Creative Game in Science

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Abstract

In this article, the metaphor of game provides insights into how successful Finnish scientists defined and depicted their creative processes. Data were juxtaposed from 26 life-story interviews of recognized scientists to reflect the complexity and individuality of the creative endeavor. Various stages and characteristics of creative processes are described in the form of a collective-data story, a collage-like dialogue that creates multiple layers of meanings to illustrate the creativity game and its elements (various roles, backstage work, rules of domain, and individual engagement).

Introduction

Researching the creative process could help to understand how and why some people are more successful in their creative practices than others. I came to view creative encounters in science as a form of game that is used to conduct successful scientific work. Thinking of creativity as a game benefits scientists in their careers and problem-solving processes by simultaneously keeping them focused and stimulating their motivation. Based on scientists' interview responses, I composed and created the elements of creative game. The parts of Goffman's (1956) play theory, where he proposed how performers have to follow certain rules and they have various roles to play while acting in front or backstage, provided the framework and creative environment to locate the elements of the creativity game.

The metaphor of creativity as game in science was created from 26 successful Finnish Academy professors (21 males and 5 females) during the open-ended interviews. These widely recognized scientists, who are also called academy professors, are selected for their 5-year research appointments through international peer-review processes. At the time of the interviews, the academy had a total of 29 professors (3 did not participate in my study). The Academy of Finland supports and finances the research of these internationally

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successful researchers from various discipline areas (e.g., physics, medicine, chemistry, biology, sociology, and education). Academy professors, who were between 35- and 65-years old during the interviews, had an average of 191 publications each and held academic senior professorships at Finnish or international universities.

Focused life-story interviews, which lasted two to four hours each, took place during 1998 in the academy professors' workplaces or their homes. Interview questions dealt with descriptions of a common working day, working habits, and various stages of professors' creative problem-solving process (see interview questions in appendix). Interview data were supported with the participants' curriculum vitae and the researcher's field notes. I transcribed and analyzed all interviews. Later I conducted member checks by sending primary findings and their interpretations to the participants for reading and evaluation. Member checks did not change my primary postulates related to creativity or the elements of the creativity game.

I did not introduce the concept of the game metaphor during the interviews, but I discovered the usefulness of it during the data analysis. The idea of a metaphor of game itself (game here also refers to the other closely related metaphors, such as "hunting," "shooting game," "chess," and "puzzle") describing scientific creativity and problem solving was used spontaneously for an example in six of the interviews. Other participants did not use the metaphor of game itself but described the elements of the game (e.g., intuition, dreams, a search for beauty) when they referred to their creative processes. Hausman (1987) extolled the meaning of examining metaphors in the creativity research: "I proposed that an appropriate way to study creativity is through a study of metaphor. Metaphors not only may exemplify creations, but they are also integral to sustained attempts to interpret and understand creative achievements" (p. 387). For example, Ville (all names have been changed) described the complexity and the individuality of the creative process and problem solving by using the game metaphor as related to truth: "Creative problem solving is a game where your purpose is to gain more knowledge. Your opponent in the absolute situation is truth itself. Truth never lies. You just ask questions from it. You cannot fool truth."

Another participant, Jaakko, referred to the same metaphor in a different context when describing both individual and cultural processes of creativity simultaneously:

> Science is like playing chess against an invisible opponent. If I do this move, I have to follow carefully my opponent's move and analyze that. I'm not the one who dictates the rules of the game. Those come from somewhere else.

In this article, I first introduce the game metaphor and the framing concepts of creativity. I use the application of Goffman's (1956) play theory to integrate his theory with my interpretations to support the elements of the creative game. Then I move to the collective dialogue, which is created to present polysemic and multiple perspectives of the creative process but not to search for one authentic understanding of creativity. Last, I connect the elements of creative game and individual experiences to the larger discourse of creativity research.

