Analogical modification in the creation of contemporary art

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Abstract

The goal of this study was to propose a framework to describe the analogical process in the context of creation. We conducted retrospective interviews with two contemporary artists in their forties using portfolios of their past works so that they could recall their creation processes in detail. We found that the artists often use analogical modification to produce new series of artwork. Analogical modification is a cognitive process used to generate a new target, in the context of creation, by changing values of a source to make differences during analogical mapping. We found three types of analogical modification, namely, subject modification, structure modification, and concept modification. Creative vision, which is formed through many years of creative activity and consists of long-term intentions or goals for creation, plays an important role in guiding the use of analogical modification. The process of artistic creation can be better understood using the framework of the interaction between activities in different time spans, such as analogical modification and creative vision.

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1. Introduction

1.1. Analogy in the context of creativity

It has been pointed out that analogy takes important roles in various human cognitive activities such as understanding, problem solving, creation, and so on (Holyoak & Thagard, 1995). Many empirical studies on analogy have been conducted and cognitive models of analogical mapping process have been constructed (e.g., Gentner, 1983; Gick & Holyoak, 1980). Mainstream analogy research has usually been conducted in the context of understanding and problem solving. Despite differences of approach, researchers agree that the analogical process consists of representation of a target, searching for a source, mapping from the source to the target, and justification of the mapping, and then learning from the experience.

Involvement of the analogical process in creative activities has also been pointed out. For example, with anecdotal evidence, Holyoak and Thagard (1995) stated that the analogical process plays an important role in scientific discovery and design. Based on detailed analysis of data from the history of science, Gentner, Brem, Ferguson, and Wolff (1997) also described the process of analogy used by Johannes Kepler while he was developing a causal theory of planetary motion. In the domain of design, it has been pointed out that the analogical process is involved in the generation of design concepts (Bonnardel, 2000; Dahl & Moreau, 2002).

The major difference between the context of understanding or problem solving and the context of creation is that...
an analogy user is given a target in the former, while s/he has to generate a target by her/himself in the latter. According to Genter’s structure-mapping theory (SMT; Gentner, 1983), when a person uses analogical mapping, s/he has to abstract a similar structure or dimension between a source and a target, ignoring features that are different between them. However, in the context of creation, paying attention only to the similarities between them is not enough, a person also has to pay attention to the differences in order to generate a new target, i.e., to create a new thing or event (See Fig. 1). In order to capture the analogical process in the context of creation, we focus on “analogical modification” for generating differences in the analogical process. Analogical modification is a cognitive process used to generate a new target, in the context of creation, by changing values of a source to make differences during analogical mapping. Analogical modification follows the framework of analogical mapping in the sense that it abstracts a structure, or a dimension, in a source and maps it onto a target. However, it also has a new feature, different from those of ordinary analogical mapping in the context of understanding and problem solving. It generates a new target by actively making differences.¹ This feature of difference making was not a main focus of previous studies that investigated the analogical process in creative domains such as design (e.g., Bonnardel, 2000; Dahl & Moreau, 2002).

Studies of understanding and problem solving suggested a process similar to analogical modification called adaptation (e.g., Novick & Holyoak, 1991). Novick and Holyoak (1991) discovered that just mapping a solution from a source problem to a target problem was not enough to succeed in mathematical problem solving and that it was important for the solvers to adjust the solution procedure of the source to the target. Such adaptation has some common features with analogical modification in the sense that people need to flexibly change some features of a source structure to apply it to a new situation. However, there is a very little room remaining for people to modify goals and procedures, in the context of understanding and problem solving, because they are required to work on clear goals in order to understand something or solve a problem. On the other hand, in the context of creation, it is sometimes necessary for people to change such constraints, such as goals and procedures, in order to generate a new target. Thus, analogical modification for creation is different from adaptation for understanding and problem solving in the sense that it has the function of target generation.

To explain the process of creation, there are several computational models focusing on the creation of new features (e.g., Hofstadter & the Fluid Analogies Research Group, 1995; Indurkhya, 1998). For example, Hofstadter et al. (1995) proposed a computational model, Copycat, for solving letter-string analogy problems. They assumed that analogy is the cognitive process of mapping from an object A in one domain to an object B that has an equivalent role to A in another domain. However, it often occurs that such objects do not actually have equivalent roles in the two domains. In such a case, two concepts slip into neighboring concepts in order to make the mapping successful. This process is called conceptual slippage. New features and new structures are created with this conceptual slippage.

Though these models are useful for explaining the process of creation, it seems that they are not sufficient for capturing the full mechanism of analogical process in the context of real-life creation, because they have tried to capture the analogical process only as an activity occurring during a short time span. When we take a closer look at the creative process in real-life settings such as artistic creation, we see that professional creators often spend many years, even decades, continuing to create many works, while previous models have focused only on the process of creation of one idea or one work. Therefore, to fully understand the function of analogy in the context of creation, we need to capture the analogical process by professional creators situated in the long-term process of developing their expertise. In the next section, explaining previous studies of artistic creation, we point out the importance of identifying analogical processes in relation to activities over longer time spans.

1.2. Cognitive process in artistic creation

Among the many domains of creativity, we focus here on artistic creation in order to describe the process of analogical modification. Because artistic creation has been one of the core activities of human beings — as shown in historical artifacts, such as the ancient—mural paintings of Lascaux, created about 15,000 years ago — we believe that describing the process of analogical modification in artistic

¹ There are at least two possible types of target generation. One consists of combining related features randomly. Another consists of generating a target using cognitive rules. In this paper, we focus on “analogical modification” as one of the latter activities.
creation brings us useful insights for constructing cognitive models of the analogical process in the context of creation.

