Milieus of Creativity

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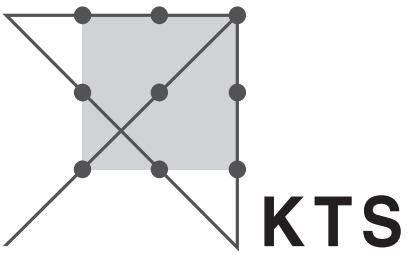
Milieus of Creativity

An Interdisciplinary Approach to Spatiality of Creativity



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Introduction: The Spatiality of Creativity

Peter Meusburger, Joachim Funke, and Edgar Wunder

The concept of creativity used to be seen entirely as an entity depending on the faculties of individuals. Research on creativity in psychology, philosophy, and art criticism focused on the attributes of geniuses, gifted persons, creative artists and scientists, and creative performance and problem-solving. Eventually, researchers acknowledged that the creative scientist or artist does not work in a social, cultural, and economic vacuum. It was accepted that creative individuals are inspired or impeded by societal and organizational structures and that they depend on evaluators, audiences, and research infrastructure. It was recognized that such people may meet with incomprehension, competition, hostility, and social conflict, that interactions play an important role, and that learning processes are situated in environments and spatial structures. With the ascendence of these new perspectives, creativity began capturing attention in other disciplines as well.

A Brief Retrospective

From Persons to Persons in Situations

When research on creativity was still in its infancy (for an overview, see Albert & Runco, 1999; Simonton, 1999), few scholars found it necessary to include the environment in their considerations. At best, they admitted that talented individuals could not develop their creativity in repressive societies. One of the first

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scholars to discuss the influence that external conditions (parents, schools, peers, role models, teachers, political institutions, and scientific policies) have on the scientific achievements and careers of eminent scientists was the German chemist and Nobel Prize winner Wilhelm Ostwald. In his 1909 book *Große Männer* (Great Men), which describes the careers of Humphry Davy, Julius R. Mayer, Michael Faraday, Justus Liebig, Charles Gerhardt, and Hermann Helmholtz, he addressed almost all individual, social, organizational, environmental, and political aspects now known to be capable of affecting creativity and scientific careers. However, this early pioneer did not work in any of the core disciplines of the social sciences. As for psychologists, they concentrated more on intelligence than on creativity, at least before Guilford's (1950) famous presidential address to the Association of American Psychologists. Ostwald's research was therefore largely ignored by the epistemic centers of the social and behavioral sciences of that time.

The environmental road to research on creativity was gradually charted in the 1940s and 1950s, beginning with Stallknecht's (1941) discussion of the relations between environment (reality and actual concrete existence) and consciousness. Osborn (1953) continued this line of thought by underlining the importance of environment for the development of creativity. So did Stein (1953) when he pointed out that there is an interaction between the creative individual, the problem on which he or she is working, and the environment in which that person exists.

> To speak solely of the existence of the stresses and strains in the environment without due consideration of the individual, as some investigators do, or to deal primarily with the stresses and strains in the individual and to overlook the nature of the problem or the environment as other investigators do, is an arbitrary approach which is a consequence of the specialization in our profession today. (p. 312)

> The creative product resonates with the needs or experience of a group. Art works resonate with feeling, while technical inventions find resonance because they fulfill practical needs. (p. 318)

> The creative work must strike a chord or resonate in some manner with the group that accepts it. (p. 321)

The way to the interactional and environmental study of creativity was also prepared by environmental psychologists focusing on the relation between actor, situation, and environment, especially by Barker's (1968) concept of action settings. Management studies, too, became interested in the psychological climate of organizations and found that creative persons are very sensitive and responsive to the attitudes and behavior prevailing within an organization or at their place of work (see Raudsepp, 1958).

Not until the latter part of the 1980s did mainstream research on creativity turn to the impact that situations and environments have on creativity. At that point, scholars increasingly began addressing issues that had been raised 80 years earlier by Ostwald (1909). More and more of these late twentieth-century social and behavioral scientists regarded behavior as a function of the interaction between a person and a situation, and situational determinants of creativity became a research focus of cognitive psychologists. It was accepted that creative individuals are embedded in particular environments capable of either fostering or hindering their

creativity and that cognitive processes are guided not only by personal capabilities or intrinsic motivation but also by interactions with and influences of the environment. This alteration in the study of creativity was summarized by two leading researchers of that period:

> There has been a concentration on the creative person, to the exclusion of "creative situations"—i.e., circumstances conducive to creativity. There has been a narrow focus on internal determinants of creativity to the exclusion of external determinants. (Amabile, 1983, p. 5)

> We cannot study creativity by isolating individuals and their works from the social and historical milieu in which their actions are carried out. This is because what we call creative is never the result of individual action alone; it is the product of three main shaping forces: a set of social institutions, or *field*, that selects from the variations produced by individuals those that are worth preserving; a stable cultural *domain* that will preserve and transmit the selected new ideas or forms to the following generations; and finally the *individual*, who brings about some change in the domain, a change that the field will consider to be creative.… Creativity is a phenomenon that results from interaction between these three systems. (Csikszentmihalyi, 1988, pp. 325–326)

> Creativity is a phenomenon that is constructed through an *interaction between producer and audience*. (Csikszentmihalyi, 1999, p. 314)

Whether in anticipation of or in response to this turn, some psychologists developed multilevel models of creativity to distinguish between the creativity of individuals, groups, and organizations (e.g., Woodman et al., 1993). Other psychologists applied a systems perspective of creativity, including contextual variables that influence creativity (Csikszentmihalyi, 1999; Simonton, 1975, 1977, 1988, 1990). All this work drew attention to the processes of problem-solving, the interaction between members of teams, the various phases of a creative process, the spatial diffusion of creative ideas and products, and the contextual or environmental determinants promoting or suppressing creativity. When referring to environmental variables, though, most authors mentioned only organizational, cultural, socioeconomic, or political factors. They disregarded the spatiality of creativity and the role of places and spatial contexts.