Metaphor of Game

The metaphor of the game served as a meaning-making tool for the professors, as well as for me. Various aspects related to the game metaphor in science helped the scientists to describe their experiences; they also guided my representation of scientists' epiphanies. "Metaphor is not just an ornamental linguistic device, but [it] is a common scheme by which ordinary people think and use language" (Gibbs, 1999, p. 213). In the larger context, metaphorical language can connect novel concepts to unknown concepts by using existing knowledge to create new knowledge (Lakoff & Johnson, 1980; Morgan, 1997; Radman, 1997). The process of metaphorical use of language could be seen also as the base of the theory building and reasoning in science. Gibbs even claimed that "It seems very sensible to suppose that the ability to think metaphorically is positively related to creativity" (p. 215), and metaphorical thinking could even contribute to the originality of the creative process (Mumford, Connelly, Baughman, & Marks, 1994).

> Metaphors are widely applied, that is, they are present almost everywhere where creative thoughts are at stake. Speaking, describing, explaining, and experimenting in metaphors is a result of the successful cooperation between the metaphoric instrumentalization of meaning and the mechanisms of the mind. (Radman, 1997, p. 68)

On one hand, metaphors are powerful tools connecting knowledge, time, and space; but, on the other hand, they are criticized for their value orientation by prioritizing one order of the facts over the other (Richardson, 1990) and creating ways of not seeing (Morgan, 1997).

Even though Hausman (1987) encouraged creativity researchers to incorporate the use of metaphors into their work, he doubted if creativity was a concept at all. Therefore, influenced by his thoughts

and a poststructural framework, the purpose of this study was not to search for one, true understanding but to create possibilities of viewing creativity and the creative processes in science differently by originating a richer, though partial, situated, and changing understanding of a creative process. This understanding is grounded in and presented through individual experiences in the form of collective dialogue. My hope is that readers will build their own understandings of the phenomenon and learn from others' encounters.

Creativity Theories of Individual and Cultural Processes

The concept and definition of creativity have agitated researchers for years. Should the definition of creativity be based on the person (e.g., Amabile, 1989; Gardner, 1993; MacKinnon, 1988; Martindale, 1989), on the product (Skinner, 1988), or on the creative process? For this article, I defined creativity as a process and looked at seminal work related to the process views of creativity. As E. P. Torrance described in an interview with Shaughnessy (1998):

> I tried to describe creative thinking as the process of sensing difficulties, problems, gaps in information, missing elements, something askew; making guesses and formulating hypotheses about these deficiencies, evaluating and testing these guesses and hypotheses; possibly revising and retesting them; and finally communicating the results. I like this definition because it describes such a natural process. (p. 442)

Torrance, among others, saw creativity as an individual process, where insights and problem-solving strategies played a significant role. Also, Wallas (1988), in his stage model of creative process (preparation, incubation, illumination, verification), emphasized intrapersonal factors of creativity, while Csikszentmihalyi (1996) viewed creativity more as an interpersonal process "where a symbolic domain in the culture is changed. New songs, new ideas, new machines are what creativity is about" (p. 8). This cultural process changes the domain, and the person acts as an agent of change. Creativity is born in the interaction between the individual, the domain, and the field. Similarly, Rogers (1988) extended the creative process to involve not only the person and the product, but also other materials, events, people, or circumstances of one's life.

The view of creativity as an individual process highlights a person's aims, capabilities, and means toward productivity; the cultural process regulates the forces of the field and the domain directing the

individual's productivity. The cultural process also pertains to the role of gatekeepers, who maintain the personal and social power of controlling the creativity field. The experiences of these professors, as well as the work of Sawyer and Csikszentmihalyi (1994), indicated that both levels of the creative process, individual and cultural, were interwoven and connected. Creative, successful work or effective novelty (Cropley, 1999) in science requires individual insights, personal input, as well as cultural tradition and transformed knowledge. Root-Bernstein (1999) grounded the roots of successful creative discoveries one third to the direct, primary problem-solving process; one third to the problem solving of similar problems; and one third to the activities done during the leisure time, as on vacation, in the shower, or during sleep. He also claimed that

> The basic drives (for making discoveries) seemed to be control, curiosity, necessity (need to discover, to find a cure, and so forth), serendipity (almost like a change, not really looking for this solution but working on something else), or aesthetics (beauty). Often several of these drives worked simultaneously. (p. 567)

