

Article

Abduction in Art Appreciation

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Abstract: Individuals usually go to art museums to enjoy artworks. Generally, in order to appreciate the art in museums, a brief summary of certain information is provided as a caption. Viewers usually read these descriptions to aid their understanding. To provide broader technical support for this activity, several researchers have proposed a protocol for art appreciation. For instance, Leder et al. proposed a stage model for aesthetic processing, which combines aspects of understanding and cognitive mastering with affective and emotional processing. We have also conducted several experiments in order to determine the effect of information during art appreciation. For instance, we conducted an experiment where information about a piece of art was offered gradually and incrementally. In the experiment, the participants seemed to be able to gradually understand the artwork according to the obtained information. Our observations indicate that they tried to create stories for the artworks in order to explain the obtained information. In addition, for the abstract artworks, if they saw the title, they understood the artworks within their own explanation in the context of the title. Our research framework suggests that we can consider this observed framework as a process of abduction, where the incremental presentation of details about art helps a user form a hypothesis about the piece of art. In this paper, we will analyze artwork appreciation and understanding with this framework from the viewpoint of abduction.

Keywords: art appreciation; information; abduction



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1. Introduction

Individuals usually go to art museums to enjoy the stimulation of artworks. Hans and Shulamith Kreitler pointed out that “(t)he art experience is motivated by tensions which exist prior to its onset, but are triggered through the production of new tensions by the work of art [1].” In addition, they mentioned that “...art must do more than merely stimulate emotional and intellectual experience, and the uneasiness that sometimes accompanies the proclamation of this (=persistent) belief.” Furthermore, they pointed out that “(s)ince the art experience is assumed to provide satisfaction to primitive, mostly repressed, sexual and aggressive impulses, sublimation, symbolization, ... used by artists for the concealment of the “true” contents may not suffice to appease the superego and dissipate the spectators’ guilt feelings. Hence, further apparent goals have to be appended to the work of art in order to mislead society and its internal representative—superego.” In this analysis, they used the theory of cognitive orientation [2] to expose how the meaning and complex structures of beliefs—i.e., cognitive orientation—determine, shape, and direct behaviour. Therefore, it is clear that, for the appreciation of art, many and various types of factors emerge.

In particular, and especially for abstract artworks, Kandel pointed out that “(a)rtists often use reduction to serve a different purpose. By reducing figuration, artists enable us to perceive an essential component of a work in isolation, be it form, line, color, or light. The isolated component stimulates aspects of our imagination in ways that a complex image might not. We perceive unexpected relationships in the work, as well as, perhaps, new connections between art and our perception of the world and new connections between art and our life experiences as recalled in memory” [3]. Accordingly, viewers understand and interpret the artwork by somehow reversing the procedure of the artists’ reduction, using a viewer’s creativity to fill in any missing details. However, for art appreciation,

such a reversed procedure of artists' reduction will be simple. In fact, we may sometimes perform the reverse assembly of the elements in a work of art. For abstract pieces of art, sometimes such a reverse assembly of elements will be necessary. On the other hand, for representational artworks, a different mechanism emerges. That is, it may not be necessary to disassemble any elements because it will be easy to look at all elements simultaneously. Additionally, it will become increasingly necessary to understand how to identify implicit stories flowing within such works of art.

Generally, for art appreciation in museums, some summary information is provided as a caption. Viewers usually read the description to help their understanding. Museums usually prepare such descriptions for general visitors. The serious problem of reading these captions is that viewers will not look at the artworks. They only read the descriptions in captions to initially achieve some understanding of the artworks, with the potential impact that the caption has more immediate initial impact than the art itself. Therefore, recently, several museums have removed or hidden such descriptions in captions and titles. Then viewers have come to look at artworks deeply and for their own interpretation based on the art itself.

To compensate for this art interpretation challenge, Leder et al. proposed a stage model for aesthetic processing, which combines aspects of understanding and cognitive mastering with both affective and emotional processing [4]. Then, in [5], they pointed out that "(a)ccording to the model, aesthetic processing of an artwork involves a number of processing stages, which might somehow proceed sequentially and therefore allow the formulation of hypotheses concerning time sensitive processing of art. After initially classifying a stimulus as an artwork, features such as colour, shape, contrast, etc. are analyzed in the perceptual processing stage." They subsequently note that "(i)f understanding and grasping the meaning is essential, as proposed in the model, then information which helps to interpret the image must affect aesthetic processing. Here we present a study in which we investigate how verbal information affects cognitive and affective components in the processing of abstract and representational artworks." For instance, they used the painting by Alexej Jawlensky (German expressionism but regarded as representational)¹. The original title is "Das Oy-Tal bei Oberstdorf." They chose "Mountain landscape" as a descriptive title and chose "Flaming mountains" as an elaborative title. For the other paintings, they noted that naming was done in a similar way. For the abstract painting, for instance, Brice Marden's "Couplet IV"², they chose "Net of colours" for a descriptive title and "Tangle of voices" as an elaborative title. Their conclusion was that "abstract paintings received higher ratings of understanding when accompanied by elaborative titles. Descriptive titles did not improve evaluations. When presentation time was restricted to 1 s, descriptive titles improved the understanding more than elaborative titles. Such short presentation times seem to restrict information processing of paintings to representations sensitive to such descriptive information." In addition, they pointed out that "it seems that at least a medium presentation time of around 10 s is needed for a first interpretation of an artwork that is already sensitive to titles affecting the understanding of an artwork." Accordingly, we can note that elaborative titles provide rather subjective information. While this strategy has functioned well, if suitable information is provided, it is possible to interpret the image suitably in terms of aesthetic processing.

