A Study on the Metaphor Analysis Metrics of Visual Trope

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Abstract: Visual trope is one of the important appealing methods of creativity to induce voluntary consumer participation. In many cases, it delivers a message using metaphors. To define the concepts of metaphor, we investigated methods of expression and significance of metaphor itself and associated forms; in all: metaphor, analogy, catachresis, metonymy, and synecdoche. We also considered the structure of each form to propose a method of metricizing the metaphor. Consequently, we found that the metaphor of a visual trope is a type of operation and development of codes. We suggested models for each form type and concept of metaphor through the evaluation of metaphor significance and case study. Metaphor significance forms mutually close relationships with codes of pragmatics, semantics, and syntax. We suggested a type of metrics or a guideline for an expression method and evaluation of a visual trope appropriate for a metaphor form type. Therefore and importantly, the following study presents unique, but manifold results that are also useful in the field of design.

Key words: Visual Trope, Metaphor, Design, Semiotics

1. Introduction

1.1. Study Background and Purpose

Information delivery through communication is an important influence in culture and life. Advertisement design plays the role of visual information delivery, and more importantly, it creates a meaning and generalizes each ideology. Communication naturally involves a message with mutual operation between senders and receivers. A visual trope is a most effective means of communication. It stirs a reader's or viewer's mind by presenting visual metaphors, which are perceived as intellectual pleasures that add analytical amusement. Moreover, in the field of design works, visual trope is a method that provides effective and useful recognition processes as a large amount of information can be communicated

significantly and efficiently. A visual trope's efficacy to deliver a message is determined by the significance of the metaphor used. Therefore, it is necessary to study metaphors and metaphor concepts associated with the diverse characteristics of communication vis-à-vis visual trope. Metaphor is a figure of speech that is most lucid, important, and widely used.² The metaphor of a visual trope operates as a single message. The message includes information, with the flow of information forming the core of the communication process coupled with the sharing of meaning - shared meaning being requisite for the accurate flow of information. Or more concisely, we define communication as a "process by which one individual shares meanings with other individuals through the flow of information" as a general definition encompassing everything.3 Alternatively, according to Jakobson's definition, all messages can indicate, express emotions, perform order connection, aesthetic, and metalinguistic functions. Further, he states that a message is vaguely composed and if one focuses on the message itself, i.e., when the interpretants pays attention to the form of the message, the message acquires an aesthetic function. In this sense, the message implies all processes. The meaning is not directly delivered to the subject through communication but through a middle individual process. If the interpretant misapprehends, it would lead to vagueness. The minimum necessary conditions to overcome this situation are visibility, steadiness, association, accuracy, appreciation, and time characteristics. Therefore, the abovementioned conditions must be satisfied for design development. In a design process, it is most important to acknowledge the importance of concept and creativity and to suggest a constructive analysis method and production technique depending on the form of the message. This study understands the structural essence of the form, irrespective of whether or not it was delivered in accordance with its original purpose, the manner in which it was delivered, and the manner in which the meaning of the metaphor was delivered to the interpretant in a visual trope. In addition, since the study of a visual trope and its significance is crucial to analyze the meaning of metaphors, this study aims to suggest a guideline for a method of expression and evaluation of a visual trope that is appropriate for a type of metaphor form by proposing an analysis based on the type of the form and metrics.

2. Study Method and Scope

There are many forms that exist as appealing methods of visual trope creativity. This study is based only on visual image, which is a non-linguistic area. Hence, metaphor forms are limited to the visual sort. Further, in order to execute the purpose of this study, the study data includes international and domestic print media. Moreover, the forms are divided into the following types: corporate, product, publicity, and

¹ Mc Alhone, B. trans. (2001) A Smile in the Mind, Design House, pp.7-20.

² Eco U. trans. (2000) Semiotics and Linguistic Philosophy, Cheong Ha, p.140.

³ Kim Woo Ryeong, Jang So Won.(2004) Theory of Non-Linguistic Communication. Nanam Publications, pp. 21~22.

