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Creative Cognition: How Culture Matters

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In order to understand how culture affects cognitive processing involved in creativity, we need to identify the basic mental mechanisms underlying the generation of new and meaningful ideas and artefacts, namely, the core of creativity. If we take into consideration the main theoretical perspectives elaborated about the processes underpinning creative thinking, we realise that three main sets of mental operations can be found: widening, connecting, and reorganising (Antonietti and Colombo 2013; Antonietti et al. 2011). *Widening* concerns the disposition to keep an open mind, to be aware of the great number of elements that can be identified in a given situation, to recognise possible, not obvious, meanings, to discover hidden aspects, and to overcome apparent constraints. *Connecting* refers to the capacity to establish reciprocal relationships among different elements, to draw analogies between remote things, to combine ideas in odd ways, and to synthesise the multiplicity of disparate elements into an overall structure. *Reorganising* consists of changing the perspective, assuming a different point of view, seeing things by inverting relationships between their elements, asking original questions, and

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imagining what should happen if unusual conditions occurred. Hence, we have to address each of these mental operations to get a better comprehension of the grounds of creative cognition.

Widening

The first mechanism that we see operating in creative thinking—that is, *widening*—consists of coming out from the limited conceptual framework within which people spontaneously pigeonhole situations and breaking the "thinking bonds" that often restrain them. To produce something new and original, it is important to move in a wider mental field which mobilises ideas and leads people to explore new directions of thinking, thus helping them to find new opportunities.

A number of authors have stressed that creativity is supported by mechanisms of thought unified by the fact that widening the mental outlook should increase the likelihood of devising and imagining new and interesting things. Starting from Guilford (1950), creativity is linked to the ability to produce many ideas, thus leading individuals to assume a broader mental set. This ability is characterised by the richness of the thinking flow (fluidity) and the ability to follow new directions (flexibility) in order to achieve uncommon and original outcomes. How can such a goal be achieved?

According to Weisberg (1993), a mental framework can be widened by search processes that increase the variety of the ideas to be considered. This author highlighted that creativity always starts from existing ideas which have been modified to fit the specific problem or goal in question. This existing knowledge provides the basic elements with which we construct new ideas. However, so that such a construction can take place, the old ideas should be changed in order to allow persons to have a higher number of ideas, hopefully different from each other. In fact, the pieces of information that the persons gradually get while trying solutions that come to mind lead them to change the direction of reasoning. Creative thinking is based on a search process which draws from its continuity with the past. We face new situations based on what we have done previously in similar or identical situations and novelty arises in the form of variations of old themes, broading our mental perspective.

Variation is a strategy used to make changes in existing ideas. In fact, by varying an existing idea, a person can create new ones, widening the range of opportunities at his/her disposal. Back in 1880, William James wrote that new concepts arise from accidental variations of mental activity, which can be either accepted or rejected. This view was taken by Campbell (1960), who

claimed that creativity involves variation, selection, and retention. According to Campbell, in fact, the basis of creative thought is a process similar to that underlying evolution. The production of an innovative idea follows the previous generation of many inadequate ideas. As a consequence, the greater the number of ideas found—most of which can prove later to be unsuitable for solving the problem at hand—the greater the probability that an interesting idea emerges.

Such an "evolutionary" view of creativity, which leads us to conceive it as a process of change and selection, has been recently revived by Johnson-Laird (1998). According to this author, creative products result from pre-existing elements which are varied in order to create something new. The changes that are produced are subject to three types of selections neo-Darwinian, neo-Lamarckian, and multi-stage. The first type of procedure that governs creativity is defined as *neo-Darwinian* since ideas are generated randomly in a first stage and they are evaluated according to certain criteria in a second stage. Only the ideas that pass this evaluation, namely, which meet the restrictions placed on this second phase, "survive". According to the *neo-Lamarckian* procedure, instead, the production of ideas is guided by a criterion. In this case, ideas are generated only within a predetermined domain. There is also the possibility of a *multi-stage* procedure when certain criteria are used to generate ideas and others to select them.

Individual differences associated with widening processes concern categorisation styles (Narayanan 1984; Wallach and Kogan 1965). In order to organise the reality conceptually, some people prefer to apply *close* categories (i.e., well-defined categories based on narrow criteria), whereas other individuals tend to use *open* categories (namely, broad categories that because of their vagueness, include a high number of items). Creativity skills are possessed by the second type of persons. A situation similar to that previously described and likely to bring out individual differences in "style" of thought is made up of a task of conceptualisation in which, faced with images of everyday objects, people have to group them into classes and justify their choices. In this task, people may adopt different criteria. There are, first of all, those who classify objects on the basis of *descriptive* and *analytical* criteria, that is, on the basis of physical characteristics and perception of common aspects (such as shape, colour, and material). Then there are those who group objects based on *conceptual-inferential* criteria, that is, criteria based on the fact that certain objects are all examples of a given concept (e.g., the objects "fork", "glass", and "cup" are grouped into as members of the category "dish"). Finally, there are those who divide the objects on the basis of *thematic-relational* criteria, inserting objects into broad, ill-defined, and not obvious categories (e.g., the

objects "comb", "watch", "port", and "lipstick" are grouped as representatives of the concept "ready to go out"). It was observed that individuals with high intelligence and low creativity prefer the conceptual-inferential criterion and exclude the thematic-relational one, whereas individuals with low intelligence and high creativity employ the relational-thematic criterion but not the conceptual-inferential one (Kelemen and Carey 2007).