Danto pointed out in [6] that "...works of art are *about* something, and I decided that works of art accordingly have meaning. We infer meanings, or grasp meanings, but meanings are not at all material. I often thought that, unlike sentences with subject and predicates, the meanings are *embodied* in the object that had them. I often declared that works of art are *embodied meaning*." Leder et al.'s experiment would suggest "embodied meaning." Accordingly, one of strategies to understand artworks is helping the viewer to be aware of "embodied meaning." This can be achieved by offering suitable information.

We conducted an experiment where information about a piece of art was offered incrementally [7]. In the experiment, the participants seemed to be able to gradually understand the artwork. The detailed results of the experiment are shown in the following

sections. The observation from the result was that the information regarding the art frequently influences art appreciation, depending on how such information is incrementally and gradually conveyed.

Our experiments suggest that art appreciation can be performed by an abductive inference, where abductive hypotheses emerge and are refined as more information is gradually conveyed. From experience, sometimes one gazes at artwork without thinking anything. It is like a refreshment. However, usually, when one considers an abstract artwork, it is quite difficult to look at; then, one typically disassembles the artwork and try to read its meaning and story. When considering several representational artworks, a story emerges. This process of reading and formulating a story can be captured by the reasoning process of abduction. In fact, Danto suggested that the understanding of artworks is the generation of embodied meaning from the artworks. In addition, as will be reviewed in Section 4, art appreciation with metaphors is abductive art appreciation. That formulation of generated interpretation is captured by abduction.

This paper analyzes artwork appreciation and understanding from the viewpoint of abduction. Abduction will be regarded as a form of generation of a story to explain the artwork.

2. Abduction

This section briefly summarizes the mechanism of hypothetical reasoning (Theorist) which can be regarded as a procedure for computational abduction.

2.1. Philosophical Abduction

Peirce classified *abduction* from a philosophical point of view as the operation of adopting an explanatory hypothesis and characterized its form [8].

- (1) A surprising fact, C , is observed;
- (2) However, if A were true, C would be a matter of course;
- (3) Hence, there is reason to suspect that A is true.

Then, Peirce illustrated this abduction process as follows:

...abduction is an operation for adopting an explanatory hypothesis, which is subject to certain conditions, and that in pure abduction, there can never be justification for accepting the hypothesis other than through interrogation.

The important keyword of the definition is *explanatory hypothesis*. That is, abduction is a process of creating an explanation for some observation. Note that Peirce did not prescribe a mechanism for the performance of computational abduction.

2.2. Computational Abduction

The first proposal for a mechanism of computational abduction was proposed by [9]. Pople explored the abductive reasoning process and developed a model for its mechanization, which consists of an embedding of deductive logic in an iterative hypothesis and test procedure. Several years later, at least two more logical abduction systems such as Theorist [10] and ALP (Abductive Logic Programming) [11] were proposed.

Theorist is considered a computational hypothetical reasoning system. A hypothetical reasoning system utilizes explanatory reasoning to identify a consistent hypothesis set from a collection of hypothesis candidates in order to explain the given observation. The generated hypothesis set can be regarded as an answer (solution) that can explain the observation. The computational inference mechanism of Theorist is described as follows:

$$F \not\vdash O. \quad (O \text{ cannot be explained only by } F.) \quad (1)$$

$$F \cup h \vdash O. \quad (O \text{ can be explained by } F \text{ and } h.) \quad (2)$$

$$F \cup h \not\vdash \square. \quad (F \text{ and } h \text{ are consistent.}) \quad (3)$$

where F is called a fact, which is always true. On the other hand, h is called a hypothesis, which is not always true, and is included in the hypothesis base H ($h \subseteq H$). O is an observation to be explained. \square is an empty set. When $F \cup h \vdash \square$, F and h are not consistent. In the knowledge base, inconsistent information is also included.

2.3. Natural Language Processing by Abduction

Many researchers have proposed several natural language processing strategies based on abduction (e.g., [12–16]). These systems are intended to support natural language interpretation and understanding and to correct the potential misunderstanding of language. For instance, an abductive interpretation by Hobbs [12] conducts text interpretation based on the concept that the interpretation is the minimal explanation that confirms the truth of the text. The interpretation of the text is abductively identified by proving that the text is coherent. In addition, Hobbs noted that it is even possible to abductively conduct a natural language processing dialogue (discourse) generation. Lascarides and Oberlander proposed a simple discourse generation method by abduction [17]. In this method, the interpretation of the laconic discourse is abductively conducted by using defeasible rules. The discourse generation is performed by nonmonotonic deductive confirmation coupled with abduction. Therefore, in natural language processing, abduction can be applied both to interpret and understand language.

2.4. Literary-Work Generation by Abduction

We have previously proposed the following literary work generation method [18]. The general idea is based on the idea that a source of literary work can be divided into small units. Each small unit will support their own (partial) conclusions. Fragments of a literary work can be generated as an abductive hypothesis set by explaining the appropriate partial conclusion. For instance, it is possible to formalize the literary work generation by the description of the hypothetical reasoning (Theorist [10]) as follows:

$$\text{Rule_set_such_as_the_connection_rule_of_sentence} \cup h \vdash \text{partial_conclusion.}$$

By this strategy, at least, an outline of a literary-work can be generated. That is, a set of generated hypothesis can be regarded as an outline of a literary work. From the *partial_conclusions*, many partial stories (outline) will be generated. After generating partial stories (outline), a whole story can be constructed by their combination.