⁴ Eco U. trans.(2001). Semiotics and Modern Arts, Open Books, p.173.

politics. This is done to propose a metrics that is based on the general contention that these types are sufficient evidence for discussing the prerequisites of an advertisement design in that they occur frequently and effectively in media. In order to understand metaphors more appropriately in a theoretical background, we analyzed their significance by finding forms of metaphor based on documents and theories, developed metrics for a systematic analysis of this, and suggested design cases using metrics in relation with categories.

3. Concept and Form of Metaphor Based on Content

Metaphor plays an important role in our daily lives. Lakoff and Johnson (1980) define the essence of a metaphor as a "comparative expression" that aids in experiencing and understanding one kind of thing in terms of another.⁵ Metaphor denies encyclopedic description of words⁶ and is an artificial process that compares two dissimilar things. If one agrees that language creates meaning within more than two codes, one can determine that a metaphor is not a rhetorical tool but a property of language itself. As a result, language is in essence a metaphor; therefore, metaphors cannot be eliminated unless humans stop writing, speaking, and even thinking. Therefore, metaphor is considered to be essential for our daily lives, and it allows the mapping of a familiar area (source area) to a situation (subject area) that does not fall within our knowledge. Metaphor mapping is a cognitive process of finding mutual similarities through comparison by transferring factors from a source area to a subject area. In other words, a metaphor expresses things metaphorically rather than directly or realistically. For example, in the phrase "time is money," "time" is considered as the familiar area of one's daily life, while "money" is the "value that makes time more important" and is considered as the subject area. The system of codes relies on a sort of "promise" or reliability of interpretation and further, on a code chain whereby codes are expressed in terms of other codes; For example, in computer language, such a system begins through, perhaps, binary code and eventually expresses useful and reliable information to its user(s). Indeed, Sebeok (1991) mentions that a code is a group of clear regulations used to transfer a message from one expression to another. Ackling to that, Guiraud (1975) promises sociality of code by stating that a code is a "system of clear social customers for codes. "What is arrived at is this: It is necessary to make a social promise to establish a code.

	Metaphor	
	mapping	
Source area	←→	Subject area
(Familiar area)		(Learning area)

Fig. 1 Terms used to define the metaphor structure

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⁵ Lakoff G. & Johnson M. (1980). 'Metaphors We Live By', University of Chicago, press Chicago, p5.

⁶ Eco U. trans. Op.cit., p.140.

Sarup M. (1989) 'An Introductory Guide to Post-Structuralism and Postmodernism', The University of Georgia Press Athens, pp.52-53.

Code executes a more complex function while using regular codes.

- 1) The main function of a code is denotation.
- 2) The code must clarify the subject or mental concept that would be connected with the code.
- 3) The code user must have a clear idea about the intention to be conveyed by a certain code connection.
- 4) Code must be deciphered within the code user group.⁸

Code is an important measure used to provide communication in a society. Without it, a message can neither be created nor deciphered in a connection link between meaning providers and interpretants. For example, let us consider the message delivered by the traffic lights. According to an international code, "red" indicates <stop> and "green" indicates cprogress>. However, <stop> also implies <obligation>. On the other hand, "green" means <free selection>, to a certain extent, to the pedestrians. In a higher meaningful dimension, <stop> means <fine> and "green" implies <hurry>, particularly, when these signs are shown to drivers. A mixture of "green" and "red" signs can be indicated, as below, depending on the semantic analysis model in Figure 3.

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(cont a) c1, c2
/s-v/-sm = <sememe>-d1, d2 <
(cont b) d3, d4,-c3, c4
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Fig. 2 Semantic analysis model of codes

Metaphor is recognized as a code, whose meaning differs depending on situations, and particularly, the appealing method for expression in a visual trope differs depending on the background of these situations. Accordingly, codes also appear to be diverse, and the meanings of symbols are delivered to consumers in many forms. Such use of codes and symbols indicate that customs and traditions of interpreting symbols between designs and customers are being used. In other words, symbols are recognized and used as social codes.