Some psychologists hypothesize that multiple components must converge for creativity to occur and that creativity evolves through a confluence of various individual abilities, societal structures, economic resources, political conditions, and cultural values (for an overview see Amabile, 1983; Sternberg & Lubart, 1999). This confluence or convergence is inconceivable without a spatial coincidence or co-presence of these components. Processes of learning and gathering experience are inseparable from interactions with a specific environment and from situational challenges.

Creativity and Space

The constituents of creativity and their interrelations materialize in social macrophenomena called creative environment, milieu, or context (see the chapter by

Meusburger in this volume). Such spatially rooted social macrophenomena are not identical with the sum of their components. A creative milieu is not produced solely by a co-presence of particular constituents. Much more decisive are their interrelations and mutual modifications. A creative milieu is a possibility or potentiality, not an actuality. According to Stallknecht (1941), a possibility or probability can be an efficient cause for action. Possibility directs attention to concrete situations, "and this direction is the mainspring of conscious initiative" (p. 622). Possibility can be an efficient cause only when in contact with mind that acts as a "catalytic agent", so to speak (p. 622). Recognizing a possibility earlier than other people do is an important constituent of creativity and competitiveness.

A creative milieu or environment represents a certain potentiality that must be activated through human communication and interaction. What makes a location attractive is its possible or imagined advantages, not the realized ones. It is the potential to communicate with other highly creative persons that attracts artists and scientists from elsewhere. It acts like a magnet for other creative people and thus enhances the attractiveness of a place. One cannot predict whether and how often this potential for integrating diverse viewpoints and knowledge bases is activated and how the relationships between creative agents develop. Those aspects can be described only after the fact. If potential, possibilities, and resources go unexploited, if agents stagnate, if they cling to dominating networks and do not listen to adherents of other paradigms or exchange knowledge beyond their discipline's borders, then locally available intellectual resources may be of little benefit. The mode and intensity of the interrelations between given components vary in time and space; they are not fixed or predictable.

There is also another reason why spatial context is more than the sum of its parts. Its symbolic meaning, reputation, and attractiveness lie not only in its present merits and achievements but also in those gained previously by agents no longer belonging to the context. A place is like a screen on which possibilities, expectations, benefits, and hopes are projected, a surface that reflects reputation back onto the persons and institutions located there.

Interdisciplinarity

The longest tradition in creativity research stems from discussions by philosophers about aesthetic creativity and from investigations by psychologists into intelligence, problem-solving, and individual creativity. But for many decades, these two pioneering disciplines of creativity research did not have much in common when it came to their concepts of creativity. According to Wittgenstein (1966), "aesthetic questions have nothing to do with psychological experiments, but are answered in an entirely different way" (p. 17). Judgment about a work of art is only remotely connected with laboratory-confirmed creativity. Similar gaps exist between other approaches and disciplines.

Human geography, too, has a long tradition in the study of the generation and spatial diffusion of innovations. However, researchers in this discipline did not

enter the field of creativity research until the 1990s after first detouring through several other areas of inquiry. Some of these scientists studied spatial disparities of educational achievement, the migration of highly skilled labor, and the importance of co-presence and face-to-face contact for the generation and transfer of scarce and valuable knowledge. Others sought reasons for the spatial concentration of high-level decision-makers, the disparities of knowledge between the center and the periphery, and the role of networks and clusters in the accumulation of knowledge (see Meusburger, 2008). Human geographers began looking into subject-oriented action theory, cognitive processes, relations between structure (environment) and agency (Werlen, 1995, 1997), and theoretical concepts of space. The more they delved into these topics, the more geographical research moved from the macro- and mesoscale (spatial structures and processes) to the microscale (human agency). The deeper they probed, the more their focus shifted from spatial units to individuals and the more they had to incorporate theories and research results from sociology, psychology, and philosophy. As they progressed, they built more and more bridges between geography and the other social and behavioral sciences.

Each discipline that is engaged in creativity research has its strengths in certain aspects and its weaknesses in others. An ever-present danger is the tendency of unidisciplinary researchers "to view a part of creativity as the whole phenomenon" (Sternberg & Lubart, 1999, p. 4). Another hazard is that their narrowed vision of creativity seduces them into downplaying the research questions and methodologies of other disciplines. Human geographers, for their part, are not greatly concerned with analyzing the characteristics of creative persons and with ascertaining the creativity of individuals or work groups with psychometric exactitude. That research agenda falls to psychologists, who have developed various experimental processes for those purposes. Geographers pursuing the topic of creativity focus mainly on the role and impact that milieus, contexts, or environments have on creativity, on the spatial distribution, disparities, and diffusion of creative ideas and products, on the factors constituting creative environments, and on the spillovers of knowledge from science parks and universities.