Regarding story generation, Ogata et al. have proposed many methods. For instance, in [19], Ogata demonstrated story generation as follows (for some sentences, English translations are given by the author):

蛇が皇女を誘拐する(A snake abducts a princess.). 老婆が嘆きの歌を歌う(An old woman sings the doleful song.). イワンが皇女の探索を決意する(Ivan decides to search for the princess.). イワンが蛇の国へ出立する(Ivan departs for the snake land.). 蛇がイワンを闘う(The snake fights Ivan.). イワンが腕を負傷する。イワンが蛇を勝つ(Ivan defeats the snake.). イワンが皇女を誘拐する(Ivan rescues the princess.). イワンが皇女を故国へ帰路に着く。蛇が飛ぶ。蛇がイワンを追いかける。イワンが岩を隠れる。皇女がイワンの傷を認知する。小人達が宮殿を建てる。宮殿でイワンが住む。イワンが皇女を結婚する(Ivan marries the princess.).

He considered Vladimir Propp's narrative study [20] from the viewpoint of "decomposition and re-composition." Based on the attempts of Propp's de-composition and re-composition, Ogata discuss the positioning of the Propp model as the narrative rhetoric in narratology. Then, he introduced the Propp model into his narrative generation system. Note that he pointed out that "by a set of specific 'function' and the pattern of chain of it, a specific genre in story can be determined." According to Propp, "function" means a

character's action from the viewpoint of the result. This type of generation (construction) will be regarded as a form of deduction-based generation.

For abduction-based generation, abductive reasoning can be used to explain *partial_conclusions*. For instance, one of the *partial_conclusions* will be "marry the princess," and the other *partial_conclusion* will be $\neg princess$ (the princess is not here.). If the *partial_conclusion* is $\neg princess$, in order to explain $\neg princess$, "search for the princess" will be generated by abduction. Then "(Ivan) searches for the princess." will be created as a short story (outline). If the princess is in the snake land, in order to explain *see princess in the snake land*, "depart for the snake land" will be generated by abduction. Then "(Ivan) departs for the snake land." will be created as a short story (outline). Of course, in order to perform abduction, it is necessary to prepare the hypothesis base including necessary hypotheses and the fact base, which confirms a base set of causal relations. This section will not show all knowledge (facts and hypotheses): as shown in [21], the required combination of deduction and abduction can generate a rather long story. However, by abduction, a set of outlines can be generated. These outlines are reasonable because they are logically generated.

Note, however, that a phrase with a literary flavour cannot be generated only by simple abduction. For this problem, Ref. [18] proposes a method such that, with reference to a certain literary work, abduction can be performed to generate a new literary work. This process can be regarded as pastiche.

In the method, a portion of hypothetical reasoning is conducted as follows:

$$rulesuchassentenceconnection \cup h \vdash (partof)conclusion \quad (4)$$

The original poem is the following ("月夜の浜辺 (A beach in a moonlit night)" by 中原中也 (Chuya Nakagara)):

月夜の晩に、ボタンが一つ (On a moonlight night, a button)
 波打際に、落ちていた。(I found it on the beach side.)
 それを拾って、役立てようと (I picked it up to utilise it...)
 僕は思ったわけでもないが (I did not think so...)
 なぜだかそれを捨てるに忍びず (I did not know why... I could not help to throw it away.)
 僕はそれを、袂に入れた。(I put it in my sleeve.)

For instance, as a conclusion, "to satisfy my hunger" is used. Then in the case of $\neg knife$, bitter summer orange (road side), a hypothesis set³ h will be such a set as {pick up (bitter summer orange (road side)), peel (nail, bitter summer orange (road side)), eat (bitter summer orange (road side))}.

By the above hypothesis set combination, an abstract will be composed. Then, such a poem as follows will be generated:

月夜の晩に、夏みかんを一つ (On a moonlight night, a bitter summer orange)
 道端に、見つけた。(I found it on the road side.)
 それを採って、役立てようと (I picked it up to utilise it...)
 僕は思ったわけでもないが (I did not think so...)
 なぜだかそれを捨てるに忍びず (I did not know why... I could not help to throw it away.)
 僕はその皮を、ナイフが見つからず、爪で剥いた。(For the bitter summer orange's rind, since I could not find a knife, I peel it with my nail.)

This seems good, because it was generated based on the poem of Chuya Nakahara (中原中也). Thus, emotional phrases can be generated which would be rather difficult to generate by only the logical method.

Finally, for literary work generation, abduction functions well. Even people perform this type of generation.

One may not think abduction in the literary domain is related to abduction in artwork appreciation domain. However, as pointed out in the Introduction, Kandel's artwork understanding is a reversed procedure of the artists' reduction, and it is not related to abduction in the literary domain. However, our experiment measured artwork appreciation by the story generation. Accordingly, in such a procedure, participants also perform abduction in the literary domain.

3. Artworks Appreciation

In this section, we review several procedures and their strategies to appreciate artworks. First, we review a very famous strategy that has been used as a foundation, namely a technique called Visual Thinking Strategies (VTS). We then show our experiments where we tried to see how viewers watch and understand artworks.

