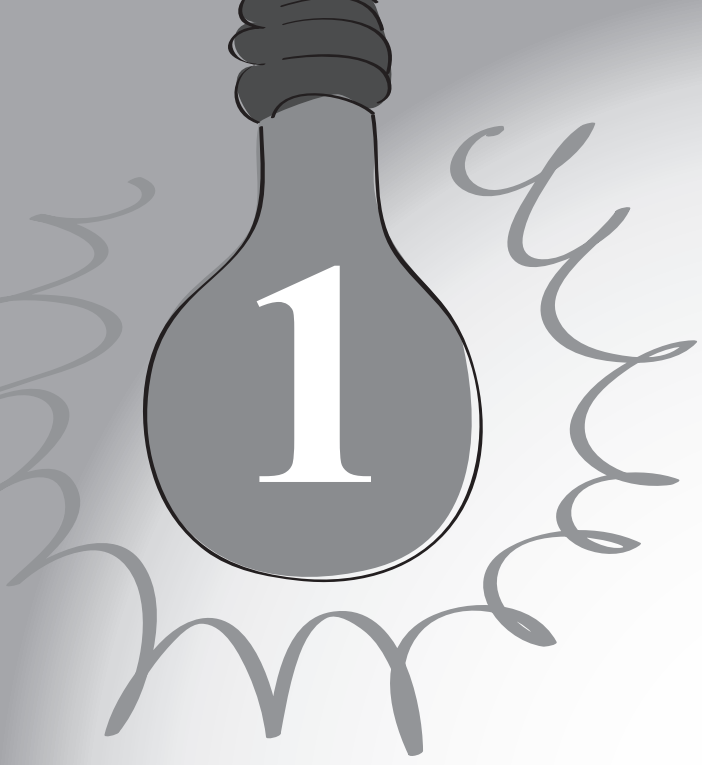

Theoretical Perspectives of Creativity

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Invention of the fireless firecracker

Psychologists have been studying creativity for a long time, but this phenomenon is fiendishly difficult to fathom. One reason is that it arises in the most unexpected way. Consider this true story of Paul Yap, a budding inventor who hails from Singapore, an Asian society which is well-known for being a "fine" city (Ng, 2007). That is, Singapore is tightly-regulated and there are many fines for infringing the laws of this country. For example, Singaporeans cannot light up a firecracker to celebrate the Chinese New Year, as it has been banned following several fire mishaps. If they do so and get caught, they risk a hefty fine.

Now Paul is a Chinese, and knows why the Chinese has traditionally celebrated their new year with firecrackers. The loud bang that comes from lighting up a firecracker will scare away any beast or evil spirit lurking around the corner. Paul felt that a Chinese New Year minus firecrackers was too quiet, not feisty enough. As a keen inventor, Paul tried hard to think of an innovative solution to the firecracker ban in Singapore. But he failed to think of a creative idea and decided to put his mind to other matters. It was during this time – when Paul was attending to some other task – that the creative idea arose in his mind. It manifested itself

in a most unexpected way: when Paul was having a dinner at a Chinese restaurant with his family.

Following an established custom, at the end of the dinner, the waiter would hand small wet napkins to the diners to wipe their mouths with. Each napkin came in a sealed plastic wrapper. The diner would pop it open by clapping it between both hands. Paul was momentarily startled when his daughter popped a sealed napkin open in front of him. The noise of the pop was still ringing in his ears when Paul suddenly caught hold of the creative idea that he had been chasing after: a fireless firecracker. This innovative device would make use of the abrupt release of compressed air to create the loud explosion. It would get around the ban on firecrackers in Singapore, as it would not lead to a fire mishap.

Paul's fireless firecracker took three years, S$80,000 in production costs and more than S$100,000 in patent agency fees before he finally completed the prototype. Paul was invited by a wealthy businessman to test out his invention at a company function. He spent S$20,000 on this event, but it was money well spent: the businessman bought a share in his venture. Paul had another big hit with his invention when the Singapore Government used his fireless firecrackers in several National Day celebration parties.

Although this original notion of the fireless firecracker arose in the most unexpected way, the creative process that Paul went through in coming up with this innovative idea had been experienced by other inventors before. It consists of four stages: preparation, incubation, illumination and verification (Wallas, 1926). In the *preparation* stage, the creator is deeply immersed in the problem and finds out a lot of information related to it. But he is unable to solve the problem so he puts it aside to attend to other matters. However, the problem remains in the subconscious mind of the creator. It undergoes further transformation during the phase of *incubation*. Eventually, a creative idea to deal with the problem emerges from the depth of the subconscious mind. This occurs abruptly like a thief in the night, leading the creator to experience a sudden burst of insight. This phase of *illumination* is quickly followed by *verification*, as the excited creator elaborates on the creative idea.

Competing views of what is creativity

From this true story of how Paul invented the fireless firecracker, we can see that creativity is a complex phenomenon which is not easy to grasp intellectually, not least because a creative idea has the tendency to appear in the most unexpected way. Indeed, I have likened psychologists who study creativity to the three blind men trying to fathom what an elephant is (see Ng, 2009, pp. 2-7). Each blind man has a unique understanding of the elephant (tree trunk, slender rope, rubber hose) depending on which part of the elephant he felt (leg, tail, nose). In a similar vein, different psychologists have competing views of what creativity is as they examine it from a variety of theoretical perspectives. Instead of arguing over which theory is right or wrong, we should appreciate it for its unique insight on creativity.

For example, the psychoanalyst views creativity as a form of defence mechanism that enables us to deal with anxiety or loss (e.g., Freud, 1900). By contrast, the humanistic psychologist views creativity as a form of self-actualisation that enables us to live our lives to the fullest (e.g., Rogers, 1976). In opposition to the psychoanalyst and humanistic psychologist, the behaviourist denies the existence of creativity altogether. This is because all behaviours, including creative ones, are the result of reward and punishment. Since behaviour is due to reinforcement, it cannot be attributed to the uniqueness of the individual. As Skinner (1972) infamously observed: "A poet is no more responsible for the content or structure of a poem than a chicken is responsible for laying an egg…a poet writes a poem as a hen lays an egg, and both feel better afterwards" (quoted in Ng, 2009, p. 6).

