and joy in their lives.

In looking at these articles I cannot help wondering about their origin: How did I end up writing all these words? What convolutions of the brain, what sequence of events and experiences led me to choose these topics, and conjured to keep me involved in them long enough to say something new about them?

I know that asking such questions undermines whatever scientific credibility I might have. After all, science is supposed to be an impersonal endeavor. One’s history and subjective experience are in comparison trivial epiphenomena of no consequence to the unfolding of objective truth.

Yet, as a student of human nature, I cannot subscribe to this belief. The sciences—physics and chemistry, and the human sciences even more—are human constructions; even at their most rigorously abstract, their knowledge is a product of *human* minds, expressed in words and symbols most accessible to other human minds. And each mind consists of information coded chemically in the brain, plus the information collected by living in a particular environment at a particular time. Thus, scientific knowledge bears the stamp of the unique combination of genes and memes contained in the minds of those individuals who formulated and transmitted it. Hence I must conclude that whatever I have written over these past 40 years has been filtered through my own unique place in the cosmos, and that therefore a brief acquaintance with the place where I am coming from may help the reader to put the ideas contained in these writings in a more meaningful context.

I remember quite clearly the first time I entertained the possibility of leaving a written record of my attempts to understand human nature. I was about 15-years old, standing across the Termini railroad station in Rome. It was a typical torrid summer day: dust was blowing under the sycamore trees, buses were honking,

trolleys were screeching on the rails, crowds were pushing in all directions. I was waiting for a bus to take me away from this maelstrom to the cool serenity of the Palatine hill, where I had been invited by a friend to spend the afternoon in his parents’ luxurious apartment. I was poor—my father, who had been briefly appointed Hungarian ambassador to the Italian government, had almost immediately resigned his position in 1948, after a new Communist government had been put in power by the Soviet armies in Budapest, to replace the lawfully elected deputies of the centrist Small-holders’ Party. Like many other choices my father made in his life, this had been the right one; on the other hand, he had to pay for his integrity by giving up his job and all we owned back in Hungary. We became stateless refugees in a country that was slowly recovering from the ravages of World War II and hardly in a position to help the stream of homeless refugees from Central and Eastern Europe.

So while waiting at the bus stop, I only barely had the price of the fare in my pocket. Worse than that, I felt very ambivalent about this trip. My friend was a thoughtful, kind boy; nevertheless I dreaded having become, in a matter of months, dependent on his generosity. The previous year, our fathers had been colleagues—his was the envoy of the Spanish government, as mine had been of the Hungarian. Now he continued to live the pampered life of the diplomatic corps, while I quit Junior High School in order to make some money translating and doing odd jobs. My friends and his parents were vaguely aware of my family’s situation, and expressed sympathy and concern. When I was visiting, they made sure I ate well, offered me delicacies to take home, and occasionally had their chauffeur take us to watch a soccer game. None of this, however, helped salve my pride. In fact, it made matters even worse; not being able to reciprocate, I felt myself sinking deeper and deeper into a condition of helplessness I abhorred.

In this disconsolate condition, trying to avoid being pushed off the sidewalk by the cheerfully vociferous throngs of people walking towards the Esedra Fountain and the bulk of the Baths of Emperor Diocletian hovering in the background, I held one thing in my hand that was like a talisman linking my carefree past to a future that, while bleak at the moment, I was resolved to make shining again. Improbable as this sounds, it was one of the volumes of Carl Jung’s *Complete Works* from the Bollinger series. I had encountered Jung’s writing only recently, but was captivated by his vision. “Waiting for the bus, a question suddenly popped into my mind: if he could write about such things, there is no reason why I could not also”

After all, my short experience of life had prepared me to ask some of the same questions that Jung was confronting. I had seen just a few years before what seemed like a solid society fall to pieces, a permanent way of life collapse. Both my older half-brothers had been drafted at the last moment to defend Budapest against the advancing Soviets, and both were lost—Karcsi, barely 19-years old, died with all but half a dozen of the 1200 or so students of the Engineering School of the University, trying to hold up an armored division with ancient muskets just issued to them out of an armory; my brother Moricz disappeared without trace in some Russian gulag. Grandfather Otto starved hiding in the basement during the freezing cold of the 1944–1945 winter siege, and aunt Eva, just out of medical

school, was blown apart by an artillery shell as she was caring for the wounded on the streets. In other words, it had been a typical mid-century childhood for that part of the world—senseless, brutal, and confusing.

