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Chapter 1

Creativity and Innovation: Basic Concepts and Approaches

Min Tang

1.1 Introduction

Creativity and innovation are important driving forces for personal development, economic growth, and societal advancement. Especially in the new millennium, when people are facing fast development of new technologies, accelerating changes in life and work and when natural or man-made disasters constantly occur, the importance of creativity and innovation cannot be underestimated. Furthermore, at a global level, our modern society is evolving from the "Information Age" to the "Creativity Age" (Bornet, 2009). One distinctive characteristic of the creativity age is that economies and societies are turning from "knowledge" to "creativity" as their key characteristic (Dubina, Carayannis, & Campbell, 2012) and that economic activity is focused on producing ideas rather than producing things (Sawyer, 2012).

In this time of transition, individuals who can unleash their creative potential and make the best of their unique creative talents will become the real winners of the competition. Companies who can effectively manage their creative minds and innovation system will thrive in the changing marketplace, while the less creative competitors will eventually fail and disappear. No wonder the United Nations (UN) has listed "creativity" as a core competence that students should develop in the UN Competency Development Guide (United Nations, 2010). In Europe, creativity and innovation are indispensable for growth and sustainable development, with a variety of initiatives incorporating creativity and innovation into lifelong learning to foster sustainable and competitive development of the economy such as the Erasmus+ and the Horizon 2020

projects. In Asia, important initiatives in creativity and innovation have been launched, such as China's strive to transform China into "an innovation-oriented country" by 2020 and a world leader in science and technology by 2050 (The State Council, P. R. China, 2006), the establishment of the National Innovation Council in India (Abhyankar, 2014), and the launch of the three Masterplans for ICT in education in Singapore since 1997 (Singapore Ministry of Education, 2009).

In spite of the increasing awareness of the importance of creativity and innovation, scientific research into creativity and innovation is still non-mainstream due to the relatively short history of this field. In most cases, laypersons and scholars alike tend to use the words "creativity", "innovation", "creative" or "innovative" interchangeably. Indeed, creativity and innovation are two conceptually closely related concepts, but they are by no means identical. Particularly for scholars, it is necessary to differentiate these two concepts, partition their integral elements, and get to know the approaches of how these two complex phenomena are usually measured. To demonstrate this, I combine the leading theories from the fields of educational psychology, organizational psychology, and engineering and present the definitions of and research approaches to creativity and innovation.

1.2 Defining Creativity and Innovation

Etymologically, creativity derives from the Latin participle "creare" which means "to make, produce", and it is also related to "crescere" which means "arise" or "grow" (Kampylis & Valtanen, 2010). According to Weiner (2000) (as cited in Sawyer, 2012, p. 19), the word "creativity" appeared for the first time in an 1875 text by Adolfus William Ward and was used to suggest that there is something similar across all disciplines. Though already invented, this word did not find its place in standard English dictionaries until after World War II in the third New International Dictionary of 1961. The use of the verb "create" has a relatively longer history. Weiner (2000) (as cited in Sawyer, 2012, p. 21) reported that "create" was firstly used in English by George Puttenham in 1589 to compare poetic creation to divine creation and to differentiate artists from craftsmen. The root of this assertion can be traced back to the Greek myth of the Muses, which are generally regarded as the sources of inspiration and creativity. Unconscious or subconscious processes such as instinct, insight, and imagination are key components of creativity according to this perspective. In earlier times, it was the typical belief that people were like empty vessels and the creative individuals were those who were bestowed by a divine being (such as God or Muses) with special creative gift. In this vein, the so-called Romanticist view maintained that creative individuals, particularly artists, should simply listen to the inner Muse, liberate one's instinct and emotion, and create without conscious control (Sawyer, 2012). In contrast to the Romanticism is the Rationalism which

believes that creativity is generated by the conscious, deliberate, intelligent, and rational mind (Sawyer, 2012).

1.2.1 *Definitions of Creativity*

Creativity is regarded as "one of the most complex and fascinating dimensions of human potential" (Treffinger, Sortore, & Cross, 1993, p. 558). Maybe because of its complex nature, there is no universal definition for creativity yet, though attempts have been continually made to provide a sort of standard definition to creativity (e.g., Amabile, 1983; Runco & Jaeger, 2012). Reviewing the history of creativity research, Sawyer (2012) identified three major waves of creativity studies: The first wave was in 1950s and 1960s when the focus of the study was on the *personality* of exceptional creators. The second wave was in 1970s and 1980s, when the focus of the study was shifted to the *cognitive* aspects (i.e., internal mental processes) of creative behavior. The third wave was in the 1980s and 1990s, when the cognitive approach was extended to the creative social system (i.e., groups of people in social and cultural contexts).

Each of these approaches has its own distinctive analytic focus and each of them defines creativity slightly differently, which he summarized into two major definitions of creativity. The first definition is the so-called "individualist definition". This definition combines the first wave personality psychology with the second wave experimental cognitive psychology and underlines the personality traits, thinking, perception, and learning behavior of the creative person. The individual definition that Sawyer (2012, p. 7) proposed is "Creativity is a new mental combination that is expressed in the world". Three distinct features characterize this definition: (1) Creativity must be something new, novel, or original; (2) Creativity involves a combination of two or more thoughts or concepts that have never been combined before by the individual; (3) Creativity must be expressed in a certain way in the world. Unexpressed and uncommunicated personal concepts or thoughts cannot be regarded as creativity. From this definition (particularly the third feature), we can see that even from the individual perspective, creativity cannot be defined without referring to the social sphere. Indeed, as Csikszentmihalyi (1994, p. 8) pointed out, it would be impossible to approach creativity without taking into account the social/environmental parameters around a person, as creativity is not an attribute of individuals but is of social systems making judgments about individuals. The second definition is the so-called "sociocultural definition". This definition reflects the focus and approach of the third wave creativity study and defines creativity as "the generation of a product that is judged to be novel and also to be appropriate, useful, or valuable by a suitably knowledgeable social group". There are also three important features of this definition: (1) Creativity must refer to a concrete product; (2) This product must be judged as novel, appropriate,

useful or valuable; (3) Persons who make the judgement must be from a suitably knowledgeable social group. Amabile (1982, p. 1001) was among the first in this group who proposed this product-centered definition of creativity. In her words, "… a product-centered operational definition is clearly most useful for empirical research in creativity". Along with this definition, she also developed the Consensual Assessment Technique (CAT), which assembles a group of field experts to assess creative products or responses. CAT is one of the most frequently used methods of creativity assessment in different domains.