In an attempt to shed light on the nature of creativity, many psychologists have developed theoretical models of this complex phenomenon based on empirical research in creativity. One model is the *4 Ps of creativity* (Rhodes, 1961), which looks at the attributes of the creative *person*, the stages of the creative *process*, the characteristics of the creative *product* and the elements of the creative *press* or environment. According to this model, *a creative product is the outcome of a creative process, engaged in by a creative person, all of which is nurtured by a*

creative press. More recent versions of this model have extended it to six Ps. The fifth P is *persuasion* as creators must persuade others of the value of their original ideas (Simonton, 1988) while the sixth P is *potential* as a distinction can be made between the creative potential of youth and creative achievement of adulthood (Runco, 2003).

Another model is the *4 Cs of creativity* which traces the development of creativity from mini-c to little-c to pro-c to Big-C creativity (Kaufman & Beghetto, 2009). *Mini-c* creativity is "Beginner's Mind" creativity and it occurs frequently in young children and novice learners (e.g., discovering the interesting activity of drawing). *Little-c* creativity, also known as "everyday creativity", refers to the creativity of ordinary people in everyday life (e.g., the amateur artist who draws nice pictures of beautiful landscapes). *Pro-c* creativity is the creativity of professionals who make a living via their creative expertise (e.g., the accomplished artist who holds an art exhibition). Finally, *Big-C* creativity, also known as "eminent creativity", refers to those creative geniuses whose original ideas and contributions have left an indelible impact on our world (e.g., Picasso creating Cubism).

In addition to the 4 Ps and 4 Cs of creativity, there are other models with interesting names like the Amusement Park Theory of Creativity (Kaufman & Baer, 2004). This particular model attempts to resolve the debate concerning whether creativity is domain-general or domain-specific. Simply put, is the creative person talented across many different domains such as the arts and sciences (*domain-generality*)? Or is the creative person talented in only one domain like the arts or sciences (*domain-specificity*)?

As we can see, much has been theorised about the nature of creativity. In turn this has created an intellectual jungle with a diverse array of competing views. According to Kozbelt, Beghetto and Runco (2010, p. 21), this panoply of perspectives on creativity is due to the "richness of the topic itself, which encompasses the subjective experience of the moment of a private, minor insight by an ordinary individual as well as the greatest achievement of human genius throughout our history". They caution that to understand creativity in all of its richness, there is a need to

strive for balance and moderation so that no one theoretical perspective is emphasised at the expense of others (see also Ng, 2009, p. 7).

To achieve this goal, Kozbelt and colleagues reviewed a variety of contemporary theories of creativity: Developmental, Economic, Stage & Componential Process, Cognitive, Problem-Solving & Expertise-Based, Problem-Finding, Evolutionary, Typological as well as Systems. For each category of theory, Kozbelt et al. (2010) highlighted its underlying assumptions, key concepts, major studies and contemporary exemplars. For example, developmental theories of creativity assume that creativity is a phenomenon which develops over time and it is due to an interaction between person and environment.

In addition, Kozbelt and colleagues discussed each theoretical perspective with reference to other elements, such as the 6 Ps and 4 Cs of creativity. For example, problem-solving and expertise-based theories of creativity focus on the creative process/product/person rather than creative press/potential/persuasion. Evolutionary theories of creativity, which adopt a Darwinian approach involving the blind generation and selective retention of ideas, focus on Big-C creativity rather than mini-c/ little-c/pro-c creativity. In the rest of this chapter, due to space limitation I will take an in-depth look at just four contemporary theories of creativity (though I encourage the reader to explore the other theories on his own). They include developmental, evolutionary, systems and economic theories of creativity.

Developmental theories of creativity

Psychologists who study the development of creativity across the life-span are interested in finding answers to a variety of questions. For example, what type of family environment is most conducive to the nurturance of individual creativity? What psychological processes mediate the link between the playful activities of childhood and the creative accomplishments of adulthood? As Kozbelt, Beghetto and Runco (2010) noted, developmental theories of creativity are practical and useful, as they can shed light on how to design conducive environments at home which can nurture the creative potential of children.

Concerning the above question, much empirical research has established that creative individuals grow up in an enriched home milieu where parents – who themselves place a high value on learning and education – provide their wards with opportunities for intellectual stimulation, such as visits to the library and trips to the museum (see Ng, 2009, p. 47). As a result of growing up in this sort of family, the growing child displays a deep interest in a certain field or domain.

A respondent in Gute, Gute, Nakamura and Csikszentmihalyi's (2008, p. 347) study, which examined the early lives of highly creative people, expressed appreciation of his parents in this way: "They were very generous to me because I showed an aptitude for education, and so they helped me get a lot of education. And also, they helped me to get a kind of grounding in music and literature, and so on and so forth, by their example and their advice, and just by sending me where that was to be found".

Other researchers found that home environments which fostered personal interests, individual autonomy and self-confidence spurred the development of creativity. Harrington, Block and Block (1987) tested the psychological principles put forth by the humanistic psychologist Carl Rogers. Rogers had argued that creativity in children was most likely to occur when they were internally open to experience, possessed a strong belief in themselves and enjoyed toying with different ideas. In turn, these internal conditions of children were fostered by psychological safety and psychological freedom in the external environment.

Harrington et al. (1987) conducted a longitudinal study to test this argument which involved 106 children and their families. They categorised different child-rearing practices according to whether it was consistent with Roger's view, for example, encourage the child's expression of feelings, stimulate the child's curiosity and exploration, let the child make his own decisions etc. Path analysis was used to examine the relationship between child-rearing practices and creativity, after controlling for gender, IQ and preschool creativity scores. Harrington et al. found that children with parents who used child-rearing practices which were consistent with Rogers' theory were more creative than children with parents who used child-rearing practices which were not consistent with the theory.

Still other scholars have examined the link between play and creativity. An early theorist in this domain of inquiry was Vygotsky, a Russian psychologist who argued that the creative imagination of adulthood had a basis in the unstructured play activities of children. More specifically, through play children develop combinatory imagination or the ability to combine elements of experience into new situations and behaviours. This type of imagination is important in both artistic and scientific creativity. In the words of Vygotsky (1967, p. 7): "the child's play activity is not simply a recollection of past experience but a creative reworking that combines impressions and constructs from them new realities addressing the needs of the child".

