A

Creativity

The section contains chapters by some giants of recent creativity and innovation research: Mihaly Csikszentmihalyi, Teresa Amabile, Michael West and Claudia Sacramento. All emphasise how the community in which a person operates affects creative and innovative outcomes.

Mihaly Csikszentmihalyi has drawn attention to the social context out of which creativity and innovation emerge. For example, he has demonstrated the beneficial role of working at a place and time in which other individuals are engaged in related creative activities: painting and sculpture in Florence in the 14th century, the development of computers in Northern California in the 1960s and 70s, industrialisation in SE Asia in the last quarter of the 20th century role. Here Csikszentmihalyi outlines his systems theory of creativity, relating creative effort by individuals to the state of the domain they are working in and the characteristics of those who assess the worth of the creative endeavour in the field concerned. This offers a penetrating analysis of how creative endeavour emerges within a social field. Drawing on years of research in the field, Csikszentmihalyi discusses the interplay between knowledge about the domain, gatekeepers in the field and creative individuals. Many of the points made here in relation to other domains apply equally well to creativity and innovation in organisational settings.

Teresa Amabile has drawn attention to the importance of intrinsic motivation in creative endeavour. Business has traditionally rewarded people extrinsically with pay and promotion but creative actions often arise out of a long standing commitment to and interest in a particular area. She appreciates this is only one part of the equation, and

that expertise in the domain concerned and sufficient mental flexibility to question assumptions and play with ideas, are also important. Here she summarises some of the implications of her studies among scientists, researchers and managers in organisations for creativity and innovation. She points out the critical importance of challenge, for example, matching people to tasks they are interested in and have expertise in, allowing people freedom as to how they achieve innovation, setting a sufficiently diverse team the task of innovation, along with sufficient resources, encouragement and support.

Michael West and Claudia Sacramento draw together research on team task, team composition, organisational context and team processes that affect the level of team innovation in organisations. They consider the effect of intrinsic motivation and differing levels of extrinsic demands on team tasks, noting that though high levels of external demand may limit the development of new creative ideas early on in the innovation process, a moderate level of external demand often facilitates the implementation of innovation in groups. They go on to consider the role of diversity and selection procedures on the group composition, the part played by the organisational climate and rewards, and the role of group norms that encourage attempts at innovation and reflection, the effect of handling conflict constructively, actively seeking cross-team links, and the benefits of clear leadership that is sensitive to others needs.

1

A Systems Perspective on Creativity

Mihaly Csikszentmihalyi

Psychologists tend to see creativity exclusively as a mental process [but] creativity is as much a cultural and social as it is a psychological event. Therefore what we call creativity is not the product of single individuals, but of social systems making judgements about individual's products. Any definition of creativity that aspires to objectivity, and therefore requires an intersubjective dimension, will have to recognise the fact that the audience is as important to its constitution as the individual to whom it is credited.

An outline of the Systems Model

This environment has two salient aspects: a cultural, or symbolic, aspect which here is called the domain; and a social aspect called the field. Creativity is a process that can be observed only at the intersection where individuals, domains, and fields interact (Figure 1.1).

For creativity to occur, a set of rules and practices must be transmitted from the domain to the individual. The individual must then produce a novel variation in the content of the domain. The variation then must be selected by the field for inclusion in the domain.

Creativity occurs when a person makes a change in a domain, a change that will be transmitted through time. Some individuals are more likely to make such changes, either because of personal qualities or because they have the good fortune to be well positioned with respect to the domain – they have better access to it, or their social circumstances allow them free time to experiment. For example until quite recently the majority of scientific advances were made by men who had the means and the leisure: clergymen like Copernicus, tax collectors like Lavoisier, or physicians like Galvani could afford to build their own laboratories and to concentrate on their thoughts. And, of course, all of these individuals lived in cultures with a tradition of systematic observation of nature and a tradition of record keeping and mathematical

Source: M. Csikszentmihalyi (1999) Edited extract from R. Sternberg (Ed) (1999) *Handbook of Creativity*. Cambridge: Cambridge University Press, 313–35.