Connecting

Already in 1932 Vygotsky formulated a view of creativity based on the concept of "association", thanks to which parts of the original material are re-elaborated so to produce workable products which can be communicated to others. This perspective was resumed by Mednick (1962), who claimed that creativity results from so-called *remote associations*, which allow individuals to connect ideas that are distant from each other. According to him, creativity is the ability to combine, in a new and unusual way, disparate elements that apparently have little in common. For example, Henry Ford succeeded in reducing the production cost of the Model T, an innovative car that was launched on the market, demanding that the goods supplied to the factories were packed in boxes of a defined size and with the screw holes made in specific locations. The walls of the boxes were actually used, being designed with the right dimensions, as the floors of the cars that were built in the factory. The ingenious idea was to establish a relationship between two elements usually conceived as distinct: packaging material and the product inside the package.

Other authors have also recognised association as the fundamental process of creativity. For example, Koestler (1964) called *bisociation* the operation consisting in bringing together two reasoning structures commonly regarded as incompatible, or finding similarities between different fields of knowledge. Innovation emerges as soon as two different levels of reasoning overlap, thus producing something that did not exist before. In support of his view, we can remind that technologies for radar devices were inspired by the mechanism of emission and reception of ultrasounds by bats. Current research aimed at improving the systems for humidification of the passenger compartments of cars have been inspired by studies on the anatomical structure of the nose of the camel. Again, the design of a house roof that was white to repel heat in summer and dark in winter to absorb heat was inspired by the analogy with the scales of a fish. The flounder, when swimming in the water, takes on the colour of the surrounding environment. This happens thanks to the chromatophores, vesicles of dark pigment which is retained when pressure

exerted on the skin of the animal is low (as when the fish swims close to the surface of water) and is released when pressure increases (as when the fish moves to deep water). This phenomenon suggested the idea of building a roof completely covered with black plastic small white spheres. The heat dilates the spheres (as it happens in the summer), making the roof lighter, whereas winter weather, which is cold, restricts them, making the roof darker (Gordon 1961).

Another form of connection involved in creative thinking is described by Rothenberg (1979). He proposed the existence of a form of thought—called *Janusian* (from Janus, the Roman divinity with two faces looking in opposite directions)—which marks the genesis of artistic and scientific products. It consists in composing the terms of an antithesis, namely, in being able to hold simultaneously two opposite elements and attempting, against the initial inconsistency or paradox, to integrate them. Rothenberg cites, as evidence of his theory, autobiographical accounts of scientists and artists, the analysis of the preparatory notes or pre-release versions of literary works and paintings, and a long series of interviews with artists and scientists relating to the mental processes activated during their work.

In order to give an account of the creative process, in recent times Simonton (1999) postulated the existence of *mental elements*, that is, the fundamental psychic units, such as feelings, emotions, concepts, and ideas. Combinations of well-organised and stable mental elements give rise to *configurations*. Following a process of "consolidation", configurations can become so cohesive that they can be treated as a unit. The more configurations are integrated, the more psychic functions are consistent and organised. Units are usually combined together permutations. In these permutations what is relevant is not so much the elements which are combined, but the way in which they are combined. Simonton argued that creative people have, first of all, many mental elements available. The greater the number of these elements, the greater the number of possible permutations. In other words, creative people are those who have a greater chance of producing new combinations of mental elements. Secondly, creative people have a particular skill in performing random permutations. This should help them to create a rich mental structure of interconnected elements.

This aspect of creativity is stressed in the *Geneplore* model (Finke et al. 1992; Smith et al. 1995; Ward et al. 1995), according to which original and innovative outcomes can result by a process in two phases: the *generative* phase, in which an individual constructs mental representations, and the *exploration* phase, in which these representations are interpreted in order to lead them to suggest creative discoveries. In the generative phase, the representation results as a consequence of an associative process through which elements are combined together.

Reorganising

If we were asked to determine the volume of a ball, we could use our school memories trying to recall the formula to calculate the volume of the sphere. But if we were required to determine the volume of an irregular solid (e.g., a small rock), there would be no formula or past experience that could help us. Instead, we might think to immerse the rock in a graduated jug, partially filled with water, and measure the resulting increase in the level of the liquid. The increase corresponds to the volume of the dipped rock. In this case, success is caused by setting the problem in different terms: not related to formulas, but as a practical-operational problem. Reorganising the starting representation of a situation, in order to assume a new perspective, allows one to find an original and effective response.