3.1. Visual Thinking Strategies (VTS)

VTS was proposed by Philip Yenawine [22]. During the application of the VTS process, a teacher facilitates a student-centered discovery process focused on carefully selected images. The teacher is central to the process but not the authoritative source; instead, the students drive the discussions, aided by the teacher. As the facilitator, a VTS teacher helps the observing students to:

- Look carefully at works of art;
- Talk about what they observe;
- Back up their ideas with evidence;
- Listen to and consider the views of others;
- Discuss and hold as possible a variety of interpretations.

The performance example of the VTS is shown in the web site of the Milwaukee Art Museum (<http://teachers.mam.org/collection/teaching-with-art/visual-thinking-strategies-vts/> (accessed on 1 March 2022)).

Visual Thinking Strategies (VTS) is an inquiry-based teaching strategy for all grade levels. One does not need any special art training to use this strategy. The goal of VTS is not to teach the history of a work of art but, rather, to encourage students to observe independently and to back up their comments with evidence.

How to perform VTS

1. Project artwork. Choose a work that is not abstract.
2. Ask students to look closely and silently at it for a minute or two.
3. Three questions guide the discussion.
 - Open with: "What's going on here?"
Summarize student responses using conditional language ("Raoul thinks this could be..."). This keeps the conversation open to other interpretations by other students.
 - If appropriate: "What do you see that makes you say that?"
This encourages students to back up their statements with things they see in the work of art.
 - Ask the group: "What more can we find?"
This continues the conversation.

Tips for conducting VTS

- During discussion, link responses together—compare and contrast what other students have said.
- Avoid inserting information. Let students look closely and reason out their responses rather than discussing the facts. If a student comes to a factually incorrect conclusion, gently correct if absolutely necessary during your classroom lesson, not during the VTS conversation.

- Allow the conversation to go where it will, even if it gets off topic. Remember, the goal is not to share information but to encourage critical thinking.
- At the end of the conversation, continue with your lesson, linking the content with comments that students made.

A video of VTS discussion with first grade students can be seen at <https://vimeo.com/9678152> (accessed on 1 March 2022).

While guiding the application of VTS, teachers will not show their own answers. Instead, teachers encourage students to discuss freely as possible.

We also conducted this type of experiment for the determination of the character of the person in artworks. Very interesting results have been obtained. Unfortunately, we have not yet completed a full description of those experiments.

Returning to the principle of VTS, during the discussion, students can gradually create and change their thinking. Perhaps their thinking will move to an “appropriate” perspective, and the other peoples’ interventions will function as hints or catalysis for their interpretations to create their own story about the art.

According to our summary in Section 2, the VTS procedure can be regarded as abduction because the students, using VTS, tune their thinking according to other peoples’ viewpoints. The students generate and incrementally change their story (hypothesis) to explain both theirs and others’ observations.

3.2. *The Effect of the Title*

In the introduction, we showed how the works of Leder et al. concluded that “abstract paintings received higher ratings of understanding when accompanied by elaborative titles”. Descriptive titles did not improve evaluations. When presentation time was restricted to 1 s, descriptive titles improved the understanding more than elaborative titles. Such short presentation times seem to restrict information processing of paintings to representations sensitive to such descriptive information.” In addition, they pointed out that “it seems that at least a medium presentation time of around 10 s is needed for a first interpretation of an artwork that is already sensitive to titles affecting the understanding of an artwork.” Therefore, we surmise that titles seemed to provide guidance for interpretation but are not substantial in function. Thus, titles function to guide art appreciation and understanding.

In noting this difference from the above VTS objectives, in [23], we experimented with how captions could change the viewers’ behaviour. In the experiment, the provided title was hidden for some artworks. We conducted this type of curation as a shikake [24]. The title was covered with a sliding cover. In the experiment, we found a very interesting phenomenon: when uncovering the title and after reading the title, one of the participants created a new story according to the title. This phenomena can be regarded as the effect of information. By reading the title, information included in the title was obtained. Actually, this artwork was created by Jean Fautrier and was an abstract artwork. Accordingly, the artwork was rather difficult to understand without any information. With the title (Forêt (forest)), the participant could create a story such as “I found a fairy in a forest” in the context of a forest. Therefore, a suitable piece of information sometimes helps viewers’ understanding and interpretation.

Even simple information, such as a title, can help a user create a story, and this story creation process can be regarded as abduction: the participant tried to explain the title “forest” to generate a story (see Figures 1 and 2).

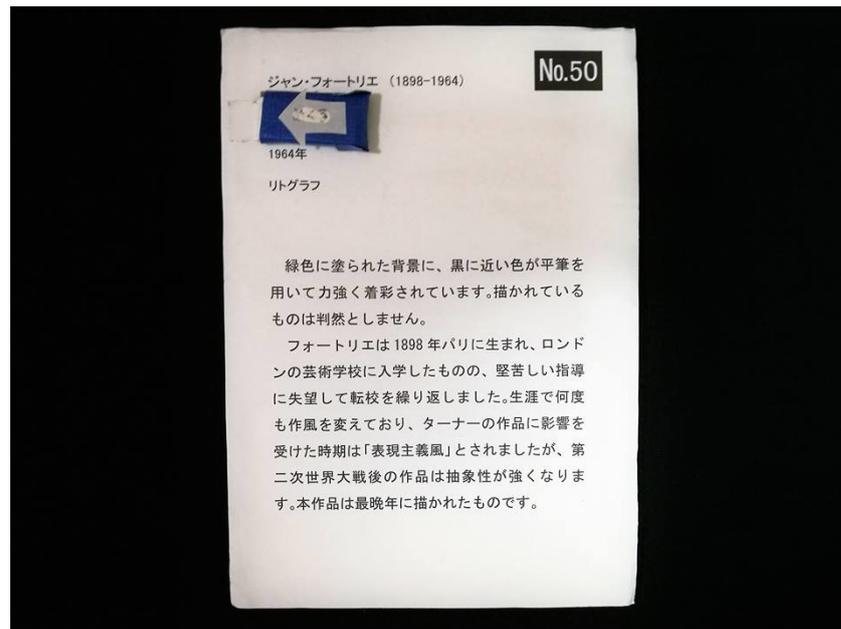


Figure 1. Caption with hidden title. At the top of the caption, name, birth and dead year of the artist are described. In the bottom explanations of the artwork and the artist are described.