The war was now over, but few seemed to ask the question: How did this happen? How can we prevent it from happening again? Of course there was a lot of blame going around, with the Left pointing its finger at the bourgeoisie for having collaborated with Fascism, and the Right explaining the tragic turn of events by the brutality of the godless Commies; but these arguments could not be the whole story, right? There must be something deeper, something we didn't understand yet, that held the keys to such irrational behavior ... Yet most adults seemed to take these events in stride, chalk them up to unfortunate conditions that were unlikely to happen again. In the meantime, let's sweep our sorrows under a rug and try to resume life as if nothing had happened.

This attitude did not make sense to me. I felt that WWII had been a warning sign of a systemic fault in the human condition, one that needed a radical remedy before the Four Horsemen saddled up again. Because none of the grownups seemed interested in taking seriously this radical perspective, I had turned early in my teens to literature, philosophy, and religion, where radical perspectives abounded. Yet, I felt that these approaches to solving the mysteries of human behavior were often disconnected from the realities I experienced in everyday life; too often they relied on simplistic explanations or on mystical revelation, and—true as many of their conclusions might have been—they required leaps of faith that I felt unable, or unwilling to take.

Then, as a result of some really serendipitous circumstances, I happened to read one of Jung's books. I was not even aware that a discipline called “psychology” existed. I thought at first that Jung was a philosopher, or perhaps a historian, or one of those scholars who wrote literary criticism. But whatever he was, I recognized in his writing the passion for going beyond the conventional assumptions about life, a radical re-evaluation of culture, society, and biology that I been looking for but had not yet found.

Waiting for the bus in front of Stazione Termini was the first time it ever occurred to me that I might follow in the footsteps of scholars like Jung, and the other psychologists I had read following his writings. I should add that this epiphany took only a few minutes of that hot afternoon; almost immediately the realities of my position as a destitute high-school dropout took over. The idea was attractive, but shamefully ridiculous. I never went back to it consciously after that day, although at some level the hope must have survived, because 6 years later, when I was making a career for myself in Italy using the linguistic skills I had acquired at home and during our travels, I decided instead to leave for the USA and study psychology.

The decision to become a scholar was rather unusual in our family. On both sides, landowning had been the career of choice. Father's family also included military men and a physician or two. My mothers' ancestors included several judges and provincial administrators as well as physicians. In recent generations, visual artists—both men and women—were superabundant; among nephews and

nieces there is a well-known sculptor, a children’s book illustrator, a photographer, a textile designer, and the dean of the Hungarian Institute for Industrial Design. But no one, to my knowledge, had ever dabbled much in abstract knowledge.

The one exception was my mother. Although she—like most women of her generation—did not finish high school, Edith was very interested in literature; for instance, she translated Goethe’s *Merchen* into Hungarian, and then into Italian. More to the point, throughout her adult life she kept adding to a manuscript she had started at the time she married my father, who had been recently widowed; it was a history of humankind seen from a Christian perspective, as a slow unfolding of knowledge that was to lead to the Kingdom of God. She was deeply influenced in this endeavor by Teilhard de Chardin, a French Jesuit who at one point taught physics to my brother Moricz at the Lycee Chateaubriand in Rome. It was mother who gave me a copy of Chardin’s *The Phenomenon of Man*, a book that opened up wondrous vistas to my teenage eyes. My mother’s History was a brave endeavor; the onion-skin pages of the manuscript fluttered in the candlelight of World War II, with its optimistic message seemingly grossly inappropriate given the atrocious realities. She laid her copy away in disgust several times, but then took out her battered typewriter again, to add a few more centuries to the progress of goodness on earth.