Geographers examine creative milieus from a variety of angles. In one strand of argumentation, places, locales, and areas are ascribed a constitutive role in the generation of career paths (Pred, 1986; Thrift, 1983). Just as certain age cohorts or time periods offer different opportunities and risks, certain locales and spatial contexts offer different learning opportunities, role models, value systems, challenges, social networks, opportunities for professional careers and vertical social mobility, and face-to-face contact with high-level decision-makers of various fields. From this point of view, a locale is a "meeting place of social structure and human agency, substantive enough to be the generator and conductor of structure, but still intimate enough to ensure that the 'creature-like aspects' of human beings are not lost" (Thrift, 1983, p. 38). A location influences the aspirations, motivations, and interaction of individuals and organizations disposing of the skills, prior knowledge, and resources to exploit these chances.

Economic geographers and regional economists have contributed to the interest in creative milieus by studying the spatial distribution of technical and organizational innovations, innovative products and processes, patents, and research input

and output and by analyzing the impact of clusters and networks. Taking a different route, other students of creativity retrospectively explore its spatial disparities by analyzing the careers, professional achievements, and social mobility of elites and the performance of outstanding scientists and artists. This biographical material serves as background information about a creative person, the conditions of his or her early socialization, and the chances and challenges that contributed to that individual's creative career. The emphasis falls on the interrelations of factors and the influence that various spatial contexts and path dependencies have on creativity and scientific careers. Such research on creativity thus complements and amplifies the work done in this area by other social and behavioral sciences.

The attention that creativity has received in an increasing number of disciplines has enriched the work on this subject and has broadened scholarly horizons. The researchers from each field of inquiry bring their own specific ideas, core competencies, and main interests to the task. At the same time, this expansion of research has been problematic. The scales, methodologies, theories, definitions, and indicators of creativity used in research differ from one discipline to the next (and even from author to author within the same discipline). Recognizing that elucidation of a lengthy creative process requires resources other than the description of a creative environment, scholars agree that an individual's creative performance must be measured, analyzed, and explained with resources and techniques that diverge from those used to study the spatial distribution of creative products. In short, the resulting variety complicates interdisciplinary discourse and sometimes dilutes concepts of the core disciplines.

Although innovation, invention, and the generation of scientific knowledge are closely related to creativity, surprisingly few economists and economic geographers have taken notice of the results reported in science studies, psychology, and the geography of knowledge. Until recently, psychologists have similarly disregarded the vast amount of relevant work in science studies. This aglossia results partly from the fact that the concepts, definitions, and methodologies in these disciplines differ from those in economics and economic geography. But it might also be due to parochialism that leads publishers and readers to assume that the most innovative ideas, theories, and results appear in a few journals of one or two disciplines. Until recently, the exchange of ideas and concepts across disciplinary borders left much to be desired.

Goals and Content of This Book

The very appearance of this book in a series entitled "Knowledge and Space" indicates one of the goals behind this enterprise: to raise awareness that spatial disparities of creativity exist and that spatial contexts are important in knowledge generation and creative processes. Are societal factors spatially footloose? What is the point in focusing on places, spatial structures, and spatial relations in creativity research? How should the term *environment* be conceptualized? Are only

social factors relevant for the development of creativity or should one also include material artifacts and resources in its definition? How can relationships between environment, cognitive processes, and action be explained without falling victim to geodeterminism? Environmental psychology, human ecology, social geography, semiotics, and actor-network theory offer at least some ways to link between nature (material objects) and society (humans) and thereby find out how sociomaterial things act upon humans and what meaning "materiality [has] in the course of knowledge production" (Jöns, 2006, p. 559).

Yet gaps and contradictory results of the continuing inquiry into creativity remain. Another goal of this book is, hence, to address at least a few of them and to promote an understanding of the approaches taken in other disciplines and at other levels of analysis. In the first six chapters the authors review the most fundamental results of research on creativity from the perspectives of psychology, philosophy, and geography. Psychologist Joachim Funke (Chapter 1) focuses on possible definitions, the methods of analysis, and known determinants of the construct called *creativity*. Robert Sternberg (Chapter 2), drawing on his "investment theory of creativity," argues that creativity is not the same across different domains (e.g., art and science) and that knowledge is one crucial variable explaining why creativity is domain-specific. To be a creative individual in a given domain, one must at least know what the state of the art in that domain is. But knowledge is by no means sufficient for creativity. The third psychologist, Dean K. Simonton (Chapter 3), focuses on scientific creativity, trying to predict creative performance in science by using combinatorial models.

The philosophers Günter Abel (Chapter 4) and Hans Lenk (Chapter 5) deal with possible typologies of creativity, analyzing the typical structures of creative processes. Both authors highlight the importance of symbolizing signs in that approach, the relationship between creativity and rules, and the use of creative metaphors to help overcome limits of human understanding and explanation. The geographer Peter Meusburger (Chapter 6) discusses fundamental concepts of creativity research from the viewpoint of their applicability to human geography. Asking why highly creative individuals are not evenly distributed over time and space, he points out the crucial role of particular milieus in which individuals are raised, trained, and embedded.