In support of Vygotsky's contention, empirical research has established a strong link between play and different components of creativity. They include cognitive components like divergent thinking and problem-finding, as well as affective components like access to affect-laden thoughts and openness to affect states. These components are important for the creative production of ideas and solutions. For example, if one is able to come up with a variety of ideas (divergent thinking) or identify the right problem to solve (problem-finding), this increases the probability that an innovative solution will be found. In a similar vein, being in touch with one's emotions (access to affect-laden thoughts and openness to affect states) enables one to be imaginative and craft interesting stories for entertainment.

Research has found that different types of play influence the development of different components of creativity. Pepler and Ross (1981) found that *divergent play*, in which the child was given the opportunity to creatively find solutions to problems or engage in activities that had more than one answer, promoted the growth of divergent thinking in the child (e.g., building a city from a pile of blocks). By contrast, children who engaged in convergent activities fared poorly in ill-structured tasks, for example, they were less likely to think out of the box, often getting stuck on one incorrect solution, and were much more likely to give up before the task's completion.

Other researchers found that *pretend play*, which involved the use of fantasy and make-believe in which one thing was playfully treated as if it were something else (e.g., box to castle) stimulated the development of affective components of creativity. In this regard, Fein (1987) proposed an affect symbol system which stored information about emotional events in the mind. This affect system is activated during pretend play, enabling the child to work with emotional memories. In a similar vein, Russ (1993) highlighted the importance of pretend play in helping children to gain access to emotional memories and fantasies. When children (through pretend play) are open to various affect states and affect-laden thoughts, they become imaginative and creative.

Although empirical research has established a strong link between play and creativity, unfortunately in our modern society it is increasingly difficult for children to engage in unstructured play activities (Russ & Fiorelli, 2010). This decrease in child-driven play time arises as parents over-schedule structured activities for their children (e.g., enrolling the child in an academic-focused preschool to strengthen his intellectual development). Such play deprivation is associated with many negative consequences.

For example, an important constituent of creativity is intrinsic motivation or enjoying the task for its own sake. This love or passion for the craft enables the creator to tolerate the negative tension inherent in creative work, such as the chore of mastering the knowledge base or the necessity to deal with setbacks during the creative process (Simonton, 1999a & 1999b). But in our modern society, with its intense focus on academic content and over-scheduling of structured activities at home, it is difficult for children to develop this joy of learning through play. To gain an insight on how the play activities of children had evolved over the years, Russ and Dillion (2009) reviewed the empirical research on play and creativity which was conducted from 1986 to 2008. These studies employed similar play tasks, instruction sets and scoring systems (e.g., Affect in Play Scale, Russ, 1993 & 2004).

Over this 20-year period, organisation of play narrative and amount of affect expression were unchanged. By contrast, imagination in play

narrative has increased significantly in recent years. Russ and Dillion concluded that there is less unstructured time available for play nowadays, but children are still finding a variety of ways to be creative by using their imagination. For example, children may change a conventional activity into a competitive game to see which player can finish first or last the longest; or they may modify the outer environment to engage in a make-believe game. Indeed, it is heartening to discover that children continue to play games and create learning experiences where and when they can, even though there are fewer outlets and opportunities to play in modern society.

To encourage parents to facilitate this natural desire of children to play and be creative instead of hindering it, Russ and Fiorelli (2010, p. 245) made the following recommendations. Specifically, parents should give children time to engage in pretend play and reinforce acts of everyday creativity in the child; encourage children to explore different domains of activities so each child can find what he deeply enjoys; foster an environment in which the child feels safe and comfortable to express ideas that are unconventional; provide optimal scaffolding to guide the child to be independent and solve problems on his own; as well as encourage the child to verbally express a variety of feelings so he learns to feel comfortable with feelings and integrate them into easily accessible memories.

Evolutionary theories of creativity

Creativity theories in this category draw on the seminal ideas of Charles Darwin, the founder of evolutionary theory. Darwin (1859/1958) provided a detailed description of his theory in The Origin of Species. First published in 1859, it has gained notoriety as "the book that shook the world", because it overturned the cherished view which we hold of ourselves (e.g., Christians believe that human beings are made in the image of God). On the contrary, Darwin asserted that species are not immutable but undergo changes via the process of natural selection, so that, for instance, monkeys can evolve into human beings.

Evolution via natural selection occurs because in every species, spontaneous variation in traits arises due to genetic recombination and mutation of genes. For instance, the beaks of finches may be big or small, and these traits are fit for different tasks. Specifically, big beaks are fit for manipulating large seeds whereas small beaks are fit for manipulating small seeds. Organisms with a trait that is fitter or better adapted to a certain environment are likelier to survive and reproduce their kind. In a forest where trees produce big seeds, finches with bigger beaks are likelier to survive and reproduce in comparison to finches with smaller beaks. Over time, the beaks of finches become bigger rather than smaller. This elegant line of argument is known as "survival of the fittest".

According to Simonton (1999a & 1999b), the Darwinian perspective on evolution has a lot of repercussions for the study of creativity. This is because the creative production of ideas and solutions involves a process which is akin to evolution via natural selection. Specifically, in coming up with an innovative solution to a problem, a variety of ideas must first be generated (spontaneous variation of traits). Out of this welter of ideas, a promising solution is selected for further refinement (the fitter the trait, the likelier it is to be selected).

Campbell (1960) developed a two-stage model to depict this creative process, which is known as *blind-variation-selective-retention (BVSR)*. The first stage – *blind variation* – involves the proliferation of ideational variations. In other words, the creator comes up with as many ideas or variants as possible. The second stage – *selective retention* – involves the refinement of the chosen solution. Here, the creator identifies a promising idea for further elaboration based on different criteria like originality (how unique is this idea), practicality (how effective it is), aesthetics (how elegant it is) and so on.

Campbell chose the word "blind" to describe his model of creativity because this term denotes the lack of foresight in the production of variations (Simonton, 1998a). That is, the creator is not able to purposively generate the most suitable idea for a certain task. Instead, the search for a creative solution arises from a random process of trial-and-error. The creator stumbles on the solution by chance, so to speak.