Figure 2. Forêt by Jean Fautrier.

3.3. Using Captions with Several Levels of Explanation

We [7] conducted an experiment, where our question was how the description of a caption would influence or help the visitor's thinking. In a previous experiment [23,25], only one caption pattern was offered to each participant. However, In this more recent experiment, all caption patterns were provided. That is, all participants underwent the same experiment, with the opportunity to be influenced by multiple titles for just one work of art.

This experiment used a painting shown in Figure 3 and was conducted in our laboratory on a very small scale in the interest of reducing the time required. Because we must observe and control the experiment, we must check if participants see the next piece of in-

formation before they finish the current experiment. In this case, the number of participants was 6 (1 male and 5 female). Their age ranged from 19 to 55 years old. The number was very small. We conducted this experiment as a face-to-face experiment. In one experiment, we could deal with only 1 or 2 persons. Accordingly, we could not conduct experiments with a lot of people. The experiment was conducted in the style of questions on a piece of paper. Since the artist was not well-known in Japan, first no information was shown; then, the information regarding the painting (title) was shown, and then finally, information regarding the artist was shown. Note that a question was given to each participant as well. When participants finished their answer, the next piece of paper with the question was given. We prepared a question with three levels of information as follows⁴;

1. Please write freely about the thought and impression of the artwork, and what you remember and events related to the artwork.
2. Please imagine and write the story occurring in the painting.
3. The title of this painting is “New Day.” Please imagine and write the story occurring in the painting. If something is different from what you imagined in the previous question, please write that.
4. The painter who drew this painting is a female painter living in Beograd in Serbia. Her name is Ivana Živić. She was born in 1979 in Sarajevo. She drew this painting in 2018. Please imagine and write your version of a story occurring in the painting. If something arises that is different from what you imagined in the previous question, please provide a written comment.



Figure 3. Experiment: using captions with several levels of explanation.

All participants answered the questions three times. Information provided about the painting increased as participants proceeded with the experiment. All participants underwent the same experiment and were given as much time as they required. The time required for one session (three answers) ranged from 30 min to 45 min.

One of the answer⁵ sets was:

The participant goes to an art museum and gallery once or twice in three months. Their attitude toward art appreciation is rather good or favourable.

1. Outside is bright and open but separated.
Light is streaming in the room but she cannot go outside.
There is no gravity inside the room, and she can swim and calm.

Although she is confined in the room, she can look at the bright outside. She does not feel bad but feels calm and good.

2. Since she is ill or is confined in the house, she cannot go out of her house. She dreams to go out to the outside world and go out from the window in her mind.
3. The reason she could not go out of her house was not unavoidable but intentional. And she did not dream to go out of her house but did go out of her house.
4. She remembers her girlhood. She remembers that since the outside world was dangerous, she wanted to go out of house but could not, and that she strongly dreamed that she could go out of house. Before being shown the statement, I think the painter drew her current situation, but after reading it, I changed my mind to think that she drew in her reminiscence. The reason why she did not go out of house was the Yugoslav Wars?

Another answer⁶ set was:

The participant goes to art museums and galleries once or twice in half a year. Their attitude towards art appreciation is that they rather dislike it. Once, the participant has drawn artworks and currently takes photos.

1. I think she is like in the water.
Since light shines on her, the colour is dark, but the painting gives a bright impression. Similarly, since she looks up, I feel that she has a certain hope.
Although the inside of the double-paned window opens, outside is a fixed fitting (does not open). Thus, since the room is separated from the outside world, the room looks fantastic.
The paint is faint? A white paint? Accordingly, I feel the painting is old.
Although a light source is only on the window, since the light shines to the tips of the toes, she has emerged out of darkness as the subject.
Strangely, she looks peaceful; accordingly, I feel something of uneasiness.
2. She has been confined in the dark room a long time. She did not especially feel inconvenient (actually, she was confined but she has been living a normal life). However, suddenly she felt a strong impulse to open the window, and she opened the window. Then, the light shone from overhead, and her body floated in the air as if she were in the water. From the window, soft and green (grass) scent came. She felt filled by the warm scent and closed her eyes. However, the window did not open and no light came in the room.
3. She woke up in the early morning and was walking around the room to open windows as usual. Outside of the window, green (grass) could be seen. She was surrounded by its scent. Too deep a scent looked as if it were a green-blue light. It was the beginning of a new day. She felt her body gently float.
4. The painted girl was the painter herself who painted this painting. One day when she opened the window, the outside scenery coincided with that of the day when conflict ended. The scenery reminded her of the day's cheerful feeling. The painting expresses her feeling of the day.

One more example will be shown. The participant goes to art museums and galleries once every two or three years. Their attitude toward art appreciation is very good or favourable. Once, the participant has drawn artworks and currently takes photos.