1.2.2 *Definitions of Innovation*: *Comparison to Creativity*

In the literature of organizational psychology, innovation is often defined as "the intentional introduction and application within a role, group or organization of ideas, processes or procedures, new to the relevant unit of adoption, designed to significantly benefit the individual, the group, organization or wider society" (West & Farr, 1990, p. 9). As creativity focuses on idea generation and innovation stresses idea implementation (Rank, Pace, & Frese, 2004), creativity is often seen as the first step of innovation (Amabile, 1996; Mumford & Gustafson, 1988; West, 2002a, 2002b). It is cautioned, however, that creativity occurs not only in the early stages of innovation processes but, rather, all the way through the cyclical, recursive process of idea generation and implementation (King, 1992; Paulus, 2002; Van de Ven, Angle, & Poole, 1989). Anderson and colleagues (2004) identified three differences between creativity and innovation: (1) Creativity can only involve the generation of creative ideas but not necessarily involve the application or implementation of the ideas to applied settings. Innovation, in contrast, must involve "intentional introduction and application" of new and improved ways of doing things. Therefore, application or implementation is an inherent component of innovation; (2) Innovation must refer to benefit at one or more levels of analysis, but this is not necessarily the case for creativity; (3) Innovation is not necessarily absolutely novel to the organization, rather it is usually a mixture of emergent processes, adopted or adapted procedures, and creative reactions to restrictions imposed by the organization. Clydesdale (2006, p. 21) examined the difference from the motivational perspective and maintained that creativity is driven by intrinsic motives, whereas innovation is driven by extrinsic incentives and the "need to surpass previous standards". Runco (2006) used the originality-to-effectiveness balance theory to differentiate these two concepts. According to him, originality and effectiveness are two indispensable prerequisites for any effort to be labeled as being creative, innovative or neither creative nor innovative. Anybody who creates something that is only original but not effective at all is usually regarded as psychotic. Anybody who is only effective at solving problems can be called routine problem solver but not creative

problem solver. Creativity and innovation both require originality and effectiveness, though the weight on each of them is different. Creativity (particularly artistic creativity) lays more weight on originality, while innovation requires that the effort must be useful and can be sold (effectiveness). As the determination of the effectiveness of an innovative effort is a social rather than personal process, innovation is primarily an *interindividual* social, whereas creativity is more an *intraindividual* cognitive process (Anderson & King, 1993).

To summarize, creativity and innovation are related constructs and are very often used interchangeably by laypersons. However, they are by no means identical and differ from each other in terms of the different weight they lay on certain individual, social, motivational, and assessment criterion aspects (see Table 1.1 for a summary of the major differences). Therefore, it is necessary, particularly for researchers, to distinguish creativity and innovation for research purposes (Anderson, Potočnik, & Zhou, 2014; Rank, Pace, & Frese, 2004; West, 2002a).

1.2.3 *Creativity, Innovation, and Related Concepts*

The term "innovation" has been studied and used in a variety of disciplines such as economics, business, engineering, and sociology and is often poorly understood and confused with terms such as change, invention, design, and creativity (O'Sullivan & Dooley, 2008). To gain a better understanding of the concepts of creativity and innovation, it is necessary to compare these two concepts with their other "siblings", words that people usually use as synonyms of creativity and innovation. In the fields

Table 1.1: Comparison of the conceptual meanings of creativity and innovation.

	Creativity	Innovation	Scholars
Individual perspective	Stresses idea generation	Stresses idea application or implementation	Anderson, Potočnik, & Zhou (2014), Rank, Pace, & Frese (2004); West & Farr (1990)
Social perspective	Not necessarily consider benefits	Must consider benefits	Anderson, Potočnik, & Zhou (2014)
	Intraindividual	Interindividual	Anderson & King (1993)
Motivational perspective	Intrinsic motivation	Extrinsic motivation	Clydesdale (2006)
Assessment Criteria	Usually absolute novelty	Usually relative novelty	Anderson, Potočnik, & Zhou (2014), West (2002a)
	More weight on originality	More weight on effectiveness	Runco (2006)

of psychology, sociology, business, and engineering, discovery, invention, and entrepreneurship are most frequently used. Therefore, in this part, I will concentrate on four "siblings" of creativity and innovation, namely, discovery, design, invention, and entrepreneurship.