Although there have been many studies conducted on the art appreciation process (e.g., Arnheim, 1974; Berlyne, 1974; Child, 1965), the artistic creation process by professional artists has not been well studied yet, with only a small number of exceptions such as Getzels and Csikszentmihalyi (1976), Mace and Ward (2002), and Yokochi and Okada (2005).

Mace and Ward (2002) constructed a descriptive model of the artistic creative process based on data from interviews with 25 artists. In this model, artistic creation process consists of four phases: conceiving of the artwork, developing the idea, making the artwork, and finishing the artwork and resolution. They emphasized the importance of generation and development of concepts and ideas before actually making an artwork. Yokochi and Okada (2005) conducted field observations and an experiment in order to capture the creation process of a Chinese-ink painter. They discovered that the painter intentionally used other people’s lines as a constraint and, from these, generated new images to create a new style of painting. These studies indicate that the process of generation of ideas and concepts is crucial for artistic creation.

There are also studies that try to capture artists’ creation process over a longer time span. Yokochi and Okada (2007) have investigated the process of the development of artistic expertise. Using artists’ portfolios of artworks, created since they started their careers, they asked 13 contemporary artists to describe their intentions and techniques as well as long-term changes of activities in the process of developing expertise. They identified three phases in the process of developing artistic expertise: “constrained by external criteria”, “forming one’s own internal criteria”, and “harmonious creation”. When the artists were young, they made artworks based on external criteria. Later on, they recognized the limitations of this approach, and started to focus on internal criteria. Finally, on average about 13 years after beginning their artistic careers and having created several series of artworks, artists formed their own personal creative vision and became able to make artworks with confidence. Creative vision is defined by the artists’ long-term intentions, or central goals, for creation, and these underlie the process of artistic creation over a long time span. The artists in the third phase create original artworks under the guidance of such creative vision. Based on interviews and observation, Israeli (1981) also pointed out that artists develop consistent styles of creation over a long time span.

These studies suggest that to fully understand the process of artistic creation, we need to investigate the relationship between the short-term process of creation of an artwork and the long-term process of creative expertise. By only paying attention to techniques used in the creation of each artwork, we will not be able to figure out why the artist uses specific motifs or gets fixated on certain colors, or in which direction s/he will move forward. Such reasons for actions or goals, for her/his creation of each artwork, need to be understood while being situated in the context of activities in the longer time span. If we do not capture the relationships between short-term and long-term creation processes, we will be able only to microscopically describe the cognitive process that the artist uses, although we do not deny the importance of such studies. On the other hand, if we focus only on activity over a long time span, such as the development of creative vision, we will not be able to understand how daily creative activities are guided by that creative vision and how such creative vision is formed and clarified through the accumulation of daily creative activities.

### 1.3. Constraints on analogical modification

This framework of interaction between activities in different time spans has important value for clarifying the function of analogical modification. As shown in a latter section of this paper, we find that contemporary artists frequently use analogical modification. It is theoretically possible for an artist to create unlimited numbers of expressive techniques by using such analogical modification. However, if s/he were to use it randomly, it would be impossible to establish the personal, original style of art making which characterizes many prominent artists. Therefore, some constraints, such as knowledge accumulated through the long-term process of developing expertise, are needed for an artist to choose meaningful techniques among an unlimited number of possibilities. We focus on super-ordinate concept and creative vision mentioned above (Yokochi & Okada, 2007) as such constraints on timing and direction of analogical modification use.

A super-ordinate concept is defined as an abstract concept that has the common features of concrete examples (Hatamura, 2003). Hatamura claims that things and events consist of element, structure, and function. In order to cre-

### Table 1

<table>
<thead>
<tr>
<th>Term</th>
<th>Explanation</th>
<th>Examples</th>
</tr>
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<tbody>
<tr>
<td>Creative vision</td>
<td>Long-term intentions or goals for creation that underlie the process of artistic creation over a long time span</td>
<td>“How should the world be viewed?”, “Death and life”, etc.</td>
</tr>
<tr>
<td>Super-ordinate concept</td>
<td>An abstract concept that has the common features of concrete examples</td>
<td>“Erase the meaning”, “Continuity”, etc.</td>
</tr>
<tr>
<td>Expressive technique</td>
<td>Skills and methods used to create artwork. In this paper, we focus especially on cognitive techniques used to create artwork</td>
<td>“Erase the main character”, “Connect drawings with rotation”, etc.</td>
</tr>
</tbody>
</table>
ate something new, it is thus necessary to create a new function combining elements and structures. To do so, elements need to be organized at a higher level by using a super-ordinate concept. For example, a super-ordinate concept for a steering wheel and a brake of a car is a “control device for driving”. Using such a super-ordinate concept, we can search for a new type of control device for driving such as a micro-computer controller to automatically avoid a traffic accident. Thus, by going up to a super-ordinate concept level, the combination of elements is restructured and new elements are chosen to create a new thing or event. If we compare the old elements and the new ones, we can tell that analogical modification with a super-ordinate concept occurred here.

On the role of abstraction in creativity, Ward (1995) also pointed out that going up to a super-ordinate concept and choosing another solution are very important ways to discover better solutions without being distracted by irrelevant elements.

### 1.4. Three types of analogical modification

Based on the issues that we have described above, we can assume several types of analogical modifications according to their relationship with activities in different time spans. In this paper, we focus on three levels of activities in different time spans, i.e., expressive technique, super-ordinate concept, and creative vision. (See Table 1 for explanation.) One type of analogical modification is an artist applying an expressive technique used in a previous artwork to a new subject and thus creating a new artwork. We call this type of modification “subject modification”. Another type is an artist modifying parts of the structure of a source within the same super-ordinate concept to create a new artwork series. This modification is guided by a super-ordinate concept, and is called “structure modification” in this paper. The third is an artist generating a new super-ordinate concept under the control of her/his creative vision in order to create a new artwork series. We call this modification “concept modification” (See Table 2 and Fig. 2).