Previous studies also showed that creative people see things in unusual ways and play with ideas, concepts, and elements (Csikszentmihalyi, 1996; Roe, 1988; Rogers, 1988. Sternberg, 1988). But why and how do they do it? An essence of the creative process can be understood in the way scientists utilize contradictory thoughts to understand disparate ideas simultaneously, as Rothenberg (1988) indicated in his concept of "Janusian thinking." One professor described his Janusian thinking as follows:

> I am able to analyze contradictory thoughts simultaneously in my head. I will put a fence between thoughts and in the other side I use different strategy and in the other side another strategy. I know that before the thought is ready I cannot take the fence out. Finally when the solution is clear and whole, the fence could be taken off and various parts can be connected.

This participant's strategy of using contradictory thoughts, however, connected the creative process to the problem-solving strategies in a singular, one-faceted presentation of the whole process of creativity instead of presenting various spaces, as Dunbar (1999) guided creativity research toward characterizing scientific creativity "as a search in various problem spaces" (p. 529). I decided to combine many views on and insights into creativity through the use of game metaphor to provide readers with wider, sometimes even con-

tradictory, excerpts. Creative game as used in this article mostly highlights creative problem solving in science, but it dismisses many other aspects of creative encounters.

Concepts of Goffman's Play Theory Applied to the Everyday Life of Scientists

Goffman (1956) postulated that interactions among people could be viewed as a play. Each performer has a role and may act in the front region and in the backstage. He also explained how certain settings demand specific performances, which are controlled by the set rules.

In this article, I use some concepts of Goffman's play theory to construct the metaphor of creative game in science, as participants of this study have defined it. Especially, I focus on and elaborate four points: the various roles of professors; the backstage work; the rules of discipline, which are controlled by gatekeepers; and the rules of individual engagement created by the scientists themselves. As the players in Goffman's theory, academy professors had various roles to play: a player against a visible opponent, a hunter of ideas, a lazy thinker, an efficient cooperator, a writer, and a painter, among others. Scientists' multiple roles were directed by gatekeepers, the rules of the domain (e.g., types of acceptable products, leadership requirements, working schedules), stages of the creative process, and the nature of working environments (e.g., laboratory, hospital, school, business world). For instance, scientists had different roles as independent creators but were also members of the larger scientific communities and, usually, the leaders of their labs.

As in the role of individual creator, many stages of the creative process can happen backstage, where other people cannot witness the process (intuition, incubation of the ideas; see, for example, Wallas, 1988). The process of incubation rarely happens around other people; it sometimes even requires a silent, lonely place where the creators can isolate themselves from the others. On the other hand, in the front stage, professors cooperate with national and international colleagues, making their work public by sharing the research process and its results. The image of the solitary scientist working long hours in the laboratory must be combined with a view of the cooperative and international presenter. Many of the interviewed scientists confirmed Dunbar's (1999) notion of the significance of *group power* and asserted the importance of contributing reasoning to many individuals. Additionally, looking for truth and real meanings was constituted as a central part of the backstage creative work (MacKinnon, 1988). According to the scientists in this

study, it seems as if they experienced an inborn desire to find solutions, to solve mysteries, which motivated them to reach their limits and work overtime.

In the process of trying to understand these scientists' creativity, I used Csikszentmihalyi's (1996) theory of talent development to guide me in seeing how the game of creativity was closely connected to the individual, to the domain, and to the field. Similarly, as noted in Goffman's (1956) theory, *play* is directed by the set of rules; the creative game in science cannot operate without the rules of discipline or the elements of individual engagement. The gatekeepers of the field created the rules of the discipline (see also Kuhn, 1996) by controlling which products are considered creative and, thus, which will become accepted as new parts of the domain. While discipline rules were sometimes well established and known, silent rules, which were more implicit or sometimes unspoken, also existed. In many cases, unspoken rules were taught to new players by mentors (Piirto, 1992; Raehalme, 1996; Sternberg, 1996) or by other members of the scientific community when novices pushed the limits of what was considered acceptable ways to practice science.