Discovery

In the *Encyclopedia of Creativity*, discovery is defined as the finding of something unexpected that yields an "effective surprise" and it links observations, ideas, or theories not only in new but in previously unexpected ways (Root-Bernstein, 1999, p. 559). In this vein, Verstijnen *et al*. (1998) stressed the *unanticipated* character of discovery. Indeed, what can be discovered is not necessarily something new and original. Particularly in geography, it is usually about discovering something that already exists but nobody else has ever seen (e.g., the discovery of the New World by Christopher Columbus). In science, discovery is a little bit different, as it requires not only finding something unexpected but also adding meaning to it. Nobel laureate Albert Szent-Gyorgyi once said, "Discovery is seeing what everyone else has seen and thinking what no one else has thought". A classic example of this proposition is that millions of people have seen apples dropping from a tree and maybe hundreds of them have been hit by the dropping apples, but only Sir Isaac Newton thought of the Universal Law of Gravitation. Chance favors the prepared mind. To achieve this unexpected or unanticipated effect, a complex process is usually entailed, which involves philosophical, empirical, theoretical, aesthetic, and social elements. "The surprise of insight that some investigators identify with discovery is but one temporally distinct phase of the complex process" (Root-Bernstein, 1999, p. 560). Runco (2014) maintained that all active discoveries assume a kind of search, either it is the search for solutions to problems or the search for problems themselves. Kuhn (1962) distinguished normal science from revolutionary science. According to him, normal science has a well-articulated paradigm or set of problem-solving techniques, which can address the defined problems with a fair assurance of success. In contrast, revolutionary science challenges the assumptions of existing problem-solving modes, thus usually resulting in completely new methods. This distinction of normal vs. revolutionary science is similar to the distinction of adaptive vs. innovative creative styles (Kirton, 1976), the incremental vs. radical creativity (Gilson & Madjar, 2011) and the incremental vs. radical innovation (Tushman & Romanelli, 1985). Discovery is closely related to invention. Quite often discoveries foster or lead to inventions or vice versa. For example, the discovery of the fogging of photographic plates by radioactive materials led to the invention of X-rays. The discovery of the antagonisms between microbes led to the invention of penicillin. On the other hand, inventions breed new discoveries. For example, the invention of the microscope led to the development of

the cell theory, and the invention of the CT scanner, PET, fMRI, and EEG enabled scientists to observe the function of our brains, thus leading to more discoveries and even foster the development of a new scientific field such as neuroscience. No wonder Root-Bernstein (1999, p. 566) concluded that "invention and discovery are integrally entwined and both can be the results of the investigative process". Invention will be discussed in a later section.

Design

Design has always been closely associated with creativity because a designer's profession is all about planning for the making of something new (Goldschmidt, 1999). Design is widely used in the artistic or engineering fields such as graphic design, fashion design, product design, industrial design, etc. All these types of design lead to tangible artifacts. This term is also used in the context of non-tangible constructs, such as social design, though Goldschmidt (1999) noted that in this and similar cases, *planning* instead of design would be a more appropriate term. Here, we can see that design is a specific type of planning that results in concrete artifacts. This definition differentiates design from invention. Invention involves design, but is more than design. Invention does not only plan but also brings the new artifacts into life to meet a need or solve a problem. More about invention will be discussed in the following part. Design is also quite often used in describing innovation and related processes. For example, Villa (1998) indicated that continuing innovation in industries can be seen as a frequent *redesign* of offered products as well as of the production processes required. Also, he proposed an "innovation loop" concept and introduced a conceptual model of *multi-resolution design* process. On the other hand, Hsiao and Chou (2004) see design work as not only consisting of logical rules dealing with distinct procedures but also innovative thinking producing intricate creativity. Put together, these theories suggest that design, invention, creativity, and innovation are entwined closely in product design and new product development (NPD), which is one essential part of the innovation process.

Invention

Udell, Backer, and Albaum (1976, p. 93) stated "invention is a manifestation of creativity which is often conceived as the ability to bring something new into existence and sometimes thought of as the psychological process of processes by which novel and valuable products are created". In the *Encyclopedia of Creativity*, Hertz (1999, pp. 95, 96) provided three definitions of invention. One definition of invention, as quoted from the Webster's dictionary, is "a device, contrivance, or process originated after study and experimentation". Another definition coming from the

U.S. Patent Office states "invention is something that is novel and useful: novel, meaning something that someone skilled in the particular field would not know, and useful, meaning that it has some practicality". The third is an operational definition that is provided by the author: "invention can be defined as object, idea, or process that is protected by a patent". Henderson (2004, p. 105) gave a more comprehensive definition of invention as follows: "An invention is created through the production of novel ideas, processes, or products that solve a problem, fit a situation, or accomplish a goal in a way that is novel, implementable, useful, and cost-effective and alters or otherwise disrupts an aspect of technology". The World International Property Organization (WIPO, 2008) defines invention as "a product or a process that provides a new way of doing something or offers a new technical solution to a problem". Synthesizing the major features of invention, Tang (2010) defined invention as (a) a distinct form of creativity that is closely related to problem solving and design, (b) stressing both problem solving and problem finding, (c) having a close relation to patent, and (d) being subject to unique criteria (novelty, practical use, and patentability) and evaluation process (patent examiners as the "gatekeeper"). From these definitions, we can see that invention is a form of *intentional creativity* with the aim to create something new to solve an existing problem, to improve an existing solution of a problem or to find purposes or applications for existing utensils or materials. Because technology and engineering have the strong power to help people solve problems, inventions are usually predominantly related to these two fields. How about creativity in other fields such as economy and business? In these fields, creativity usually appears as innovation.

Entrepreneurship

Whenever we talk about innovation, we cannot avoid talking about entrepreneurship. Entrepreneurship is defined as "the visualization and realization of new ideas by insightful individuals, who were able to use information and mobilize resources to implement their visions" (Nystrom, 1995, p. 67). According to him, an entrepreneur is not necessarily highly creative, but he/she must be good at promoting or implementing radical changes. Chell (2007, p. 18) defined entrepreneurship as "the process of recognizing and pursuing opportunities … with a view to value creation". This definition emphasizes what creativity researchers called "problem finding" and "appropriateness". "Problem finding" refers to entrepreneurs' ability to recognize opportunities and "appropriateness" refers to their focus on value creation. Value creation is also core to Phan, Zhou, and Abrahamson's (2010) definition of entrepreneurship, which they called as a cyclical process of value creation that enhances NPD processes and fosters new institutional forms leading to new ventures and successful innovations. Innovation has been regarded as an essential part in the new

venture success (Baron & Tang, 2011). The sum of organizational innovation, renewal, and venturing efforts characterized with innovativeness, risk taking, and proactiveness forms another concept "corporate entrepreneurship" (Sebora & Theerapatvong, 2010). Corporate entrepreneurship facilitates the introduction of changes and innovation in organizations. Therefore, some scholars have suggested a considerable overlap between organizational innovation and corporate entrepreneurship (Lassen, Gertsen, & Riis, 2006).