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(cir/car)-c/hurry
/green/ = <green>-d/advance <
(cir/ walk) c/ select
/red/ = <red>-d/ stop-d /wait-c /duty(cir/passage)-c/penalty
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Fig. 3 A case of applying semantic analysis model of codes

4. Metaphor Operation and Ideology

Ideology is a belief people have with respect to their overall nature, humanity and society. Perhaps today's "myth" can be claimed to be is delivered through mass media, whereby mass media has the scope and power to determine social culture and to address it's audience as one human organism capable of apprehending single ideologies. According to K. Marx, who used ideology most clearly as a social

⁸ Kim, Kyung Yong (2002) What is Semiotics, Minumsa Seoul, p.105.

scientific concept, ideology is regulated by the economic structure, which is the foundation of the social structure, and indicates many forms of social mentalities such as politics, religion, arts, and philosophy. In other words, it is a superstructure that is formed by corresponding to the economic structure. In addition, it indicates a voluntarily systemized social mentality, when ideology is understood by viewing social psychology as a naturally developed social mentality.

Table 1. An analysis model of ideology

Ideology	IV. Significance	
Myth	Ⅲ. Symbolic significance	
	I .Signifiant	II .Signifie

Ideology exists within the human belief at the next stage of the myth, as described in Table 1. The fundamental definition of ideology is deeply related to a code. In a metaphor, if the code is the tool then ideology is the technology that uses this tool. It is technology operation treating organization principle of discussion. However, the detailed meaning of ideology is clearly different from that of the code. Ideology is a concept with a wide selection of definitions. The three different meanings of ideology can be explained as follows. First, ideology indicates a system of regulated codes only when it is defined as a positive implication. In other words, it can be defined as a system of equal regulation, values, and beliefs among all people. Second, ideology has a negative implication. According to Marx's definition, ideology is a system of false minds and has codes that can neglect other social classes by governing or propertied classes (Tucker, 1972 quoted). Third, ideology is defined as a secondary semiotics system by Barthes (1977). He defines ideology as a union area of the implied signifie. 9 Rhetorical formulas represent a certain ideological position, since they can be formulated semiotically. Let us consider an example of a communist politician, who's political emphasis is on the conflict between underdeveloped countries and advanced countries. If this politician states that fighting for freedom is the only way by which the colonized countries can gain independence, then the rhetorical expression "protection of free world" would represent a political position of union countries persisting on an equal ideology. In this manner, from semiotic viewpoint, ideology can be defied as a final comprehension of comprehensive succession or the comprehensive meaning of all inner comprehensions.¹⁰

5. Role and Use of Metaphor

The deliverer intends to reinforce the purpose of delivery using linguistic, non-linguistic, or rhetorical expressions in communication. Rhetorical expression in a visual trope is an important factor in creativity, and it is the differentiated appeal and creativeness in the field of creating advertisement designs that decide

⁹ Ibid., pp.240-241.

¹⁰ Eco U. trans. (2001) Semiotics and Modern Arts, Open Books, pp. 223-224.

the success or failure of marketing. The AIDA (attention, interest, desire, and action) model suggested by E.K. Strong in 1925 is generally used in the reception process of design, which can be divided into a recognition level, an emotion level, and an action level. The recognition level indicates that excellent product quality and price competition are worthless without the attention of consumers. From this viewpoint, metaphor receives higher attention since it is expressed based on new creativeness. Metaphor overcomes the general stereotype and opens a world of new imagination. The approach to create a metaphor can generally be classified into two points: emotional and purchase. The first clarifies the structure of understanding why metaphor is so creative, and the second deals with an interest to know how to get more creative ideas using metaphors.¹¹ The approach to metaphor operates all the more as a means to approach a new idea because abstract and difficult design concepts can be delivered in a more concrete and fresh manner.¹² The emotional level involves interest and desire, i.e., metaphor arouses interest in a subject by evoking and/or expressing emotions and induces new interest. This gives meaning to human emotions and develops the level for desire. In order to achieve the purpose of design, some action must be taken, since action indicates results, the design that cannot induce action is not as good as it looks.