It could have been the understanding or following of the rules of the discipline that made these research participants the key players and leading developers of their fields. They held the most recent knowledge, and it became their responsibility to put the knowledge into practice as well as to distribute it wisely. Some of them found the role demanding and hard to play due to the expectations, budget limitations, and various conflicting roles or paradigms. For instance, one participant recalled a situation where he wanted to add a part to his study from another discipline's knowledge; his mentor, however, made it clear that discipline lines were not to be crossed in this field. In spite of some creative and logistical obstacles in their academic careers, the enjoyment of the challenge kept most of the professors focused and prolific.

Similarly, as creativity simultaneously appeared to be both an individual and a cultural process, the discipline rules of the game and individual elements of engagement overlapped and coexisted in the life of the professors. Professors created strategies to nourish their creative processes and identified significant environments where they felt comfortable to create (Rogers, 1988). Each also found and established some additional individual elements to help maintain the productive creative game. In the following collective data story, I discuss in more detail how the application of Goffman's (1956) play theory interacts and connects to the game metaphor and to the professors' creative processes.

Methodological Moves Toward Collective Data Story

Early in the data analysis process, I searched for themes relating to creative processes inside individual cases across all 26 professors. I identified various themes describing creativity and creative work. The participants explained themes through metaphors (e.g., game, puzzle, creative gear, computer, shooting a target). For example, Reijo used a puzzle metaphor to illustrate themes of dissatisfaction with previous knowledge, intuition, and cooperation of creative work. When comparing data across the cases (Yin, 1994), the game metaphor became the most descriptive linguistic device to illustrate the data. The game metaphor captured the meanings created through other metaphors and pulled together individual creativity themes and responses (e.g., metaphors of puzzle, creative gear, and shooting the target can be viewed as forms of a game where preconditions of a game, such as time, place, and various strategies, become meaningful). During the interpretation of the game metaphor, I realized how it connected with some concepts of Goffman's (1956) play theory (players have multiple roles to play, some events occur backstage, various rules exist to control the play). Goffman's concepts provided an environment and created circumstances that made the elements of creative game possible.

While some of the professors in this study used metaphorical language to shape their thoughts, explicate complex phenomena (Weiner, 1991), and communicate better (Gibbs, 1999), others did not use any metaphors to expound on their thinking. These quotes of creative processes were collected from 12 participants (male and female) who used creativity metaphors or described the stages of their creative processes instead of emphasizing creative persons or products during the interviews.

Purposes of the Collective Data Story

In the following data story, which I call a *collective data story* or *collective dialogue of scientific creators*, I have juxtaposed data from the interviews of those 12 participants who used metaphors or described the elements of the creative game in order to reflect the complexity of the creative process. In this story, scientists shared their experiences in academia and interacted with each other, agreeing and disagreeing as to how their creative processes work. Additionally, I wanted to illustrate the multilayeredness of intuition, incubation, curiosity, cooperation and solitude, opponents and mentors, and consciousness and subconsciousness. Richardson (1985) used a similar

collective technique in her book, *The New Other Woman: Contemporary Single Women in Affairs With Married Men,* and explicated the structure of her collective story:

> The particulars of the stories were different, and there were different subplots, but the main thematic was the same. I had discovered the Other Woman "collective story," a historically situated story, whose theme and plot differs from the established cultural story. (p. 30)

In this article, the examples selected for the collective story described either the game metaphor itself or its elements, such as curiosity, intuition, physicality, or game strategies. Additionally, the quotes present various strategies of creative problem solving and diversity of experiences related to the creative process. The polysemic creativity themes are presented in the form of a dialogue, where the participants of the dialogue are created by the author (they do not represent any single academy professor); but the quotes, words, and messages as they appear here in the text were taken from the original interviews. The quotes, forming lines of one person in the collective dialogue, were drawn from various interviews and from various professors. However, inside one paragraph, the same person is speaking; thus, the paragraphs present one, whole message from a single professor.