1.3 Theories and Studies of Creativity: Different Approaches

After exploring the definitions of creativity, innovation, and related concepts, it is necessary to discuss the different approaches usually used for creativity studies. Sternberg and Lubart (1999) categorized the different approaches to creativity into six major diagrams, including *mystical*, *pragmatic*, *psychodynamic*, *psychometric*, *cognitive*, and *social-personality.* Each of these approaches conceptualizes creativity in different ways, has different research foci, has made certain contributions to the field, but each presents certain defects or flaws. Interested readers are encouraged to read this chapter. Acknowledging the complex nature of creativity, Kozbelt, Beghetto, and Runco (2010) classified the theories of creativity into 10 categories, including *developmental*, *psychometric*, *economic, stage & componential process, cognitive, problem-solving & expertise-based, problem-finding, evolutionary (Darwinian), typological,* and *systems.* For each of these approaches, the authors identified the primary assertions, key concepts, the 6 P's (Person, Process, Product, Place, Potential, and Persuasion) focus, the levels of magnitude (creativity level), and listed example studies. This chapter is also recommended for readers who want to have an in-depth overview of the different approaches of creativity studies.

Due to the scope of the current chapter, I will not go deeper into the above-mentioned six or ten creativity theories. Instead, I will follow the three major waves of creativity studies of Sawyer (2012) mentioned in the earlier part of the chapter — the *personality, cognitive*, and *sociocultural* approaches — to summarize the typical approaches that scholars adopt to study creativity.

1.3.1 *Personality Approach to Creativity*

The personality approach views creativity as a combination of creative personality traits — either cognitive or non-cognitive. Due to the influence of Guilford and Torrance, creative cognitive personality traits have close associations with divergent thinking and creative problem solving. Among others, imagination (Csikszentmihalyi & Getzels, 1973; MacKinnon, 1962; Rossman & Horn, 1972) and flexibility of thought

(Garwood, 1964; Helson, 1971; Rossman & Horn, 1972) are the most frequently recognized cognitive personality traits of creative individuals across domains.

From the non-cognitive perspective, personality psychologists try to understand the affective and motivational traits which influence the creative process. Meta-analyses show that the most conspicuous traits of creative individuals are tolerance of ambiguity, risk-taking, preference for disorder, delay of gratification (Dacey, 1989); aesthetic sensitivity, broad interests, attraction to complexity, independence of judgment, self-confidence, creative self-concept (Barron & Harrington, 1981); autonomous, introverted, open to new experience, norm-doubting, self-confident, self-accepting, driven, ambitious, dominant, hostile, and impulsive (Feist, 1998). In Feist's study, he found that openness, conscientiousness, self-acceptance, hostility, and impulsivity had the largest effect size in explaining creativity. Since the publication of the Big Five personality trait theory, numerous studies have been carried out to examine the relationship between the Big Five personality traits and creativity. Through decades of investigation, two relatively consistent results seem to occur. The first is a positive correlation between openness and creativity (e.g., Feist, 1998, 1999; McCrae, 1987; Werner *et al.*, 2014) with an average $r = 0.28$ between openness and creative behavior (Guastello, 2009) and $r = 0.47$ between openness and creative self-beliefs (including self-rated creativity) (Karwowski & Lebuda, 2016). The second is a negative correlation between conscientiousness and creativity, particularly for artists (e.g., Guastello, 2009; Werner *et al.*, 2014). Other than this, the results about the relation between other Big Five personality traits and creativity are inconsistent. For example, while some studies find a positive relation between extroversion and domain general-based measures of creativity (Richardson, 1985; Schuldberg, 2005), others do not (Matthews, 1986; McCrae, 1987). Some studies even suggest an opposite trend: an introversion–creativity connection among artists and writers (Mohan & Tiwana, 1987; Roy, 1996). Even within scientists, the correlation is complex in that scientists were much more introvert than non-scientists, while creative scientists were more extrovert than less creative scientists (Feist, 1998). Though some studies tend to depict a less agreeable image of creative scientists and artists (e.g., Feist, 1998), this result does not apply to an American adult sample (Kaufman *et al.*, 2009) or a Chinese student sample (Werner *et al.*, 2014). The correlation between emotional stability and creativity is also mixed. Studies of professional writers and visual artists show that these highly creative professionals are more likely to suffer from mental illness than creative people in other fields (Kaufman, 2001, 2014; Ludwig, 1995; Post, 1994). The neurological explanation for this is that the hyperactivity in the frontal lobe of our brain is connected to this artistic endeavor; and activity in this area of the brain is also closely tied to mental illnesses such as schizophrenia and depression (Flaherty, 2005; Heilman, Nadeau, & Baversdorf, 2003). However, such a relationship was not confirmed with

non-professional samples. Studies in the USA (Kaufman *et al.*, 2009) and China (Werner *et al.*, 2014) using normal adult or student samples revealed no significant correlations between emotional stability and creativity in any artistic domains. Instead, both studies found a positive relation between emotional stability and creativity in math/science and interaction.

Taken together, the inconsistent results about creativity and emotional stability with different samples seem to suggest that the relationship between these two constructs needs to be differentiated between domains (Kaufman & Baer, 2002) and discerned at different levels of creativity. Apart from concern about the personality structure of the creative individuals, personality psychologists are also interested in the question of to which extent creative personality traits are consistent over time, and how they change over time. To answer this question, longitudinal studies were conducted. A 44-year longitudinal study of about 80 male graduates found tolerance and psychological mindedness resulted in a significant increase in variance, explaining 20% over and above potential and intellect (Feist & Barron, 2003).