The purchase level is reached by successfully advancing the levels of attention, interest, and desire. Although it is established as a gradual process from the marketing viewpoint, it is strategically used for creativity. Therefore, a metaphor is used not only as a purchase-oriented means but also as a means to stimulate the effect of the design.

6. Metaphor and Forms of Metaphors

Basically, the significance of the code is recognized by metaphor.¹³ This is a good example of reducing all literary style into "metaphor", just like the case presented by Jakobson. Metaphor has become the basis for defining language and applying it to the general definition of language, beyond a simple metaphor or literary style. In addition, correct understanding of a metaphor provides important motive to the creation of visual image and the application of ideas.¹⁴ There are endless numbers of human concepts; most of them are made up of metaphors and the thinking process of humans is also considered to be metaphoric. Metaphor is a group of codes that permits one to partially experience some new things through certain well-known experienced ones. In other words, it is a technique used to partially understand unfamiliar codes by using the characteristics of familiar codes. For example, former president Reagan once said that "journalists are sharks"—this expression is a metaphor. A single metaphor consists of two codes,

¹¹ Choi Yoon Shik.(2001)"A study on visual metaphor of print broadcasting" Doctorate dissertation at journalism and broadcasting major, Kyung Hee University graduate school, p.80.

¹² Ibid., p.83

Brown, Richard H(1977), 'A Poetic for Sociology': Toward a logic of Discovery for the Human Sciences, Cambridge, U,K,:Cambridge University Press.

¹⁴ Park, Young Won .(2003). Advertisement design and Semiotics, Bumwoosa, p.264.

which are connected by the principle of association. The principle of association is transferred when the actual entity of a code is changed to a dimension of another code. Moreover, not only does metaphor build a reality keeping in mind all aspects of human lives but it also makes humans think and act metaphorically. We build cultural experiences into an actual entity either consciously or unconsciously by using metaphors and we reason, set goals, socialize, and execute plans within the built reality. This means that most of the significance that we accept is related to metaphors. Regardless of whether it is linguistic or non-linguistic, a metaphor allows us to think and act in accordance with the society and culture.

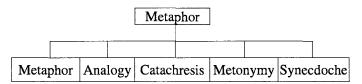


Fig. 4 Forms of metaphor

There are two types of metaphors—customary metaphor and uncustomary metaphor. Customary metaphor can be further divided into structural, orientational, and ontological metaphors. In a structural metaphor, one concept is changed into another metaphorically. With regard to orientational metaphor, the phrase "somewhere that high" in the sentence "I head towards somewhere that high everyday" exists only within the concept. On materializing the concept, this phrase becomes an ontological metaphor. 18 A noncustomary metaphor is a more imaginary and creative metaphor. It presents us with a new visual and provides us with a new meaning of our past, our usual concepts, or what we have believed in all this time.¹⁹ Non-customary metaphors provide new ideas to planners and creates post-modern forms. This is one form of catachresis—a figure of speech. Metonymy represents an entire thing by attributing a part of that thing and thus indicates the hidden meaning of the entire thing. In other words, the manner in which certain codes are used to indicate a relationship between two things is defined as metonymy. There is a strong purpose in understanding the whole of something by using a certain part of that something. Metonymy performs functions that are similar to those in the phrase "knowing one leads to ten other." While metaphor is a group of codes established by the principle of association, metonymy is established based on the principle of contiguity. Moreover, metonymy is divided into metonymy and synecdoche—where me:onymy is replaced by the indicated subject and synecdoche represents the entire indicated subject. For example, the male code "?" can be divided into metonymy and synecdoche depending on how it is interpreted; the circle in this code represents the male body and the arrow represents the penis. Thus, this symbol represents and indicates the entire male body, which is a synecdoche. If the circle is considered as a shield and the arrow as a spear, this would be a metonymy since the shield and spear are regarded as a part of the male body.²⁰

¹⁵ Kim, Kyung Yong. (2002). What is Semiotics, Minumsa Seoul, p.67.