Chapters 7–15 delve into rather specific problems and case studies in an investigation of the role that milieus, contexts, and social spaces have in the emergence of creativity. James Kaufman (Chapter 7) is concerned with the relationship between creativity and intelligence, which seems to be amazingly varied across different cultures and ethnicities. To understand the factors that support or hinder the creativity of individuals of differing problem-solving styles, Scott Isaksen (Chapter 8) examines how those people rate their working climates. Similarly, the aim of Ricarda Bouncken's study (Chapter 9) is to explore the effects that national culture has on teamwork and innovation in global teams. The results indicate that cultural values have unequal effects on teamwork and creativity in the innovation process. Martina Fromhold-Eisebith (Chapter 10), an economic geographer, is concerned with the problem of why innovative actors agglomerate and how local

contexts sustain economic creativity. On the basis of social cognitive theories, the psychologist Jens Förster (Chapter 11) conducts an experiment with a special priming procedure. He finds that exposing participants to the name of a city they regard as a creative place enhances their performance on a subsequent creativity test. Margaret Boden's research (Chapter 12) centers on conceptual spaces perceived as culturally accepted styles of thinking. She understands creativity to mean the process of moving through such conceptual spaces as one tries to transform one or more dimensions of the space. Rob Kitchin (Chapter 13) exemplifies this theoretical reasoning by highlighting the creative potential of science-fiction literature. According to Barney Warf (Chapter 14), the contingent nature of social reality not only serves as an infinite resource for creativity but also compels a retheoretization of the role that time and space have in the constitution and unfolding of social life. In the final essay of this book (Chapter 15), Stephan Günzel introduces the term "Geophilosophies" to designate fundamental modes of geographical thinking. He also argues that the notion of creative milieus can help researchers reevaluate the origins of geophilosophies in their historical contexts.

As this introduction to the book points out, creative processes on the spatial microscale and the interaction between the environment and the creative individual (or work group) have been studied extensively by psychology and other social sciences. However, less is known about why certain university departments, research units, or scientific cultures have been more successful in producing prominent scientists than others. Even more obscure is the answer to the question of how to explain macroscale spatial disparities of creativity. Why were Florence (fifteenth and sixteenth centuries), Prague (about 1600), Manchester (about 1800), Paris and Vienna (about 1900) such creative places? What cultural, social, economic, and political contexts and what spatial relations enabled Vienna to accomodate between 1890 and 1930 Josef Hoffmann, Hans Klimt, Oskar Kokoschka, Koloman Moser and Egon Schiele in the arts; Alfred Adler and Sigmund Freud in psychoanalysis; Rudolf Carnap, Otto Neurath and Karl Popper in philosophy, the philosophy of science, and mathematics; Ludwig Boltzmann, Philipp Frank and Ernst Mach in physics and philosophy; Julius Wagner-Jauregg, Robert Bárány and Theodor Billroth in medicine; Alban Berg, Johannes Brahms, Anton Bruckner, Josef Matthias Hauer, Gustav Mahler, Arnold Schönberg, Johann Strauss jun., Anton Webern, Hugo Wolf and Alexander Zemlinsky in music; Walter Gropius, Carl Hasenauer, Adolf Loos, Joseph Maria Olbrich and Gottfried Semper and Otto Wagner in architecture; Robert Musil, Arthur Schnitzler and Franz Werfel in literature; Karl Kraus in literary criticism; Friedrich August von Hayek, Carl Menger, Ludwig von Mises, and Joseph Schumpeter in economics; Hans Kelsen in legal doctrine; and many other eminent scholars in other disciplines (for details see Beller, 1993; Brix, 2003; Hanák, 1993; Janik, 1986)? How are the regional systems of knowledge production (Rheinberger, 2003) and the regional conditions of excellence defined? Why did other world cities of comparable size not boast such creative minds?

How can one open the black box and avoid the tautology that someone produces creative ideas or products because he or she is a creative person working in an environment conducive to creativity (Choi, 2004, p. 187). Ambrose (2006),

Gardner (1988), and Thiessen (1998) argue that insights from multiple disciplines are necessary in order to understand the intricate complexities of creativity, prevent intellectual stagnation, and avoid dogmatic insularity in creativity studies. The preexisting knowledge of an expert or a single scientific discipline can become a corset that stifles novel ideas so that thinking leads only to the production of tried-and-trusted, correct answers (Cropley, 2006, p. 402). We editors hope that the co-presence of different and even contradictory approaches and provocative questions in one book will encourage readers either to question some of their beloved paradigms and scientific worldviews or to clarify their assumptions and elaborate their models in increasing detail.

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Chapter 1
On the Psychology of Creativity

Joachim Funke

Creative thinking—this combination of words raises the question of whether thinking is possible without creativity, and whether creativity can occur without thinking. But one might also ask: Is this miraculous ability called creativity compatible with the rational act of thinking? Are not irrational elements more important in explaining creativity? Are creative processes accessible with scientific methods at all? Has every human being a creative potential? Instead of providing answers to these questions directly, I structure my paper around the following lead questions:

1. Which methods of analysis are available to researchers working in the field of creativity? What is the source of researchers' knowledge about this issue?
2. What does creative thinking look like, and how does it manifest itself?
3. What are known determinants of creative thinking?
4. Why is there a need for creative thinking?
5. What can be done to improve creative thinking?

Space limitations preclude detailed answers to all these questions, but after reading this article you should feel a bit more informed about the above-mentioned topics.

According to Simonton (2000), creativity is present in all fields of human activity. For example, the building in which you are now was designed by an architect; the clothes you wear were designed by a fashion designer; the chair you are sitting on was designed in a perfect way (hopefully ergonomically); and the book you are reading was designed and produced. Behind each of the things around you, which are normally called *artifacts*, is a person who has created these things with a specific intention in mind.