These childhood experiences—the senseless butchery of WWII, my mother’s belief that history had a meaning, the evolutionary vision of Teilhard, the contemporary psychology of Jung—must all have helped shape the writings contained in these volumes. At the same time, the path that led to them was a tortuous one. Because, when I arrived in Chicago in 1956 and took my entrance exams to the University of Illinois, I soon found out that neither Carl Jung, nor (God help!) Teilhard de Chardin were considered serious scholars. Reading them exposed one to ridicule, and citing their work in a student essay earned big question marks from the teacher’s red pen.

The period I spent at the University were the final years of the academic hegemony of *Behaviorism* and *Psychoanalysis*, the two currents of thought that had been ruling American psychology for the past two generations. There were useful truths to be found in both these perspectives, but by the late 1950s they already seemed more like historical relics than keys to the future.

What follows is a record of how I tried to combine what I thought were the best insights of the visionary Europeans who had shaped my childhood, with the skeptical empiricism of my new homeland. Even though I have not found definitive answers to the questions that initially motivated my investigations, I can look back on this half century of work with some feeling of accomplishment. I hope that the reader will also agree that the chapters that follow provide fresh light on some of the mysteries of human existence.

Introduction to the Volume

Art and Creativity

Preparing to start a line of research that would lead to a doctoral dissertation, I was in a deep quandary. None of the problems that were considered scientific enough to be researched for a thesis were very interesting to me. The years I had spent working at various jobs after dropping out of high school, had served to buffer me from an unquestioning acceptance of academic wisdom. Without intending to do so, I kept reading what psychologists were teaching from something like a meta-perspective (or perhaps just from a common-sense perspective). Now that I was about to become an academic myself, I could not accept academic orthodoxy uncritically. It was clear that to get a good job as a professor of psychology at a good university I should either study rats in bio-psychology mazes, or study unwary college sophomores being misled in a social psychology lab, or observe small children learning such things as object-constancy in a cognitive developmental lab. All worthwhile pursuits if what you wanted to accomplish was a respectable career as a psychologist. But, I felt that being a psychologist was a means to understanding how to live a better life, not an end in itself.

One subject that I thought might help to get me where I wanted to be, and at the same time had some legitimacy in the profession, was the topic of creativity. After all, much—or most—of what makes our lives interesting, meaningful, and worthwhile, is the result of creativity. And, because of the influence of J. P. Guilford, a psychologist from USC who had then become President of the American Psychological Association (or APA), creativity had just become a legitimate topic to study.

The resurgence of scientific interest in creativity is in itself an instructive story about how fads in science are swayed by political and economic forces. During the hegemony of behaviorism (roughly from 1920 to 1950) creativity was something that psychologists had no interest in studying. It was too soft, too subjective, too complicated a notion to be studied within the reigning stimulus–response paradigm that had become the only credible perspective for understanding human behavior. Neither were cognitive psychologists very interested in the topic, because the IQ and its measurement seemed to provide all the information we needed to know about the functioning of the human mind.

Then after the U.S. entered WWII, the Air Force came across an unforeseen problem. At the time, pilots were selected through variety of physical tests and by the conventional measures of IQ. Yet, as the air war escalated and ever more complicated planes were introduced, pilot errors increased resulting in tragic losses of life and equipment. What was puzzling was that high IQ did not prevent unforeseen errors from occurring. A very smart pilot, confronted by a sudden emergency, tended to go “by the book” even when the book had no solution for the problem. Hence the brass in the Air Force decided that in addition to IQ, they should also use some creativity test to screen would-be pilots. Because there were no tests to measure creativity, they turned to Guilford, a professor of psychology at USC who looked at intelligence from a broader perspective than most of his peers, to provide one.

The rest, as they say, is history. Although I know of no data showing that Guilford’s tests helped the War effort by decreasing air casualties, there is certainly ample evidence that they made creativity a popular topic among psychologists. Apparently pursuing the study of creativity was in the national interest; there was even good money to be had from the Department of Defense to build laboratories and careers.

