Chapter 15
Creativity Through the Life Span from an Evolutionary Systems Perspective

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What is Creativity?

Creativity has become such a commonly used term in the past few decades that everyone has formed an opinion about what it means, and there is no need to define it further. In this chapter, however, we are going to use the word in specific ways, so a few words of explanation may be useful to orient the reader. There are three main dichotomies we use, and if these are not clear, what follows might be confusing.

The first dichotomy is that between creativity with a capital C and with a lowercase *c*. Big C, or cultural creativity, refers to ideas or products that are original, are valued by society or some influential segment thereof, and are brought to completion (Csikszentmihalyi 1999; MacKinnon 1963; White 1968). This form of creativity changes the way we see, understand, and interact with the reality that surrounds us. It is the energy that propels cultural evolution. Most of this chapter deals with cultural creativity, both because it is a clearly important feature of human life and because it is the one about which most is known.

But one could argue that small c or personal creativity is just as important, if not more so. Personal creativity refers to the novel ideas or experiences that any person can have and that do not need to leave a trace anywhere else but in the consciousness of the person who has had them. A new hairdo, a shortcut in servicing one's car engine, a clever conversation may qualify. Although this form of creativity does not change the culture, it does make a vast difference to the quality of one's life—without it, existence would be intolerably drab.

These two meanings of the concept are usually thought of as being on the same continuum, the small c slowly growing into the big C. However, there are good

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M. Csikszentmihalyi, *The Systems Model of Creativity*,
DOI: 10.1007/978-94-017-9085-7_15,

reasons to consider them as relatively independent, orthogonal processes that are more different than similar, and this is how we treat the concepts here.

The second dichotomy pertains only to cultural creativity and concerns the dialectic between producers and audience. It is commonly assumed that big C creative ideas are self-sufficient, and thus creativity includes only what happens in the creative person's mind. Our approach assumes instead that without a receptive audience, the creative process is not unlike the sound of one hand clapping the Zen koan refers to. In other words, what we call creativity is co-constituted by an individual who comes up with a novelty and a social milieu that evaluates it (Brannigan 1981; Csikszentmihalyi 1988; Kasof 1995). At the very least, it should be obvious that creativity is always an attribution, and that it cannot be "seen" except when it has been so identified by some group (teachers, critics, historians) that has credibility in the eyes of society. The same is not true of personal creativity. For personal creativity, no external evaluation is necessary; only the subjective experience matters.

Finally, the third dichotomy refers to that between the distal and proximal accounts of why some people bother being creative. Distal explanations present the creative drive as motivated by the desire for fame and wealth—or, in light of the broader scope of evolutionary theory, by the selective forces of survival pressures. Although distal explanations account in part for creative behavior, they ignore the momentary experience of the creative person, which motivates the search for novelty even when wealth and fame are extremely unlikely. Distal explanations tend to be extrinsic, pointing to an external goal that is usually objective and concrete, like money, a promotion, or a prize. Proximal explanations tend to be intrinsic, subjective in nature. In the case of creativity, the intrinsic rewards include the excitement of discovery, the satisfaction of solving a problem, and the joy of shaping sounds, words, or colors into new forms.

With these preliminary distinctions in hand, we proceed to examine some of the ways that moving through the life span affects creativity. We do this first by considering the implications of evolutionary theory for aging and creativity.

Creativity and Life Span Development from an Evolutionary Perspective

According to evolutionary psychology, currently a leading paradigm concerning human behavior, one might conclude that learning—and certainly creativity—are of little use in the second half of life; being useless, that they should eventually disappear from the human behavioral repertoire as wasteful of energy, to be replaced by concerns more conducive to reproductive fitness—such as taking care of one's offspring and of their descendants. Certainly there is a great amount of evidence to the effect that among all sorts of animals, including humans, the amount of spontaneous learning and some of the behaviors underlying creativity, such as curiosity and playfulness, decrease precipitously with age (Fagan 1981).

Play, exploration, curiosity, and innovation are linked behaviors in all species. Studies of animal play show a great interspecies variability in the age at which individuals start and stop playing. Wildebeest and caribou infants start prancing playfully a few hours after birth, apparently to discourage predators from attacking them (Estes 1976). In general, however, play ceases around the time an individual first reproduces "because play at successively later ages yields successively fewer cumulative benefits and because resources devoted to reproduction are more effective for producing surviving offspring than are resources devoted to adult play" (Fagan 1981, p. 378).

Creativity has not been directly studied in nonhuman species with reference to age. Anecdotal evidence suggests that behavioral flexibility and innovation are much more likely to be shown by younger individuals. For example, Japanese macaques were observed to have trouble eating the fruits placed for them on the ground, where they were immediately covered with sand. After some time, a young female accidentally dropped a sweet potato in the water, and when she retrieved it, the fruit emerged nice and clean. After this the juvenile went on washing its fruit, and presently her mother and siblings began to imitate her (Kawai 1965). There seems to be no evidence that older males caught on to the new practice. Before one immediately jumps to conclusions about the effects of the Y chromosome on creativity, it is useful to consider the fact that Japanese macaque females, although not the dominant sex, take more of the responsibility for the maintenance of social order than males (see, e.g., Altmann 1980). This in turn suggests that the diffusion of innovation may be linked to concern for the well-being of the social network. Adult individuals who fill certain roles in the group may be more able to notice innovations and be more likely to adopt them and diffuse them than others.