1. Is it the sea? the land?...
Is she a person in a fantasy?
Is she a person in a dream?
Is it a rather old painting?
She puts on some nail polish.
She tries to go out from the dark room to a light world.
She looks lonely.
She looks a little hopeful.
2. She is a housewife, and outside of the window is a society.

Or she is a young student and is interested in a new world such as a city or entering the next stage of education.

Because of her old age or physical handicap, she might remember what she has lost. Even if outside is light and full of sunshine, she does not intend to go out from inside the house, which has no risk and stress. She just soaks in some sunlight coming from the window. This is because even if the window opens, if she goes to the outside, she will be influenced by the gravity and she will not be able to swim.

3. In the morning, she wakes up to the awakening of consciousness.
 - Just before the girl goes out;
 - Inside the room, there is unconsciousness and sleep;
 - What the girl symbolises is consciousness itself.
4. New Day is not a simple one day, but democratic days after the independence. The girl is not a symbol of the individual but a symbol of the nation.

The other answer sets are similar. Their common understandings are:

1. Phrases such as “the girl has been confined” and “she is floating” appeared. Many participants mentioned that she was in water. In fact, over the last three years, she has been working on a series of paintings called “Rooms of Water.” Unlike the other paintings, this painting does not explicitly paint water, but rather the observers considered what was painted was a girl in water. One might speculate that the painting shows a certain floating feeling.
2. Phrases such as “go to the new world” and “go out” appeared.
3. Since in the artist’s introduction, such a description as “Ivana Živić was born in 1979 in Sarajevo (BIH)” was included, the viewers tended to think of the story in the painting in the context of the Yugoslavia conflict. Phrases such as “escape” appeared.

The participants seemed to be able to gradually understand the artwork. For even such an abstract representational painting, the level of understanding was gradually improved. For example, after obtaining the profile of the painter, they could create stories according to the artist’s profile. From the phrase “Ivana Živić was born in 1979 in Sarajevo,” it may be a misunderstanding or overthinking to consider this painting within the context of the Yugoslavia conflict. In addition, this type of information might sometimes become a leading question. Regardless, such thinking can be allowed as a form of free appreciation.

The above artwork is a good representational artwork; accordingly, it is rather easy to understand. However, it is rather difficult to understand abstract artworks.

As shown in the introduction, for abstract artworks, Kandel pointed out that “(a)rtists often use reduction to serve a different purpose. By reducing figuration, artists enable us to perceive an essential component of a work in isolation, be it form, line, color, or light. The isolated component stimulates aspects of our imagination in ways that a complex image might not. We perceive unexpected relationships in the work, as well as, perhaps, new connections between art and our perception of the world and new connections between art and our life experiences as recalled in memory” [3]. Accordingly, viewers can understand the artwork by inverting the process of the artists’ reduction, using the viewer’s creativity to fill in details.

In the next experiment, we investigate more abstract artworks.

3.4. Using Captions with Gradually Increasing Information

The experiments of [26] reported a viewers’ change in their interpretative behaviour regarding artworks according to the offered information.

3.4.1. Participants

There were 22 adult participants, including mainly university students and persons between 19 and 57 years old. There were 8 females and 14 males. Their unaided observation (without glasses) or with corrected vision (with glasses) was normal. All the

participants were initially asked to answer questions about their art educational background.

3.4.2. Stimuli

The experiment was conducted in a lecture room in Chuo University on 29 May 2021. The room is usually used for lecturing, so the situation was rather different from those of the previous experiments conducted in a laboratory environment. We used 3 artworks created from 2018 to 2021 as stimuli. The artworks were placed on the table or the chalk rail of the whiteboard (see Figure 4).



Figure 4. Experiment: using captions with gradually increasing information.

These three art works are rather new, and the artists are from a younger generation. One is an abstract artwork. The others seem to be representational artworks but are rather difficult to understand.

All artworks were numbered but were displayed without any captions and labels.

The artworks were as follows:

- (1) Chikako Kai (甲斐 千香子): Lunch (お昼ご飯) (2021)
This seems to be a representational artwork.
- (2) Yuniko Kawamoto (川本 悠肖子): Protect (守) (2020)
This seems to be a representational artwork.
- (3) Yugo Kohrogi (興梧 優護): \13 (2018)
This is an abstract artwork.

3.5. Method

All participants answered the questions on the worksheet while appreciating the artworks.

The questions were:

- Please freely express your thoughts and feelings about this artwork, as well as stories that emerge about each piece of art.
- 1.1 Do you like this artwork?
In an SD method style (5).
- 1.2 Why do you evaluate it so?
- 2.1 How much can you understand the contents of the artwork?
In an SD method style (5).

- 2.2 Why do you evaluate it so?
- 3.1 How deeply are you interested in the artwork?
In an SD method style (5).
- 3.2 Why do you evaluate it so?

In the next stage, information was gradually exposed to the subjects. The first pieces of information were the artist's name and biography, as well as the title of the artwork. For the first artist, we offered the artist's concept of drawing. The second piece of information was the artist's own explanation about the artwork. After offering each piece of information, participants were asked similar questions in order to try and capture changes in interpretation caused by the incrementally revealed information. In addition, we added this additional question.

- 4. If you have a different feeling or thought, please write it down. This may be, for instance, about the contents of the artwork or the story.

Within the time limitation (30 min), each participant was asked a distinguishing question (such as Q4). This was our main objective: to know if the visitors' feelings or thoughts changed as the information changed.