Subject modification is a process that generates a target by changing the subject during analogical mapping in the context of creation. In analogical mapping, in the context of understanding and problem solving, only similarity between a source and a target is focused upon and differences between them are usually ignored. However, in order to generate a target for creation, differences between source and target also need attention. Let us explain this point with an example from movie making.

“The Magnificent Seven” (Sturges, 1960) is a famous Western movie regarded as a classic. This movie was a remake of “The Seven Samurai” (Motoki & Kurosawa, 1954) that mapped the structure of the samurai movie onto a Western movie. The story of “The Seven Samurai”, in which Samurai fighters and farmers together fight against samurai bandits in a small farm village in Japan, was mapped onto the story of “The Magnificent Seven” in which gunmen and peasants together fight against bandits in a small farm village in Mexico. In the process of mapping, to adapt the story, in order for it to make sense against the cultural background of America and Mexico, the director created many new features that were different from “The Seven Samurai”. In order to explain the process of creation of new features and structures in this way, the Copycat model of Hofstadter et al. (1995) seem to be useful. However, the process that we want to focus on, in this paper, is the process of generation of the new target, in this case, the Western movie. This analogical process can be regarded as a subject modification, because the director changed the subject and generated a new target. This is different from other types of analogical modifications, in the sense that neither super-ordinate concepts nor creative vision is involved, at least at a conscious level.

On the other hand, structure modification and concept modification work under the influence of super-ordinate concepts and/or creative vision. Structure modification is an analogical modification used to create a new expressive technique, in line with a super-ordinate concept, which underlies series of artworks. Concept modification is the process of changing a super-ordinate concept in order to generate a new target. Usually starting from a structure modification in line with a super-ordinate concept, other super-ordinate concepts are also activated in the process of artistic creation. Under the guidance of creative vision, a new super-ordinate concept that fits better with this creative vision is chosen. These types of modifications proceed over a fairly long time span. No research has focused on the process of analogical modification over such a long time span.

<table>
<thead>
<tr>
<th>Cognitive process</th>
<th>Feature creation</th>
<th>Target generation</th>
<th>Involvement of a super-ordinate concept</th>
<th>Direct guidance by creative vision</th>
</tr>
</thead>
<tbody>
<tr>
<td>Analogical mapping/adaptation</td>
<td>○</td>
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<tr>
<td>Analogical modification</td>
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<tr>
<td>Subject modification</td>
<td>○</td>
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<tr>
<td>Structure modification</td>
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<tr>
<td>Concept modification</td>
<td>○</td>
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<td>○</td>
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1.5. Outline of this research

Through case studies of two contemporary artists, we describe how each type of analogical modification is used to create a new expressive technique. Although Yokochi and Okada (2007) discovered that artists construct creative vision over a long time span as part of the process of developing expertise, they did not focus on the short-term creative process. Our study picked two artists from the artists in the work of Yokochi and Okada (2007) and conducted additional interviews and detailed case analyses in order to capture the interaction between artistic activities across different time spans.

This study adopted qualitative case analyses in order to propose a useful framework and new hypotheses for the future study of analogy in the context of creation. Although it is practically impossible to strictly control related variables with such case analyses, this study shows the strong advantage of suggesting a new direction for research based on ecologically valid field data.

2. Case study 1

2.1. Method

2.1.1. Participant

The participant of this case study was Mr. Shinji Ogawa, a contemporary artist in his forties who actively creates paintings as well as video works. His artworks have been exhibited in many museums and galleries in Japan as well as in Western countries. These exhibitions have included a highly acclaimed one-man show at the National Museum of Art in Osaka, Japan and shows in galleries in the USA. Although he started his artistic career in his twenties, we focus on his development after he had his first exhibition organized by a curator. Special attention is paid to the interaction between his activities in different time periods.

2.1.2. Procedure

We conducted ten interviews with him from 2004 to 2007, with each interview lasting approximately 3 hours. The interviews were conducted at the artist’s studio by the first and second authors. All interviews were recorded with a digital recorder and a video camera. During the interviews, while showing him his artwork portfolio, we asked him about the period, method, and intention of creation of each artwork since he started his career as an artist. (We call this method a “portfolio interview” in this paper.) After the portfolio interviews about each of his artworks, we also asked him questions about his creative vision such as whether or not there was a base or a core of his artistic creation and, if so, when it became clear in his mind, and when and how his creative activities have changed since he started his career as an artist. We asked about his ideas of originality, such as, whether or not it is necessary for him to use his own style of expression, if so, what is the originality in his artwork. We also asked questions about his daily activities for artistic creation, his educational background, and other related topics.

2.2. Results and discussion

2.2.1. The artwork series “Without You”, and subject modification

Fig. 3 shows Mr. Ogawa’s 10-year process of creation. The horizontal line indicates time and the top half of the figure shows the content of the different levels of his activity (i.e., a creative vision, super-ordinate concepts, and expressive techniques). As this figure shows, Mr. Ogawa created...
several artwork series in the past 10 years. The first artwork series was “Without You”, in which he erased a main character of a movie scene in his paintings (See Fig. 4). At the beginning of this artwork series, the following episode occurred. At the time, he was a part-time teacher at a vocational-technical school of media art. When he was preparing for a class, he accidentally erased part of a picture on a computer screen by mistakenly pushing a keyboard button. At that moment, he came up with the idea that if something very important and valuable suddenly disappears, a new value may be generated and a new world could be created. With this idea, he tried to create a new movie poster for *Roman Holiday* by erasing the main actress, Audrey Hepburn, from the original poster. This was the beginning of the artwork series, “Without You”.