In this respect it is important to recognize that the adoption of useful new ideas or practices is as important for creativity as the creative act itself. Psychologists have long accepted the popular assumption that "genius will out," meaning that a creative act will prevail and impose itself on the culture regardless of opposition. A more likely scenario is that original ideas become creative only when a critical mass of the audience recognizes them as worthy of attention. According to this systems model, creativity is co-constituted by an individual who introduces a novelty that is selected, preserved, and transmitted over time by a field of experts, or in the case of items of mass culture such as soft drinks or movies, by the market as a whole (Csikszentmihalyi 1996, 1998; Csikszentmihalyi and Wolfe 2000).

According to this model, then, the relation between creativity and age is not restricted to the individual who initiates the creative process but extends to the audience as well. The recent interest in "cultural creatives" (Anderson and Ray 2001) and in a "creative class" (Florida 2002) can be more appropriately seen as referring to audiences that are susceptible to the adoption of new ideas or products, rather than to those who are actually producing creatively. Thus one might ask: Are older adults more or less likely to recognize and adopt new ideas, practices, or artifacts than teenagers or younger adults?

Before reviewing the empirical evidence for the link between creativity and age among humans, it may be useful to consider the theoretical implications of the

evolutionary perspective. To what extent is it true that among us "resources devoted to adult play [or to creativity]" are less effective than resources devoted directly to reproduction? The peculiar survival strategy of *Homo sapiens* has always rested on the use of the cortex, on the processing and abstracting of complex information. This is becoming increasingly true as we enter what has been called a "knowledge economy" or an "information age" (Drucker 1985, 1999). With useful information and new knowledge constantly coming on line, for many thousands of years now it has been advantageous for individual men and women to retain some of their exploratory curiosity, some of their playfulness and creativity. Even from a purely sociobiological standpoint, to invest energy in new learning may often be a more effective strategy for the propagation and survival of one's genes than investing energy in more conservative, traditional ways of accruing resources.

Some evolutionary psychologists are beginning to reevaluate the role of creativity in the transmission of genes. For example, Miller (2000) argued that creative individuals, especially those working in artistic domains, are more likely to be attractive to the opposite sex and thus reproduce relatively more often. Genius is a "fitness indicator" in that it is rare, valued, and takes time to develop; it is also an "ornament that appeals to the senses," thereby attracting potential mates (Miller 2000). A similar argument has been advanced by Blackmore (1999).

Two observations are appropriate in considering these extensions of the theory of sexual selection to creativity. In the first place, the reproductive advantage of creativity presumably extends to adulthood but not to old age—yet many great creative accomplishments come late in life. Second, evolutionary explanations of behavior are always distal; that is, they account for why a given behavior survives over time, as the cumulative effects of that behavior over many generations of individuals have a chance to be selected in competition with the behaviors of other individuals who do not engage in that behavior. But evolutionary explanations have little or nothing to say about proximal causes—the ones that actually motivate the individual in his or her lifetime.

Play behavior, for example, is explained by the evolutionary perspective in terms of the advantages that an adult will have if he or she played as a child. Compared to other adults who did not play extensively early in life, such a person may be slightly more savvy at interpersonal relations, better controlled, better able to compete within a clear set of rules, and so on. These are all distal reasons, however. Children do not play because they expect to become more successful adults. They play because it's fun. The proximal reason for playing is that the experience is enjoyable. A similar distinction between distal and proximal explanation holds for creativity as well. Whatever the long-term advantages it confers, the reason people involve themselves in the processes of discovery and invention is that nothing in "normal" life compares with the experience (Csikszentmihalyi 1996).

But with human beings there is perhaps an even more important difference for expecting creativity and learning to continue throughout life. As a species we are dependent on the social milieu to teach us the accumulated experience of innumerable ancestral generations. Other social organisms—such as ants, termites, or

coyotes—also depend on the group to which they belong, but not for learning—what they will ever know is already programmed in their genes. Even though experience within the group is necessary to unlock most of this programmed knowledge, there is little or no evidence of unprecedented behaviors arising in such groups, unless as a result of genetic mutation. As humans we inherit not only our ancestral genes but also the memes (Csikszentmihalyi 1993; Dawkins 1976)—the units of useful information—that our forebears have discovered and that are then packaged into myths, histories, philosophies, technology, and science.

Societies that can use past information efficiently tend to provide more comfortable environments and longer life spans for their inhabitants. Such societies presumably encourage continued learning and creativity not only in childhood, but later and later into adulthood. And as more innovative individuals live longer in such societies, this mutual synergy may place in motion a benign spiral of individual and social improvement.