The idea that a reversal in the mental framework is a psychological mechanism that underpins creativity emerged early in the history of psychology. Some suggestions coming from the Gestalt psychology tradition can be interpreted along this perspective, according to which new ideas come from a restructuring act. It consists in the transformation of the point of view from which the current situation is analysed, thus leading people to identify new properties of the given elements and/or new relationships among them or new functions of the available materials (Wertheimer 1959).

The restructuring act appears to be the core of what De Bono (1967, 1990) calls *lateral thinking*. Lateral thinking is opposed to vertical thinking. The latter consists in the application of rigid reasoning patterns related to consolidated habits, routines, previous experience. It is characterised by sequential and systematic processing procedures in which the various steps are connected to each other on the basis of logical links. Vertical thinking may be associated to the image of the ascent of a staircase (where each step rests on the previous one) or to the construction of a tower by means of the superposition of many cubes. In contrast, lateral thinking moves from one pattern of reasoning to another one, induces people to look at problems in new ways, to follow directions not explored previously and not usually considered to overcome the obstacles, to examine all alternative forms of reasoning. As an example of the application of lateral thinking, consider the following. A person, equipped with a barometer, has to find the height of a skyscraper. The person may implement vertical—namely, not creative—thinking. He or she might use the barometer, the length of which is known, as the unit of measure and, descending the stairs of the skyscraper's external service, count how many times the length of the barometer is reportable on the length of the wall. The person, drawing on his/her knowledge of physics, could also throw the barometer

from the top of the skyscraper and count the time it takes to reach the ground. By knowing the acceleration of gravity, he or she can obtain, from the time of the fall and through the formula "space = acceleration of gravity time squared divided by two", the measure of the distance travelled by the barometer, that is, the height of the building. The barometer may also be used as an altimeter: Calculating the difference in air pressure between the base and the top of the skyscraper (as it is known, the pressure gradually decreases if we rise above the sea level), that person can convert that difference in metres using a formula. The person could then tie a string to the barometer so he or she can use it as a pendulum. Once on top of the skyscraper, the person will hold the string and let the baromenter go: As a direct consequence, the barometer will oscillate. The oscillation period (equal to the time it takes for the pendulum to go from one end of its trajectory to the other end) can then be traced and, through an appropriate formula, the length of the rope, and then the height of the building, might be computed. In all these cases, the person comes to "vertical" solutions using laws and knowledge previously known. Such solutions always refer to the idea of measurement metrics. What could be a solution suggested by lateral thinking? Giving the barometer to the porter of the skyscraper and obtaining the requested information in return! In this case, thinking does not follow what mathematics or physics can suggest, but "jumps" into a quite different representation of the situation.

The reversing of a mental framework can also follow another path, that is, trying to apply a mental framework outside its normal scope. This is what Schank (1988) suggested. According to this author, to understand reality we must have *knowledge structures*, which are generally derived from repeated experiences. A knowledge structure which was used several times to give an account of events constitutes a *pattern of explanation*. A parsimonious strategy is to treat a new situation as not so different from the previous ones, that is, to apply a pattern of explanation that we applied to other known situations. This prevents us from performing all the processing that would be necessary if we treated the situation as if we encounter it for the first time. Creativity emerges when, in order to face the new situation, we adapt a pattern of explanation, originally set for another situation, to the current situation. Creativity consists in applying a pattern of explanation which is not expected to be applied to that situation. In other words, creativity comes from the misapplication of a pattern of explanation. Faced with an unusual event, we fail to apply the typical pattern of explanation for that situation, but we apply another pattern of explanation. The patterns of explanation, when applied outside of their familiar context, may produce creative results. The creative attitude is what allows the individual to leave the patterns of explanation to be applied

to apparently not relevant situations so that they can lead to the discovery of useful properties.

Some cognitive styles are linked to the cognitive capacity to perform mental reorganisations. The field-independent cognitive style—detected by the ability to locate hidden figures in more complex images—was shown to be related to creative thinking and to the insightful solution of problems (Martinsen 1997). Consider the shapes reported in Fig. 6.1. The complex picture (Fig. 6.1b) contains the simple shape (Fig. 6.1a). Field-dependent subjects hardly identify the simple shape because they are "overwhelmed" by the complex shape, in which the simple shape is not evident. The perceptual organisation of the complex shape is that of a species of gallery divided into sectors so that the simple shape (a kind of house with a domed roof), which is included in the complex shape and all its elements are actually visible, can be hardly detected. In front of figures like Fig. 6.1b, field-independent subjects can take a point of view different from the common one. Their perceptual organisation does not remain bound to what is imposed. They succeed in "breaking" the dominant perspective and discovering what is hidden in the overall figure. Those skilled in overcoming the forces in the perceptual field and organise it according to alternative principles tend to employ a similar strategy in situations where the answer requires a reorganisation of the cognitive field and the identification of relationships and structures not immediately obvious.