He has applied this expressive technique, “to erase a character or a thing from an original piece”, to various movie posters, an ancient Japanese picture scroll called “Choju-giga”, Bach’s musical notes, photographs of painters’ studios, Ukiyoe paintings, Western paintings by artists such as Vermeer and Velazquez, and so on. In this line of work, he applied this expressive technique to various subjects with different motifs and contents. Since a new subject is selected, and a new target for a new artwork is generated, in this context of creation, we can regard this process as an intentional use of subject modification (See Fig. 5).

2.2.2. Construction of creative vision

Approximately a year after he started the “Without You” series, he constructed his creative vision, “How should the world be viewed?”. With this creative vision implying that there is a possibility that not only the world we are seeing now but also many other similar worlds could exist, he wanted to actualize this idea in the form of artworks. This creative vision was finally clarified in his mind after searching for it throughout the previous 10 years of creative activity (Yokochi & Okada, 2007). However, although there were several keywords such as “techniques to capture the world” and “parallel world”, the creative vision was not well developed yet at that point. That is, denotation and connotation of the creative vision that define the directions in which the artworks can be

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3 The periods of creation of each artwork series overlap somewhat. This is a common trend in the creation process of artists.
developed were not yet clear. At that time, his creative vision served as an anchor point for his creation. By connecting his creative activities to keywords such as “techniques to capture the world”, he was wandering around, searching, to create the next artwork. Mr. Ogawa recollected it as follows:

The essence of “Without You” is that when the most important thing disappears, another context starts to be activated. Though other values always exist there, we cannot see them if a salient value dominates. I wanted to imply this. At that point, without any clear ideas, I wanted to see what would happen when I erased something important.

The creative vision (“How should the world be viewed?”) was not clear (when I created the “Without You” series). It was when I started to create video works such as “Chain World” that my creative vision became much clearer.

2.2.3. Creation of a new artwork series based on a super-ordinate concept

Around the time when he constructed his creative vision, Mr. Ogawa happened to pick up a postcard at hand with old Western scenery and drew a duplicate building next to an original one. Then he mailed it, as a postcard, to a gallery owner. When he heard from the gallery owner telling him that staff members of the gallery talked highly about his postcard, Mr. Ogawa decided to start a new artwork series, “Perfect World”, in which he duplicates a person or a thing in postcards or photographs of scenery (See Fig. 6). In this artwork series, he tried to imply another possible world by erasing the meaning of a person or a thing in an original picture by duplicating a motif. Comparison of “Without You” and “Perfect World” tells us that he used an analogical modification, based on the super-ordinate concept “Erasing the meaning”, and changed the number of people or things from minus (subtracting) to plus (adding). Thus, the analogical modification used in this situation was structure modification, choosing another value in the same super-ordinate concept.

2.2.4. Discovery of a new super-ordinate concept through externalization

Mr. Ogawa started to search for a new technique to “erase the meaning” while making artworks in “Perfect World” series. He happened to notice that two different photographs he had used for the “Perfect World” series actually captured the same scenery from two different perspectives. Because he previously had believed that those photographs showed completely different scenes, this discovery was a surprise to him. After that incident, he had a dream in which a new scene emerged when he zoomed in on an object in a scene and then zoomed out from it. Using the technique from this dream, he created the new
artwork “Chain World” (See Fig. 7). Mr. Ogawa realized that zooming in to the level of ink dots of a photograph could be an expressive technique that corresponded with the super-ordinate concept, “Erase the meaning”. Thus, he started with a structure modification for further creation.

However, creating a new artwork also leads the artist to externalize his own ideas (Schön, 1983; Suwa & Tversky, 1997). And, with such an externalization, artists come to notice new features, features that they were not aware of before. Mr. Ogawa noticed that this technique was also related to a new super-ordinate concept, “Continuity”. Thereafter he started to create artworks based on “Continuity” instead of “Erase the meaning”. Each idea for artworks includes various potential super-ordinate concepts. When an idea is brought into realization as a form of artwork, several super-ordinate concepts could be activated in the artist’s mind. Creative vision takes an important role, in such a situation, in order to decide which concept needs to be chosen for future work. Mr. Ogawa thought that modification based on “Continuity” fit better with his creative vision, “How should the world be viewed?” than “Erase the meaning”, used in the “Without You” series. The following quote indicates that.

*From “Without You” to “Perfect World”, I was trying to change a world by adding or subtracting something in the small world that I created. However, when I created “Chain World”, I became conscious of the connections between worlds.*

*In “Without You”, there was an original world to copy from. But, my recent work makes us feel that there might not be an original world. I feel that this is closer to my intention. If this idea works, then I will be able to take this line of artworks further.*

There is a dynamic relationship between creative vision and super-ordinate concepts in the sense that creative vision constrains the choice of a super-ordinate concept and at the same time creative vision becomes elaborated through finding a new super-ordinate concept. That is, in this case, the content of the participant’s creative vision “How should the world be viewed?” changed drastically from the idea that there was an original world to copy from, and changing parts of it, to the idea that there might not be an original scene to copy, and connecting such scenes to create a new world. Mr. Ogawa described this transition saying, “This is the time when the level of my work drastically improved.” This means that he realized that there was a big leap in his creativity in this transition.

Since he abandoned the super-ordinate concept “Erase the meaning” and generated a new super-ordinate concept “Continuity” through this process, we can call this specific type of analogical modification a concept modification. The fact that unexpected discovery accompanied this modification process means that analogical modification can be used not only in an intentional and conscious form but also, at least partially, in an accidental and unconscious form.

### 2.2.5. Artwork series based on “Continuity”

Though his creative vision served only as an anchor point at the beginning, now it began to act as a framework for his creation. Becoming aware that “Continuity” was a useful super-ordinate concept for achieving his vision, he began to create artwork series paying attention to this idea. To make artworks by changing values of a super-ordinate concept (i.e., to use the structure modification process) means to limit the search space for artistic creation as creative problem solving; introducing such a constraint seemed to facilitate the development of artistic activity.