1.3.2 *Cognitive Approach to Creativity*

The cognitive approach conceptualizes creativity as being largely influenced by underlying cognitive processes or mechanisms (Baer & Kaufman, 2006; Sternberg & Lubart, 1999) and focuses on thinking skills and intellectual processes (Runco, 2014). There exists a variety of cognitive theories of creativity depending on the specific foci of the studies. Some scholars differentiated divergent thinking from convergent thinking (Guilford, 1950; Torrance, 1974). Divergent thinking is the thinking in varied directions without searching for the one correct answer whereas convergent thinking is the thinking focused on looking for one correct or conventional answer. Newly developed theories about creativity, such as creativity is domain-specific (Tardif & Sternberg, 1988) and creativity involves both problem finding and problem solving (Wakefield, 1991) showed that divergent thinking and creativity are not completely synonymous. Divergent thinking is a necessary but not sufficient element of creativity. The generation of ideas that are both original and effective entails both divergent and convergent thinking (Cropley, 2006; Hany & Heller, 1993). Mednick (1962) conceptualized creativity as the cognitive ability of making remote associations between concepts and developed the Remote Association Test (RAT) (Mednick & Mednick, 1967). Though the conceptualization of creativity as remote association cognition has its merits, the validity of the RAT instrument is questionable till today. There is the argument that RAT measures sensitivity to language rather than creative potential (Worthen & Clark, 1971). On the other hand, the one-correct-answer form of the RAT is not optimal to detect the complex process of making remote associations. Some researchers focus on analogical thinking and creativity (e.g., Gentner, 1989; Novick, 1988).

Analogical thinking is defined as the transposition of a conceptual structure from one habitual setting to another new setting (Welling, 2007). Dunbar (1995) identified three kinds of analogy in scientific work, including local analogies (one part of one experiment is related to a second experiment), regional analogies (systems that are developed in one domain and used in a similar domain) and long-distance analogies (systems that are developed in one domain but used in a dissimilar domain). Other often discussed cognitive skills closely related to creativity include retrieval, restructuring, combination, synthesis, imagery, categorical reduction, etc. (for reviews see Finke, Ward, & Smith, 1992; Runco, 2014; Sawyer, 2012).

In parallel to the studies of the conscious components of creative thinking, the unconscious or subconscious attributes of creativity have also caught the attention of psychologists. Among others, the well-cited four-stage model of Wallas' (1926) model of creative process acknowledged both the conscious and unconscious process of creative thinking. The four processes are preparation, incubation, illumination, and verification. While preparation and verification stages are mainly systematic and conscious, the stages of incubation and illumination also involve unconscious processing of information. Incubation means "a stage of creative problem solving in which a problem is temporarily put aside after a period of initial work on the problem" (Smith & Dodds, 1999, p. 39). There is empirical evidence supporting an incubation effect, that is, being interrupted and forced to work on an unrelated task increases solution rates for creativity-related problems (for review, see Ellwood *et al.*, 2009). Illumination is also known as insight. Insightful thinking is different from divergent thinking. While divergent thinking looks for various ideas, insightful thinking leads to one solution (Runco, 2014), which is usually accompanied with an "Aha" experience. Insights seem to be mysterious, as they are quick and spontaneous. However, the evidence suggests that insights are not instantaneous. Rather, they are protracted and develop over time (Gruber, 1988; Wallace, 1991). Weisberg (1993, 2006) carried out both laboratory studies of undergraduates and cases studies of prominent scientists, artists, and inventors to understand the mechanisms underlying leaps of insight and the "Aha" experiences. His data and analyses show no evidence of sudden spontaneous cognitive leaps, unconscious illuminations, or bolts of lightning from the blue with the "great" minds. He found that the prominent creative individuals think exactly the same way as ordinary people do by using what we already know to generate something new and by creating novel things through reasoning, analogical thinking and the accumulation of new pieces of information. Moreover, he noted that though we all possess these thinking skills, high-level creative persons differ from the lower-level ones in the level of the skills and in some motivational characteristics such as achievement motivation, commitment and productivity. In particular, he emphasized the positive relation between knowledge and creativity and echoed the

"10 years rule" of reaching high-level creativity that has been confirmed by many other researchers (e.g., Bloom, 1985; Gardner, 1993; Hayes, 1989).

1.3.3 *Sociocultural Approach to Creativity*

Through decades of exploration, more and more scholars agree that multiple components must converge for creativity to occur. Although different scholars have varying preferences to name this approach, such as "congruence" (Sternberg & Lubart, 1991), "interactionist" (Treffinger *et al.*, 1993), "systems" (Csikszentmihalyi, 1988) or "synthetic" (Heller, Perleth, & Lim, 2005), there is a common consensus among the scholars that an excessively individualistic perspective is insufficient to reveal the complex nature of creativity. Creativity of a person involves an interaction of multiple factors in and outside the person and can, therefore, be optimally examined only if both the *individual* and the *environmental* variables are taken into account. This is the sociocultural approach to creativity. This approach defines creativity as being composed of two integral components: the product or process must be novel, and it must be appropriate to some domain of human activity (Sawyer, 2012).

The sociocultural approach can be dated back to the 1980s with the seminal work of Teresa Amabile and her colleagues. On the basis of a consensual definition of creativity, that is, a product is creative when experts in the domain consensually agree that it is creative (Amabile, 1982, p. 1001, 1996, p. 33), Amabile and colleagues conducted a series of studies about the role of motivation in creativity. They observed that intrinsic motivation (i.e., doing something for its own sake) is generally associated with increased creativity, while extrinsic motivation (i.e., doing something as a means to an end) often leads to decreased creativity except when the extrinsic motivator is informational rather than controlling. The role of motivation is reflected in Amabile's (1983) Componential Model of Creativity which is composed of *domain-relevant skills*, *creativity-relevant skills*, and *task motivation.* Amabile (1996, p. 5) argued that social factors such as rewards, competition, modeling, stimulation, evaluation, peer pressure, surveillance, etc. have a powerful impact on creativity through their effect on motivation. Therefore, the task of the sociocultural approach to creativity is "to identify particular social and environmental conditions that can positively or negatively influence the creativity of most individuals". Like most of the researchers of creativity, Csikszentmihalyi entered the field with an interest in the personality traits and cognitive processes of creative people. Through almost three decades' research on this topic, however, he was more and more aware of the interdependence of the individual and sociocultural aspects of creativity. In his own words, "I came to the conclusion that in order to understand creativity one must enlarge the conception of what the process is, moving from an exclusive focus on the individual to a systemic perspective that includes the social and cultural context in which the 'creative' person operates"