This omnipresence of creative products in the environment contrasts the comparatively small amount of research that has been conducted on creativity. For many centuries, creative activities were seen as something miraculous, something that comes over a person and needs no further explanation. With the advent of empirical psychology at the end of the nineteenth century, those assumptions

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about mysterious creative acts slowly changed. An impressive increase in research took place in the 1960s and 1970s, stimulated by an important paper written by Guilford (1950), who argued the need for more and better research on this creativity. But besides Guilford's call for research by the scientific community, there was an event outside academia having at least the same importance or even more: space flight and the endeavor to discover the moon and outer space. Historically, creativity research gained huge impetus from the "Sputnik shock" of the Americans (see Amelang & Bartussek, 1997, p. 260). On October 4, 1957, a small satellite started from the Russian space shuttle platform *Baikonur* and orbited the world—a shock for the Americans who believed their nation to be the leading technological force in the world.

Out of concern that the United States was not producing enough creative scientists, large programs (for example, "Headstart") were immediately launched, an effort that helped identify and support gifted people. With the advent of this research, many new insights about creative processes were gained and came to form psychologists' current point of view definitively. Before going into more detail, I first have a look at the research methods for assessing creativity.

What Types of Creativity Assessment Are Available?

A psychometrically sound assessment of a person's creativity is a difficult enterprise. However, many psychologists have tried to meet this challenge. A comprehensive survey of tests for the measurement of creativity is found in Krampen (1993). In general, there is a distinction between language-based and language-free procedures. Language-based procedures require performances that result in verbal utterances. For example, Guilford's concept of divergent thinking (see below) produced a test labeled "Unusual Uses," which required respondents to name as many uses for a given object as possible. The common brick, for instance, can serve as material for building houses but also as a bedwarmer (after heating it), as a weight in a car's luggage trunk to keep the vehicle from skidding on slippery roads, as a weapon against enemies, or as part of a bed made out of bricks. Flexibility of thinking shows up not only in the simple quantity of different uses named but also in the number of different categories like building material, storage medium, weight, or weapon. Aside from flexibility and fluency, there is also an interest in the originality of responses. Using the brick as a sponge is not obvious to everyone and is therefore a more original idea than its proposed standard usage for building.

Another language-based measurement of creativity, the Remote Associates Test, was proposed by Mednick (1962). The task for the respondent is to find a common link between three stimulus words with a low associative link between them. For example, the common link between *humor*, *pitch*, and *night* is the color black. This procedure measures the flexibility of associations. For sure, one can ask whether this procedure really tests creativity. The procedure described assesses the availability of conceptual structures in semantic memory, which is not unimportant

for creative processes, but creative processes are not sufficiently described by this conceptual availability.

Language-free tests for assessment of creativity rely mainly on drawing activities required of the respondent. On the Torrance Test of Creative Thinking (Torrance, 1966), given pictures are to be either completed, newly combined, or produced. Figure 1.1 shows an example for each of the three tasks.

Neither language-based nor language-free assessment procedures have really been able to stand up to criticism. Hussy (1986) went as far to as say that "those measurement instruments for the assessment of creative processes have to be qualified as ineffectual" (p. 78). Even though the psychometric assessment of creativity is not possible by means of reliable and standardized diagnostic procedures, there do exist experimental procedures, which should be mentioned briefly.

Important insights based on experimental studies come from the area of analogical transfer (see Gentner & Stevens, 1983; Holyoak, 1985, 2005). The main question is whether respondents detect the structural equivalence between two different domains spontaneously or rather by means of the experimenter's help. For example, think of the analogy between the solar system and the atomic system (given by the fact that in both systems single elements run on a circular curve around the core and are attracted by that core). Analogical reasoning helps transfer some aspects from the source domain to the target domain. Of course, this facet of creativity is not the whole picture. Results of analogical transfer show the difficulty people have when trying spontaneously to detect the parallels in the deep structure of two domains

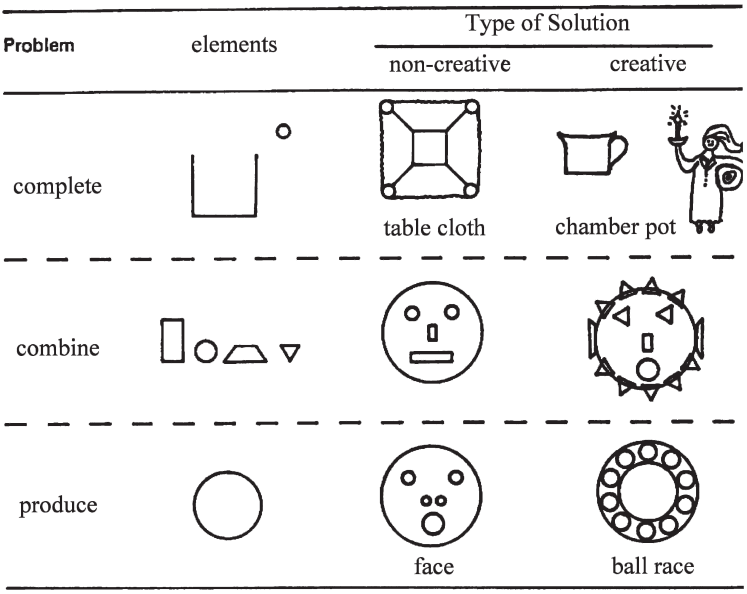

Fig. 1.1 Three examples of creative tasks (completion, combination and production) with nonverbal elements and two types of solution (creative and noncreative)

that are dissimilar on their surface. If hints about the similarity are given, attributes of the source problem can often be used for the target domain. An example is the transfer of solution strategies from one domain to another.

Within the context of scientific discoveries, the principle of induction, which is used in analogical problem-solving, comes into conflict with the principle of falsification. Scientists who want to discover things by means of induction and the use of as many analogues as possible simultaneously have to follow the principle of falsification, which requires strong tests of hypotheses (Bredenkamp, 1980).