Simonton (1999b) has conducted a lot of research on the BVSR model of creativity and shared his findings in Origins of Genius: Darwinian Perspectives on Creativity. In this book, Simonton marshalled an impressive array of evidence to show why BVSR furnished the most complete basis for understanding human creativity. They fell into a variety of categories, including anecdotal accounts of real-world creators, experimental studies on the creative mind as well as scientific analysis of creative products.

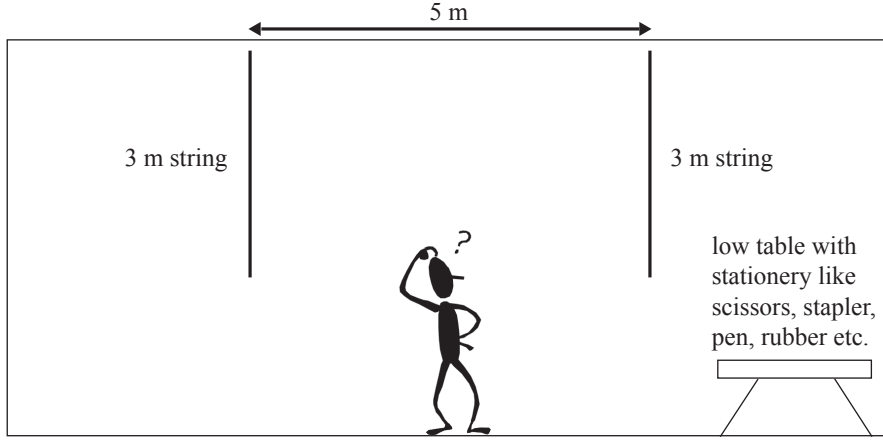
Anecdotal accounts of creators. Many notable creators in different fields like the arts and sciences have explicitly claimed that their creativity appears best described by a process akin to variation-selection. Paul Valery, the French poet and essayist, asserted that "it takes two to invent anything. The one makes up combinations; the other chooses, recognises what he wishes and what is important to him in the mass of the things which the former has imparted to him" (quoted in Simonton, 1999b, p. 27). Michael Faraday, the English chemist and physicist, wrote that "the world little knows how many thoughts and theories which have passed through the mind of a scientific investigator have been crushed in silence and secrecy by his own severe criticism and adverse examinations, that in the most successful instances not a tenth of the suggestions, the hopes, the wishes, the preliminary conclusions have been realized" (quoted in Simonton, 1999b, pp. 27-28).

Other creators observed that this process by which new ideas emerge tended to occur at a blind or unconscious level. The French mathematician Hadamard claimed that mathematical creativity required the discovery of unusual but fruitful combinations of ideas. This random operation occurred in the deep recesses of the mind. Poincare, another French mathematician, described this process of creation in detail. Specifically, the creator tries to find a solution to a vexing problem. When the creator fails in this attempt, he turns to other activities. It is during this time, when the creator is not focusing his attention on the problem, that he experiences a sudden insight. This gets the creator all excited again about the vexing problem. He now puts aside other activities to work out the detailed solution. This creative process – preparation-incubation-illumination-verification – is what Paul Yap, the inventor of the fireless firecracker in Singapore, has gone through.

Taken together, the anecdotal accounts of these real-world creators indicate that the creative production of ideas follows a blind-variation-selective-retention process. But as Simonton (1999b) observed, impressionistic data – even those provided by notable experts in their field – cannot live up to the scientific standards of enquiry. This is because many of these accounts occur well after the creative discovery has been made. Even if the account is made on the immediate aftermath of a discovery, there is considerable doubt about the adequacy of introspective information. In order to provide a more objective source of evidence to support the BVSR model of creativity, Simonton reviewed a variety of experimental studies on the creative mind.

Experimental studies of the creative mind. Creativity is usually associated with the insightful solution of a problem. Indeed, the term "insight" is often used to denote the sudden moment of illumination in the creative process. Psychologists have attempted to examine the phenomenon of insight in the psychological laboratory. Typically, in an experimental study on insight, a creative puzzle is posed to the respondent. An example is the two-string problem shown in Figure 1.1. In this puzzle, the respondent is presented with the following scenario. There is a study with two strings hanging from a ceiling. The strings are three metres in length and five metres apart. How do you tie the two strings together?

Figure 1.1 The two-strings puzzle



Initially, the respondent would experience difficulty in solving this puzzle, as the most obvious solutions fail utterly to deal with the problem (e.g., using both hands to connect the two ends of the strings together). This initial failure causes the respondent to analyse the problem from other angles. As the respondent ponders about the puzzle, he is exposed to a wide variety of external stimuli (e.g., daily routines & challenges) as well as internal stimuli (e.g., memories & associative thoughts). This random mix of priming stimuli generates many novel solutions in the creative mind which have varying degrees of effectiveness in solving the puzzle. Eventually, the respondent stumbles upon the correct formulation (e.g., tie a small rubber to the end of one string and swing it as a pendulum).

To summarise, when a respondent solves a creative puzzle, a blind-variation-selective-retention (BVSR) process occurs in the creative mind. Since the sequencing of creative ideas which results in a correct solution is random in nature – it is determined by chance factors pretty much irrelevant to the problem – this BVSR process is said to be "blind". In other words, the respondent cannot command the right idea for solving the puzzle to arise in the creative mind. Hence when the appropriate solution appears in the welter of competing ideas, it has the quality of insight or the sudden moment of illumination in the creative process. In turn, the respondent would experience the famous "Aha!" feeling associated with the abrupt discovery of the creative solution.

According to Simonton (1999b), although experimental studies on insight support the BVSR model of creativity, the main drawback of such research is in the nature of the problem being solved. Specifically, the typical insight problem, such as the two-string problem, has a well-defined answer. But in the real world creativity does not begin with an *a priori* understanding that there exists a correct answer. Unlike the creative insight approach, the *creative cognition* approach recognises that real-world creativity is open-ended in nature. It seeks to analyse the phenomenon of creativity using open-ended tasks which require the respondent to generate truly original ideas.

A good example is the experimental studies associated with the *Geneplore model of creativity* developed by Finke, Ward and Smith

(1992). The term "Geneplore" stands for "generate and explore", as Finke and colleagues believe that the creative process involves the generation of combinations followed by the exploration of their possibilities. In a typical experiment based on this creative cognition approach, participants would be given shapes or forms (e.g., circles, cylinders) from which to construct objects with recognisable functions (e.g., furniture, appliances). Expert judges would evaluate the creative products of the participants. Examples of these unique inventions included a hip exerciser, a shoestring un-lacer and a hamburger maker.