(Csikszentmihalyi, 1994, p. 135). In 1988, Csikszentmihalyi proposed a dynamic model of the creative process, in which creativity is understood as a phenomenon that results from the interaction between three main systems: (1) a domain, which is a culturally defined symbol system that preserves and transmits creative products to other individuals and future generations; (2) a field, which is composed of people who control or influence a domain, evaluates and selects new ideas; (3) A person, who draws upon information in a domain and transforms or extends it via cognitive processes, personality traits, and motivation. Csikszentmihalyi's Systems Model of Creativity has a huge impact on contemporary creativity studies. Many scholars got inspiration from this model for their studies including the well-known study of Gardner (1993) about creating minds, which will be introduced in the following part. Researchers of creative celebrities quite often adopt the sociocultural approach. Simonton (1997, 1999) analyzed geniuses in different areas, time periods and cultures, and concluded that social environment can have nurturing or inhibitory effects on the development of creativity. Unlike Amabile, Simonton has focused on broader environmental factors, such as those created by economic, political, social, and cultural conditions. Also unlike Amabile, Simonton has proposed that the effects of environment on the creativity of eminent people could vary across different social situations. In other words, different environments can shape eminent people's creativity in different ways. Applying Csikszentmihalyi's model to his study about creative celebrities from seven different disciplines, Gardner (1993) examined the highest level of creativity through interaction among person, domain, and field. At the personal level, cognitive ability, personality and motivation, social-psychological issues, and life patterns were examined. At the domain level, nature of symbol systems, kind of activity, and status of paradigm were focused, and at the field level, an individual's relation to mentors, rivals, and followers, level of political controversy, and hierarchical organization were considered.

Reviewing the development of theories and studies of creativity, Glăveanu (2010) identified the move of creativity conceptualization from the "He-paradigm", which focused on the solitary creative geniuses, to the "I-paradigm", which attributed creativity to each and every individual to the current "We-paradigm", which is characterized as systematic, relational, and multi-disciplinary and whose focus is the sociocultural roots and dynamics of creative acts. Glăveanu emphasized that the starting point of the We-paradigm is that researchers need to acknowledge the interdependence between Ego and Alter (Markova, 2003, p. 13), as the individual and sociocultural spheres are not isolated from each other but closely interdependent.

1.4 Innovation Research: Different Levels of Studies

As mentioned in the previous part, innovation is usually defined as "the intentional introduction and application within a role, group or organization of ideas, processes

or procedures, new to the relevant unit of adoption, designed to significantly benefit the individual, the group, organization or wider society" (West & Farr, 1990, p. 9). Anderson *et al*. (2014) summarized the studies by four levels of analysis: individual, team, organizational, and multi-level.

1.4.1 *Individual Level Studies*

Numerous studies about creativity and innovation in the workplace concentrate on the individuals. Typical foci of this level of analysis are motivation, personality traits, goal orientation, and self-concept. Intrinsic motivation has been identified as one major component of many creativity theories. For example, "intrinsic motivation" is one of the components of Amabile's (1983) componential model of creativity. In Woodman and Schoenfeld's (1989, 1990) interactionist model of creative behavior, intrinsic motivation is also acknowledged as a component that is conducive to an individual's creative accomplishment. In the interactive approach, which focuses on the development of an individual's creativity within society, Csikszentmihalyi (1990) and Gardner (1993) both included intrinsic motivation as a personal characteristic that contributes to creativity. Non-experimental studies in organizations also support the intrinsic motivation principle of creativity. Shin and Zhou (2003) found that the intrinsic motivation of Korean high-tech employees partially explained their creativity. Another study with an American employee sample also found that employees' intrinsic motivation was one fundamental antecedent to the supervisor-rated creativity of the employees (Dewett, 2007). While intrinsic motivation seems undoubtedly favorable for creativity, the opposite — extrinsic motivation undermines creativity — seems to be not always true. For example, rewards are typical extrinsic motivators, but studies do not always find a detrimental effect of reward. Instead, it was found that under certain specific conditions, the expectation of reward can sometimes increase levels of extrinsic motivation without having any negative impact on intrinsic motivation or performance. It was found that rewards undermine intrinsic motivation and creativity only when they lead people to feel controlled by the situation (see Deci & Ryah, 2002). Rewards can actually enhance intrinsic motivation and creativity when they confirm competence, provide useful information in a supportive way, or enable people to do something that they were already intrinsically motivated to do. Amabile (1996) noted that these boosting effects are most likely when initial levels of intrinsic motivation are already strong.

While examining the role of personality on innovation, more and more researchers acknowledged the complexity of the relationship and treated personality traits as moderators or mediators. For example, Raja and Johns (2010) examined the interaction of the Big Five personality traits with job scope to affect organizational creativity. Job scope is composed of five core job characteristics including skill variety, task identity, task significance, autonomy, and feedback (Hackman & Oldham, 1980).

They found that when job scope was high, neuroticism and extraversion each had a negative relation with creativity. Interactions between conscientiousness/agreeableness and job scope were not significant. On the other hand, when job scope was low, openness was found positively related to creativity. George and Zhou (2001) found a non-significant relation between openness and employee creativity, but demonstrated that it interacted with feedback valence and the nature of tasks to affect creativity. Baer and Oldham (2006) discovered an inverted U-shaped creative time pressure–creativity relation for employees who scored high on openness to experience while simultaneously receiving support for creativity.