Creativity and Physical Aging

In terms of the relationship between creativity and adult development, it is useful to distinguish between the effects of physical and social aging. However, it is quite difficult to untangle the purely physical effects of aging from those due to social aging. Clear physiological effects include declines in memory functions in old age, impairment of fluid intelligence, and loss of energy. These changes, however, are of relatively little consequence to many forms of creativity. In many ways, social aging is more consequential. This involves passing through social roles that require different behaviors from the person, either enhancing or jeopardizing his or her creativity. Social aging will be discussed in the following section; here we review the scant information available on the purely physiological impact of aging on creativity.

Contrary to popular belief, age—even considerable old age—need not be an impediment to creativity, Michelangelo was 79 years old when he painted the strikingly original frescoes in the Pauline Chapel of the Vatican. Benjamin Franklin was 78 when he developed the bifocal lens for eyeglasses, Giuseppe Verdi composed the opera *Falstaff* at 80, and he never wrote anything as joyfully playful as that composition in the 60 years of his musical career. Frank Lloyd Wright broke new architectural ground at age 91 with the building of the Guggenheim Museum in Manhattan. One could go on and on with examples that show how originality and perseverance need not decrease until the very end of life.

It is true that beginning with the 7th decade of life, it is usual to report a waning of energy and troubles with memory and sustained effort, especially in tasks requiring what has been called "fluid intelligence" (Cattell 1963). However, age decrements in intellectual functioning appear to be less severe than they were once held to be (Schaie 1996), and they may be more than compensated for by increased knowledge that accrues with life experience (Baltes and Staudinger 2000).

It is likely that age presents more obstacles to scientific than to artistic creativity (e.g., Chandrasekhar quoted in Wali 1991; Lehman 1953). In our study of creativity in later life (Csikszentmihalyi 1996; Nakamura and Csikszentmihalyi 2003), some of the scientists complained that memory decrements were constraining the assimilation of new knowledge, or learning, needed for creative work. For example, a scientist in his 90s observed that he can no longer store and retrieve effortlessly the information he reads. Another complains, "At my age it's a lot harder to learn all these techniques…. You think how lucky children are…, I get discouraged… mathematics comes easily to me. And physics… [But] all the experimental side… running the programs, does not come easily." (All excerpts quoted in this chapter refer to interview transcripts collected during the Creativity in Later Life Study; see Csikszentmihalyi (1996), Nakamura and Cskiszentmihalyi (2003).)

At 75, one social scientist whose research plate is overflowing, cast an interested eye toward a neighboring specialty, but noted, "that is not anything that I am ever going to get into… I would not even have the memory." A busy physicist's reasoning was somewhat different: The demands of learning a controversial new paradigm would have required putting aside his ongoing, engaging work; besides, the new area did not promise to lead to the kind of "final" or "complete" answers that this scientist finds satisfying.

Faced with demands to assimilate new ideas and particularly new technologies to do creative work, many scientists are clearly aided by the resources accruing from earlier achievements. Some rely on collaborators' knowledge of new technologies, others on support staff's ability to use computers. In other words, above and beyond their continuing impact on productivity, the external resources at the disposal of eminent individuals can substitute for having to engage in new learning.

Social interaction is a major means of staying current in certain domains, such as physics. Some scientists even return to the role of student, violating expectations concerning the conduct of distinguished older scholars. Vibrant examples of late-life learning were provided by two eminent physicists, both still active in their eighties. In recent years, each has sought younger experts at other universities in a specialty that they wished to learn. One explained: "I realized that there is a development in general relativity that I ought to learn about and I did not know…. So I got up on my hind feet and phoned and made an appointment and spent 2 days there talking with people, both this fall and the previous fall."

At the age of 80, this scientist flew from the East Coast to the Midwest to consult with a former college student who had just entered the University of Chicago. Thus, relying on networks of informants can compensate to a large extent for not being able to keep up personally with the progress of disciplinary knowledge.

Investigations of creativity based on the historiometric method pioneered by Lehman (1953), Dennis (1956), and recently expanded by Simonton (1999) and Martindale (1990), have attempted to establish the optimal ages at which creative contributions are typically made. These approaches involve arranging the

achievements of a scientist or artist in chronological order and plotting them along the life span axis of the creator. In a recent review, Simonton (1999, p. 120) claimed: "Illustrious creators can be examined from the moment of conception to the very instant of death, plus everything that takes place within this long interval." However, a problem historiographers encounter is that one cannot determine from the published record when the creative ideas actually occurred. A revolutionary idea hatched in early life may not be fully developed until maturity or later; thus the attribution of a specific date for the creative accomplishment is often inaccurate.

Nevertheless, the application of this method makes it possible to come up with some generalizations about the life histories of creative people. Dennis (1966) and Lehman (1960) concluded that the peak of "superior output" for creative people occurs at age 30—the age at which Mozart composed the *Marriage of Figaro* and Edison invented the phonograph. In all, 40 % of all major contributions to the culture were made in that decade of life. Half as many (20 % each) occurred at ages 20 and 40; and the remaining 20 % were spread over the rest of life. One possible contaminant of such results is the inclination to project a more inflated evaluation of the early work of well-known creators based on their lifetime output. In any case, it is impossible to ascertain the extent to which the decline after 40 years of age is due to physical causes or to the social changes associated with age that will be discussed in the next section.