Unfortunately, this scenario is not that unusual. Even the IQ tests, originally developed in Paris for testing children applying to private schools, became the most popular psychological tool after the US Army adopted it as a screening test for recruits in World War I. It is like a page from Greek mythology, where Hephestus, the ugly and lame god, became so useful to his peers enchanted by the inventions he forged in his lab under Mount Etna, that Aphrodite—the most desirable goddess on Mt. Olympus—agreed to marry him. Everyone was more or less happy until Ares, the god of war (and therefore the main costumer of Hephestus’ inventions), became interested in Aphrodite. She, in turn, could not resist a god in uniform; so while Hephestus kept toiling at his forge, Ares and Aphrodite gamboled in the bed upstairs. Thus do the claims of war often trump the honor of thinkers.

In any case, Guilford made creativity an acceptable topic for a dissertation. To make things easier, a professor in my department at the University of Chicago, Jacob Getzels, had just co-authored a book entitled *Creativity and Intelligence*, in which he and his colleague Philip Jackson reported research where they compared students high in intelligence and high in creativity (as measured by Guilford-type tests), with children equally high in intelligence but *low* on creativity. The first group was in many respects more interesting and more promising than the second, yet the latter was preferred and esteemed much more by teachers.

Getzels had developed a theory of creativity based on the concept of problem-finding. Basing his argument on anecdotal evidence from the lives of creative scientists, he concluded that these individuals differed from less creative peers not so much in the ability to *solve* problems, but in their knack for seeing new problems, and formulating these in ways that then could lead to a solution. One of his favorite sayings was attributed to Albert Einstein to be something to the effect

of: a creative scientist is like a detective, but a detective who first must commit the crime that needs to be solved. This explained in part why teachers did not like creative students, no matter how intelligent they were; students are supposed to solve the crimes put before them by their elders, not their own.

With Getzels' support, I was able to immerse myself in the study of creativity. But instead of counting responses to Guilford-type tests, which I thought to be a very pale reflection of creativity, I wanted to study some actual instance of the creative process. I chose artistic creativity for two reasons. First, following in the footsteps of many of my relatives, I had myself painted canvases as a teenager, as well as illustrated magazine articles and movie posters. Familiarity with the process made it likely that I would better understand what other artists were doing and saying. Second, because the development of the creative process is much more transparent and public in the visual arts than in any other field where creativity occurs, one can follow the development of a drawing online, so to speak—the artist starts with a blank surface, and an observer can watch the creation of a work of art from beginning to end, with all the choices, false starts, changes, and new developments that the process entails. In other words, observing artists at work allowed one to study the creative process as it occurs, instead of trusting the recollection of the artist with the inevitable editorial cuts and embellishments that memory provides.

I was able to obtain permission from the School of the Art Institute of Chicago (SAIC), one of the premier art schools of the country, to use office and studio space on their premises, and to test and interview students. This work took over a year, and culminated with a series of intensive observation of fine art students drawing in the studio under semi-experimental conditions.

The data collected at SAIC allowed me to write my doctoral thesis and resulted in a book Getzels and I wrote together a few years later entitled *The Creative Vision*. The first two chapters in the pages that follow are examples of the several articles that appeared in journals during these years. Moreover, all the subsequent writings on the subject were influenced to a lesser or greater degree by this first study.

The idea behind my thesis was basically simple: to find a way to operationalize the “problem-finding” process described in the abstract by Getzels and see how it applied to creativity in art. Just to give one example of the dozen measures: I took still pictures of the drawing of the art students every 3 min (this was before video cameras were widely available). Some students' finished drawings (let's call them type A) were recognizable from the first charcoal strokes—the basic structure did not change from beginning to end. Other students' finished drawings (type B) had no resemblance to how the drawing started. Which of these two kinds of drawings, A or B, do you think were judged by experts to be more original and aesthetically valuable? Contrary to what most people would say, it was the type B drawings that were rated higher.