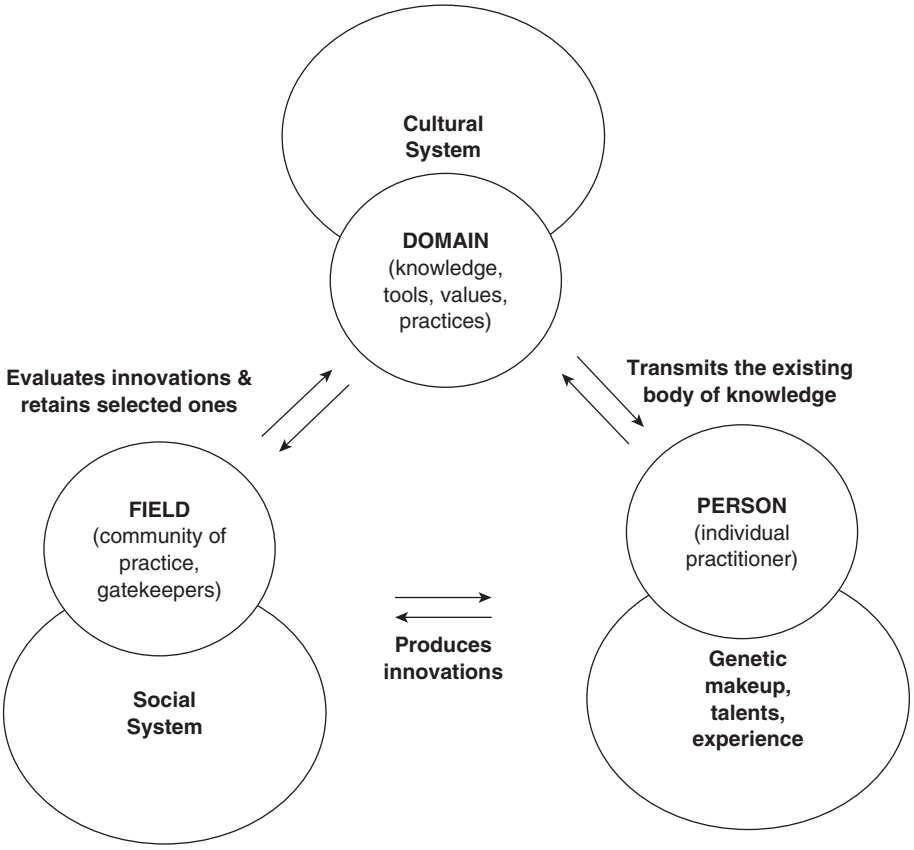

Figure 1.1 *A systems model of creativity*

symbolisation that made it possible for their insights to be shared and evaluated by others who had equivalent training.

But most novel ideas will be quickly forgotten. Changes are not adopted unless they are sanctioned by some group entitled to make decisions as to what should or should not be included in the domain. These gatekeepers are what we call here the field. Here field refers only to the social organisation of the domain – to the teachers, critics, journal editors, museum curators, agency directors, and foundation officers who decide what belongs to a domain and what does not. In physics, the opinion of a very small number of leading university professors was enough to certify that Einstein's ideas were creative. Hundreds of millions of people accepted the judgement of this tiny field and marvelled at Einstein's creativity without understanding what it was all about. It has been said that in the United States 10,000 people in Manhattan constitute the field in modern art. They decide which new paintings or sculptures deserve to be seen, bought, included in collections, and therefore added to the domain.

The cultural context

Creativity presupposes a community of people who share ways of thinking and acting, who learn from each other and imitate each other's actions. It is useful to think about creativity as involving a change in memes – the units of imitation that Dawkins (1976) suggested were the building blocks of culture. Memes are similar to genes in that they carry instructions for action. The notes of a song tell us what to sing, the recipe for a cake tells us what ingredients to mix and how long to bake it. But whereas genetic instructions are transmitted in the chemical codes that we inherit on our chromosomes, the instructions contained in memes are transmitted through learning. By and large we can learn memes and reproduce them without change; when a new song or a new recipe is invented, then we have creativity.

Cultures as a set of domains

It is useful to think about cultures as systems of interrelated domains. Cultures differ in the way that memes (i.e. technical procedures, kinds of knowledge, styles of art, belief systems) are stored. As long as they are recorded orally and can be transmitted only from the mind of one person to another, traditions must be strictly observed so as not to lose information. Therefore, creativity is not likely to be prized, and it would be difficult to determine in any case. Development of new media of storage and transmission (e.g. books, computers) will have an impact on rates of novelty production and its acceptance.