3.5.1. Presented Information

In the previous experiments, we created information based on the information on artists' homepages or the information available from galleries. In this experiment, for the artists' profile and concept, we created information based on the information on the artists' homepages or the information available from galleries. However, for the second piece of information, we used information obtained by interviewing the artists or used the artist's own writing about their artwork (included in their artwork portfolio).

As the first piece information, we gave profiles of the artists. The following is part of the second piece of information⁷

- (1) Chikako Kai (甲斐 千香子): Lunch (お昼ご飯)
I felt the hidden repulsion of lining up neatly and obeying orders when I was student. Accordingly, I expressed the repulsion as a porcelain bowl, where I put mayonnaise on the finger dolls, then eat the rice with it, destroying them.
- (2) Yuniko Kawamoto (川本 悠肖子): Protect (守)
I grew vegetables with my friend in the share-field. However, I have not been there because of the coronavirus crisis. Accordingly, I do not travel on a train to the field, and I do not go there, so I have no time to blow up my image. (...)
When I create a Japanese style painting, I try to search a subject matter from my memory to remind myself that I left a work glove on the vegetable's prop. (...)
I drew the painting with my desire that the work glove guard the vegetables instead of me until I will be able to go there.
- (3) Yugo Kohroggi (興梧 優護): \13
This painting belongs to the series of abstract paintings begun in 2018. (...)
For this series of paintings, I focus on the abstract aspect and remove concrete aspects as much as I possibly can.
Regarding the question of what image did I have in my head when I drew the painting, I can say I thought of pareidolia (シユミラクラ現象). I am interested in the brain's cognitive effect. I use the phenomena in which the figure seems to be something intentional to introduce the viewer's eyes to something (this is called movement in the school of painting.). I create paintings in this series by thinking about such cognitive effects. (...)
The pictorial movement has the most important meaning in my artworks. In my painting, if the drawn figure is deformed and shaking, viewers unconsciously follow the brushstrokes and colour in order to correct the deformation. Then, into a painting, which should be a still image, we can embed moving elements. (...)

3.5.2. Results and Discussion

In the previous experiments [27], we observed that regarding preference, it was rather difficult for observers to change their mind. However, if the artist's comments were obtained, they tended to like the artworks more.

For these preferences, we obtained rather different results than the previous experiments.

Regarding preference, in most cases, very few participants added or reduced their score. That is, they did not change their preferences. However, for artwork 2, after showing the second piece of information, half of the participants adjusted and reduced their preference score (from -3 to $+3$). The comments from the participants who reduced their score were "since artist's thought was rather different from mine..." and

"since artist's image and mine was almost the same, and there was not bland new matter, the painting was rather boring." These reasons were extreme opposites. It seems that, if the artist's thinking was the same as the participants' thinking, they thought that the image was not new. That is, they needed a brand-new concept. On the other hand, since the artist's thinking is typically different from participant observer's thinking, they tended to dislike the artwork. This may also be a natural situation.

For the observers' story making, since time was rather short, few participants created stories after reading the information. In addition, since the titles were thought to be too abstract, participants could not generate stories. Since artists' information was very detailed, they tended to confirm their stories. However, some of them created additional stories.

For artwork 1, one participant wrote that "the situation where dolls which are "beautifully" lined up are put on a bowl in the destroying manner can be understood as a story after reading the sentence." The participant could generate a (new) story after reading the artist's comment. Perhaps the participant felt a story according to the artist's comment.

For artwork 2, one participant wrote that "I could know the concrete reason. Accordingly I feel loneliness on the current situation and expectation to the future. My impression the the artwork become better than the first glance." The participant could generate a future story by the artist's comment. This story generation can also be regraded as abduction.

Another participant wrote that "I did not expect the specific image as under the COVID-19 pandemic. However I could read the image as waiting. I think it is interesting to think that if in another time, for instance after 11 May 2011, I can have another image." Actually, the participant imagined various stories. The participant assumed different situations to create different stories. Of course, this is an abductive process.

For artwork 3, which is the most abstract work, one participant wrote that "Compared with the artwork 2, I cannot understand the motifs clearly. However in a short while, I can see a male. I'm interested in how I will be able to see the other perspectives." The artist did not show an exact answer as a male but suggested pareidolia. The participant saw a male in the artwork. This process is not precisely an abduction: according to Wikipedia, "pareidolia is the tendency for perception to impose a meaningful interpretation on a nebulous stimulus, usually visual, so that one sees an object, pattern, or meaning where there is none." Therefore, after obtaining a pattern as a male, the participant will be able to generate the other stories by abduction. That is, in order to explain the existence of the male, the participant will create a new story.

Another participant wrote that "I became interested gradually (time axis). First I felt ?, then I describe as a cloud. That is, I become to feel it is a social situation." This participant saw a cloud in the artwork. Then, the participant abducted a social situation from the cloud.

As shown above, these activities can be regarded as abduction.

The above analyses reflect participants' changing minds according to the information received. Some of them changed their stories according to the information they received. This change in story occurs by abduction.

We could collect only a small volume of results since the experimental time was rather short compared with the previous experiment. For example, we could not collect full stories from the participants. However, in this experiment, we could observe the abductive process.

For instance, the second artist mentioned the coronavirus crisis. She added that “I drew the painting with my desire that the work glove would guard the vegetables instead of me until when I will be able to go there.” In response to this information, a participant wrote “... I feel loneliness on the current situation and expectation to the future. My impression the the artwork become better than the first glance.” Regarding the current situation “the coronavirus crisis” and the artist’s statement “the work glove guard the vegetables instead of me until when I will be able to go there,” the participant abduced a future story (after the coronavirus).