Following “Chain World”, he started a new series called “Pirouette”. This video artwork contains the technique of connecting drawings through rotation (See Fig. 8). Mr. Ogawa recollected the beginnings of this artwork as follows:

*There is a scene in “Chain World” in which a picture rotates to transition to the next scene. Since that had been sitting in my mind for a while — in a good sense — I*
sought a way to make an artwork using only rotation to change scenes.

This episode shows that he intentionally used the technique “rotation”, that he happened to use in the previous work, to create a new artwork based on “Continuity”. This means that structure modification sometimes also includes subject modification.

Mr. Ogawa’s next work was a video work, “Interference”, in which he superimposed layers of different pictures in order to make an integrated picture, and then removed the layers one by one to break down the world (See Fig. 9).

“Interference” is, for example, a mountain, a sunny sky with a cloud, a tower, and people standing on the top of a hill; suppose there is a scene like that. If you see it from the side, everything is separately positioned on different layers on the computer. That means that you can slide some of the objects (i.e., layers) linked together. There is another background behind the current one. Thus, you can slide this background, this person, and the sun together in this direction. You can see a completely different scene sliding into the current one. I made the video artwork with this idea.

Mr. Ogawa mentioned that this idea came from his experience making “Chain World” and “Pirouette” with the layer technique on the computer. We can see subject modification in the creation of this artwork. At the same time, we can say that structure modification is involved, because it is located in the super-ordinate concept “Continuity”.

After this work, Mr. Ogawa continued to use structure modification in order to create new artworks such as “Continuum 1–4”, “Moiré”, and so on.

Mr. Ogawa describes the relationship between his creative vision and the creation of his artworks as follows:

I do not know what will come next. But, by making a functional structure similar to an ants’ nest, it will all fall into place. These artwork series are my “world”… I am experimenting with how the world works.

In this way, Mr. Ogawa’s artwork develops through inheriting his previous artwork series and searching for new patterns of technique under constraints of creative vision and super-ordinate concepts. During this process of creation, his creative vision and super-ordinate concepts were further clarified and new original artworks were created.4

2.3. Summary of case study 1

As mentioned above, there are three types of analogical modification in relation to super-ordinate concept and creative vision. One is subject modification, with which an artist maps the same technique onto a new subject in order to generate a new target. This type of modification appeared in artwork series like “Without You”. Another one is structure modification, with which the artist searches for a new technique based on the same super-ordinate concept. This type of modification was often used by the artist, consciously and intentionally, as a kind of rule. Many new artworks were created with this type of modification, and, in this way, his artistic activities became productive. The third one is concept modification, used in the situation in which a new super-ordinate concept is generated. After searching for a new technique based on an existent super-ordinate concept (with structure modification) and externalizing his ideas in the form of artwork, other types of super-ordinate concepts were activated in his mind. According to his creative vision, he chose a better super-ordinate concept to actualize the creative vision. With this type of modification, there is a higher chance for an artist to come up with an idea that includes some unexpected dimensions. Thus, an artist is highly likely to feel a big leap in his artistic development when using concept modification. In this case study, we showed that through dynamic interaction between a shorter time span of activity, like analogical modification, and a longer time span of activity, like creative vision evolution, the artist’s creation process progresses.

There is a caveat to mention. For the sake of explanation, we described these three types of modifications as rather independent processes. In the actual artistic creation of an artist, these three types of analogical modification are actively connected with each other in order to create a new expressive technique. For example, in the current case study, the concept modification that generated a new super-ordinate concept “Continuity” started as a structure modification.

3. Case study 2

In case study 2, we will verify how the findings in case study 1 can be generalized to the creation process of

4 The quality of his artworks has been highly acclaimed by critics (Akiba, 2006; Hirayoshi, 2006).
another contemporary artist. Due to the limitation of space, instead of describing the details of his creation process, we will summarize the use of the three types of analogical modification in his creation process.

3.1. Method

3.1.1. Participant

The participant of this case study was Mr. Kenji Sugiyama, a contemporary artist in his forties who mainly works on installations. His artwork has been exhibited in many museums and galleries in Japan as well as in Western countries. He has received many art awards, including the Philip Morris Art Award and the PARCO ART PROJECTS URBANART best award. He was also selected several times for artist-in-residence fellowships in other countries.

3.1.2. Procedure and preparation for data analysis

The same procedures as in case study 1 were used here for data collection and data analysis.

3.2. Results and discussion

Fig. 10 shows transitions in Mr. Sugiyama’s past 10 years of artwork series, and the relationships of these series with expressive techniques, super-ordinate concepts, and his creative vision. In the past 10 years — since around when he established a creative vision — he created four artwork series, in the following chronological order: the “Inside Outside” series (1994–1998), the “Institute of Intimate Museums” (hereinafter called “IIM”) series (1998–), the “Director” series (2001–), and the “Viewer” series (2005–). Mr. Sugiyama said, “(Around 1996) I realized that I had been interested in how to see, the methodology and device of seeing.” His creative vision became clarified around then. His artwork series since then have been created based on this creative vision. He first created the “Inside Outside” and “IIM” series based on the super-ordinate concept “Viewpoints from different physical places”. With this super-ordinate concept, he tries to show different features and aspects depending on the physical standpoints and angles chosen to view the artwork. Then, he created the “Director” and “Viewer” series based on the new super-ordinate concept “Individual perspectives”. In these artworks, he intended to show perspectives from different social roles: a world from a curator’s perspective and a world from a viewer’s perspective. Mr. Sugiyama was conscious that those two super-ordinate concepts had different foci and he used them intentionally.