Another dimension of cultural difference is the accessibility of information. With time, people who benefit from the ability to control memes develop protective boundaries around their knowledge, so that only a few initiates at any given time will have access to it. Priestly castes around the world have evolved to keep their knowledge esoteric and out of reach of the masses. Even in the times of Egyptian civilisation, craft guilds kept much of their technical knowledge secret. Until recently in the West, knowledge of Latin and Greek was used as a barrier to prevent the admittance of the masses to professional training. The more such barriers, the less likely it becomes that potentially creative individuals will be able to contribute to a domain.

Similarly, how available memes are also bears on the rate of creativity. When knowledge is concentrated in a few centres, libraries, or laboratories, or when books and schools are rare, most potentially creative individuals will be effectively prevented from learning enough to make a contribution to existing knowledge.

Cultures differ in the number of domains they recognize and in the hierarchical relationship among them. New memes most often arise in cultures that, either because of geographical location or economic practices, are exposed to different ideas and beliefs. The Greek traders collected information from Egypt, the Middle East, the north coast of Africa, the Black Sea, Persia and even Scandinavia, and this disparate information was amalgamated in the crucible of the Ionian and Attic city-states. In the Middle Ages, the Sicilian court welcomed techniques and knowledge from China and Arabia, as well as from Normandy, Florence in the Renaissance was a centre of trade

and manufacture, and so was Venice; later the maritime trade of the Iberian Peninsula, the Netherlands, and Great Britain moved the center of information exchange to those regions. Even now, when the diffusion of information is almost instantaneous, useful new ideas are likely to arise from centres where people from different cultural backgrounds are able to interact and exchange ideas.

The role of the domain in the creative process

Cultures are made up of a variety of domains: music, mathematics, religion, various technologies, and so on. Innovations that result in creative contributions do not take place directly in the culture, but in one of such domains.

There are times when the symbolic system of a domain is so diffuse and loosely integrated that it is almost impossible to determine whether a novelty is or is not an improvement on the status quo. Chemistry was in such a state before the adoption of the periodic table, which integrated and rationalized knowledge about the elements. Earlier centuries may have had many potentially creative chemical scientists, but their work was too idiosyncratic to be evaluated against a common standard. Or, conversely, the symbolic systems may be so tightly organised that no new development seems possible: this resembles the situation in physics at the end of the preceding century, before the revolution in thinking brought about by quantum theory. Both of these examples suggest that creativity is likely to be more difficult before a paradigmatic revolution. On the other hand, the need for a new paradigm makes it more likely that if a new viable contribution does occur despite the difficulty, it will be hailed as a major creative accomplishment.

At any historical period, certain domains will attract more gifted young people than at other times, thus increasing the likelihood of creativity. The attraction of a domain depends on several variables: its centrality in the culture, the promise of new discoveries and opportunities that it presents, the intrinsic rewards accruing from working in the domain. For instance, the Renaissance in early-fifteenth-century Florence would have not happened without the discovery of Roman ruins, which yielded a great amount of new knowledge about construction techniques and sculptural models and motivated many young people who otherwise would have gone into the professions, to become architects and artists instead. The quantum revolution in physics at the beginning of this century was so intellectually exciting that, for several generations, some of the best minds flocked to physics or applied its principles to neighbouring disciplines such as chemistry, biology, medicine, and astronomy. Nowadays similar excitement surrounds the domains of molecular biology and computer science.

As Thomas Kuhn (1962) remarked, potentially creative young people will not be drawn to domains where all the basic questions have been solved and which, therefore, appear to be boring – that is, offer few opportunities to obtain the intrinsic and extrinsic rewards that follow from solving important problems.

Domains also vary in terms of their accessibility. Sometimes rules and knowledge become the monopoly of a protective class or caste, and others are not admitted to it. Creative thought in Christianity was renewed by the Reformation, which placed the bible and its commentaries in reach of a much larger population, which earlier had been excluded by an entrenched priestly caste from perusing it directly. The enormously

increased accessibility of information on the Internet might also bring about a new peak in creativity across many different domains, just as the printing press did over four centuries ago.

Finally, some domains are easier to change than others. This depends in part on how autonomous a domain is from the rest of the culture or social system that supports it. Until the seventeenth century in Europe it was difficult to be creative in the many branches of science that the Church had a vested interest in protecting – as the case of Galileo illustrates. In Soviet Russia, the Marxist-Leninist dogma took precedence over scientific domains, and many new ideas that conflicted with it were not accepted. Even in our time, some topics in the social (and even in the physical and biological) sciences are considered less politically correct than others and are given scant research support as a consequence.