Goal orientations are individuals' beliefs which serve as motivational mechanism that influences how employees interpret and act in achievement situations (Elliot & Church, 1997). Scholars differentiate intrinsic (learning or mastery goal orientation) from extrinsic (e.g., performance) goal orientations. The influence of goal orientations and creativity and innovation was also examined in organizational studies. One stream of studies found that learning orientation (emphasizes personal development of competence) had a positive main effect on creativity, whereas performance orientations (focuses on showing competence to external observers) did not (Gong, Huang, & Farh, 2009; Hirst, Van Knippenberg, & Zhou, 2009). A positive relation was also found between mastery orientation (the belief that one's capabilities and competences are changeable) and innovative behavior (Janssen & Van Yperen, 2004). In addition, Shalley *et al*. (2009) found a positive main effect of growth need strength (i.e., individual differences in their desire to seek personal growth while working on their jobs) on creativity.

Self-concept is one's belief, perception and evaluation of himself or herself. Creative self-concept is typically composed of creative self-efficacy, creative role identity, and creative self-esteem. Creative self-efficacy in the workplace is defined as employees' self-belief about the degree to which they think they are capable of being creative (Tierney & Farmer, 2002). Tierney and Farmer (2011) examined creative self-efficacy development and creativity over time in organizations. They found a positive relation between creative self-efficacy and creativity. They also found that when employees' creative role identity increased and perceived creative expectations from supervisors were higher, employees' creative self-efficacy also increased. Rank *et al*. (2009) found that for employees with low organization-based self-esteem, the more their supervisors exhibited transformational leadership, the greater the employees' innovative behavior. It is worth mentioning that with the increase of globalization and individual mobility, more and more individuals may have multiple identities. Studies have been conducted to examine the influence of identity integration on creativity. It was found that identity integration (i.e., comfortable negotiation between dual identities and experience compatibility between them) benefited creativity (Cheng, Sanchez-Burks, & Lee, 2008; Mok & Morris, 2010).

1.4.2 *Team Level Studies*

Recent years have witnessed notable advances in the team level studies of creativity and innovation. Among others, Hülsheger and colleagues (2009) and Rosing and colleagues (2011) have published a meta-analysis of creativity and innovation studies at the team level. Studies at this level can be categorized into team structure and composition, team climate and processes, and leadership style (Anderson, Potočnik, & Zhou, 2014).

One stream of studies of the team structure and composition focuses on team diversity. Teams are widely used in organizations with the hope of achieving innovation. However, mixed results have been found about the relation between diversity and team innovation. Some studies were able to prove a positive association of diversity with higher performance and innovation (Borrill *et al.*, 2000; Bantel & Jackson, 1989; Payne, 1990). Particularly, Andrews' (1979) meta-analysis of 1,222 research teams revealed that diversity accounted for 10% of the variance in scientific recognition, R&D effectiveness, and number of publications, which are indicators of team creativity. However, a recent meta-analysis of over 30 years of team level studies with 104 independent samples found only a weak correlation between job-relevant diversity (average correlated correlation = 0.16), and an insignificant negative correlation between background diversity (average correlated correlation = −0.13) and team innovation (Hülsheger, Anderson, & Salgado, 2009). These findings reaffirm earlier research, suggesting that greater diversity may lead to lower team cohesiveness and lower implementation capabilities, which would undermine team innovativeness (Anderson & King, 1991).

In contrast to the contradictory and low correlation between diversity and team innovativeness, the positive correlation between positive team climate and innovativeness is clearer, with team vision (average correlated correlation = 0.49), support for innovation (0.47), task orientation (0.41), team cohesion (0.31), and participative safety (0.15) all positively correlated with team innovativeness (Hülsheger, Anderson, & Salgado, 2009). The authors concluded that these findings provided further support to the importance of social processes and relationships to team level innovation (e.g., Perry-Smith & Shalley, 2003) as well as the importance of team climate and group process to effective innovativeness within work teams (Choi *et al.*, 2011; Pirola-Merlo & Mann, 2004; Zhang *et al.*, 2007).

The relation between leadership and innovation has received more and more attention. Some scholars differentiated transformational leadership from transactional leadership (Burns, 1978; Judge & Piccolo, 2004). Transformational leaders offer a purpose that transcends short-term goals and motivates followers to reach high performance, whereas transactional leadership establishes an exchange-based relationship by clarifying goals, rewarding goal achievement, and by intervening only when

necessary (Bass, 1999). A recent meta-analysis involving over 800 teams found that transformational leadership was correlated substantially more strongly for the opening-up phase of innovation, whereas transactional leadership was more effective for idea implementation (Rosing, Frese, & Bausch, 2011). This study also reported the relation between other leadership styles and innovation. For example, Somech (2006) found that both *participative leadership* (shared decision making by supervisor and employee) and *directed leadership* (providing a framework for decisions and actions) were positively correlated with team innovation. Oldham and Cummings (1996) observed a positive correlation between *non-controlling leadership* and rated individual creativity, but not with patents or suggestions. Krause and colleagues (2007) reported a positive correlation between *consultative-advisory leadership* (providing advice and guidance) and implementation success. As Rosing *et al.* (2011) summarized, more directive, transactional leadership behaviors are more effective for innovation as they move innovations towards implementation.

1.4.3 *Organizational Level Studies*

In organizational settings, it is often found that creativity and innovation tend to flourish when there are opportunities for exploration and autonomy, and when originality is supported and valued (Amabile, 1990; Witt & Boerkem, 1989). Studies addressing resources in terms of *time* and *money* have repeatedly proven that resources available to projects are directly related to the projects' creativity levels (Cohen & Levinthal, 1990; Damanpour, 1991; Farr & Ford, 1990; Tushman & Nelson, 1990). It was found that organizations that provide training and employee involvement practices, use performance-based pay systems, enable flexible working hours, emphasize job variety and autonomy, and demonstrate more human resource flexibility enjoy higher levels of innovation (e.g., Martínez-Sánchez *et al.*, 2009, 2011; Shipton *et al.*, 2006). Studies focusing on management attributes to innovation found that management support (Choi & Chang, 2009) and top managers' favorable attitude towards innovation (Damanpour & Schneider, 2006) are conducive to organizational innovation. A large-scale study of 468 business firms or business units located in 12 European nations (Elenkov & Manev, 2005) highlighted the role of leadership of top managers on organizational innovation by finding that leadership variables explained nearly half of the variance ($\Delta R^2 = 0.48$) in top management influence on innovations. In addition, a complex role of sociocultural context on the relation between leadership and organizational innovation was observed. On the one hand, sociocultural context had a direct impact on the extent of use of leadership factors. On the other hand, sociocultural context (e.g., dimensions of national culture) also moderated the relationship of leadership with top management influence on innovations.