This collage-like technique was used to illustrate the themes and elements of the creativity game more effectively (see Lather & Smithies, 1997). In the collage, I also arranged preexisting information in novel ways to render postmodern thinking (Brown, 1999). The technique speaks for multiple realities and refuses to claim one true description. Instead of creating individual case stories or portraits of the professors, I mixed many voices to make a collective dialogue. The collective dialogue is a type of "messy text" used to "reflexively map multiple discourses that occurred in a given social space. Hence, they were always multivoiced, and no given interpretation is privileged" (Denzin, 1997, p. xvii). Within the collective dialogue, speakers can disagree with each other or contradict themselves. Lather and Smithies described their purposes of creating a messy text in the following way:

> Trying to find a form that enacts that there is never a single story and that no story stands still, we practiced a kind of dispersal and forced mobility of attention by putting into play simultaneously multiple stories that fold in and back on one another. This raises for readers questions about bodies, places, and times, disrupting comfort spaces of thinking and knowing. (p. 220)

I believed that it was important in the collective dialogue to not prioritize any voice or view of creativity because creativity experiences seemed to be very individualistic, situated, and always changing. Therefore, in collective dialogue, data and interpretation become more layered, complex, and nonlinear when compared to other more traditional forms of representation.

Additionally, I constructed collective dialogue to protect identities of the participants. Lather and Smithies (1997) described in their book, *Troubling the Angels,* how they took quotes out of sequence and combined them across support groups to enhance "theme development, dramatic flow, and to protect confidentiality" (p. xvii). In my collective story, I also added some additional words, such as "for me," "yes," " I don't know," or "I agree with you," to make the dialogue more coherent and paragraphs more connected.

The collective story produced snapshots of moments in a person's creative life. "Lives did not stand still however. The whole was always in flux, so the level of creative output will vary greatly with the passage of time" (Dacey & Lennon, 1998, p. 11). Various stories of the creative process as a game produced moments of authenticity (Denzin, 1989), and multiple voices provided a possibility for readers to resonate with the dialogue. Richardson (1985) referred to the validity of her study of other woman and stated how "validity will rest in whether what I present resonates with the experiences of other Other Women" (p. xii). Similarly, part of validity of this analysis and representation rests in whether other scientists, in addition to the 12 scientists whose quotes were used to create the dialogue, will recognize and resonate with the concept of the scientific creativity game and its elements.

Collective Data Story

Riikka: I could define scientific work as a game with an invisible opponent. First, I do this move, and then I wait for the opponent to make his move. Then, I have to analyze his move. It is not me who dictates the rules; it is my invisible opponent.

Kalle: Yes, as a player I have to be sensitive. Keep my feelers up and figure out what is going on, what other people are doing. I hunt for ideas.

Veini: I can't produce the solution immediately; it will be found through intuition. In my brain, there is some kind of model that self-activates. A good inventor has a detector that tells him immediately

that this is wrong. Everything starts from the dissatisfaction. I'm dissatisfied with the existing situation and, therefore, look for new solutions.

Reijo: For me, everything new is challenging. When something goes or works just the opposite way than expected, that fascinates me. But tell me, how do you come up with your good ideas?

Kalle: I sit by the lake and do nothing. You have to be lazy enough that ideas will come. I have to have my vacation when I can just sit still and do nothing. When the batteries are unloading, the larger, long-term visions will appear. You have to have time to think and stare at the water.

Reijo: Well, I need well-structured daily routines in order to be creative. I have created a very aesthetic rhythm when I go to the countryside to my cottage. Every day I have exactly the same schedule. I get up, write, walk with my dog, check out my fishing nets around 5:00, continue writing, and go to bed around 9:00. There are no neighbors, just darkness and the sounds of nature. When I am there by myself and do my daily chores, thoughts just flow. New questions arise from the subconscious, and the process goes on.

Kalle: One place that works for me is an airplane. When I fly to New York, for example, and sit on the plane for 8 hours and read, ideas inevitably appear. Another time is in the mornings in the shower. I have gotten into the habit of writing my ideas down immediately; otherwise, I will forget them. As a matter of fact, I think I do a lot of thinking subconsciously; when I wake up in the middle of the night, the idea is clear. I have a pencil and a notepad beside my bed. I just write.