It seems that if participants could take a longer time, more interesting results would be obtained.

In the following, we explain the process of abductive story generation during artwork appreciation.

4. Abductive Story Generation during Art Appreciation

From the previous experiments (captions with several levels of explanation), we confirm that we can model art appreciation as an abductive process. Since most of the participants created the same or similar stories, we will consider that one result.

In answer 1, the participant created a story from the only image in the paint. As an explanation for the phrase “she cannot go out of her house,” quite a general reason such as “since she is ill” was given. That is, for Equation (2), in order to explain “she cannot go out of her house” (*O*), “she is ill” (*h*) was generated. This hypothesis was generated because when we cannot go out, usually the reason is illness. Another reason of “physical inconvenience” was used, but we consider this to be the same reason as illness. In the next session, as a title, when “New Day” was given, the participant generated an explanation as “(f)rom today, she strongly thinks of going out of her house.” That is, the imagined situation “she did not want to go out of her house” (*O*) changed to “she could not go out of her house.” As a solution, as *O*, “goes outside” was obtained; then, *h* as “thinks of going out of her house” was generated. For the term “New,” the phrase “(f)rom today” was used, which can mean “new.” Such a phrase as “early in the morning” was also used. All participants created stories by using a term which can explain “new.” In addition, the profile of the painter was offered.

The painter is a female painter living in Beograd in Selvia. Her name is Ivana Živić. From the fact that “the painter was born in 1979 in Sarajevo,” the participants remembered the Yugoslavia conflict, which occurred during 1991 and 1999. In order to explain *O* as “the Yugoslavia conflict,” *h*, such as “since outside world was dangerous she wanted to go out of house but could not”, was generated. All the participants created their stories in the context of the Yugoslavia conflict.

Thus, when we create a story, we will abductively make an inference. In general, art appreciation can be modelled by abduction. Of course, we do not perform art appreciation by such a simple process. According to Kandel’s observations [3] on art appreciation, we separate (disassemble) the artwork to basic components during art appreciation. Accordingly, it is necessary to discuss the process of art appreciation based on the above situation.

In a general comment about abductive art appreciation, in [28], Mitchell discussed the metaphorical perspective that “(p)aintings should be interpreted according to the metaphor that constitutes them as works of art. There are indeed such things as true and false interpretations, and the work of interpretation requires no little knowledge of the cultural environment of the artist. So, for example, to understand Warhol’s can of Campbell’s soup one must first have some knowledge of American culture in the 1960’s as well as some acquaintance with the American Pop Art movement. Danto cautions, though, that no amount of interpretation can ever replace firsthand experience with works of art. Like linguistic metaphors, paintings resist translation and substitution; the power of the visual metaphor cannot be captured in abstract conceptions.” As he mentioned, “[o]n the way to understanding the special structure of meaning which characterizes works of art we will first consider the structure of metaphors. (...) Hence Danto writes that “a metaphor

presents its subject and presents the way in which it does present it." His theory was based on Danto's philosophy [29]. Actually, metaphor seriously functions in appreciation. If the viewer cannot be aware of (fundamental) meaning, metaphor will help in understanding. As Xu et al. mentioned in [30], "(a)bductive inference is consistent with metaphorical thinking in the basic cognitive characteristics and mechanisms, which can be interpreted in the contemporary study of mind. These similar insights seem to suggest that a new window to the mystery of human mind may be opened." I agree with their proposal. Thus, art appreciation with metaphor is abductive art appreciation.

Our third experiment, Kohrogi's explanation, will be about metaphor.

5. Conclusions

Here, we show several experiments to demonstrate how people perform art appreciation.

In the first experiment, the artwork title was hidden. For an abstract artwork, such as that by Jean Fautrier, it is not easy to understand the artwork. Usually, participants cannot understand or recognize what is drawn. However, we found a very interesting phenomenon. After uncovering the title and after reading the title, one of the participants created a new story according to the title. Perhaps this participant tried to create a story according to the title. This is actually an abductive procedure. In order to explain the title, the participant generated a hypothesis, such as a fairy in a forest.

In the second and third experiments, information was gradually added. For instance, in the second experiment, participants tried to create stories according to the profile of the artist. The artist was born in 1979 in Sarajevo. Participants created stories based on Sarajevo. In order to explain the birth place, they abduced stories related to the Yugoslav Wars.

Of course, several patterns of art appreciation were conducted. However, part of the understanding or interpretation can be regarded as being performed abductively.

In these series of experiments, we obtained very interesting results. We aim to conduct additional experiments with more time.

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Notes

- ¹ <https://www.akg-images.co.uk/archive/Das-Oy-Tal-bei-Oberstdorf--um-1912-2UMEBMI20RE8.html> (accessed on 28 April 2021).
- ² <https://www.moma.org/collection/works/95259> (accessed on 28 February 2020).
- ³ For hypothesis generation, a hypothesis base and knowledge base are prepared, and AAR, which is an extension of hypothetical reasoning, is applied.
- ⁴ Before the questions, questions about the user's profile (How often do you go to (art) museums? etc.) were conducted. However, in this experiment, the answers to the questions were not taken into consideration.
- ⁵ Answer sets have been translated from Japanese to English by the authors.
- ⁶ Answer sets have been translated from Japanese to English by the authors.
- ⁷ The original descriptions are written in Japanese; the author translated them into English.

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