Creativity is the engine that drives cultural evolution. The notion of evolution does not imply that cultural changes necessarily follow some single direction or that cultures are getting any better as a result of the changes brought about by creativity. Evolution in this context means increasing complexity over time. Complexity means that cultures tend to become differentiated over time, that is, they develop increasingly independent and autonomous domains [and that] the domains within a culture become increasingly integrated, that is, related to each other and mutually supportive of each others' goals. Creativity contributes to differentiation, but it can easily work against integration, [as] new ideas, technologies, or forms of expression often break down the existing harmony between different domains.

The social context

In order to be called creative, a new meme must be socially valued. Without some form of social valuation it would be impossible to distinguish ideas that are simply bizarre from those that are genuinely creative. But this social validation is usually seen as something that follows the individual's creative act and can be – at least conceptually – separated from it. The stronger claim made here is that there is no way, even in principle, to separate the reaction of society from the person's contribution. The two are inseparable. As long as the idea or product has not been validated, we might have originality, but not creativity.

Nowadays everyone agrees that Van Gogh's paintings show that he was a very creative artist. It is also fashionable to sneer at the ignorant bourgeoisie of his period for failing to recognize Van Gogh's genius and letting him die alone and penniless. But we should remember that a hundred years ago those canvases were just the hallucinatory original works of a sociopathic recluse. They became creative only after a number of other artists, critics, and collectors interpreted them in terms of new aesthetic criteria and transformed them from substandard efforts into masterpieces.

Without this change in the climate of evaluation, Van Gogh would not be considered creative even now. In the sciences as well as in the arts, creativity is as much the result of changing standards and new criteria of assessment, as it is of novel individual achievements.

Societal conditions relevant to creativity

The second main element of the systems model is society, or the sum of all fields. Fields are made up of individuals who practice a given domain and have the power to change it. For example, all the accountants who practice by the same rules comprise the field of accountancy, and it is they who have to endorse a new way of keeping accounts if it is to be accepted as a creative improvement.

Other things being equal, a society that enjoys a material surplus is in a better position to help the creative process. A wealthier society is able to make information more readily available, allows for a greater rate of specialization and experimentation, and is better equipped to reward and implement new ideas. Subsistence societies have fewer opportunities to encourage and reward novelty, especially if it is expensive to produce. Only societies with ample material reserves can afford to build great cathedrals, universities, scientific laboratories. But it seems that there is often a lag between social affluence and creativity: the impact of wealth may take several generations to manifest itself. So the material surplus of the nineteenth-century United States was first needed to build a material infrastructure for society (canals, railroads, factories), before it was invested in supporting novel ideas such as the telephone or the mass production of cars and planes.

Whether a society is open to novelty or not depends in part on its social organization. A farming society with a stable feudal structure, for instance, would be one where tradition counts more than novelty. Societies based on commerce, with a strong bourgeois class trying to be accepted by the aristocracy, have on the other hand been usually favourable to novelty. Whenever the central authority tends toward absolutism, it is less likely that experimentation will be encouraged (Therivel, 1995). Ancient Chinese society is a good example of a central authority supported by a powerful bureaucracy that was able to resist for centuries the spread of new ideas.

Rentier societies, where the ruling classes lived off the profits of land rent, pensions, or stable investments, have been historically reluctant to change because any novelty was seen to potentially threaten the status quo that provided the livelihood of the oligarchy. This condition might become relevant again as the United States moved more toward an economy where pensions and retirement plans are a major source of income for an increasing number of people.

A different and more controversial suggestion is that egalitarian societies are less likely to support the creative process than those where relatively few people control a disproportionate amount of the resources. Aristocracies or oligarchies may be better able to support creativity than democracies or social regimes, simply because when wealth and power are concentrated in a few hands, it is easier to use part of it for risky or 'unnecessary' experiments. Also, the development of a leisure class often results in a refinement of connoiseurship that in turn provides more demanding criteria by which a field evaluates new contributions.