The ease, in front of ambiguous figures (i.e., figures that can be interpreted in more than one way or where you see more than one object), to switch from the other interpretation was found to be related to creativity. For instance, the shape reported in Fig. 6.2a (the so-called Necker's cube) can be seen in two ways: either with face down, as if it were in the foreground (and thus with the cube which develops in perspective towards the top, from right to left, as if it were seen from below: Fig. 6.2b) or with its face up, as if it were to be in the

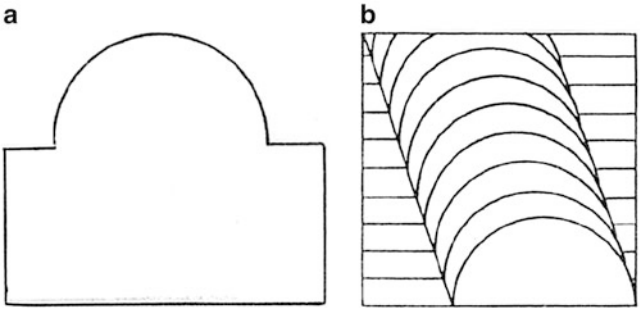

Fig. 6.1 An example of hidden shapes

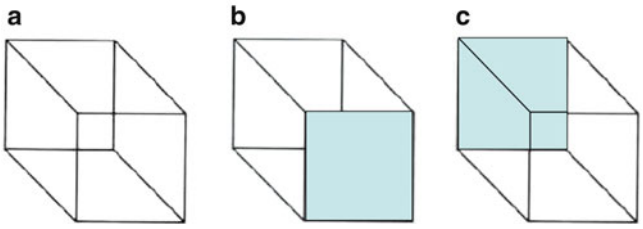

Fig. 6.2 Example of an ambiguous figure

foreground (and thus with the cube which develops in perspective from top to bottom, from left to right, as if it were seen from below: Fig. 6.2c). Creative people can in a given time change the two perspectives in their mind a greater number of times than non-creative people.

Are Widening, Connecting, and Reorganising Universal Cognitive Mechanisms?

In order to assess if the core mechanisms underpinning creative cognition can be detected in different cultural settings, we can look for examples of their implementation outside the environments in which the theories mentioned before were developed; otherwise we can infer that they are limited to the context where they have been identified. In other words, if we assume that widening, connecting, and reorganising the mental framework are three basic processes which fuel creative thinking, we are expected to find that they are operating (i) not only in eminent people—as those often taken into consideration, as we saw, to support a given theoretical perspective—but also in non-eminent people; (ii) not only in recent years, when researchers began investigating creativity and elaborating theories about it, but also in the past; and (iii) not only in Western countries but also elsewhere. In this section, some instances of the application of the three creative mechanisms in question by ordinary persons, many centuries ago, and in non-Western contexts, are reported to support the alleged pervasiveness of widening, combining, and reorganising as core cognitive operations involved in creativity.

As far as widening is concerned, two ingenious ways to prevent thieves to steal a car devised by laypersons are reported in Fig. 6.3. In the absence of the suitable instrument, the owner of the first vehicle presumably wondered if something else can be used to reach the goal. By keeping an open mind, he or she was reminded that a tool which is used typically to ensure a bicycle to

Fig. 6.3 Examples of application of the widening mechanism by ordinary people

poles or bars can be, in the absence of better ways, applied to the car (3a). In the second case (3b), by broadening the mental set of the tools which can be employed to the purpose of closing the car doors, an object (the lock), which is routinely used for other purposes, was found. As another example, consider the way a person found to repair a chair whose leg detached (Fig. 6.4). In all these cases, if people's thoughts would be restricted to the narrow range of the proper objects to be used (which were unavailable in those contexts), a satisfactory solution could not be achieved. So, it seems that the ability to have a wide mental perspective about the situations to be addressed help people to discover unusual but productive ways to face them.

If we focus on what happens in non-Western socio-cultural settings, we find that a similar mechanism is operating in other situations. Let's consider some examples. The biologist Stephan Jay Gould collected a wide set of shoes he bought in different countries of the world during his travels (e.g., in Equador, Nigeria, and India). All these shoes had in common the fact that were produced by recycling materials originally devised for other aims (for instance, sandals had been produced with rubber derived by abandoned tyres) (Johnson 2010). In Indonesia in 2005, a large set of incubators was offered to be employed in paediatric hospitals, but the technology was too sophisticated to work in that context, where the climate is dangerous for electric circuits and replacement pieces were not available and, for this reason, in a short time span the incubators were out of action (statistics show that 95 % of the technology donated to the Third World fails to work after five years). Thus, in a hospital, a different way to build incubators was designed, by using mechanical pieces coming from cars fallen into disuse (Johnson 2010). In India, a potter, Mansukh Prajapati, transformed the local art to shape crockery so to use clay to create a sort of refrigerator which was working without electricity (Radjou et al. 2012). In the same country, it is reported that people share a code, based on the number of rings before the call begins, to communicate by

Fig. 6.4 A further example of application of the widening mechanism by ordinary people

using the phone without spending money (Radjou et al. 2012). In all these cases, persons succeeded in either solving a problem or innovating something since they were not restricted to the habitual ways of using materials and procedures (tyres and car motor engine are only for cars, clay has to be shaped to produce pots only, the phone is meant to communicate by speaking) but enlarged their vision of what was available in their environment and thus found a larger set of opportunities.