The above-mentioned test procedures and the assessment procedures from the area of analogical transfer are not the only instruments and techniques available for research in creativity. Hocevar and Bachelor (1989) mention the following additional techniques: (a) personality inventories, which allow the assessment of certain psychological attributes; (b) biographical inventories, which ask for background information about a person and his or her developmental conditions (the role of biographical analyses as sources for creativity research is stressed by Gardner [1993]); (c) scales for the assessment of attitudes and interests, which ask for specific preferences; (d) person-related assessments by teachers, peers, and supervisors who have seen the rated person for long time periods and know the person well; (e) eminence ratings (e.g., citation frequency, space in biographical texts, and awards); (f) checklist-based self-reports about special performances; and (g) ratings of creative products.

Each of these methods has its pros and cons, so the search for a single type of creativity assessment is misleading. There is no one simple measurement of creativity. Only through a combination of different approaches can a reliable picture emerge. How this picture looks is explained in the next section.

What Is Creative Thinking?

There is the already mentioned popular assumption that creative thinking might be the result of a sudden inspiration, that the solution to a problem suddenly appears in front of the mind's eye (Boden, 1991). Contrary to that popular assumption, psychological research as early as Wallas (1926) indicates that creative solutions are the result of an enduring and long process (Weisberg, 1989). At least the following five phases of creative processes are traditionally mentioned.

Phase 1: Preparation

It is difficult to have a good idea without having worked intensively in the domain under question. Creative inventors know the most important principles of their discipline, and all creative artists have dealt with the products of their predecessors and contemporaries. Creative scientists not only have a long history of ideas behind them but have also reached a high degree of expertise in their domain (Ericsson, 1996). Intensive preparation is a necessary ingredient for important discoveries and

creations. Among expertise researchers (e.g., Ericsson, 1996), a saying goes that, roughly speaking, someone who has spent more than 10,000 h on a special topic can be called an expert.

Phase 2: Incubation

Sometimes it is helpful to stop working on a problem for which a creative solution is needed. During the phase of not working on the problem, the brain nevertheless is at work. Incubation becomes strong after the previous phase has laid the groundwork for a kind of "mental infection."

For a long time, it was unclear what happened during this incubation phase. The dynamic of human memory is responsible for the processes of change in associative connections between ideas and representations over time (Finke et al., 1992). The processes during the incubation phase remain below the level of consciousness of the creative person and cannot be influenced actively. But research on the cognitive unconsciousness has provided experimental data showing that intuitive information-processing occurs (Dorfman et al., 1996; Smith et al., 1995; Ward et al., 1997).

Phase 3: Insight

At a certain point in time, a recombined association passes through the threshold of consciousness and produces a flash of insight—the illumination. Gestalt psychologists have called this moment the " 'Aha!' experience." Occurring after appropriate preparation and after some time of incubation, it is the moment of the creative product coming to mind. In medical terms, one has reached the "crisis."

Phase 4: Evaluation

The creative insight has to be evaluated—not all creative insights are really useful. Evaluation is the place for norms and values, which help decide whether a new idea should be discarded or propagated.

Phase 5: Elaboration

From the first idea of an electric light bulb to its first prototype, a long journey had to be taken. Thomas Edison is often quoted for his statement, "Genius is 1 percent inspiration and 99 percent perspiration"—meaning that a lot of force is

necessary to make a creative idea work. On the way from the first idea to the final product (a picture, a technical product, a text), a lot of surprises and changes can occur as well.

The above-mentioned five stages of a creative process represent normal stages of information-processing. The opening question, "What is creative thinking?" now has its first answer, which I want to enrich by one further idea. This idea comes from the differentiation between convergent and divergent thinking introduced by Guilford (1967). By *convergent thinking* Guilford means logical procedures, which analytically lead to a certain solution. Divergent thinking, which is predominant in creative processes, is characterized by unusual associations, a shift of perspectives, and the enlargement of the horizon. Normally, a problem-solving process starts with the generation of a sizeable number of ideas (divergent thinking), from which one or more are later selected for elaboration (convergent thinking).

A further conceptual classification differentiates between productive and reproductive thinking. Even if a strong demarcation is not possible, one can describe the endpoints of the scale precisely. With *reproductive thinking* psychologists describe cognitive processes that have only to be reproduced for solving specific problems. Suppose, for example, you want to multiply two numbers, say, 369 × 264. Even if the exact operation with those two figures has been never done before, the way of solving the problem (the application of the multiplication process) is known and can be reproduced. By contrast, *productive thinking* means that a new way of arriving at a solution has to be found. It is this productive aspect that makes creative processes similar to problem-solving processes. Both constructs have indeed much in common, especially when it comes to complex problem-solving (Funke, 2006).

What Are Known Determinants of Creative Thinking?

Historically, there are three different perspectives on creativity research: (a) the creative person, (b) the creative process, and (c) the creative product. Because some insights about the creative process were mentioned in the previous section, I now go into more detail on the creative persons and their environment. Some statements about the creative product are also made.