3.2.1. Creation of artworks with subject modification

Mr. Sugiyama’s use of subject modification saliently appeared in the “Inside Outside” and “IIM” series. The “Inside Outside” series consisted of installation pieces that showed sculptures through constructions with walls or windows. This construction prevented viewers from seeing the sculpture in an ordinal way and forced them to see it from various viewpoints such as from behind it. This art technique, manipulating a view by constructing walls and windows, was applied to various gallery and museum settings. Each time, a new installation was constructed to actualize this art concept. Then, he began the “IIM” series with an artwork of an intimate museum using empty spaghetti boxes, in which small photocopies of his previous artworks were exhibited. He continued to apply the same technique for making intimate museums inside of clothing, envelopes, EMS parcels, cheese packages, and so on.

3.2.2. Creation of a new artwork series based on a super-ordinate concept

The two artwork series mentioned above, “Inside Outside” and “IIM”, have the common super-ordinate con-
cept, of showing “viewpoints from different physical places”. That is, the “IIM” series succeeded the core concept of the “Inside Outside” series and showed it with a different technique. Mr. Sugiyama described how he switched from “Inside Outside” to “IIM” as follows:

By the end of the “Inside Outside” series, I was fairly fed up with it. I was wondering where it could go if I continued. The artworks became larger and larger. It became too much for me. I wanted to make them in a size that I could carry... I thought that if I could show the same idea in a simpler way, that would be OK with me. So, I struggled to find a new way... When I saw an empty box of spaghetti (when I was in the artist-in-residence program in Canada), it looked like a building with windows through which light comes in. If I connected the boxes and looked into the windows, I might be able to see an aisle inside. What if I connected them to make an art museum? It would surely be great fun! If I put everything that bothered me into the boxes, all the problems that I was facing could be solved. I felt very excited and started to make it.

Mr. Sugiyama was first searching for a new technique to actualize the same super-ordinate concept, “viewpoints from different physical places”, in a more feasible way, because artworks in the “Inside Outside” series became too large for him to control. In this process, he happened to see an empty box of spaghetti. Then, he became aware that even in a small space he would be able to show viewpoints from different physical places. Thus, Mr. Sugiyama used structure modification based on the same super-ordinate concept to produce a new expressive technique.

3.2.3. Creation of an artwork series based on a new super-ordinate concept

In his transition from “IIM” to “Director”, concept modification took place. After making artworks in the “IIM” series for a while, Mr. Sugiyama felt bored and wanted a change. He recollected this as follows:

I became bored with making the “IIM” series, because what I was doing was just searching for other materials to make intimate museums. It was not so interesting to me anymore. I wanted to break the framework one more time. I wanted a twist. In the “IIM” series, I tried new materials such as clothes, direct mail, and so on. But, a museum is a museum! If I could push it further, it could be more interesting. Pushing it further, I found the “Director” series. I wanted to introduce a kind of story into my artwork. That was also a reason.

This episode suggests that the creation of many artworks in the “IIM” series using subject modification made him realize the limitations of this technique and forced him to develop a new artwork series. Paying attention to the museum aspect in the “IIM” series, he came up with the idea of seeing things from the curator’s perspective. Thus, the new series “Director” started. While making this artwork, he generated the new super-ordinate concept “Individual Perspectives”, and began to create the “Viewer” series using structure modification.

3.3. Summary of case study 2

In Mr. Sugiyama’s creation process, similarly to that of Mr. Ogawa, there were three types of analogical modification involved. These results suggest that our findings on analogical modification are not limited to a specific artist’s case, but can be generalized, at least to some extent, to the process of creation of contemporary artists.

4. General discussion

This study aimed to clarify the nature of analogical modification in the context of creation. Through case studies of two contemporary artists, we described the artistic creation process using the framework of interaction between activities in different time spans. The main findings from our study were as follows:

(1) In the process of artistic creation over a relatively short time span, artists frequently use analogical modification to create new expressive techniques. There are three types of analogical modification in relation to creative vision and super-ordinate concepts, namely, “subject modification”, “structure modification”, and “concept modification”.

(2) Creative vision plays an important role in constraining such analogical modification. That is, creative vision serves as a framework to guide the process of artistic creation. Moreover, through such a creative process, creative vision itself becomes elaborated.

(3) Thus, artistic creation can be better understood as the dynamic process of interaction between activities in a short time period, such as analogical modification, and activities over a long time span, such as the development of creative vision.

4.1. Creativity and the role of difference making

Previous studies have shown that people are strongly constrained by their own knowledge. For example, when they are asked to draw novel space creatures inhabiting a distant planet, they tend to incorporate the features of Earth animals that they know well into their novel designs (Ward, 1994). This suggests that people have a bias that, somehow, prevents them from being creative.

If this is the case, how can people overcome such a bias? Using methods for difference making is a useful candidate mechanism that might do so. In the domain of creativity research, for example, there have been some studies focusing on methods for difference making. Osborn (1953), who is famous for the “brain storming” technique, also developed
a “checklist” with which people can generate new ideas by, for example, modifying some attributes or reversing some values of an ordinary idea. Ueda (1997) also reported that scientists create new theories by focusing not only on the similarities but also on the differences between a source and a target.

Our study showed that such a cognitive process for difference making (in this case, analogical modification) has been used frequently by artists in order to create new artwork series.

4.2. Super-ordinate concept and creative vision

Some kinds of constraints, such as knowledge accumulated through the long-term process of developing expertise, are needed for an artist to be able to choose meaningful techniques from an unlimited number of possible ones. Our study focused on creative vision and superordinate concepts as such knowledge.

According to Markman and Gentner (1993), there are two types of differences used in similarity comparison, alignable differences and nonalignable differences. Alignable differences are differences between two objects with different values on the same dimension. Nonalignable differences are also differences between two objects, but not on the same dimension. For example, differences between human and chimpanzee are alignable differences, while those between human and Mars are nonalignable differences. It is known that people can easily notice alignable differences, although it is difficult to identify nonalignable differences. That is, in order to realize differences, it is necessary for us to align two objects based on an abstract concept. This indicates that abstracting higher-order concepts is important for difference making.