As an older instance of the creative power of widening the mental field, we can mention the case of Leonardo da Vinci (1452–1519), who designed a system to automatically move a rotisserie. Instead of focussing on the spit, Leonardo looked at what is around it. When we cook a dish stuck on the spit over the fire, it produces smoke. Would it not be possible to turn the smoke into something useful? If smoke is conveyed in a hood at the end of which it is placed a windmill, the smoke, going up, will set it in motion. Such bloodstream motion of the whirlwind can be transmitted, with appropriate couplings, to rotate the spit without any human intervention. The same process can be identified as the source of the invention of mills. The problem was to find a way to rotate a mechanism and the solution was found by looking at the surrounding environment and finding something (water or wind, according to the country) which can be conveyed to produce rotation. This is a case which testifies that widening the mental perspective, so as to identify possible alternative resources

and suggest creative ideas, is an operation which is performed by both eminent and non-eminent people in different countries and ages.

Now we can consider the second mental operation in question, namely, connecting. Indeed connecting can contribute to creativity in two ways: either by leading people to find shared aspects between two (or more) usually unrelated entities or by suggesting people to arrange available things differently than how they are normally found. As an example of the former, we can mention how the Velcro closure system for clothes was designed by George de Mestral. During a trip, he noticed that his socks were covered with berries with spikes, coming from the bushes he walked through, which were attached to the tissue of the socks. He thought that, in analogy to what happened to the socks, a closure system might be devised consisting of a strip of fabric with small hooks to be superimposed to another strip of furry fabric (McSweeney and Raha 1999). Realising a possible connection between the berries attached to the socks and human cloths led de Mestral to conceive a germinal idea which was at the basis of a huge commercial success.

The second way combining may produce creative outcomes is exemplified well by an artefact produced by Pablo Picasso in 1942 (now exhibited in the Musée Picasso in Paris) called *Tête de taureau* where two pieces of a bicycle (namely, the handlebars and the seat) have been rearranged in an order which does not correspond to the manner in which they are combined in a typical bicycle, so as to represent the head of a bull[1]. In the same vein also people with lower artistic reputation than Picasso combined different common materials in an original way so to represent a fantastic animal (Fig. 6.5: The object was included in an exhibition of anonymous authors within the marble mine of Fantiscritti, near Carrara, Italy).

As a more "exotic" example of the use of connecting, we report an anecdote coming from the Zen tradition (Reps and Senzaki 1998). There was a famous wrestler called O-nami (the name means Great Waves). He was the strongest but, when he had to compete in front of an audience, his shyness made him weak enough to be defeated by the worst of his students. O-nami was entrusted to the wisdom of his Zen master, who thus thought of solving the problem: "Your name is Great Waves—the master told him—So, this night you will stay at the temple and you will imagine to be those waves, those enormous waves that destroy any what they meet in front of them. Do so and you will be the greatest wrestler in the country." O-nami meditated all night by imagining being no longer a fighter but a big wave. In the morning, O-nami participated in the fight and won all the fights. And since then, no

[1] See https://en.wikipedia.org/wiki/Bull%27s_Head

Fig. 6.5 Creative combinations of elements

one in Japan could any longer beat him. In this case the connection, suggested by the name of the protagonist of the story and stressed by the Zen master, between the fighter and the wave led the wrestler to perceive himself much stronger than he believed before and, thanks to such a change in his self-representation, to take advantage of his potentialities.

The process of relating an entity to something else, which apparently has no connection, had been often applied in the past to solve practical problems. For instance, ancient Romans found a less expensive way to construct pipelines within their towns by using a series of amphorae inserted one into another one so to constitute a long duct (Fig. 6.6). The link between the problem of finding a way to transport flowing water and the practice of using amphorae to transport goods suggested a cheap solution to the first problem. A case of creative use of connections, defined here as arranging pieces in a different way compared to the common one, was documented in the past, when people were used to copy on a booklet some selected passages of the book they were reading and then combing them in a different order to try to find new insightful ideas (Johnson 2010).

Fig. 6.6 Pipelines constructed with amphorae

The last mental operation underlying creativity is reorganising. A folk implementation of this mechanism can be identified in the anonymous invention of a new way to produce butter by shaking milk. The usual procedure consisted in pouring milk into a vertical container and then shake it thanks to a stick which had to be moved up–down (Fig. 6.7a). This was not a comfortable movement. At a given time, someone thought that the container might be placed in horizontal and let rotate thanks to a crank, so requiring a less fatiguing movement (Fig. 6.7b). Reversing the axis of the movement to be carried out resulted in an improvement of the production process.