Reijo: Talking about nighttime and ideas appearing in the dreams, one time I had this difficult question without the solution. Suddenly we (me and Heikki, who is my coresearcher) were in my dream and in the train, which was going from Oulu to Kuopio. During that train trip, Heikki explained this solution to me. And it was the right solution. When we published the results of our study, we nicknamed it the "Oulu-Kuopio train theory."

Jaakko: That could be true for you, but I do not believe in ideas that appear in dreams.

Riikka: I do not know; I think that there is something subconscious in the creative process. For me it's like a computer, which is working in my head all the time, or like a diesel car. The first 4 hours are gone before the car is warm.

Kalle: I agree with you. The creative process takes time. I write a story and put it aside for a while. Then, when I return to it, I can immediately see what is wrong with it. I will write it again. I may do the rewriting many times because it clears my thoughts.

Reijo: Being patient is still not enough; you have to also believe in your vision. When I create, I will give a birth to the idea. I will carry the idea in my mind, and it is delivered when it is ready. For example, after almost 10 years of experiments and linear research, the solution suddenly appeared. We were not sure if the chosen direction was the right one. But then one night when I was working in the lab, everything just found its place. I knew this was going to be a big discovery. I have heard that some scientists have very aesthetic ways to see their work and their texts. It has to be almost perfect and whole—the whole that could be read as a painting. Have you used specific strategies to approach the problem?

Riikka: Ideas might appear when I buy milk. How I get the idea or where it comes from is hard to describe. It is like mystics; it arises from the desires or from fantasies. I have a specific feeling. It might happen when I sleep.

Veini: For me, the creative process is like shooting at the target with many bullets from various directions. I will try to reach the goal with different strategies. Little by little, I can make sense of what the target looks like since I am able to see what kind of marks the bullets have left. Using numerous tools is the key.

Kalle: Writing helps for me. I incubate, and problems go through the subconscious. But I have to prepare myself by reading, thinking, and puzzling with my thoughts. I have to input material into my brain constantly. I try to reach consensus inside my head to find a new structure. The way that I organize or code my thoughts is essential.

Reijo: In addition to all that, for me creativity is born in the interaction. Every day I have to meet people, talk to them about my ideas, and get feedback. I also talk aloud a lot, which clarifies my thoughts. Scientific work is like putting the puzzle together. Someone else has

tried to solve it before, but he has put the pieces in the wrong order. It is my job to figure it out, find the mistakes, and put the pieces in their right places.

Commentary on the Collective Story

The collective data story was the form of representation chosen to illustrate stories and lived experiences of the scientists. Although the creative processes among these scientists were situated, flexible, individual, and transformative, common elements of the creativity game were traced across the interviews and resulted from the cross-case analysis. These elements are presented below, but not in any specific order, to answer the research questions of "What is needed for significant insight to develop and occur?" and "How does the creative game help to understand the structure of problem solving?" After introducing the elements, which are themes from the interviews and from the collective dialogue making the creative game possible, I ground all four of them into the data, a theoretical frame of creativity, and into Goffman's theory. I also illustrate the connections among the elements, the findings of previous studies of creativity, and the data.

- Preconditions of a creative game: A dissatisfaction of previous knowledge, an ability and intuition to see the interesting and right problems, curiosity, and competitive mind.
- Physicality (place of the game): An ability to find individual ways to work comfortably mostly in the backstage by being in nature, in a sauna, in the shower, for example. Solutions to complex problems appeared in dreams; there existed a need for an ascetic rhythm.
- Process (the game itself): A need for time (especially during the incubation of ideas) and an unceasing interest in the domain.
- Game strategies: An intuition, an ability to use writing to clear the thoughts, a search for the beauty in solutions, cooperation.

In the following illustration of the elements of the creativity game, Goffman's (1956) theoretical concepts (various roles, backstage work, rules of discipline, and individual engagement) were interwoven into the description of each element. His concepts constituted a discourse and a basic structure that connected the elements together, directed the implications of the elements, and described the circumstances that made the elements and the creativity game possible.