Simonton (1999, p. 122) summarizes six age-linked findings about creativity: Creative individuals tend not to be firstborn; they are intellectually precocious; they suffer childhood trauma; their families tend to be economically and/or socially marginal; they receive special training early in life; and they benefit from role models and mentors. Most of these conclusions relate to the earlier years of life, indicating the lack of systematic knowledge about creativity in the second half of life.

The relation of age to creativity is likely to depend on the particular domain in which the person is operating: "The overall age functions, including the placement of the first, best, and last creative contribution, are contingent upon the specific domain of creative activity" (Simonton 1999, p. 122). To determine answers to questions such as "Why do mathematicians and lyric poets do their most original work earlier in life than, say, architects or philosophers?" one cannot simply consider changes in the maturation of the creative person's brain. One must also explore the interaction between the mind and the symbolic system of the domain and the social constraints and opportunities of the field. For example, in symbolic domains that are very well integrated, like mathematics, chess, or musical performance, it is relatively easy for a talented person to move quickly to the cutting edge of the domain and thus be well positioned to innovate in it. In domains that are less logically ordered, such as musical composition, literature, and philosophy, there is less agreement as to what the most urgent issues are. Specialized knowledge is not enough; one needs to reflect on a great amount of experience before being able to say something new. Therefore one would expect important new contributions in these domains to be made later in life.

Social Aging: The Effects of the Field on Creativity

Although there is not much that can be said about the purely physiological effects of age on creativity, it is clear that as a person matures into adulthood and then old age, there will be many changes that affect his or her productivity, in both positive and negative ways. These changes are the consequence of different roles that the creative person is likely to play in the field, beginning as an apprentice, and then becoming an expert practitioner, and finally a gatekeeper. Each of these roles provides different opportunities and demands different responsibilities.

Careers in science or the arts—or for that matter, in any other domain as well—are rarely a matter of smooth sailing. As Thomas Kuhn, historian of science, noted, new ideas are rarely adopted by the leading figures in the field whose fame rests on an older paradigm. Instead, it is the younger scientists who wish to prove their mettle who adopt new ideas and try to change the domain (Kuhn 1962). Or as Pierre Bourdieu, French sociologist, wrote:

> The history of the field arises from the struggle between the established figures and the young challengers. The ageing of authors, schools, and works is far from being the product of a mechanical, chronological slide into the past; it results from the struggle between those who have made their mark… and who are fighting to persist, and those who cannot make their own mark without pushing into the past those who have an interest in stopping the clock (Bourdieu 1993, p. 60).

Sooner or later, a promising scientist usually becomes head of a lab, takes on duties in scientific societies, edits journals, writes textbooks, and serves on innumerable committees. Similar changes await successful artists who become public property of agents, collectors, and foundations. In this way, cutting-edge work can become restricted with advancing age; Older scientists may stop doing bench work in the lab to take on administrative positions, and older artists may become distracted from the voice of the muse by their lionizing audience.

The observation that over the course of a career one's training ages was made by Zuckerman and Merlon (1972). They noted both the possibility of career obsolescence that aging scientists may encounter and the disadvantages that neophytes in a discipline may face. Attention is finite at any age, and during the late career it may be further limited by accumulated obligations and by the slowing that accompanies physiological aging. Most original scientists and artists are primarily concerned with their own creative work. Staying abreast of developments in the wider domain or in other disciplines thus competes for attention with their own evolving work agenda. On the other hand, this agenda itself impels learning. Scientists described "trying to audit" the literature and attending seminars to hear colleagues present "hot new findings." Artists need to stay in touch with new developments on the art scene as well as new techniques. A social scientist in his fifties said:

I learn something new every year. I mean, a major area, like I'll learn a new mathematics…. Last year I studied anthropology a lot and learned about primate behavior…

So that's the other philosophy I have, which is to learn something about everything and have a wide variety of experiences because you never know, and over the years, those experiences come in handy, I think. It's a well-known statement about inventions that what you really need is some luck and a prepared mind. So I've worked hard to have a prepared mind.

The eminent older scientist plays roles other than that of an innovator; these, too, may occasion exposure to new knowledge. Gatekeeping roles, such as editing professional journals, may have this impact. A social scientist in his sixties who had recently founded a new journal, noted that it would "force me to read some kinds of things that I wanted to read, because as the editor I really need to"; "I've never paid as much attention to work by other people as I should pay." Teaching can be a way either of staying current within a domain ("students in a sense are telling us what's going on at the frontier") or of broadening one's knowledge ("the heterogeneity of inquiry and interest that come with teaching give you more back-burners to opportunistically develop"). Informal discussions with junior collaborators and other colleagues and attending conferences may have the same effect.

How extraneous demands impinge on the time and attention of renowned artists was conveyed by Canadian writer Robertson Davies, who at age 80 commented:

> One of the problems about being a writer today is that you are expected to be a kind of public show and public figure and people want your opinions about politics and world affairs and so forth, about which you don't know any more than anybody else, but you have to go along or you'll get a reputation of being an impossible person, and spiteful things would be said about you, (Csikszentmihalyi 1996, p. 206).