Reorganising the mental representation of a process is acknowledged as a strategy that can produce innovative solutions also in Eastern countries. In a tribe of Central Malaysia (the Senoi) telling and re-elaborating dreams is viewed as an important part of the education of youth. Every morning, starting with the children and then moving to the adults, each member of the tribe tells the community what he or she dreamed during the previous night. Following this, the senior wise men of the tribe gather in a board where they discuss the most impressive dreams they heard. The aim is to help those who have made a dream in which there is evidence of adverse factors (fear, hatred, accidents, death) to take advantage of these experiences to turn it towards

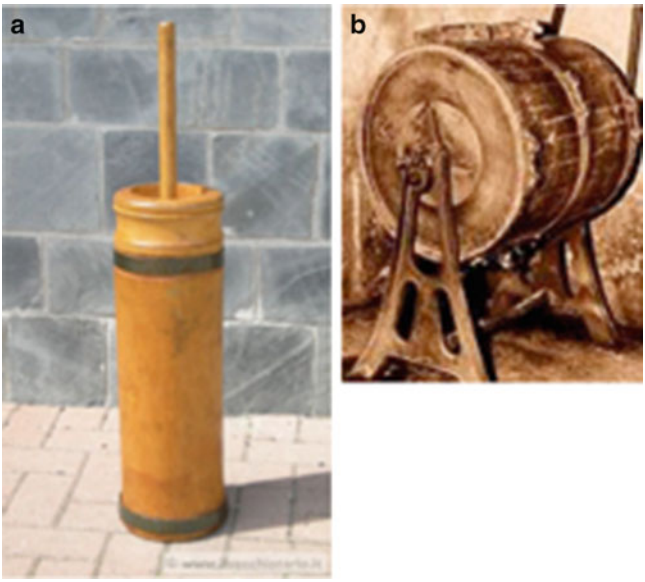

Fig. 6.7 The evolution of the way to produce butter by shaking milk

positive goals. In fact, the person who tells the dream that is later the subject of discussion is invited to dream it again but in a different way during the day, in a relaxed state. From this day-dream process, the dreamer has to come back with something creative that can be communicated to others: an action to be taken, an inspiration for an artistic product (a poem, a song, a dance, a sculpture, a tale), or the solution of a problem. For example, it was reported that a child dreamed of meeting a scorpion on the path and escaped. The child was then asked to re-elaborate the dream during the day. After several mental visualisations of the dreamlike scene, the child communicated to the elders of the tribe that he achieved a satisfactory outcome. By reviewing in his mind the scorpion that obstructed the passage, the child realised that he would go to call his older brother and ask him to take the scorpion by the tail and so clear the path. Using this approach, after various attempts, a person can learn to reorganise a situation in his mind until he or she reaches an effective solution to the problems he or she encounters (Hester et al. 2012; Matos 1985).

Also some historical cases highlight how useful it is to conceptualise in a different manner the critical situations we live in, sometimes reversing the starting condition and so behaving in a way which is just the opposite of what common sense suggests. During the Thirty Years' War (in the seventeenth century), the Spanish army had defeated the French and was spreading out into French territory, destroying villages and pillaging the population.

A small village received the news of the arrival of the Spanish army and the people gathered to decide what they could do to defend themselves. It was clear that trying to oppose the enemy troops with barricades would be futile, given the disproportion between the number of attackers and the villagers. Hence, the men of the village decided to do just the opposite of what people would expect. Rather than trying to resist the enemy and defend their home and family, they escaped, leaving only children and women in the village. This reversal of attitude—to leave their loved ones and their properties rather than defend them—proved to be a winning solution. When the Spanish army reached the village, they entered it without a fight. If the soldiers had fought, they would then have had the "right" to persecute the losers, but since they did not "earn" the looting right, according to their military code they would had been men without honour if they used violence without having to fight for this right. So the Spanish army passed over, respecting the people and properties in the village (Langer 1980).

The three basic mechanisms of creativity that we considered—widening the mental field, connecting disparate elements, and reorganising the point of view—are also expressed in some ancient Chinese military strategies, such as those included in the collection entitled *The 36 stratagems*. As an example of widening, it is worth mentioning stratagem VII, which reads: "Create something from nothing", which was applied to find this expedient. We are in 755 AD and the army of An Lushan is besieging the city of Yongqiu. The besieged at some point have no more arrows. Where could they find arrows? They broaden their mental outlook. They do not think only of the arrows that they could find within the city. Where, widening the horizon, could there be other arrows? Among the enemies, of course. How then is it possible to seize the enemy's arrows? The besieged build puppets with straw which then they let down the city walls with ropes. The attackers mistook the puppets for real warriors and then started throwing arrows at them. The arrows penetrated into the puppets. When the puppets were well filled with arrows, they were recovered and, once drawn into the walls, the arrows which were embedded in them were drawn, ready to be used by the besieged against the enemies.

The XXI stratagem says: "The golden cicada leaves its shell". This is a case in which we see at work the mechanism of connecting. In the twelfth century BC, a city was besieged by the troops of Ningzong Jin. People living in that town understood that it was necessary to leave it, but the flight must take place without letting the besiegers notice it, otherwise they would block the fugitives. The inhabitants of Ningzong then came up with this trick. They hung some goats on the trees and put drums under their paws. Kicking the drums, goats produced a clamour that was interpreted by the besiegers as a

sign that the besieged were preparing an attack. They then closed ranks and prepared to fight by placing all the army in front of the main gate of the city, where they expected the besieged to go out. Once this happened, the inhabitants could well leave the city unmolested through a back door, no longer guarded since all troops of the besiegers had been concentrated elsewhere.