As shown in our case studies, focusing on Hatamura’s (2003) super-ordinate concept was an effective way of understanding the abstract cognitive process involved in analogical modification. Artists, in fact, used analogical modification with such super-ordinate concepts actively at certain times in the evolution of their artistic expertise.

There are three types of analogical modification, “subject modification”, “structure modification”, and “concept modification”. Subject modification is an effective way to understand the strengths and weaknesses of an expressive technique through searching for the scope of application of this technique. Structure modification deepens an artist’s own thoughts about her/his artwork series by enabling the accumulation of creation of artworks under the same super-ordinate concept. In concept modification, discovery of a new super-ordinate concept occurs through externalization of ideas in the form of artworks. Importance of such resulting “unexpected discoveries” or “surprising results” has been reported in the domain of design research (Suwa & Tversky, 1997) and scientific discovery (Kulkarni & Simon, 1988). In our study, one artist also reported that he experienced a major leap in his artistic creation when he used such a process of concept modification. Being different from structure modification, which is a somewhat rule-based process, concept modification does not proceed only at an intentional and conscious level. These results show that both the intentional development of artistic creation using a super-ordinate concept and making a big leap with the active use of unexpected results are necessary for creation by professional artists. Introducing these three types of analogical modification to analogy research as well as to creativity research is one of the contributions of this study.

4.3. Why is analogical modification a type of analogical process?

Analogy is a cognitive process that processes a target by mapping some features of a source onto a target while changing (i.e., modifying) other features of the source. In many cases, feature structures mapped from the source onto the target are those related to a goal of analogy while the feature structures that are not mapped are those not related to the goal. Therefore, people need to know what feature structures are related to the goal when using analogy. Because the target is clearly given in the context of understanding and problem solving, people need to focus on similarity between source and target and search for a source adequately related to the goal.

Subject modification in the context of creation can also be regarded as basically equivalent to the analogical process in the context of understanding and problem solving. Subject modification includes analogical mapping in which an expressive technique (i.e., a feature structure) is mapped onto a new subject. However, in the context of creation, not only the features that are mapped onto the target but also those that are not mapped (in this case, subject) often have very important roles in analogy, because if you map the same feature structure on the same subject in the same way, there is no creation. Thus, creation requires difference making from the source (i.e., modification). In this sense, both similarity and difference need to be focused in analogical process in the context of creation. Thus, subject modification is an analogical process in the context of creation in the sense that people map feature structures of the source onto the target (similarity focused) generated through modifying features of the source (difference focused).

A feature structure, if abstracted further, becomes a super-ordinate concept or creative vision. Therefore, structure modification and concept modification mean that they map features at a more abstract level (super-ordinate concept in structure modification, and creative vision in concept modification) while modifying less abstract features that are less related to the goal (a structure in structure modification, and a super-ordinate concept in concept modification). In this sense, structure modification and concept modification are more abstract levels of analogical process in the context of creation.
4.4. Relationship between our findings and models of analogy

Many models and theories on analogy-making have been proposed from the cognitive perspective. Without question, the most influential one among them has been structure-mapping theory (SMT; Gentner, 1983) and its computational implementation called structure-mapping engine (SME; Falkenheimer, Forbus, & Gentner, 1989). SMT first emphasizes the importance of structural similarity between source and target domains, which is defined by common systems of relations between objects in the respective domains. Thus, in this theory, an analogy is a way of noticing relational commonalities independently of the objects in which those relations are embedded. In order to notice such relational commonalities, people have to use higher-order concepts, just as the artists whom we interviewed used abstract concepts such as expressive technique and super-ordinate concept. SMT and our theory are thus similar to each other in that both insist on the importance of the use of higher-order concepts in analogy-making. However, the major difference between them is that our artists paid as much attention to dissimilarity as to similarity between two domains (artworks) while SMT primarily concerns similarity; dissimilarity is ignored in SMT. In this sense, our theory is rather similar to ACME model (analogical constraint mapping engine; Holyoak & Thagard, 1989) because both take goal (pragmatic) and crucial dissimilarity (exclusive relational) constraints into consideration.

Our theory and the ACME model are, however, strikingly different from each other in that our theory focuses on the artists’ flexible change of representation of a source domain while the structured representations of the source and target domains were given a priori and fed into ACME model. As we explained, our artists often changed some values of a source domain to make differences during analogical mapping and generated a new target (expressive technique). This analogical modification process, which is closely related to representational building and adaptation, is absent in most models and theories of analogy-making including SMT/SME and ACME.

However, there are some exceptional models and theories that do attempt to build flexible, context-sensitive representations during the course of the mapping phase (Hofstadter et al., 1995; Indurkhya, 1998). In order to explain how a new feature can be generated during analogical mapping, Indurkhya (1998) introduced a multilayer model of cognition, which distinguishes between the ontology of features (lower layer) and the interrelationships or structure between the features (upper level), and proposed two types of mechanism for representation building: a top-down mechanism called projection and a bottom-up one called accommodation. This theory can be considered to be related to our theory in that both use a multilayer model of cognition to explain feature creation and representational change. However, Indurkhya’s theory did not explicitly explain how people made differences during analogical mapping by using abstract or higher-order concepts, although it emphasized the importance of feature creation in analogy-making and even proposed a cognitive framework (a multilayer model of cognition with two types of mechanisms for representation building) for explaining feature creation. Moreover, his theory did not take into consideration the long-term analogical modification process that our artists showed. In contrast, our theory insists on the importance of a long-term analogical modification process and of interaction between activities in different time spans.