Interviews conducted with the artists right after they had finished drawing revealed that type A drawings were the result of the artist having a clear idea of what he or she wanted to end up with—an idea inspired by previous knowledge

of art: “I wanted to convey the sense of despair that you find in Munch’s paintings” or “I wanted to create a startling vanishing-point” or “I wanted to play off the similarities between the smooth surface of this bunch of grapes and the shining casing of this automobile carburetor.” Artists who approached the task in this way produced drawings that experts rated less original, interesting, and valuable.

Type B drawings evolved during the process of drawing. The artist typically had a strong emotional response to the objects he chose to draw (the experimenter provided a choice of 30 objects from which the artist could choose as many as he wished to create a still life; after that point, he was told he could ignore the objects, and draw whatever he wanted). But the objects were not chosen because they could well represent art theory or history, as was true for the artists who ended up making Type A work. Instead of their smooth surface, one artist chose to draw a bunch of grapes because an uncle had a vineyard in Michigan where the artist had spent many a nostalgic summer vacations. But once he arranged a still-life to draw, Artist B would let the first strokes suggest what the next ones should be; the drawing developed organically—it was *discovered* rather than *re-presented*. Type-B artists reported in their interviews that by the time the drawing was well advanced, it took on a life of its own: the artist was solving a problem that had no known precedent, a problem that emerged out of the process itself. In other words, they were like Einstein’s detective who had to commit his own crime before solving it.

The distinction between problem-finding and problem-solving is further illuminated by one of a series of published exchanges with Herbert Simon, then the only psychologist to have won a Nobel Prize in Economics, for his work on decision making (Daniel Kahneman has now joined him as the second psychologist to be given the Prize). Simon, in his presidential address to the APA, claimed that the computer program he wrote, *when given the right information*, could come up in a few minutes with discoveries in chemistry and physics that took the original discoverer years to make. From the elliptical pattern that the planets follow to the synthesis of urea, Simon’s program could make one creative discovery after another in a fraction of the time it took humanity to make. From this, he concluded that creativity was nothing more than fast problem-solving.

Of course, what Simon did was to transform what historically had been a *discovered* problem into a *presented* problem. Tycho Brahe and Friedrich Wöhler had to decide what was the right information necessary to solve planetary motions and the synthesis of urea, respectively; Simon’s software was handed the necessary information and the method for reaching the solution. In so doing, anything resembling creativity was leached out of the process. [Chapter 5](#) contains one of the stages of our debate.

But the study of young artists at the SAIC had included much more than problem-finding. In fact, only [Chap. 1](#) deals with it directly. [Chapter 2](#) deals with another recurrent theme in creativity: the personality of the artist. Here the major surprise was that art students majoring in different areas—Fine Arts, Applied Arts, Advertising Art, Art Education—turned out to have very different patterns of

values and personality traits. For instance, students with artistic talents and social values ended up majoring in Art Education, but those with high political values chose Advertising Art. Skilled artists who held high theoretical and aesthetic values became Fine Artists. This finding from 1973 is echoed in [Chap. 14](#), published in 2004, where the conceptual framework for understanding the artistic personality is further developed.

Other sub-themes are the influence of the social context on creativity (running through [Chaps. 6, 7, 9, and 13](#)) and developmental issues addressing how creativity unfolds from childhood to old age (dealt with in [Chaps. 9–11, 15, and 18](#)).

But what probably will be seen as the major contribution to the topic of creativity starts in [Chap. 3](#), and continues throughout [Chaps. 4, 8, 10, and 13–15](#). These chapters develop the conceptual model and theory of what became known as the *Systems Model of Creativity*. Because this model has been widely discussed and occasionally applied by other authors, it may be useful to describe briefly how and why it came about.