Finally, stratagem II provides us an example of the reorganising operation. It says: "Besiege Wei to rescue Zhao". In 330 BC, the king of Wei Zhao was besieging the city. Allied to this was the kingdom of Qi, who sent General Tian Ji Zhao for help. Tian Ji, however, did not do what would be expected, that is, going to Zhao to attack the besiegers. Instead, he marched towards the capital Wei. Upon receiving this news, the army which was besieging Zhao left the siege to return to the capital rushed to help defend it. The action of Tian Ji reached the goal—to induce the enemy to raise the siege by Zhao—not pointing towards the goal that seemed obvious (Zhao), but away (thereby making a rollover) and moving towards an alternative target. The reorganisation of the field led Tian ji Zhao to save the city without fighting at all, thereby producing a creative solution to the conflict.

Cultural Variations in Creativity

The examples reported in the previous paragraph suggest that the basic mental mechanisms underpinning creativity are operating in different populations, cultures, and historical periods, but cannot support such a claim by themselves. We cannot know what had actually occurred in the mind of the persons who were involved in the mentioned cases. However, the fact that those stories have been passed down across different generations and countries and were considered worthy to be told and documented testifies to the fact that they have been perceived as representative of the process of innovation, creative problem solving, and decision making. In any case, further evidence is needed.

There is a widespread consensus that the basic grammar and logic of evolutionary thinking applies to human creativity (Kronfeldner 2010). It is also true that the neurological bases for creativity presumably are the same in different contexts and that creativity as a product should not differ across cultures (for reviews see, for example, Abraham 2013; Jung et al. 2013; Kaufman et al. 2010). Despite this shared starting point, research about cross-cultural differences on creativity reports somewhat mixed findings. On the one hand, studies focusing on naïve conceptions of creativity failed to highlight any differences between results collected in the West and results collected using a

similar methodology in the East (Ng and Smith 2004). Typically, self-report measures were employed, asking participants to provide synonyms of creativity, to list behaviours that belong to creative individuals, or to select the top characteristics of creative people choosing from a list of trait adjectives. For example, studies investigating teachers' naïve conceptions in the West (Barron and Harrington 1981; Montgomery et al. 1993; Runco 1984) and in the East (Rudowicz and Yue 2002), by asking participants to rate or suggest creative characteristics of students, found similar results. For all samples, regardless of their culture, a creative person tends to be seen as artistic, curious, imaginative, independent, innovative, and intelligent.

Yet, even if the conceptions are the same, the individual evaluation of these conceptions appears to be different (Palaniappan 2012). Teachers in Eastern cultures dislike personality traits associated with creativity in the West (Westby and Dawson 1995; Scott 1999), even if Asian students (e.g., students from China, Hong Kong, Taiwan, Japan, South Korea, and Singapore) are expected and encouraged to be creative by their schools (Ng and Smith 2004). This negative evaluation provided by teachers can be read in the light of what Torrance (1963) said about creative students. For their nature, they tend to have traits that are perceived by teachers as "obnoxious" (Pizzingrilli and Antonietti 2010). These "negative" traits have been associated with creative students also in a study by Davis (1986), where creative people were also described as lacking courtesy, refusing to take "no" for an answer, and with a personal tendency to be critical of others. These traits may be perceived more negatively in the Asian culture where, according to Confucian tradition, the teacher serves as a moral exemplar to students. In return, students show their reverence for their teacher by behaving with meekness and obedience (Jin and Cortazzi 1998; Ng and Smith 2004).

A similar line of reasoning could be applied outside the classroom. As Ng (2001) argued, creative thinkers should be dogmatic people. This is required by the fact that a creative act involves the introduction of new elements into an established domain. This action may threaten the conventional manner of doing things, leading to social resistance from the community. A creative person must hence be ready for conflict and confrontation (Ng and Smith 2004). Ng (2001) also suggested that dogmatic creators are more common in individualistic cultures, where individuals are psychologically prepared for conflict and confrontation, compared to collectivistic cultures that do not prepare their members for conflict and confrontation.

An analogous reflection could also be applied to the differences between Arabic and Western culture, starting from two other characteristics universally associated with creativity: curiosity and risk taking (Amabile et al. 1996).