A similar situation is described by physicist Eugene Wigner, who recalled the sudden change in status of physical scientists after the harnessing of nuclear power at the end of World War II:

> By 1946, scientists routinely acted as public servants… addressing social and human problems from a scientific viewpoint. Most of us enjoyed that, vanity is a very human property…. We had the right and even perhaps the duty to speak out on vital political issues. But on most political questions, physicists had little more information than the man on the street (Wigner 1992, p. 254).

As the original contributions of a person are beginning to be recognized by the field, the power of the creative person as gatekeeper and leader grows apace. Ironically, but as might be expected, this rarely translates into greater creative output. Fields may restrict opportunities for creative work by escalating expectations for administrative and statesmanlike activities. And finally, the social system in which the fields are embedded may distract successful creative individuals by diluting their focus of attention from the tasks they are best qualified to perform. For instance, scientists often complain that policy makers mistake their specialized expertise for a more general wisdom and ask them to sit on committees and boards where their expertise is no better than that of the average person on the street.

In line with these considerations, the literature has focused from the start on the related questions of whether older scientists resist new paradigms or indeed actively obstruct a field's embrace of new ideas or conversely, whether they

become significant contributors to the new areas themselves. In other words, literature has been concerned about the actions of the older scientist in the role of gatekeeper as much as innovator (Zuckerman and Merlon 1972, p. 309). A variety of mechanisms that could account for age-associated resistance have come to be recognized, such as the force of accrued social and intellectual investments. In addition, counter findings have also emerged, for which possible mechanisms have been suggested. In particular, older eminent scientists may be better equipped than the young to endorse revolutionary ideas when these are first publicized, because they have already achieved their professional goals and are less concerned with defending orthodox positions.

As stated earlier, the systems model suggests that the distinction between the contribution of new ideas and their adoption is not as crucial as it seems from an individualistic perspective on creativity. If the adoption of novelty is as important as its discovery, then even those scientists and artists who have abandoned active work but still exercise leadership in the field are indispensable to creativity. Thus, perhaps a better question to ask is, what does a gatekeeper have to do to contribute to creativity?

Obviously, remaining open to novelty and staying abreast of new developments are prerequisites. If gate-keepers are too rigid, the domain becomes starved for new ideas and eventually declines. But a domain can be destroyed just as well by gatekeepers who are too open to novelty and who, by admitting every fad, destroy the integrity of the domain. Thus "conservatism in science is not all bad" (Hull 1988, p. 383). Perhaps it is better to speak of skepticism rather than conservatism, in which resisting the new and clinging to the old are coupled. The shift would be consistent with Hull's basic insight ("No one complains that scientists, young or old, resisted novel theories that we now take to be mistaken").

Our data suggest an additional way in which the appearance of aged conservatism might be created. One 79-year-old Nobel laureate in economics expressed the kind of spirited rejection of a current fad in his discipline that might seem to be a typical example of resistance to new ideas with old age:

I'm about to give a speech next week… at a conference, in which I'm going to denounce the work that's been going on for 10 years… which I think has been relatively format and sterile, but it's been done by all the smart people. They've, lots of them, gotten their professorships very young…. I'm predicting that it's reaching the end of it's period of joy and happiness. Very, very clever people working on very special problems… and I think it's become a very scholastic enterprise. In the way we use that language to denounce the medieval church teachings and so forth, and that it will fail, although you can have a run with it in the market. We have fads in science.

However, from a life span perspective, a different possibility merits attention: that this scientist has challenged new ideas throughout his career, so that the upcoming speech represents a form of continuity rather than a swing toward conservatism. And, indeed, this scientist observes:

One characteristic I have, and you'd get that if you asked other people about me, is that I always have a non-faddish view of things. If a theory sweeps the

profession, I'll be the last guy that accepts it, in general. I've been a critic, for example, of… the rage of the '30s, and wrote on it… I wrote what was maybe the standard refutation of [another theory], after it became very widespread. So I don't have any instincts to say that since everybody's doing it, that's right. I've more the instinct: "Well, hey, are they looking at it hard enough and from enough different attitudes?"

As this scientist readily notes, the maverick stance means that he has also been slow to accept ideas that later become "the universal truth." Nevertheless, skepticism was mentioned by a number of respondents as a valuable attribute in those who aspire to make original contributions to a domain. In this light, it is conceivable that skeptical scientists do important work, attain eminence, and go on to become eminent—and still skeptical—older scientists. A question for future investigators is: Does a characteristic skepticism come to be viewed differently by other members of the community when a scientist is old? The structure of the domain and the field are important in determining whether someone will continue to produce useful new ideas or things, but it is even more important to preserve the personal drive for playfulness and discovery.

Preserving the Passion

If there is one trait that a person must possess to continue on a creative trajectory, it is curiosity. Without a strong dose of curiosity a promising artist or scientist will be tempted to settle for a comfortable career that does not require the risk of striving for novelty. In our studies of creativity in later life, we found this trait mentioned over and over by creative respondents. "I am incredibly curious," said a neuropsychologist; "I am relentlessly curious," said a well-known composer; "I am enormously curious," said an astronomer. Joshua Lederberg, a leading geneticist, admitted to a "voracious curiosity." Cognitive scientist Donald Norman claimed that the "one thing I try to do, is always be curious and inquiring."