By the 1980s, I had had time to digest the results of our studies at the SAIC. The findings did not sit quite well with me. For instance, in a longitudinal follow-up of the former students 18 years after they graduated, it turned out that some of the most promising and gifted young fine artists were employed in real estate, were teaching, or remodeling old houses. One was a thriving plumbing contractor in New Jersey, another designed sweaters in Paris. Although they might have been doing their work quite creatively, the promise of an independent, creative artistic career that had motivated them in the Art School had either never materialized, or had been cut short. Another instance: at SAIC women students had outscored men in the various creativity tests we used, and they had better ratings from art teachers in terms of artistic promise. Eighteen years later, not one of the women artists were known professionally or were exhibiting their work, while at least half a dozen of the men were getting to be established artists.

These findings suggested that if you wanted to know how creative products came about—how new music was composed, novel books were written, or scientific theories elaborated—knowing how “creative” a person might be was not enough. Studying individuals to determine how creative they were was like listening to one hand clapping. Creativity, I concluded, could not be understood unless one took into account the impact a person had in his or her community of peers; its causes could not be understood without taking into account the traditions from which the novelty came, and the contribution society made to the individual’s ideas.

I remembered, for instance, when I was about 11-years old and my father took me for the first time to see Giotto’s cycle of frescoes on the walls of the Scrovegni Chapel in Padua. For days he spoke in awed tones about the wonderful treat in front of us: we were going to witness, with our own eyes, one of the most significant steps in Western art—the transition from the stiffly anorexic Gothic style of representing the human form, to the more fluid, expressive forms that presaged the great art of the Renaissance. Many years later I did not remember much of our visit, except one conclusion I drew from it: that the man who drew the Walt Disney comics I had loved so much was a much greater artist than Giotto.

This experience reappeared a generation later. Now I had a way to understand it better: creativity was a *social construction*. The mother who taped her child's first finger paintings on the fridge door, the first grade teacher who called some children "creative" if they had a vivid imagination, the advertising copy-writer who came up with a nifty slogan, the scientist who first stumbled into a novel concept—were all called creative because someone believed the products each made were new and worth admiring. When I saw the Scrovegni frescoes I was not impressed because I lacked the art connoisseur's knowledge that provided a context for Giotto's accomplishments. The paintings looked at with fresh eyes, so to speak, were anything but remarkable. The context by which a mother judges her child's daubs is her knowledge that, just a few months before, her child had been a baby incapable of controlling its fingers; but now just look how boldly the colors are smeared across the paper!

The creativity of a work of art emerges against the background of previous art, which constitutes the *domain* of art. Past traditions are the background from which a new work emerges, and judged to be worth preserving in the domain—by including it in museums, collections, art books, and journals. Similarly, a scientific theory or experimental finding emerges against the background of the domain of science, and if considered an advance, will be added to it in its own turn.

But, the attribution of creativity is not a democratic process. When Einstein first published his papers on relativity, it is said that only four physicists in the world understood the importance of his ideas. But because these four were recognized as some of the leading thinkers of the time, their opinion of Einstein quickly trickled down to the second tier of scientists, then to the third; within a decade or so his name was familiar to men on the street. In most human endeavors, the opinion of a small elite determines what's new, what's not; what is valuable and what is not; what belongs to the domain and what should be excluded from it. This elite is what we call the *field*.

The field of basketball, made up of coaches and experts in that game, decides who should be the Most Valuable Player of the NBA each year; the fields of Toyota, Ford, or General Motors decide what new models will be produced next year; the field of pop music—recording studios, producers, and distributors—decide which new songs to release. The only domains that are truly democratic are those in the mass market, where each consumer votes with his or her pocketbook which products will enter the ephemeral domain of products to which they belong.

Of course fields are often "wrong" in the sense that later generations of experts indignantly castigate the choices made by the earlier ones. For instance, now we laugh at the nineteenth-century academic painters who were preferred by the field of art over the Impressionists, Cubists, Expressionists, and so on. How could the experts have been so short-sightedly wrong? How come no one recognized the greatness of Van Gogh while he was still living? The point is, the early experts were not "wrong" and the current experts are not necessarily "right." Walt Disney might still be remembered as a greater artist than Giotto. As our knowledge, life experience, and tastes change, so does our appreciation of previous

accomplishments change, like patterns in a kaleidoscope. And less obviously, the same shifting appreciation of the field holds for the sciences: the names of men who were considered great innovators fade from memory, while those of others who were ignored in their lifetimes shine with renewed vigor in following generations.