The Creative Person

Is it necessary to have extraordinary intelligence for producing creative products? This question was answered by Galton (1869) from the genetic point of view and by Terman (1925) from the perspective of gifted persons (see also Subotnik & Arnold, 1994). Sternberg (1995) concludes, "Bright but not brilliant" (p. 366), which should be read as follows: Above a certain threshold of intelligence, an increase in this ability has no further implications for creative performances. Getzels and Jackson

(1962) have set this threshold at an IQ of 120. The assumption underlying one's conception of intelligence should not be that there is one single general intelligence but that there are multiple intelligences (verbal, logical, spatial, musical, motoric, personal), as formulated in Gardner's (1983) conception or in Sternberg's (1996) ideas on successful intelligence consisting of analytical, creative, and social competencies.

Besides intelligence, there is the more general question concerning the predictive value of personality traits of creative persons. Martindale (1989) and Simonton (1999), for example, point to the importance of variables such as independence, nonconformism, unconventional behavior, broad span of interests, openness for new experiences, risk-taking, and cognitive and behavioral flexibility. Also, the old debate on genius and madness finds some support because creativity is linked to a certain degree to psychopathology (see Eysenck, 1995; Ludwig, 1995). But those pathological behaviors are not necessarily conditions for creativity—on the contrary, sometimes the creative person demonstrates how psychological deficits can be used in an adaptive way (see Csikszentmihalyi, 1997; Ludwig, 1995; Rothenberg, 1990).

With respect to age, it is often said that creativity has a peak when a person is between 20 and 30 years old and decreases thereafter (e.g., Lindauer, 1993). As far as researchers know today, such a pessimistic statement seems unjustified because many factors help maintain creative production at a high qualitative and quantitative level (for gender differences, see Kämmerer, 2000).

The Creative Environment

Life-span oriented research demonstrates that creativity does not always grow where the best and optimal conditions exist. On the contrary, in many cases challenging experiences seem to increase the creative abilities of a person (Simonton, 1994). This finding is interesting because it shows the importance of a creative environment in addition to the creative person. The environment consists of other persons who are creative in a similar way in the same domain. Martindale (1990), for example, shows that writers orient themselves to what other writers (and selected critics) do. These structures were found by Martindale also in art and music. This research shows that it is not enough to concentrate on a single creative person when trying to understand the creative product.

Aside from the influence of environment, there is also a sociocultural influence (Zeitgeist) that belongs to the creative environment. In history, many countries have experienced a flowering of creativity upon the introduction of democracy and liberal systems, as was the case in ancient Greece. According to Simonton (1994), this pattern may be attributed to tendencies to anchor heterogeneity instead of homogeneity. Cultural diversity seems to be an important factor for improving creative environments. Historiometric analyses of creative products seem to support this view (see Simonton, 1984).

The Creative Product

With respect to the creative product, which is a result of creative thinking, two criteria are seen as important: (a) novelty and (b) the usefulness of a particular solution to a problem. Perceived novelty depends on both the evaluating person and social consensus; a creative innovation can have novelty even if it turns out later that this invention has already been made elsewhere. In this vein, Boden (1994) refers to the difference between personal novelty (P-creativity) and historical novelty (H-creativity).

The second criterion, usefulness, ensures that not everything new is simultaneously labeled a creative product. For a product to be called creative, some of the constraints posed by the problem have to have been solved in an optimal way. For example, if one wants to illuminate a dark room in a building, large mirror systems seem less useful than the electric light bulbs used nowadays.

Besides those main criteria, Lubart (1994, p. 291) mentions three subsidiary ones: (c) quality, (d) importance, and (e) history of discovery. With these additional criteria the gradations of product creativity can be conveyed. For example, it makes sense to say that a qualitatively outstanding new product is better than a half-baked product. The importance of a product is also related to its scope. For instance, a new car-alarm system that distinguishes between animal and human contact with a vehicle and thereby avoids false alarms has a lower scope than a new method for cooking with solar energy. Lastly, the history of discovery can change an evaluation if one learns that the invention came about by pure chance instead of hard work. Normally, respect for creative products increases if they are known to have resulted from a very ambitious long-term effort.

The evaluation of a creative product depends not only on historical context but also on the social reference group. This perspective produces a large span of different evaluations of the same creative product. According to Lubart (1994), different background experiences are responsible for that diversity. Art teachers, for example, who have seen many pictures, evaluate a picture by a child more critically than do the child's parents, who are totally enthusiastic about the first products of their son or daughter but who have no real comparison available. Also, different weighting may be responsible for this phenomenon. Depending on the emphasis given to the different criteria, the resulting span of evaluation can be explained.

Why Is Creative Thinking Needed?

The necessity of creative thinking is not open to question if one ponders the continuation of this world. Even though some products of that creativity confront humanity with the greatest ever potential for self-destruction, creative human activity is also precisely what is important for the survival of the human race. Is it necessary for experts to take lessons in creativity? For sure, because experts, especially, can become blind to new ideas (*déformation professionelle*). As early as 1942, Luchins demonstrated with his water-jug problems that human respondents develop certain

strategies very quickly and subsequently keep using them even under conditions where easier methods are available.

Gestalt psychologists labeled this effect *functional fixedness* and *Einstellungseffekt*. Frensch and Sternberg (1989) demonstrated its influence in an interesting experiment in which bridge players representing different levels of expertise were pitted against controlled computer opponents. One half of the games were played under normal game conditions; the other half, under either superficially or fundamentally changed rule structures. It turned out that the experts suffered from fundamental rule changes more than the novices did but that even then the experts were better and faster than the novices. Nevertheless, these results show that experts have difficulties adjusting their knowledge to new conditions. Sometimes it might be better to know less (see also Gigerenzer, 2006).