When investigating the creative process in science, some preconditions are needed in order for the creativity game to occur. Professors like Veini felt dissatisfied with current knowledge, or they found gaps to address in their current practice or paradigm. In order to find the gaps, it was necessary first to understand and accept the larger discourse and the rules of the discipline (Kuhn, 1996). The values of the discipline (domain) controlled the creation of new, acceptable knowledge, as well. Therefore, scientists had to constantly create new branches in the tree of previous knowledge. "The expert was able to relate a novel problem to something already known and to use this knowledge as the basis for dealing with the new problem" (Weisberg, 1988, p. 154). Groundbreaking ideas were usually born in the intersection and cooperation of many domains, which reflected a component of front-stage work. "It is necessary to have enough knowledge to take the creator to the edge of the field but still be flexible enough to go over the border" (Starko, 1995, p. 104). It is not enough to see inadequacies; one must also overcome them.

Formulating good problems, the role of *idea hunter* was identified as a part of successful intelligence (Sternberg, 1996). Successful scientists can determine which problems are worth solving and which are not (Csikszentmihalyi, 1996; Sternberg, 1996; Walberg & Stariha, 1992). That attribute can be characterized as an ability to select intuitively important problems (Martindale, 1989) as an act of "putting out feelers" (Goffman, 1956, p. 121) or as sensing what is important and crucial but not said.

> Rather than being victims of the unexpected, they create opportunities for unexpected events to occur, and once these events do occur, they have specific reasoning strategies for determining which of these events will be a clue to a new discovery. (Dunbar, 1999, p. 527)

How did the professors know some problems were more valuable than others? Maybe it was intuition, which became useful and perhaps needed in the stage of sensing the problems. Many professors, such as Veini and Reijo, incorporated play with different solutions or the fascination of opposites as part of their creative process. These professors had enough background knowledge to be able to differentiate the valuable problems from less valuable and interesting ones.

The creative process was as much a game that engaged the mind as one that included body. The professors emphasized the importance of finding their own rhythm to work. For example, Reijo and Kalle

removed themselves from established everyday discourses and environments to improve their productivity. Usually they escaped daily routines, and the initial but substantial part of their creative work was conducted backstage, where professors were able to create a comforting, familiar atmosphere. Csikszentmihalyi's (1990) concept of *flow* portrayed well the participants' experiences of the creative process. Csikszentmihalyi developed the theory of optimal experience based on the concept of flow: the "state in which people are so involved in an activity that nothing else seems to matter; the experience itself is so enjoyable that people will do it even at great cost, for the sheer sake of doing it" (p. 4). Riikka illustrated how organizing, writing, and reorganizing thoughts took time, but the academy professorship allowed her to forget the time while working. Whereas, Kalle described it thusly:

> I am thinking about theory all the time. It is hard to say when I am working and when I am not. Time just passes. I do not do anything else. On one hand, it appears that I am doing many things; but, on the other hand, I am only working.

Among Kalle, Reijo, and Riikka, ideas appeared in the garden, in the shower, in the airplane, in dreams, and so on. Scientists freed their minds and allowed time and space for new ideas to appear. The "creator must suspend conscious ego control to dip down deep into 'primary process' thinking—the process of fantasy, daydreaming, wishes, and irrationality" (Simonton, 1994, p. 95). Weisberg (1988) referred to Kekule's dream where Kekule found the solution of the structure of benzene in his dream. Previous research and experiences of these participants illustrated that "the richness of associations, intuitions, imagery, and dream-like thinking" (Simonton, 1994, p. 98) was necessary to create successful solutions to the problems. Dreams and daydreams became part of an incubation process for fruitful research. During the incubation, creators, such as Kalle and Reijo, played with alternative solutions and multiple discourses, while at the same time evaluating the value of various solutions to their work (Sawyer & Csikszentmihalyi, 1994; Wallas, 1988). The incubation stage took time (Patrick, 1988); it lasted hours or years, until a person's mental map of the solution became ready.

In addition to being sensitive to the problems and a variety of solutions, it was important to aim toward finding beauty, looking for "beautiful solutions," for example, in the role of painter. Some scientists, like Kalle, were not satisfied until the problem or solution had reached the beautiful shape of thoughts. The play with thoughts was an important and motivating part of the creativity game.