This is as it should be. If creativity is a social attribution, it makes sense that the attribution should change as society changes. But this message is hard to accept these days, when creativity has become something of a mystical substance, a secular variant of the belief that each of us carries a spark of the divine spirit. The Systems Model is a first step toward a de-mystified, scientific understanding of how certain actions, and the individuals who act them out, end up being considered creative.

In the last analysis, however, important as the Systems Model is, being a psychologist I was most interested in the individuals whose actions lead to the attribution of creativity. What kinds of people achieve a reputation for creativity? What kind of lives do they live? An unexpected opportunity allowed me to provide some answers to these questions. One summer day in the late 1980s, Larry Cremin, then the president of the Spencer Foundation, called me up unexpectedly as I was vacationing in Vail, Colorado, and asked me if I would be interested in studying how creativity unfolds during the lifetime of eminent individuals. If I was, he said, the Spencer Foundation might be interested in funding such a study. I had never met Cremin, but his proposal sounded intriguing, to say the least.

To make a long story short, with the generosity of the Spencer Foundation, I, along with several of my student, was able to conduct long in-depth interviews with 91 individuals who by any measure would be considered creative in their respective domains: historians like John-Hope Franklin and William McNeill; musicians like Oscar Peterson and Ravi Shankar; poets like Hilde Domin and Mark Strand; chemists like Manfred Eigen and Ilya Prigogine; physicists such as Hans Bethe and Subrahmanyan Chandrasekhar; and many others of equal stature in other fields. Twelve of them had earned Nobel Prizes, two of them—Linus Pauling and John Bardeen—twice.

Out of this study we wrote several journal articles and a book, *Creativity: Flow and the Psychology of Discovery and Invention*, which was first published in 1996 and has since been translated into eight languages. The initial study also stimulated many interesting applied studies, ranging from the production of successful new motion pictures to the creative collaboration among space scientists from different national backgrounds in the launching of the probe exploring the moons of Saturn. In the present volume, the study of creative individuals is touched upon in [Chaps. 9, 11, 12, 15, 17, and 18](#).

Finally, in recent years I had the good fortune to establish a collaboration with a young Swedish neuroscientist, Fredrik Ullen, who offered his knowledge and laboratory facilities to do an fMRI study of creativity. Ullen had been recommended by one of the creative scientists I featured in my book—George Klein, who was then the head of the tumor biology lab at the Karolinska Institute in Stockholm. So, Ullen, his student Sarah Bengsten, and I designed an interesting

experiment, where professional pianists were asked to improvise a short melody while monitored in a magnetic resonance “tube,” and then to repeat their improvisation. The areas of the brain significantly more active while playing in the *improvise* versus the *replicate* conditions were assumed to be implicated in thought processes of a more creative kind.

This study—reported in [Chap. 16](#)—is only a first step, but suggests very interesting directions for future research. What I found particularly suggestive is that the area of the brain most specifically active when improvising, the Dorso-Lateral Pre-Frontal Cortex (or DLPFC for short), is also very active when playing poker. Not chess, but poker. It appears to be where decisions are made when one has insufficient information to reach a rational conclusion. I cannot but wonder, do schools ever exercise this part of the brain? Children are taught to solve problems with learned algorithms—rules of spelling, arithmetic; they learn to memorize dates and names. They learn to solve problems by accepted methods. In other words, they learn to solve *presented* problems—but they do not learn how to find *discovered* problems, which requires improvisation. And this, in turn, apparently needs the cooperation of the DLPFC, an area of the brain left dormant in schools.

The 18 chapters in this volume are a representative selection from the best articles on creativity I published in scientific journals. They cover a lot of ground, and they point in several directions. Taken together, I hope the reader will find in them new ideas as well as a comprehensive view of this fascinating domain.