Societies located at the confluence of diverse cultural streams can benefit more easily from that synergy of different ideas that is so important for the creative process. It is for this reason that some of the greatest art, and the earliest science, developed in

cities that were centres of trade. The Italian Renaissance was in part due to the Arab and Middle Eastern influences that businessmen and their retinues brought into Florence and the seaports of Venice, Genoa, and Naples. The fact that periods of social unrest often coincide with creativity (Simonton, 1991) is probably due to the synergy resulting when the interests and perspectives of usually segregated classes are brought to bear on each other. The Tuscan cities supported creativity best during a period in which noblemen, merchants, and craftsmen fought each other bitterly and when every few years, as a different political party came to power, a good portion of the citizenry was banished into exile.

External threats also often mobilize society to recognize creative ideas that otherwise might not have attracted much attention. Florence in the fifteenth century spent so many resources on the arts in part because the leaders of the city were competing against their enemies in Sienna, Lucca, and Pisa and tried to outdo them in the beauty of their churches and public squares (Heydenreich, 1974). The reason that high-energy physics became such an important field after World War II is that practically every nation wished to have the technology to build its own nuclear arsenal.

Finally, the complexity of a society also bears on the rates of innovation it can tolerate. Too much divisiveness, as well as its opposite, too much uniformity, are unlikely to generate novelty that will be accepted and preserved. Ideal conditions for creativity would be a social system that is highly differentiated into specialized fields and roles, yet is held together by what Durkheim (1912/1967) called the bonds of 'organic solidarity'.

The role of the field

What does it take for a new meme to be accepted into the domain? Who has the right to decide whether a new meme is actually an improvement, or simply a mistake to be discarded? In the systems model, the gatekeepers who have the right to add memes to a domain are collectively designated the field. Some domains may have a very small field consisting of a dozen or so scholars across the world. Others, such as electronic engineering, may include many thousands of specialists whose opinion would count in recognizing a viable novelty. For mass-market products such as soft drinks or motion pictures, the field might include not only the small coterie of product developers and critics, but the public at large. For instance, if New Coke is not a part of the culture, it is because although it passed the evaluation of the small field of beverage specialists, it failed to pass the test of public taste.

Some of the ways in which fields influence creativity follow. The first issue to be considered is the field's access to economic resources. In some domains it is almost impossible to do novel work without access to capital. To build a cathedral or to make a movie required the collaboration of people and materials, and these must be made available to the would-be creative artists. The masterpieces of Florence were built with the profits that the city's bankers made throughout Europe: the masterpieces of Venice were the fruit of that city's seagoing trade. Dutch painters and scientists blossomed after Dutch merchants began to dominate the sea-lanes: then it was the turn of France,

England, Germany, and, finally, the United States. As resources accumulate in one place, they lay down the conditions that make innovation possible.

A field is likely to attract original minds to the extent that it can offer scope for a person's experimentations and promises rewards in case of success. Even though individuals who try to change domains are in general intrinsically motivated – that is, they enjoy working in the domain for its own sake – the attraction of extrinsic awards such as money and fame are not to be discounted.

Leonardo da Vinci, one of the most creative persons on record in terms of his contributions to the arts and the sciences, constantly moved during his lifetime from one city to another, in response to changing market conditions. The leaders of Florence, the dukes of Milan, the popes of Rome, and the king of France waxed and waned in terms of how much money they had to devote to new paintings, sculptures, or cutting-edge scholarship: and as their fortunes changed, Leonardo moved to wherever he could pursue his work with the least hindrance.

The centrality of a field in terms of societal values will also determine how likely it is to attract new persons with an innovative bent. In this particular historical period, bright young men and women are attracted to the field on computer sciences because it provides the most exciting new intellectual challenges; others to oceanography because it might help to save the planetary ecosystem; some to currency trading because it provides access to financial power; and some to family medicine, because it is the medical specialty most responsive to societal needs. Any field that is able to attract a disproportionate number of bright young persons is more likely to witness creative breakthroughs.

In the domains of movies or popular music, which are much more accessible to the general public, the specialized field is notoriously unable to enforce a decision as to which works will be creative. It is instructive to compare the list of Nobel Prize winners in literature with those in the sciences: few of the writers from years past are now recognized as creative compared with the scientists.

In order to establish and preserve criteria, a field must have a minimum of organization. However, it is often the case that instead of serving the domain, members of the field devote most of their energies to serving themselves, making it difficult for new ideas to be evaluated on their merits. It is not only the Church that has hindered the spread of new ideas for fear of losing its privileges. Every industry faces the problem that better ideas that require changing the status quo will be ignored, because so much effort and capital has been invested in existing production methods.