This curiosity does not concern just the work at hand, but often extends to the broadest issues imaginable. Nadine Gordimer, the Nobel Prize—winning novelist, explained when she was interviewed in our study of creativity in later life:

Writing is a form of exploration of life…. Of course, some people have a ready-made structure of explanation. People who have a strong religion, no matter what it is. Whether you're a Christian or a Muslim or a Jew or whatever. You have got an explanation of why you're here… what the purpose is and what the future is. That you're going to go to Heaven or whatever it is, or you're going to become part of the universal spirit; there's an explanation for your life. What if you haven't got that?

John Wheeler, one of the most distinguished theoretical physicists in the world, said that past 80 years of age he is still driven by "a desperate curiosity. I like that Danish poem… 'I'd like to know what this show is all about before it's out.' To me that is the number one thing—to find out how the world works."

In most cases, this curiosity was present in early life. There is no question that if one wished to increase the frequency of creative ideas through life, the place to start would be in trying to enhance the curiosity of children. A distinguished astronomer recalls:

When I think about my childhood, I was enormously curious. I mean, I can actually think of questions that… I don't know how old I was, I certainly wasn't ten, I might have been six….I mean really in my childhood… things that puzzled me about the physical universe. I mean, I can even remember asking questions like "why, when we drove down the road the moon was following us?" I mean I could give you five questions that bothered me as a child…. I just had an enormous curiosity from the very beginning and just wanted to do these things…. I was just curious about how things work and I was trying to—and after a while I learned that the questions that I was most curious about no one knew the answer to. So, if I wanted to get the answer I had to go out and observe and do these things myself. But in a sense it was to learn the answer to these very curious questions that drove me.

John Wheeler again: "I can remember I must have been 3 or 4 years old in the bathtub and my mother bathing me, and I was asking her how far does the universe go, and the world go, and beyond that"

A neuropsychologist recalls:

The thing that has driven me my whole life—and I have always said this and I know is true. It is curiosity. I am incredibly curious about things, little things I see around me…. My mother used to think that I was just very inquisitive about other people's business. But it was not just people it is… it is things around me. I am a noticer. I am sure much less now than when I was young. But it is noticing quirks, the things that patients do or that people do. And then I wonder why and I want to investigate it.

Oscar Peterson, renowned jazz pianist, grew up in an African American family in Montreal, and he recalls the curiosity that drove him as a child and still drives him approaching 70 years of age:

I was mischievous. I admit it I was always seeking projects to do, you know. Finding out what made things work, things that I shouldn't be fooling with…. I remember destroying a phonograph once, under the guise of repairing it And things like that. I wasn't a bad child, in the sense that I'd go out and start fires or beat up neighborhood kids or anything like that. But I was always into little nooks and crannies, getting my nose into things it shouldn't have been into. I was a very curious child.

For most creative individuals, this early curiosity is preserved through the years, and becomes a lifelong project. Gunther Schuller, one of the most original composers of our time, stated: "I'm the eternal student. I always want to learn more and study more, because… the longer I live, the more I realize that as much as I know, it's very little in the overall scheme of things. And the more I learn, the more I learn how much more there is to learn….it's an endless process."

Astronomer Vera Rubin repeats the same theme:

But, yes, just the curiosity of how the universe works…. I still have this feeling. When I am out observing at a very dark site on a clear night and I look at the stars, I stilt really wonder how you could do anything but be an astronomer, and that's the truth. How could you live looking up at those stars and just not spend your life learning about what's going on. I think when I was young I had no concept that the things that were puzzling me no one knew the answer to. I thought it was just like learning math. You just went to a book and you would learn all about these things. And I think that is the way that children's books and elementary books are written. I think the understanding of how little we know came much, much later.

This intrinsically motivated desire to learn is an organic part of the process of answering a question for oneself; it accompanies and feeds creativity. It differs from learning obliged by membership in the field (the need to maintain mastery, expertise), which can actually displace or discourage curiosity if it becomes too absorbing an obligation.

The neuropsychologist comments on the danger of being caught up in the concerns of the field, rather than following one's own interests and intuition:

So I like to see people curious and interested in things around them, including the patients and the atmosphere…. Where people are really having to do so much course work and… they are so busy doing that that the curiosity, or the adventure, the spirit of the adventure goes, and I think that, that is bad.

Creative persons take steps to make sure that the pressures placed on them by the expectations of the field do not stifle their passion for discovery. Natalie Davis, one of the most original and respected historians of her generation, said.

It's hard to be creative when you are just doing something doggedly…. If I felt my curiosity was limited, I think that the novelty part of it would be gone. Because it is the curiosity that has often pushed me to think of ways of finding out about something that people… previously thought you could never find out about or ways of looking at a subject that have never been looked at before. That's what keeps me running back and forth to the library, and just thinking and thinking and thinking and thinking.

Many other variables enter the equation that preserves creativity throughout life —from dogged perseverance to sheer luck. In fact, when asked to explain their lifelong success, creative individuals most often mentioned luck. Being at the right place at the right time was seen by many of them as the main difference that separated them from less successful peers. But curiosity, the desire to learn, seems to be one characteristic that is absolutely necessary. Without it, the temptation to abandon the quest for novelty becomes too strong; it is so much easier to rest on one's laurels and reap the benefits of one's early accomplishments.