More important was the question of how the originality of these inventions depended on the experimental conditions. In one condition, respondents were able to select the shapes for the imaginative constructions by themselves. In another condition, respondents were given a random selection of forms by the experimenter. In a third condition, either the respondents would choose the category of object they wanted to invent or it would be randomly chosen by the experimenter. Respondents generated the most original and feasible solutions when the object parts they had to work with and the category of object they had to invent were not selected by themselves but instead randomly chosen by the experimenter. In other words, creativity is maximised when the process is blind and serendipitous rather than planned and deliberate. By beginning with the totally unexpected, respondents were forced to stretch their creativity to the highest degree. According to Simonton, this finding offered support to the BVSR model of creativity, even though the creative cognition approach drew its inspiration from cognitive psychology rather than evolutionary theory.

Scientific analysis of creative products. Simonton (1999b) observed that creative geniuses are defined by the creative products on which their reputations are founded (e.g., Einstein and his theory of relativity, Shakespeare and his plays etc.). Consequently, no account of creativity can be considered complete without a scientific analysis of creative products. When Simonton examined this matter further, he made several interesting discoveries about creators and their products. First is the sheer productivity of the eminent creator. Specifically, in any given domain of creative activity, it is typical to find that around 10% of the creators

are responsible for 50% of the contributions in the field. For example, if there are 100 researchers in a field of study, then just 10 of them will be responsible for half of everything published.

Second, the output of creative products tends to increase as a curvilinear, single-peak function of career age (when the creator starts to do creative work) rather than chronological age (when the creator is born). The specific shape of this curve varies according to the discipline. In domains like pure mathematics and lyric poetry, the curve approaches the peak rapidly and the subsequent decline in productivity is equally steep. By contrast, in fields like geology and philosophy, the rise to the peak is more gradual and the subsequent descent is also less precipitous. In other words, mathematicians and poets tend to reach full bloom earlier rather than later but fade away just as quickly. By contrast, geologists and philosophers take their time to produce creative work but do it for a long time thereafter.

Finally, Simonton (1999b) highlighted an important finding which has implications for the BVSR model of creativity: the probability of conceiving a *hit* or truly successful product is a constant function of the total number of works. Simonton termed this phenomenon as the *equal-odds rule*. This rule can be expressed in a numerical way. Specifically, if we calculate the ratio of hits to total attempts (hits + misses), this *hit ratio* should not systematically change (increase or decrease) as the creative career progresses. Instead, it should fluctuate randomly from year to year. This is precisely what Simonton found in his empirical research on eminent creators in different domains.

To account for this finding, Simonton used the BVSR model of creativity to account for the equal-odds rule. According to this model, not only is the creator generating new ideas based on a random and haphazard process (blind variation). In addition, he is selecting a certain idea using a trial-and-error procedure and based on a set of criteria that is constantly changing (selective retention). Under these circumstances, the creator has no immediate control over the outcome of his creative labour, nor can he learn how to improve his chances. In other words, the creator cannot increase the number of hits in relation to misses even with experience. The upshot is the equal-odds rule.

A real-world example of this rule can be gleaned in the later phase of Einstein's scientific career. By his 40s, Einstein is already an accomplished creator who revolutionised physics and overturned the Newtonian worldview of the universe with his theory of relativity. Einstein spent the remaining decades of his life trying in vain to develop a unified field theory of physics. One commentator wryly noted that had Einstein gone fishing after discovering the theory of relativity, the world of physics would not have missed his creative talent.

Because the BVSR model strives to be an encompassing framework on creativity, it has attracted the attention of other researchers, who have expressed disagreement with its fundamental premises or challenged its empirical standing. One theoretical objection is forwarded by Gabora (2007), who argued that ideas are not discrete, independent units that exist in some dormant state, waiting to be selected out from other alternatives in a Darwinian manner. Instead, Gabora proposed a *context-driven actualisation of potential* (CAP) which involves a change of state in response to a context, which can propel creative thought via a non-Darwinian process.

Gabora (2001) described this CAP model using a fictional example of how the torch was invented as a result of an ember rolling out of a bonfire. As Gabora pointed out, in a situation like this, it is not a given that the inventor would notice the ember and gain the insight that it could be used for making a torch. Since it is not a completely certain event, the change of cognitive state at the instant the ember rolls out of the fire is best regarded as a contextual-probabilistic event. Still, the changes of cognitive state before and after this event proceed in a deterministic rather than random manner. This is due to the specific context of sitting before a bonfire and needing light to find the way home. In summary, Gabora asserts that creative thought is not a matter of blind-variation-selective-retention as Simonton has argued. Instead, it is a case of context-driven actualisation of potential or CAP. That is, the creator gradually brings clarity to a vague idea via successive iterations of this idea from different real or imagined perspectives.

Kozbelt (2008, p. 221) has also cast doubt on the BVSR model of creativity by posing these questions: "What are the prospects for

meaningful learning and improvement in high-level creativity? As creators acquire expertise in a domain, can they use this accumulated knowledge to be more creative or show better judgement about their ideas and works? Or is creative productivity mainly driven by complex chance processes which are largely impervious to learning, as Simonton has argued?"

In an attempt to find out which model fits empirical reality better – expertise acquisition view or BVSR model – Kozbelt analysed hit ratio by examining the complete output of 65 eminent composers which totalled 15,657 works altogether. The masterpiece status of each piece of work was determined by citation and recording count measures. Works were assigned to 5-year age intervals, synchronised across composer by age at first masterwork. Hit ratio was calculated for each interval for each composer by dividing masterwork-level music with total output. It was found that the composers' hit ratios tended to begin very low, increased on average until about age 50, and later in life declined somewhat due to extraneous factors. For example, ill health can undermine the ability of the mature composer to maintain a high hit ratio, especially if he loses the stamina and ambition to produce large-scale works which are more likely to garner critical acclaim than smaller compositions.