Another important dimension along which fields vary is the extent to which they are ideologically open or closed to new memes. The openness of a field depends in part on its internal organization, in part on its relation to the wider society. Highly hierarchical institutions, where knowledge of the past is greatly valued, generally see novelty as a threat. For this reason, churches, academies, and certain businesses based on tradition seek to promote older individuals to leadership positions as a way of warding off excessive change. Also, creativity is not welcome in fields whose self-interest requires keeping a small cadre of initiates performing the same routines, regardless of efficiency: some of the trade unions come to mind in this context.

It requires an adroit balancing act for those responsible for evaluating novelty to decide which new ideas are worth preserving. If a historical period is stagnant, it is probably not because there were no potentially creative individuals around, but because of the ineptitude of the relevant fields.

It might be objected that some of the most influential new ideas or processes seem to occur even though there is no existing domain or field to receive them. For instance, Freud's ideas had a wide impact even before there was a domain of psychoanalysis or a field of analysts to evaluate them. Personal computers were widely adopted before there was a tradition and a group of experts to judge which were good, which were not. But the lack of a social context in such cases is more apparent than real. Freud, who was immersed in the already-existing domain of psychiatry, simply expanded its limits until his conceptual contributions could stand on their own as a separate domain. Without peers and without disciples, Freud's ideas might have been original, but they would not have had an impact on the culture, and thus would have failed to be creative. Similarly, personal computers would not have been accepted had there not been a domain – computer languages that allowed the writing of software and therefore, various applications – and an embryonic field – people who had experience with mainframe computers, with video games, and so on who could become 'experts' in this emerging technology.

In any case, the point is that how much creativity there is at any given time is not determined just by how many original individuals are trying to change domains, but also by how receptive the fields are to innovation. It follows that if one wishes to increase the frequency of creativity, it may be more advantageous to work at the levels of fields than at the level of individuals. For example, some large organizations such as Motorola, where new technological interventions are essential, spend a large quantity of resources in trying to make engineers think more creatively. This is a good strategy as far as it goes, but it will not result in any increase in creativity unless the field – in this case, management – is able to recognize which of the new ideas are good and has ways for implementing them, that is, including them in the domain. Whereas engineers and managers are the field who judge the creativity of new ideas within an organization such as Motorola, the entire market for electronics becomes the field that evaluates the organization's products once these have been implemented within the organization. Thus, at one level of analysis the system comprises the organization, with innovators, managers, and production engineers as its parts but at a higher level of analysis the organization becomes just one element of a broader system that includes the entire industry.

The individual in the creative process

The great majority of psychological research assumes that creativity is an individual trait, to be understood by studying individuals. The systems model makes it possible to see that before a person can introduce a creative variation, he or she must have access to a domain and must want to learn to perform according to its rules. This

implies that motivation is important. But it also suggests a number of additional factors that are usually ignored, for instance, that cognitive and motivational factors interact with the state of the domain and the field.

Second, persons who are likely to innovate tend to have personality traits that favor breaking rules and early experiences that make them want to do so. Divergent thinking, problem finding, and all the other factors that psychologists have studied are relevant in this context.

Finally, the ability to convince the field about the virtue of the novelty one has produced is an important aspect of personal creativity. The opportunities that one has to get access to the field, the network of contacts, the personality traits that make it possible for one to be taken seriously, the ability to express oneself in such a way as to be understood, are all part of the individual traits that make it easier for someone to make a creative contribution.

But none of these personal characteristics are sufficient, and probably they are not even necessary. Conservative and unimaginative scientists have made important contributions to science by stumbling on important new phenomena. At the same time, it is probably true that persons who master a domain, and then want to change it, will have a higher proportion of their efforts recognized as creative.

The background of creative individuals

One of the first issues to consider is whether an individual is born in an environment that has enough surplus energy to encourage the development of curiosity and interest for its own sake. The following personal background factors can affect the incidence of creativity:

- A child is likely to be discouraged from expressing curiosity and interest if the material conditions of existence are too precarious
- Ethnic and family traditions can have a very important role in directing the child's interest toward specific domains
- Cultural capital (i.e. home learning, schooling) is essential for a child to develop expertise in a domain
- Tutors, mentors, and connections are often indispensable for advancing far enough to have one's ideas recognized
- Marginality (social, ethnic, economic, religious) seems to be more conducive to wanting to break out of the norm than a conventional, middle-class background

Even though it is said that necessity is the mother of invention, too much deprivation does not seem to lead to innovative thinking. When survival is precarious – as it has been and still is in most of the world – there is little energy left for learning and experimenting. It is not impossible for a talented person to emerge from a ghetto or a third-world country, but much potential is lost for lack of access to the basic tools of a domain.