In their review of the creativity and innovation studies in organization, Anderson, Potočnik, and Zhou (2014) have also summarized studies and findings of other attributes such as knowledge and networks, organizational structure and strategy, organizational size, culture and climate, external environment, innovation diffusion, corporate entrepreneurship, etc. Due to the scope of the current chapter, I will not go into detail with each of these aspects. Interested readers are recommended to read this article.

1.4.4 *Multi-level Studies*

The above-mentioned levels of studies can also be analyzed simultaneously at multiple levels or across levels. For example, the importance of leadership has been repeatedly proven at individual, team or organizational level (see the previous part). How is the exact role of leadership and leader–member exchange on individual creativity? One multi-level study revealed that cognitive team diversity was positively related to individual creativity only when self-efficacy of individuals was high, and cognitive team diversity was positively related to team member creativity only at high levels of team transformational leadership (Shin *et al.*, 2012).

Another multi-level study found that transformational leadership was most strongly related to individual creativity when high identification with the leader and high innovative climate were present (Wang & Rode, 2010). With analyses at multiple levels, we are able to go deeper into the complex system of innovation and unveil the interaction and mechanism among individual, team, organization, and environment. Given the complex nature of creativity and innovation, this approach presents particular promise to uncover and elucidate processes underlying innovation (Anderson, Potočnik, & Zhou, 2014). Therefore, more studies taking a multi- or across-level approach are needed for future innovation studies.

1.5 Conclusion

In daily life and research alike, creativity and innovation are used in parallel to a number of similar concepts. I concentrated on four concepts that are widely used in science, psychology, sociology, business, and engineering. Generally speaking, discovery is frequently used in science and geography, and emphasizes the finding of something unexpected. Design is widely used in arts, engineering and technology. It stresses the planning of making some concrete artifacts. Invention has a close relation to technology and engineering. It is a complex innovative process around design and problem solving. Discovery and invention are integrally entwined — new discoveries can lead to new inventions and new inventions can result in new discoveries. Entrepreneurship is exclusively used in business to describe insightful individuals who

are able to use information and resources to implement innovations and create values. However, there seems to be controversy if creativity or innovation is the umbrella concept in this "family" of concepts. Some scholars regard creativity as the umbrella concept and other related concepts as particular forms or manifestations of creativity (e.g., Tan, 2000). Others, in contrary, believe that innovation is the umbrella concept and creativity is one subset of the innovation system (Sattler, 2011). Particularly, the basic process model of innovation which is composed of three major process steps assigns creativity to the first step in that process, namely, idea generation and selection. Both conceptualizations seem plausible. The first one is more from the developmental psychological perspective, which focuses primarily on the *person* and his asset (e.g., creativity or creative potential), then look into the *consequences* of this asset (e.g., innovation). The second one is more from the management perspective, which sets innovation in the middle and looks for essential *antecedents* of this goal and, more often than not, they will find creativity. It is premature to say one conceptualization is better than the other. It all depends on which perspective the researchers take when they approach these two concepts.

In spite of its relatively short history as a separate study field, creativity research has been flourishing for the past decades. There exist different ways of categorizing the different approaches to creativity (e.g., Kozbelt, Beghetto, & Runco, 2010; Sternberg & Lubart, 1999). I summarized the typical approaches that scholars adopt to study creativity by following the three major waves of creativity studies of Sawyer (2012) — the *personality, cognitive*, and *sociocultural* approaches. The personality approach views creativity as a combination of creative personality traits. Though the relationship between the Big Five personality traits and creativity are *overall* more inconsistent than conclusive, more and more studies do seem to point to a positive correlation between openness and creativity and a negative correlation between conscientiousness and creativity (particularly for artists). The cognitive approach so far has studied both the conscious and subconscious spheres of creativity. The conclusion that can be made based on the review of the literature from this perspective is that there is no evidence of sudden spontaneous cognitive leaps and unpredictable unconscious illuminations with the creative minds (Weisberg, 1993, 2006). Rather, unconscious mechanisms such as insights are protracted and develop over time (Gruber, 1988; Wallace, 1991) where the "ten years rule" explains more about the "myth" of reaching high-level creativity.

In terms of innovation, we quite often differentiate three types of innovation: incremental vs. radical innovation, technological vs. administrative innovation and product vs. process innovation. Innovation has been so far often studied at four levels: individual, team, organizational, and multiple levels (Anderson, Potočnik, & Zhou, 2014). The major determinants for organizational innovation can be summarized as: (1) innovative organizational culture that encourages open flow of communication,

risk-taking, self-initiated activity, participative safety, respect for diversity, etc.; (2) innovation-conducive work climate that facilitates participation, freedom of expression, freedom to experiment, trust and respect for the individual, etc.; (3) creative leadership styles such as participative, transformational, directed, non-controlling leadership, etc.; (4) provision of enough resources and skills and effective communication systems for the implementation of innovation.

Due to the complexity of creativity and innovation, it is cautioned not to make any overstatement of the influence of any *single* attribute on creativity and innovation. To better understand creativity and innovation, we should take a systems approach, which includes *multiple* factors from different perspectives and across levels, to analyze the interaction of the multiple factors and their influence on personal creativity and organizational innovation. Of course, the methodological challenges of the systems approach (see for a review Tang, 2015) need to be taken into serious consideration when implementing such an approach for training, research or management purposes.

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