For many of these professors, as the example of Reijo indicated, writing was one form of clearing thoughts and making sense of ideas. Richardson (1994) elucidated that writing was a "process of discovery. A process where I find something out. I write in order to learn something that I didn't know before I wrote it" (p. 517). According to Piirto (1998), creative writers make sense out of their work by writing. It clarifies their thoughts. In addition to writing, speaking loudly fostered creators to make better sense of their thoughts.

Another game strategy used by these academy professors was intuition. It played a significant role in the problem-solving stage (e.g., Sawyer & Csikszentmihalyi, 1994; Wallas, 1988). According to Planck (as cited by Simonton, 1994), the "scientist must have a vivid intuitive imagination, for new ideas are not generated by deduction, but by an artistically creative imagination" (p. 93). Simonton called the ability described by professors Kalle, Reijo, and Riikka a "mavericity, the property of making unusual associations in ideas, of doing the unexpected" (p. 93). The unusual association of ideas occurred mainly below the threshold of consciousness. "Consciousness does not have to be obsessed with chaos, so long as subconsciousness is pursuing the byways and alleys of memory. Then 'out of the blue' something potentially brilliant emerges, thrusting itself into central consciousness" (Simonton, 1994, p. 94).

The Dilemma of Capturing Creativity

The individual and situated creative experiences of these scientists trouble the notions of a common, universal creative process, but they open up possibilities to learn from the collective dialogue and professors' experiences. When readers analyze how to connect their personal creative processes to Goffman's play theory and to the game metaphor, they can make better sense of their own creativity. What roles do you play, how do you organize your backstage work, and how do various rules of discipline and individual engagement direct your own creative processes? Could previous strategies make you more successful in your creative encounters? Can the use of metaphorical language point to some unique connections about creativity? Can you view creativity as a game with a playful attitude?

Given the multidimensionality of creativity, readers have to be aware that the quotes used in the collective dialogue were not meant to cover the creative process in its individual or cultural wholeness, but to illuminate the examples of particular professors' creative practices. The choice to use the game metaphor in describing creativity

represented only one approach to viewing the creative process in science at any specific time, place, or discourse. These experiences do not necessarily match or reflect the experiences of every scientist because these Academy professors had enough freedom, time, and money to pursue their academic interests and follow their intellectual curiosity.

Therefore, there are still many stories to be heard. The drawing of a complete picture of human creativity seems almost impossible for any researcher. To have collected the scientists' responses and variety of explanations together in isolated categories or detailed generalizations would not have done justice to any of the professors' individual experiences. We cannot ever become the other or fully understand or represent each others' experiences, but we can offer interpreted glimpses of participants' stories (Talburt, 1999). In this research, the dialogue with different participants helped me to reach equilibrium in presenting multiple voices and realities while still preserving individuality and feelings of real experiences.

To sum up, I believe that creativity for all should be about the change and seeing the surrounding world with different eyes. It is also a question of possibilities, having a wider range of experiences, the courage to implement new ideas, and a willingness to play a creative game. It is crucial to know the history of any domain as well as to have the capability to go beyond existing knowledge in order to bring innovations to the field. Creative workers in science may learn to play according to the rules of the game but simultaneously allow opportunities for exploration and discoveries. After reading and analyzing professors' stories, I committed myself to presenting a multidimensional and unmediated perspective of creativity without creating strong boundaries around the phenomena. I believe that creative approaches should be encouraged in studying creativity, especially because we cannot be sure what creativity is about, after all. Can we ever prioritize one's experiences of creativity above the others? Can there ever be one *true* approach to creativity?

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Appendix

Interview Questions Related to Creativity
How do you describe your creative process?
What is the role of creativity in your work?
Do you have certain places or times when ideas occur?
If you face a difficult problem, how do you come about to solve it?
How do you find or create motivation after a less motivating period of assignments?
What kind of assignments provides you the most pleasure?
Have your working habits changed during the years?
How do you differ (if at all) from colleagues who are not as creative?

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