Ethnic groups, and families within them, differ in the amount of importance they place on different domains. Jewish tradition has emphasized the importance of learning,

and Asian-American families have instilled strong academic and artistic motivation in their children (Kao, 1995). Some cultural groups emphasize musical abilities, others focus on engineering or technology. Such traditions help to focus a child's interest on a particular domain, thus providing the preconditions for further innovation.

It has been observed that many creative individuals grew up in atypical conditions, on the margins of the community. Many of them were orphaned early, had to struggle against relative poverty and prejudice, or were otherwise singled out as different from their peers (Csikszentmihalyi and Csikszentmihalyi, 1993). For example, all seven of the creative geniuses of this century described by Gardner (1993) were outsiders to the societies in which they worked. Einstein moved from Germany to Switzerland, Italy, and the United States; Gandhi grew up in South Africa; Stravinsky left Russia; Eliot settled in England; Martha Graham as a child moved from the South to California, where she became exposed to and influenced by Asian art; Freud was Jewish in Catholic Vienna; and Picasso left Spain for France. It seems that a person who is comfortably settled in the bosom of society has fewer incentives to change the status quo.

Personal qualities

Having the right background conditions is indispensable but certainly not sufficient for a person to make a creative contribution. He or she must also have the ability and inclination to introduce novelty into the domain.

The following individual qualities seem to affect the incidence of creativity:

- In certain domains (e.g. music, mathematics) genetic inheritance may play an important role in directing interest to the domain and in helping to master it
- A great deal of intrinsic motivation is needed to energize the person to absorb the relevant memes and to persevere in the risky process of innovation
- Cognitive ability such as fluency, flexibility, and discovery orientation seem necessary to engage successfully in the process of generating novelty
- To be able to innovate successfully, a person needs to have appppropriate traits – which may vary depending on the field and the historical period. In general, one must persevere and be open to experience, as well as adopt apparently contradictory behaviors

Talent, or innate ability, refers to the fact that it is easier to be creative if one is born with a physical endowment that helps to master the skills required by the domain. Great musicians seem to be unusually sensitive to sounds even in their earliest years. It would not be surprising, however, to find that interest or skill in certain domains can be inherited. Howard Gardner's (1983, 1993) postulate of seven or more separate forms of intelligence also seems to support the notion that each of us might be born with a propensity to respond to a different slice of reality, and hence to operate more effectively in one domain rather than another. Many creative individuals display unusual early abilities that are almost at the level of child prodigies described by Feldman (1986). On the other hand, a roughly equal number who have achieved

comparable creative contributions appear to have had rather undistinguished childhoods and were not recognized as exceptional until early adulthood.

Cerebral lateralization research has led many people to claim that left-handers or ambidextrous individuals, who are presumed to be using the right side of their brains more than right-handers, are more likely to be creative. Left-handers are apparently over-represented in such fields as art, architecture, and music: many exceptional individuals from Alexander the Great to Leonardo, Michelangelo, Raphael, Picasso, Einstein, and the three presidential candidates of the 1992 election – Clinton, Bush, Perot – were all left-handers (Coren, 1992; Paul, 1993).

Perhaps the most salient characteristic of creative individuals is a constant curiosity, an ever-renewed interest in whatever happens around them. This enthusiasm for experience is often seen as part of the 'childishness' attributed to creative individuals (Csikszentmihalyi, 1996; Gardner, 1993). Without this interest, a person would be unlikely to become immersed deeply enough in a domain to be able to change it. Another way of describing this trait is that creative people are intrinsically motivated. They find their reward in the activity itself, without having to wait for external rewards or recognition. A recurring refrain among them goes something like this: 'You could say that I worked every day of my life, or with equal justice you could say that I never did any work in my life.' Such an attitude greatly helps a person to persevere during the long stretches of the creative process when no external recognition is forthcoming.