This latter point can also be applied to Hofstadter et al. model of analogy, Copycat, and to its extended version, Metacat (Hofstadter et al., 1995; Marshall, 2006). Their models assume that new features and new structures are created with conceptual slippage. Such slippage is monitored by “theme” in Metacat. Since “theme” corresponds relatively closely with our “super-ordinate concept”, when this model is applied to real-life artistic creation, parts of the process of analogical modification can be explained by this model. However, in order to fully understand the analogical process occurring in real-life creative settings, we need to model analogical modification in the interaction with activities over a long time span. For example, how those three types of analogical modification can be implemented and how such analogical modification processes change in the process of developing creative expertise are some important questions that need to be answered by a model of analogy in the context of creation.

4.5. Framework of interaction between activities in different time spans

It may look as if “interaction between activities in different time spans” can be replaced by “interaction between activities at different levels of abstraction”. However, creative vision as an activity over a long time span does not always have a high level of abstraction. Artists form creative vision such as “Seeing”, “How should the world be viewed?”, or “Death and life”, usually, in their mid-thirties after more than 10 years of creative experience (Yokochi & Okada, 2007). When it is first formed, creative vision is just a keyword that serves as an anchor point in order to search for new expressive techniques. It is often the case that super-ordinate concepts related to the keyword are not yet clear at the beginning. Artists then begin to create artworks more intentionally and more consciously as super-ordinate concepts become clarified through the continuous creation of artworks. In their mid-forties, their creative vision becomes elaborated with a higher level of abstraction and acts as a framework to guide their artistic creation. Within such a long time span of creative activity, artists can finally establish their own artistic styles. Paying attention to this aspect, the time span of artistic creation, enables us to understand the process of analogical modification in the context of expertise.
4.6. Potential problems of this study

4.6.1. On the portfolio interview method

In this study, we adopted a retrospective interview method using artists’ portfolios. It has been pointed out that retrospective interviews introduce the possibility of not reflecting actual processes due to memory distortions (Ericsson & Simon, 1993). In order to solve this problem completely, we would need to record on-line data about the creation process. However, it is practically impossible to record, for periods of time spanning more than 10 years or so, the artist’s real-life creation process. As an alternative way to solve this problem, we repeatedly interviewed one of the artists, Mr. Shinji Ogawa, over a period of 4 years. In order to check the reliability of this technique, interviews were conducted once every several months in the first 2 years, and every half a year in the last 2 years. Although we do not have space to describe interview data in detail here, we see a definite consistency in the interview data over the past 4 years. That is, the super-ordinate concepts and creative vision that the artist reported at the beginning did not change when he recalled them again 4 years later, although the content of the current super-ordinate concepts and creative vision that he has 4 years later, of course, has been elaborated as the creation process has developed.

Another problem is that the interview method can capture only conscious processes in verbal form. The Copycat model, by Hofstadter et al. (1995), assumes that analogy occurs as an interaction between conscious and unconscious processes. The “theme” that is assumed to be a conscious process in their model corresponds to the “super-ordinate concepts” in our study. Such conscious process is important for creation, as Hofstadter et al. (1995) suggested. We used the interview method in order to capture such conscious and verbal processes that guide the course of creation. We are aware that non-verbal levels of processes such as automated physical activities, like drawing in the air (Yokochi & Okada, 2005), are also involved in artistic creation. Thus, in addition to the verbal processes, we also need to capture such unconscious processes as well; in future studies, we plan to use behavioral and physiological measures.

4.6.2. Generalizability of our findings

Our findings on the creation processes of two contemporary artists seem to be fairly applicable to many other equally experienced artists in modern and contemporary art. Because it is important for modern and contemporary artists to create new concepts in their artwork, analogical modification, which produces a new pattern of thought by constructing abstract concepts, seems to have an important role for creation in this field. On the other hand, artists in traditional fields in which they are not necessarily required to propose new concepts might use this process rarely.

However, we do not claim that every modern and contemporary artist follows exactly the same process that we described here. Instead, our goal was to propose a framework for further research to capture analogical process in the context of creativity. By using this framework to accumulate data on the creative process of various artists, we will be able to understand the contents of creative vision and super-ordinate concepts, as well as the way in which each artist combines three types of analogical modification. Such knowledge will bring us a deeper understanding of the uniqueness of each artist.

Furthermore, it is plausible to think that analogical modification is also used often in fields other than art, such as design, science, and engineering, where conceptual process seems to have an important role. For example, Ueda (1997) discovered that scientists in theoretical astronomy used an analogical process that is somewhat similar to analogical modification. The scientists focused not only on similarities between a source and a target but also on differences between them when they used analogy to make discoveries. We need further empirical research to understand how our findings can be generalized to other fields.

5. Conclusion

Analogy has been mainly studied in the context of understanding and problem solving. This study aimed at understanding analogy in the context of creation. Creation involves a process to generate new and useful ideas, events, or things (Sternberg & Lubart, 1999). It has been anecdotally suggested that analogy takes an important role in such a creation process (Holyoak & Thagard, 1995). In the field of modern and contemporary arts, we found that artists often used analogical processes with which they mapped a technique or a concept onto a new situation to create a new artwork. However, such a process is somewhat different from analogical process in the context of understanding and problem solving. Although a target is given in those contexts, the target must be generated in the context of creation. If someone maps the same technique or concept on the same subject in the same way, there is no creation. Therefore, in order to create something new, a process of difference making needs to be involved. Thus, both similarity and difference become essential in analogical process in the context of creation. We proposed a new mechanism, called analogical modification, as an analogical process for creation. We found three types of analogical modification, subject modification, structure modification, and concept modification, in relation to expressive technique, super-ordinate concept, and creative vision. In order to understand the analogical process more comprehensively, a model of analogy needs to integrate the process of analogical modification.

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