According to Kozbelt (2008), these results are at odds with the BVSR model of creative productivity which argues that hit ratio should be independent of age (equal-odds rule). They also cast doubt on two related claims made by Simonton. First, great creators are not good judges of their own work. Second, the creator's ability to judge his own works should not improve with experience. On the contrary, the strong age linear effect is consistent with an expertise acquisition view of creativity, and implies that creative achievement is under the creator's control. That is, the creator can gradually learn to allocate creative resources more wisely to achieve longitudinal improvement in his creativity.

Systems theories of creativity

Theories in this category adopt the view that creativity is best conceptualised not as a single entity, but as a complex phenomenon

which arises from a system with different components interacting with one another (Kozbelt, Beghetto & Runco, 2010). Csikszentmihalyi (1999) explained why such a systems approach to creativity is necessary by recounting his experience as a researcher. Like most psychologists, Csikszentmihalyi assumed at first that creativity was an intrapsychic process which could be understood by analysing the motivational inclinations and thought processes of highly creative individuals who came up with original products.

But through his longitudinal study of artists, Csikszentmihalyi found that many individuals with much creative potential stopped doing art and pursued ordinary occupations, while other individuals with less creative potential managed to produce works of art that were hailed as important creative achievements. For example, young women in art school displayed as much if not more creative potential in comparison with their male classmates. But twenty years later, none of the creative females had achieved outstanding recognition, whereas a few creative males managed to become successful artists. Csikszentmihalyi was forced by these findings to adopt a view of creativity that encompasses the social environment in which the individual operates. That is, the right question to ask is not "what is creativity?" but "where is creativity?".

Csikszentmihalyi located creativity at the interaction of three components, namely, domain, person and field. The *domain* consists of a set of symbolic rules and procedures (e.g., architecture or mathematics). The domain is a necessary component of creativity because it is impossible to introduce a creative variation without reference to an existing pattern. As Csikszentmihalyi observed, what is new is meaningful only in reference to what is old, and without rules there cannot be exceptions just as without tradition there cannot be novelty. The *person* refers to the creative individual who makes a significant change to the domain due to innate talent, hard work, serendipitous discovery, fortuitous chance, traumatic life experience and so on. An example is Victor Frankl, the Jewish psychiatrist who survived the Nazi gas chambers in World War II and went on to invent logotherapy, a branch of psychiatry which is concerned with our existential quest for meaning.

Finally, the *field* refers to the gatekeepers in a certain domain, such as art critics, journal editors, museum curators, music professors and so on. These *gatekeepers* decide which idea, theory, product or invention constitutes a significant contribution to a certain domain. The field of gatekeepers can be small or big. For example, some domains such as Assyrian language and literature have a very small field consisting of a dozen or so scholars across the world. By contrast, in other domains like motion pictures, the field of gatekeepers consists of not just movie critics but extends to the millions of cinema-goers across the world, whose cumulative decisions to watch a movie or not can determine whether it turns out to be a box-office hit or fiasco.

According to the systems theory of creativity, only when the field endorses the work of the creator will he be hailed as a creative genius. For example, before Albert Einstein was proclaimed as the official successor of Isaac Newton, he was just a wannabe in physics who immersed himself in the scientific literature, like Newton's law of gravitation, Faraday's research on electricity, Maxwell's equations on electromagnetism and so on (Ng, 2007). Newton had postulated the existence of the luminiferous ether, a hypothetical medium for the propagation of electromagnetic and gravitational forces, but no one really knew what it was. Einstein tried to understand it by conducting an experiment, and nearly injured himself seriously in attempting to solve this vexing scientific problem. In the end, Einstein came up with a brilliant solution that does away with the elusive ether of Newton. This was the theory of relativity, which explained how matter and energy curved the geometry of space-time to create our everyday phenomenon known as gravity.

But before Einstein could be hailed as the successor of Newton, the theory of relativity had to be experimentally verified by the scientific community. According to relativistic theory, a massive object like the sun would warp the space around it. If this theoretical postulation was correct, then starlight should bend as it passed by the sun. This bending of starlight could be captured in photo during a solar eclipse. A team of gatekeepers, led by the British astronomer Sir Arthur Eddington, attempted to do this during a solar eclipse on 29 May 1919. Eddington and his colleagues photographed and measured the positions of several stars which lay in the same direction in the sky as the sun during the solar eclipse. When they

developed these photos, they found that starlight was bent as it passed by the sun, as predicted by the theory of relativity.

This important finding was officially announced during a special gathering of scientific and other luminaries in London. The English philosopher Alfred North Whitehead, who witnessed this historical moment of truth, likened it to a Greek drama: "We were the chorus commenting on the decree of destiny as disclosed in the development of a supreme incident. There was dramatic quality in the very staging: the traditional ceremonial, and in the background the picture of Newton to remind us that the greatest of scientific generalisations was now, after more than two centuries, to receive its first modification…a great adventure in thought had at last come home to shore" (quoted in Ng, 2001, p. 20).

Because of its emphasis on the social dynamics of creativity, the systems theory can account for an interesting anomaly of creativity in the real world, namely, the often mysterious fluctuations in the social attribution of "creative genius" over time. For instance, the reputation of Raphael as a painter has waxed and waned several times since his heyday at the court of Pope Julius II. The conventional explanation for the fluctuating fame of Raphael is that the person is creative, only his reputation changes with the vagaries of social recognition. However, the systems perspective, in stressing that creative work does not occur in a social vacuum, but is instead embedded within a cultural context, argues that it makes perfect sense to say that Raphael was creative in the 16th and 19th centuries, when the art community (field of gatekeepers) was moved by his masterpieces in the domain, but not in between or afterward, when it found them to be routine and mannered (Csikszentmihalyi, 1999). In other words, the manifestation of creativity occurs via a dynamic interaction of domain, field and person, and who is regarded as a creative genius can be socially constructed, deconstructed and reconstructed several times over the course of history.

The systems theory of creativity also implies that any budding creator must make a distinction between making and selling a creative product (Ng, 2007). In this context, "making" refers to the creation of a novel idea, whereas "selling" refers to the act of persuading the gatekeepers in the field of its value. This is because in the marketplace

of creative ideas, it is the opinion of these gatekeepers which ultimately matters. If the creator pays no attention to these opinion-makers, he may be first in the market with a creative product, but he may not emerge as a winner.