By contrast, Krems (1995) describes a series of experiments in which novices and experts (interns, mechanics, and programmers) had to build hypotheses and draw conclusions from given symptoms. Across all analyzed domains it was consistently found that (a) experts modified their hypotheses much more often than novices did when searching for causes, (b) experts were less prone than novices to verification (i.e., more intense attendance to supporting information than to falsifying information), and (c) the ability to change hypotheses flexibly was based more on case-based knowledge than on rule-based knowledge and was therefore bound to certain domains of knowledge and the experience that one had therein. If one looks into these results, the flexibility of experts might be better than was indicated after the experimental study by Frensch and Sternberg (1989).

The necessity of creative thinking is due not only to the potential blindness of experts when solving complex problems. In a world in which the provision of food and water to an exponentially growing human population is becoming more and more important, in which the military potential for destruction is enough to kill this planet more than once, and in which anthropogenic emissions are increasingly interfering in Earth's very sensible natural cycles (see Wissenschaftlicher Beirat Globale Umweltveränderungen, 1999), the necessity of human creative potential is that it seems to be the only ray of hope. Had it not been for creative processes, the whole history of humankind would not have taken the course that researchers have been able to reconstruct.

Therefore, it is important not only to study the conditions of creative activities but also to look for active improvements in creative thinking. Parents, teachers, schools, and universities are in a certain sense institutions of socialization and can do much to improve creative behavior. The final section deals with this training potential.

What Can Be Done to Improve Creative Thinking?

Many programs have been developed for the improvement of creative thinking. Even though there are researchers who believe that creative potential is given to only a small proportion of humans, a larger group of creativity researchers believes that every person can do something to develop his or her creativity. Amabile (1983,

1996) points to the importance of freedom to decide, unexpected rewards, a positive climate for renovation, and a stimulating milieu as factors that improve creativity. On the other side, she names pressure from colleagues or from evaluation as factors that decrease creativity.

According to Sternberg and Lubart (1991), individual and environmental factors have to be combined. Sternberg (1995, pp. 363–364) formulates several recommendations and attitudes in order to increase creative output:

1. Develop a high motivation for being creative in a certain domain. Do not let yourself be captivated by extrinsic motivation (e.g., money) as reward for creative productions—money corrupts! In general, the motivation for creative acts should come from within a person (intrinsic motivation).
2. Show a certain degree of nonconformism; rules that hinder your creativity may be disregarded. But not all rules and habits are bad. With respect to your own performance, the highest expectations and strong discipline with respect to production are necessary.
3. Be convinced fully of the value and importance of your creative action. Criticism and deprecation from others should not bother you. Self-critique should monitor your own progress and how to improve it.
4. Carefully choose the topics on which you focus your attention—look especially for those not highly appreciated by others.
5. Use analogies and divergent thinking as much as possible. But creative thinking also always has an eye on old traditions, if only to disagree with them.
6. Look for colleagues who help you fight against convention and test new ideas. Search for comrades-in-arms who encourage you to take risks.
7. Assimilate as much knowledge about your domain as possible. This strategy helps prevent you from inventing the wheel for the hundredth time. Try not to be absorbed by these data.
8. Make the strongest commitment to your creative enterprise.

As this list shows, no one factor is made responsible for creative activities; they arise from a broad bundle of conducive conditions. In addition to a creative environment, knowledge, personality, intellectual processes, and intrinsic motivation are necessary ingredients. Sternberg and Lubart (1991, 1995) have labeled their concept "Investment theory of creativity," suggesting that a creative individual "buys low and sells high." Buying low means picking up and creatively developing an idea underestimated by one's contemporaries. Selling high means maximally exploiting the developed idea (financially and otherwise) if you convince other persons of its value.

Yet another part of improving creativity is an important aspect of many training programs, namely, that of putting evaluation on hold in the phase of generating ideas. This objective helps prevent summary rejection of original ideas. If evaluation comes into play too early, it can be a strong barrier against innovation. Ahrens (2000) describes the negative consequences of that premature evaluation has on innovation at British universities. Postponing evaluations is a central part of a method called "brainstorming" developed by Osborn (1953). A small group of

persons (6–8) is given the task of generating ideas for 60 min. During this period no critique or discussion is allowed. Afterwards the noted ideas are checked and three questions are asked: Is the idea immediately ready to use? How much do we have to develop the idea? Is the idea useful in principle? The distinction between production and evaluation made by Osborn has been very successful in the context of creative processes (see Taylor, 1964) and has been enriched by many variations (see Seiffge-Krenke, 1974, pp. 264–265). Brainstorming is still a very popular technique used in many companies (see Farr, 1990). Time will soon tell whether "electronic brainstorming" (Roy et al., 1996) is as useful as the older technique.

The history of science demonstrates that creativity depends not only on persons but also on available knowledge within a certain domain. As soon as basic ideas become well-known in a "young" discipline, there is an explosion of creative ideas in that domain. If, after some time, knowledge has increased drastically and the gaps in that knowledge have narrowed, creative inventions also decrease. The domain develops from a positively accelerated development (increasing processes) into a negatively accelerated type of development (breaking face) where the ceiling is reached.

Concluding Remarks

The ideas presented in this chapter explain the necessity of seeing creative thinking as an interaction between a creative personality and a creative environment. The ideas show also that creative performance cannot be prescribed, that it is a treasure to be carefully cultivated, especially in schools and universities. Given the entire accumulation of problems on planet Earth, a major movement is necessary to concentrate humanity's forces on positive goals. Especially with respect to the psychology of creativity, people have to accept that such an endeavor cannot be sustained by individual geniuses.

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