The satisfaction of curiosity is the intrinsic reward that keeps a person struggling against high odds in an effort to come up with a new and more accurate perception of reality.

Personal Creativity

Whereas cultural creativity depends on many extraneous factors over which a person has no control—access to the domain, to the field, and sheer good fortune—personal creativity with a small c is something everyone can learn to develop. The one trait necessary for both kinds of creativity is curiosity. Individuals who are not interested in new knowledge and new experiences, who do not enjoy the thrill of discovery, are handicapped in both their professional and personal lives. The study of personal creativity, however, is still in its infancy and very little can be said about it with any authority.

Some persons, like the big C individuals quoted, are lucky in having had families that encouraged their curiosity from early on. We do not know to what extent it is possible to compensate for the lack of a stimulating early environment in later life. It is not easy to reverse habits of bored acceptance of the status quo, but perhaps it is not impossible.

At the end of our study of creativity (Csikszentmihalyi 1996, Chap. 14), a few steps for reawakening curiosity and interest were suggested. For instance, one should endeavor to be surprised each day by some experience. Even the simplest sight, sound, person, or conversation can reveal unexpected aspects if we take the trouble to attend to them with full attention. As Dewey (1934) pointed out long ago, the essence of an aesthetic experience lies in perception, which he differentiated from recognition, or the routine noticing of things that does not reveal anything new about them. Learning to perceive means being able to temporarily suspend the generic characteristics of experience and focus instead on their uniqueness. With time, the habit of perception is likely to grow into the kind of curiosity that fuels personal creativity.

Another way to break long-established routines is to surprise yourself, or others, by something you do, Instead of acting out the predictable scenario of one's personality, it helps occasionally (and appropriately) to say something unexpected, to express an opinion that one had not dared express before, to ask a question one would not ordinarily ask. It helps to take up new activities, try new clothes and new restaurants, and go to shows and museums.

As a result of breaking routine ways of experiencing and living, one might stumble on activities or interests that are enjoyable and meaningful. At that point, it makes sense to take one's experience seriously and devote more attention and time to those experiences that provide the greatest rewards. We spend far too much time doing things that are neither fun nor productive. Passive entertainment, for example, is often actually quite boring. Television viewing—which is the single most time-consuming activity people do in their free time—has many of the characteristics of addiction (Kubey and Csikszentmihalyi 2002). The more one watches the less enjoyable it is, yet the harder it is to break the habit.

What we are suggesting here about making one's life more interesting is not the same as in the Chinese curse; "May you lead an interesting life." The curse's meaning of *interesting* has the same sense as the word has in literature and the

movies: The interest comes from outside in the form of danger, drama, risk, and tragedy. What makes life interesting for creative persons does not depend on external factors. It is the ability to endow even the most common experience with wonder and curiosity that makes their lives interesting. Leonardo da Vinci, who shaped our culture as deeply as any other person, led a life that to a superficial observer would have appeared miserly and drab (see Reti 1974). When he walked through the slums of Milan, looking at the peeling plaster on walls that would suggest to him new ways of representing the wonderful landscapes that formed the backgrounds for his paintings, few recognized the depth and reach of the thoughts soaring through his mind.

Many other suggestions could be reviewed, but it can all be summarized in a short principle: To increase personal creativity in one's life, one must take charge of how one perceives the world and of what one does in it. Creativity in any form does not come cheap; it requires commitment and perseverance. With some effort one can develop those habits of allocating attention that will result in realizing the awesome complexity of existence. After that, increasing joy at discovering more of its facets should sustain a life that thrives on growth and novelty rather than uniform routine.

Conclusions

Creative involvement with the world is an essential component of cultural evolution (big C creativity), and a source of enrichment in an individual's life (small c). Comparative psychology suggests that the playful, exploratory behavior underlying creativity diminishes rapidly with age and hardly exists after the reproductive age. With humans, however, whether there is decline depends on a variety of factors. First, creativity depends on the domain in which a person works; second, it depends on the opportunities and obstacles that the field offers the person; and finally, it depends on whether the person is able to sustain curiosity, interest, and passion. In many branches of the arts and some of the sciences, creative accomplishment continues until the end of life. Although the structure of the domain and the field are important in determining whether someone will continue to produce useful new ideas or things, it is even more important to preserve the personal drive for discovery.

What is true of big C creativity also applies to the ordinary, everyday kind that fails to be noticed and adopted by the culture. Here, however, the passion itself suffices; a person who can find novelty and excitement in the beauty of life in all its manifestations need not accomplish anything of note. Just experiencing life with full involvement will be a reward more important than fame and success.