Nobody understands this hard fact of life better than Sim Wong Hoo, CEO of Creative Technology, a multi-million dollar IT firm which is based in Singapore. Sim struck his first pot of gold with Soundblaster, a sound card that gave computer gamers surround sound. Sim thought that he had another winner in the Nomad Jukebox, an MP3 player first produced by Creative Technology. At that time, MP3 technology was still in its infancy. Sim's hard-disk based Nomad Jukebox, which could store up to 1000 songs in MP3 format, heralded an exciting future for the music industry.

Creative Technology launched its Nomad Jukebox at a January 2001 Macworld trade show in America. It attracted a lot of interest from other IT companies. The late Steve Jobs, who was then CEO of Apple, heaped praise on this new product by Creative Technology. Putting the money where his mouth is, Jobs made two business proposals to Sim. Either Creative Technology licensed its innovative MP3 technology to Apple, or hived off its new MP3 player business into a new company which Apple would invest in. Sim turned down these two proposals because he felt he had a winner in the Nomad Jukebox. He believed that he could replicate the success of Soundblaster with this new invention. About eight months after Sim rejected Job's offer, Apple's iPod hit the stores. This hip and sleek player quickly gained an iconic status in pop culture. Young and trendy music-lovers in America and the rest of the world regarded it as a cool, must-have gadget. As for Creative Technology, its sale of this musical gadget languished behind Apple. Why did Sim end up in this sorry state, even though his company was the first in the market to come up with an MP3 player?

According to The Wall Street Journal, whereas Apple paid attention to the opinions of the gatekeepers in the field, Creative Technology made a critical mistake: it failed to recognise the power of marketing. Apple may not be the first in the MP3 market with its iPods, but its marketing

savvy ensured a player that was hip and sleek at the same time. Creative Technology came up with the first MP3 player, but its Nomad Jukebox – shaped like a "bloated UFO" according to a music critic – caught on only with the tech elite but not the mass consumers. Apple spent a lot of money on advertising, signing up rock stars like U2 to sell its iPods to the rest of the world. By contrast, Sim told The Wall Street Journal: "I don't want to waste money on marketing. I'm very results-oriented" (quoted in Ng, 2007, p. 50).

To summarise, being first off the starting line does not always lead to runaway success in the enterprise of creativity. Instead, to function well in the marketplace of creative ideas, the creator must pay attention to the gatekeepers in the field. Csikszentmihalyi (1999) provided a lucid account of what it takes to succeed as a creator via an in-depth interview with Jacob Rabinow, a prolific inventor who has over 200 patents on a variety of different inventions. Rabinow is also a prominent gatekeeper in the field because he works for the American Patent Office, and hence decides which inventions by various individuals deserve recognition. In describing what it takes to be an original thinker, Rabinow mentions first the importance of the domain (quoted in Csikszentmihalyi, 1999, pp. 332-333):

> So you need three things to be an original thinker. First, you have to have a tremendous amount of information – a big database if you like to be fancy. If you're a musician, you should know a lot about music, that is, you've heard music, you remember music, you could repeat a song if you have to. In other words, if you were born on a desert island and never heard music, you're not likely to be a Beethoven…You may imitate birds but you're not going to write the Fifth Symphony. So you have to have the kind of memory that you need for the kind of things you want to do…you get better and better by doing the things you do well, and eventually you become either a great tennis player or a good inventor or whatever, because you tend to do those things which you do well and the more you do, the easier it gets, and the easier it gets, the better you do it, and eventually you become very one-sided but you're very good at it and you're lousy at everything else because you don't do it well. This is what engineers call positive feedback. The small differences at the beginning of life become enormous differences by the time you've done it for 40, 50, 80 years…

Next Rabinow highlights the role of intrinsic motivation in creative work. That is, the creator enjoys playing with the contents of the domain:

> Then you have to be willing to pull the ideas, because you're interested. Now, some people could do it, but they don't bother. They're interested in doing something else. So if you ask them, they'll, as a favour to you, say: "Yeah, I can think of something". But there are people like myself who like to do it. It's fun to come up with an idea, and if nobody wants it, I don't give a damn. It's just fun to come up with something strange and different.

Finally, Rabinow turns his attention to the field of gatekeepers, focusing on how important it is to reproduce in one's mind the criteria of judgement that these opinion-makers use to evaluate the worth of a creative product:

> And then you must have the ability to get rid of the trash which you think of. You cannot think only of good ideas, or write only beautiful music. You must think of a lot of music, a lot of ideas, a lot of poetry, a lot of whatever. And if you're good, you must be able to throw out the junk immediately without even saying it. In other words, you get many ideas appearing and you discard them because you're well trained and you say, "that's junk". And then you see the good one, you say, "Oops, this sounds interesting. Let me pursue that a little further". And you start developing it…And by the way, if you're not well-trained, but you've got ideas, and you don't know if they're good or bad, then you send them to the Bureau of Standards, National Institute of Standards, where I work, and we evaluate them. And we throw them out.

Economic theories of creativity

In this category, the economic perspective is applied to creativity at both the micro-individual and macro-societal level (Lubart & Runco, 1999). The micro-individual level focuses on such issues like the personal cultivation of creative resources as well as the costs and benefits of doing

creative work. The macro-societal level focuses on other issues like the aggregate level of demand and supply of creativity in society as well as the competition for creative talent that can help a city or country to innovate and remain prosperous. From a micro-individual perspective, people differ in the amount of creative resources which they possess, due to individual differences in family background, educational level, life opportunities etc. Examples of these creative resources include cognitive abilities (e.g., imagination), personality traits (e.g., perseverance), individual attitudes (e.g., risk-taking) as well as creative skills (e.g., divergent thinking). Those who possess more creative resources – imaginative, persevering, risk-oriented – display a higher level of creative performance *ceteris paribus* (all things being equal). Those who possess less creative resources can build them up gradually. For instance, one can learn how to generate original ideas by mastering creative problem-solving techniques such as S.C.A.M.P.E.R. and bug-listing (Ng, 2007).