The importance of motivation for creativity has long been recognised, Cox (1920) advised that if one had to bet on who is more likely to achieve a creative breakthrough, a highly intelligent but not very motivated person, or one less intelligent but more motivated, one should always bet on the second. Because introducing novelty in a system is always a risky and usually an unrewarded affair, it takes a great deal of motivation to persevere in the effort. One recent formulation of the creative person's willingness to take risks is the 'economic' model of Sternberg and Lubart (1995).

Probably the most extensively studied attributes of the creative cognitive style are divergent thinking (Guilford, 1967) and discovery orientation (Getzels and Csikszentmihalyi, 1976). Divergent thinking is usually indexed by fluency, flexibility, and originality of mental operations. Whether divergent thinking tests also relate to creativity in 'real' adult settings is not clear, although some claims to that effect have been made (Milgram, 1990; Torance, 1988). Discovery orientation, or the tendency to find and formulate problems where others have not see any, has also been measured in selected situations, with some encouraging results (Baer, 1993; Runco, 1995). As Einstein and many others have observed the solution of problems is a much simpler affair than their formulation. Anyone who is technically proficient can solve a problem that is already formulated: but it takes true originality to formulate a problem in the first place (Einstein and Infeld, 1938).

Some scholars dispute the notion that problem finding and problem solving involve different thought processes: for example, the Nobel Prize – winning economist and psychologist Herbert Simon (1985, 1989) has claimed that all creative achievements are the result of normal problem solving.

The personality of creative persons has also been exhaustively investigated (Barron, 1969, 1988). Psychoanalysis theory has stressed the ability to regress into the unconscious while still maintaining conscious ego controls as one of the hallmarks of creativity (Kris, 1952). The widespread use of multifactor personality inventories suggest that creative individuals tend to be strong on certain traits, such as introversion and self-reliance, and low on others, such as conformity and moral certainty (Csikszentmihalyi and Getzels, 1973; Getzels and Csikszentmihalyi, 1976; Russ, 1993).

One view I have developed on the basis of my studies is that creative persons are characterized not so much by single traits, as by their ability to operate through the entire spectrum of personality dimensions. So they are not just introverted, but can be both extroverted and introverted, depending on the phase of the process they happen to be involved in at the moment. When gathering ideas, a creative scientist is gregarious and sociable: when starting to work, he or she might become a secluded hermit for weeks on end. Creative individuals are sensitive and aloof, dominant and humble, masculine and feminine, as the occasion demands (Csikszentmihalyi, 1996). What dictates their behavior is not a rigid inner structure, but the demands of the interaction between them and the domain in which they are working.

In order to want to introduce novelty into a domain, a person should first of all be dissatisfied with the status quo. It has been said that Einstein explained why he spent so much time developing a new physics by saying that he could not understand the old physics. Greater sensitivity, naivety, arrogance, impatience, and higher intellectual standards have all been adduced as reasons why some people are unable to accept the conventional wisdom in a domain and feel the need to break out of it.

Values also play a role in developing a creative career. There are indications that if a person holds financial and social goals in high esteem, it is less likely that he or she will continue for long to brave the insecurities involved in the production of novelty, and will tend to settle instead for a more conventional career (Csikszentmihalyi, Getzels, and Kalm, 1984; Getzels and Csikszentmihalyi, 1976). A person who is attracted to the solution of abstract problems (theoretical value) and to order and beauty (aesthetic value) is more likely to persevere.

In order to function well within the creative system, one must internalize the rules of the domain and the opinions of the field, so that one can choose the most promising ideas to work on, and do so in a way that will be acceptable to one's peers. Practically all creative individuals say that one advantage they have is that they are confident that they can tell which of their own ideas are bad, and thus they can forget the bad ones without investing too much energy in them. For example Linus Pauling, who won the Nobel Prize twice, was asked at his 60th birthday party how he had been able to come up with so many epochal discoveries. 'It's easy,' he is said to have answered. 'You can think of a lot of ideas, and throw away the bad ones'. To be able to do so, however, implies that one has a very strong internal representation of which ideas are good and which are bad, a representation that matches closely the one accepted by the field.

Conclusion

Creativity cannot be recognized except as it operates within a system of cultural rules, and it cannot bring forth anything new unless it can enlist the support of peers. It follows that the occurrence of creativity is not simply a function of how many gifted individuals there are, but also of how accessible the various symbolic systems are and how responsive the social system is to novel ideas. Instead of focusing exclusively on individuals, it will make more sense to focus on communities that may or may not nurture genius. In the last analysis, it is the community and not the individual who makes creativity manifest.

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