References

Altmann, J. (1980). *Baboon mothers and infants*. Cambridge: Harvard University Press.
Anderson, S. R., & Ray, P. H. (2001). *The cultural creatives*. New York: Three Rivers Press.
Baltes, P. B., & Staudinger, U. (2000). Wisdom: A meta-heuristic (pragmatic) to orchestrate mind and virtue toward excellence. *American Psychologist, 55*, 122–136.
Blackmore, S. (1999). *The meme machine*. Oxford: Oxford University Press.
Brannigan, A. (1981). *The social basis of scientific discoveries*. New York: Cambridge University Press.
Bourdieu, P. (1993). *The field of cultural production*. New York: Columbia University Press.
Cattell, R. B. (1963) Theory of fluid and crystallized intelligence: A critical experiment. *Journal of Educational Psychology*, *54*, 1–22.
Csikszentmihalyi, M. (1988). Society, culture, and person: A systems view of creativity. In R. J. Sternberg (Ed.), *The nature of creativity: Contemporary psychological perspectives* (pp. 325–339). New York: Cambridge University Press.
Csikszentmihalyi, M. (1993). *The evolving self: A psychology for the third millennium*. New York: HarperCollins.
Csikszentmihalyi, M. (1996). *Creativity: Flow and the psychology of discovery and invention*. New York: HarperCollins.
Csikszentmihalyi, M. (1998). Creativity and genius: A systems perspective. In A. Steptoe (Ed.), *Genius and the mind* (pp. 39–66). Oxford: Oxford University Press.
Csikszentmihalyi, M. (1999). Implications of a systems perspective for the study of creativity. In R. J. Sternberg (Ed.), *Handbook of creativity* (pp. 313–335). Cambridge: Cambridge University Press.
Csikszentmihalyi, M., & Wolfe, R. (2000). New conceptions and research approaches to creativity: Implications of a systems perspective for creativity in education. In K. A. Heller, F. J. Monks, R. J. Sternberg, R. Subornik (Eds.), *International handbook of giftedness and talent* (pp 81–93). Nailsea: Elsevier Science.
Dawkins, R. (1976). *The selfish gene*. New York: Oxford University Press.
Dennis, W. (1956). Age and achievement: A critique. *Journal of Gerontology, 11*, 331–333.
Dennis, W. (1966). Creative productivity between the ages of 20 and 80 years. *Journal of Gerontology, 21*, 1–18.
Dewey, J. (1934). *Art as experience*. New York: Minton, Balch.
Drucker, P. F. (1985). *Innovation and entrepreneurship*. New York: Harper Business.
Drucker, P. F. (1999). *Management challenges for the 21st century*. New York: Harper Business.
Estes, R. D. (1976). The significance of breeding synchrony in the wildebeest. *East African Wildlife Journal, 14*, 135–152.
Fagan, R. (1981). *Animal play behavior*. New York: Oxford University Press.
Florida, R. (2002). *The rise of the creative class*. New York: Basic Books.
Hull, D. L. (1988). *Science as a process*. Chicago: University of Chicago Press.
Kasof, J. (1995). Explaining creativity: The attributional perspective. *Creativity Research Journal, 8*(4), 311–366.
Kawai, M. (1965). Newly-acquired pre-cultural behavior of the natural troop of Japanese monkeys on Koshima Islet. *Primates, 6*(1), 1–30.
Kubey, R., & Csikszentmihalyi, M. (2002). Television addiction. *Scientific American, 286*(2), 74–81.
Kuhn, T. S. (1962). *The structure of scientific revolutions*. Chicago: University of Chicago Press.
Lehman, H. C. (1953). *Age and achievement*. Princeton: Princeton University Press.
Lehman, H. C. (1960). The age decrement in outstanding scientific creativity. *American Psychologist, 15*, 128–134.
MacKinnon, D. W. (1963). Creativity and images of the self. In R. W. White (Ed.), *The study of lives*. New York: Atherton.

Martindale, C. (1990). *The clockwork muse: The predictability of artistic change*. New York: Basic Books.

Miller, G. (2000). *The mating mind: How sexual choices shaped the evolution of human nature*. New York: Random House.

Nakamura, J., & Csikszentmihalyi, M. (2003). The motivational sources of creativity as viewed from the paradigm of positive psychology. In L. G. Aspinwall & U. M. Staudinger (Eds.), *A psychology of human strengths* (pp. 257–270). Washington, DC: American Psychological Association.

Reti, L. (Ed.). (1974). *The unknown Leonardo*. New York: McGraw Hill.

Schaie, K. W. (1996). Intellectual development in adulthood. In J. E. Birren & K. W. Schaie (Eds.), *Handbook of the psychology of aging* (4th ed., pp. 266–286). San Diego: Academic Press.

Simonton, D. K. (1999). Creativity from a historiometric perspective. In R. J. Sternberg (Ed.), *Handbook of creativity* (pp. 116–136). New York: Cambridge University Press.

Wali, K. C. (1991). *Chandra*. Chicago: University of Chicago Press.

White, J. P. (1968). Creativity and education: A philosophical analysis. *British Journal of Educational Studies, 16*, 123–137.

Wigner, E. (1992). *The recollections of Eugene P*. Wigner: Plenum Press.

Zuckerman, H., & Merton, R. K. (1972). Age, aging, and age structure in science. In M. W. Riley, M. Johnson, & A. Foner (Eds.), *Aging and society* (Vol. 3, pp. 292–356). New York: Russell Sage Foundation.