In the 21st century, an organisation thrives on its ability to innovate and come up with new services and products (e.g., Apple with its iPods, iPhones and iPads). Hence employees are encouraged to think of novel ideas and solutions in the workplace. But like any other type of economic activity, creative work entails both benefits and costs. Benefits to creative work include extrinsic incentives (e.g., making money from a new product), social recognition (e.g., garnering praise for an invention) as well as intrinsic rewards (e.g., taking pleasure in the creative activity itself). But there are also costs to creative work, which include pecuniary costs (e.g., time and resources expended on the creative process), psychic costs (e.g., emotional wear and tear of dealing with a variety of creative obstacles) and even social ostracism (e.g., being condemned by society for an outrageous idea). In addition, there are opportunity costs as well: the individual could have utilised the available time, energy and resources to undertake conventional work which entails less risk instead of creative work in which one can either win or lose big.

At the macro-societal level, there is an aggregate level of demand and supply for creative products and services within a society. In the modern world where a premium is placed on creativity, demand outstrips supply as seen in the public penchant for the newest gadgets from the

likes of Apple and Samsung or the latest made-in-Hollywood blockbuster. According to Florida (2002), this has led to the rise of the creative class in the advanced economy. In the United States, it comprises 40 million or so Americans who create for a living. This creative class is found in a variety of fields, from engineering and architecture, to music and theatre, to life sciences and education, to high-tech companies and small firms. The distinguishing characteristic of this creative class is that its members engage in work to "create meaningful new forms". This can range from designing a novel product that is widely made, sold and used; to coming up with a theorem or strategy that is applicable in many cases; to composing music or play that is performed again and again.

Because of the considerable economic clout that members of the creative class wield, both as purveyors and consumers of creative goods and services, many cities and countries around the world strive to be an attractive place for them to live and work in (Florida, 2007). To draw in creative people, generate innovation and stimulate economic development, a city or country needs to master the *3 Ts of economic development*, namely, Technology, Talent and Tolerance. That is, it should play host to a sizeable quantity of innovative and high-tech companies *(Technology)*; its resident workforce should consist of well-educated employees with a Bachelor's degree and above *(Talent)*; and most importantly, it should be an open and diverse place to work and live in *(Tolerance)*. Indeed, with regards to the last T or Tolerance, Florida (2004) found that members of the creative class are attracted to places that score high on basic indicators of diversity such as the Gay, Bohemian and other indices. Put in another way, it is not because thriving economies are populated by bohemians and gay people. Rather, artists, musicians, gay people and other members of the creative class in general prefer places that are open, diverse and tolerant.

Besides examining creativity from the micro and macro perspectives, theorists have attempted to develop psycho-economic models of creativity. For example, using the stock market as a metaphor, Sternberg and Lubart (1991, 1995) came up with the *investment theory of creativity*, which compares the creative individual to a successful investor who "buys low and sells high". That is, the successful investor buys when the share price of a certain company is dropping and sells when it is going up. This

seems like a perfectly sensible strategy to pursue when investing in the stock market. But it requires boldness on the part of the investor to buck the trend and buy shares which nobody else wants.

The creator is like the bold rather than timid investor, who is willing to "buy low and sell high" in the realm of ideas. "Buying low" for the creator means pursuing an idea which is unknown or out of favour but that nevertheless has growth potential. Often, when such a radical idea is first presented, it encounters resistance for challenging the established way of doing things. The creator persists and eventually gains acceptance of the radical idea. At this juncture when the idea has risen in value, the creator "sells high" by letting go of the idea to the highest bidder (e.g., a company purchases the right to manufacture and sell the new product from the creator). With this successful closure of the deal, the creator moves on to the next big idea, like the successful investor who explores new stocks to purchase. But just as there is no foolproof way of recognising which undervalued stocks will appreciate over time, there is no ironclad method for identifying which promising idea will eventually bear fruit.

To increase the probability of "buying low and selling high", the successful investor typically relies on a combination of two approaches (Sternberg & Lubart, 1992). One approach is fundamental analysis, which involves gauging the financial health of a company and the soundness of its business model by scrutinising its sales turnover, annual profit, growth potential, return on investment and so on. Another approach is technical analysis, which involves analysing the past performance of a stock in order to predict its future performance.

In the realm of creativity, there are analogues to these two basic approaches of investment. For *fundamental analysis*, the analogue would be to evaluate which aspects of a creative idea – originality, usefulness, social significance and so on – would ultimately enable it to gain acceptance by society. For example, an inventor may evaluate the novelty, practicality and popularity of a new device before building it. For *technical analysis*, the analogue would be to use past trends in what has been viewed as creative to predict what would be viewed as creative in

the future. For example, a fashion designer may study the consumption patterns of customers before settling on a new design for a handbag or dress.

According to the investment theory of creativity, an individual may fail to be creative for two reasons. First, he "buys high" by pursuing an idea which is already valued or known. This would be like the gullible investor who rushes to buy a popular stock that has rapidly risen in value. Second, he "sells low" by holding on to an original idea for so long until it becomes commonplace. This can occur, for instance, when a different person thinks of the same idea and decides there and then to popularise it. Again, this would be like the unsuccessful investor who did not let go of a share which has appreciated in value, typically because of greed, only to be eventually disappointed when the share price plunges.

Summary

In this chapter, we learn that creativity is a complex phenomenon and psychologists differ in their understanding of what it is as they view creativity from different perspectives. Instead of arguing over which theory is right or wrong, we should appreciate it for its unique insight on creativity. For example, the psychoanalyst views creativity as a form of defence mechanism; the humanistic psychologist views creativity as a form of self-actualisation; and the behaviourist views creativity as an ordinary behaviour shaped by reward and punishment. We also look at a few models of creativity. One is the 4 Ps which proposes that a creative product is the outcome of a creative process engaged in by a creative person all of which is nurtured by a creative press. Another is the 4 Cs which traces the development of creativity from mini-c to little-c to pro-c to Big-C creativity. In addition, we examined four contemporary theories of creativity, namely, developmental, evolutionary, systems and economic theories. Developmental theorists examine the unfolding and growth of creativity across the life-span and look at the link between childhood play and adulthood creativity. Evolutionary theorists argue that creativity involves the blind variation and selective retention of ideas and liken the creative process to evolution via natural selection in the biological

kingdom. Systems theorists argue that creativity arises from a system with different components interacting with one another; these components include the person, domain and field of gatekeepers. Finally, economic theorists understand creativity as a phenomenon which is shaped by micro- and macro-economic forces operating on both individual and society.