These traits are perceived positively and lead to comfort in both educational and work settings for most Westerners but not for the typical Arab. Most Arabs feel that proven ideas are more comfortable and tend to avoid exploring risky options (Mosafa and El-Masry 2008). According to Barakat (1993), the traditional culture in the Arab world tends to support fatalism and shame, which lead to the psychological drive to escape or prevent negative judgement by others rather than conscious questioning. This cultural attitude seems to promote conformity more than creativity, in a similar way to how it happens, starting from different cultural values, in the case of Asian cultures. This parallelism is also supported by the fact that some Arabic cultures, for example, the Egyptians, are highly collectivistic (Hofstede 1980). A study that focused on the cultural difference between Arabic and Western culture explored the different attitudes towards organisational creativity barriers of Egyptian and British participants (Mosafa and El-Masry 2008). The authors proved that Egyptians differ from British with respect to their attitudes towards organisational creativity. The two subsamples had opposite scores in all the considered factors (commitment to organisation, management support, risk aversion, time, and work pressure). These findings suggest that attitudes towards creative cognition might vary across cultures, not in the sense that some environments inhibit or hinder and other ones elicit or urge the implementation of the basic processes outlined before, but that the goals which can be reached thanks to creative cognition are differently appreciated and therefore such processes can be differently prompted and orientated according to the values and needs stressed in a given culture.

How can we hence reconcile the idea that creativity may have a common cognitive basis, a common evolutionary function, and definitively is conceived similarly across culture, with data supporting the notion that culture does influence creativity in both educational and work settings? A possible reading of this apparent contradiction is suggested by Csikszentmihalyi (1996). He claimed that creativity concerns the cultural counterparts of genetic changes resulting from biological evolution. This means that if in biological evolution random variations may happen at the level of genes and chromosomes, things are quite different when we discuss cultural evolution. When this second type of evolution is involved, changes happen when units of information are created, maintained, and transmitted by the culture. Hence, creativity should not be isolated from the socio-cultural systems in which the individual functions, at least if we want to fully understand and predict the mental processes associate to it. This last reflection leads to a second important point: Can we derive from what we have been discussing that specific cultural elements may prevent people belonging to specific cultures to fully develop their creative

potential? Probably not, since, as the examples presented and discussed in previous sections suggest, as well as data from neurological research imply, it does not look like this assumed impairment strongly affect any specific culture. On the other hand, cultural difference could help understand and predict better specific creative outcomes. This happens if we read the cultural differences linked to conceptions of creativity not as a possible limitation, but as a different way of a specific culture to foster the common elements underlying creative thinking. Some cultures might prepare people to become innovators while other cultures will lead them towards the role of creative adaptors. In both situations a creative process will take place, relying on the same mechanisms identified above.

Conclusions

Creativity is usually associated to two features: novelty and social appreciation or usefulness (Sternberg 2001). Both these features do not have an absolute nature. In fact, how can I conceive that something is actually "new", and not simply "different", in comparison to the previously existing things? How different (and including what kind of differences) has an artefact or an idea to be labelled as a "novelty"? It seems that the attribution of novelty depends on the grain of the evaluation criteria we use. For instance, innovation in music in Western cultures is mainly grounded on changes in the structural aspects of the compositions (changes in the harmonic relationships, in the sequence and elaboration of themes, etc.), whereas in some Eastern or African context even slight changes in rhythm or pitch modulation are meant as innovation (Antonietti and Colombo 2014). Differences in the grain of the evaluation criteria may involve also duration. In some contexts, innovation is expected to occur in long time periods thanks to the accumulation of small, almost unperceivable variations, whereas in other contexts novelty is expected to emerge suddenly as a consequence of a dramatic change.

The same may be true of the notion of "socially appreciated". What is conceived as useful or meaningful depends on the values we assume as reference points. For instance, many criminals might be considered "creative" on the basis of the novelty criterion since they devised ingenious ways to steal money that were not yet implemented before, but it is questionable if their "inventions" meet also the criterion of usefulness. Bizarre drawings produced by a child can be appreciated by parents or teachers who are convinced that personal expression has to be encouraged but not by adults who believe that pictorial artefact should always convey an interpersonally shared meaning.

Thus, it may be that differences in creativity across cultures do not depend on creativity itself, but on the manner creativity is conceived. In fact, creative skills and conceptions of creativity are not necessarily associated (Pizzingrilli and Antonietti 2011). A person might be able to manage mental operations which underlie creativity while failing to apply them since he or she does not think that they are relevant to perform the task in question. In light of this distinction, we can maintain that the basic mechanisms of creative cognition are activated differently according to the culture the individual belongs to. Beliefs about where and when it is relevant to implement such mechanisms—as well as about the expected frequency of their occurrence, their desirability, the aims they should address, how they should be activated (for instance, in isolation or collectively), the timeline of the expected outcomes (abruptly or through progressive adjustments), and so on—can vary from one environment to another. In addition, attributions concerning the merits and failures associated to creative cognition might vary, as well as the pedagogical support and the kinds of incentives and encouragements provided. In other words, culture leads societies to build different niches around creative cognition and modulate its application.

This perspective has some implications for practice. It stresses the need to devise measures of creative thinking skills that actually assess what is meant and appreciated as creative in a given culture (Villani and Antonietti 2013). Furthermore, also in experimental investigations aimed at assessing cross-cultural differences, tasks should be devised so as to match the interpretation of creativity that is currently shared in the environments where they take place. Finally, hints at fostering the creative potentials of students and workers should be tuned to the values of the cultural milieu they are addressed to.

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