Lakoff, George & Johnson, Mark (1980), 'Metaphors We Live By', Chicago & London: The University of Chicago Press, p,158.

Kim, Kyung Yong. op. cit., p.69.

¹⁸ Ibid,.p.72.

¹⁹ Lakoff, George & Johnson, Mark(1980), Metaphors We Live By, Chicago & London: The University of Chicago Press, p.139.

²⁰ Kim, Kyung Yong. op. cit., p.74.

7. Significance of a Metaphor of a Visual Trope

7.1. Study Method

Based on the results of a documentary research, we studied the systematic analysis and design idea technique for the metaphor significance of a visual trope and the structural issue of metaphor significance.

The following tasks were set for the study:

- Task 1. How can the metaphor of a visual trope be analyzed?
- Task 2. Semiotically, what relationship is being formed with the metaphor of a visual trope?
- Task 3. What kind of an influence does the layout have on metaphor significance in the advertisement designs? We suggested a metaphor analysis metrics concerning the trichotomy of semiotics depending on study tasks, and a guideline for the production method and the structure of meaning forms of each category through former studies.

7.2. Analysis by Forms of a Visual Trope

Research was conducted by creating the following divisions: (1) corporate advertisement image, (2) product advertisement image, (3) public advertisement image, and (4) politics advertisement image. Each communication has a layout and forms based on visual factors and principles of the design. Table 2 and 3 are analysis checklists used to study whether an appropriately harmonized design is delivered as significance to interpretants. After setting details, the forms of an expression were arranged into symbolic, active, informational, sensual, positive, negative, offensive, and defensive types. This is an important guide in the expression method that unfolds ideas, establishes creative concepts, and selects the texture for each division. Moreover, the stages for the layout are divided into these principles of design: order, margin, tension, motion based on balance, rhythm, emphasis, and unity. Lastly, the last operation, conformity (agreement) in politics-related advertisement, the service of delivering to the public, product attractiveness, and trust corporate promotes are induced from the significance of the last interpretant.

Table 2. Anaylsis of Design Type in Advertisement

Category	Organiz-	Product	Definition	Person
l	ation			
Туре	Company	Brand	Public	Politics
Expression	Symbol	Information	Positive	Offensive
	Activity	Sensibility	Negative	Defensive
Layout	Balance/Contrast/Emphasis/Unity/Regularity/			
	Space/Tension/Movement			

Suitability	Trust	Impression	Conscious	Suitability
			-ness	

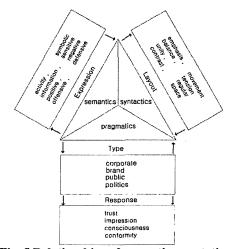


Fig. 5 Relationships of semantics, syntatics, prag matics, and analysis graph for each design type

This analysis Table 2 is an important category from a planner's viewpoint to establish a concept, unfold an idea, and plan to achieve the subject of appeal for each design type. Also, from an interpretant's viewpoint, it can be an analysis data of the process for each factor in visual communication.

Simple terms and codes are used in the analysis, as shown in Table 3.

Table 3. Code of Design Type in Advertisement

Co-sym	Pu-pos	
(Symbolic model of corporate)	(Positive model of public)	
Co-act	Pu-neg	
(Active model of corporate)	(Negative model of public)	
Br-inf	Po-off	
(Information model of brand)	(Offensive model of politics)	
Br-sen	Po-def	
(Sensitivity model of brand)	(Defensive model of politics)	

7.3. Development of the Analysis Metrics

We exchange meanings through codes within a social culture. Most humans function based on the codes. Humans do not act reflectively immediately after recognition. We compare, analyze, and transform end form into abstraction, make images by generally orienting each recognition experience, and socially materialize by adding a sensitive form. The constructed image again promotes its reality through an individual recognition experience, and leads to another general promotion through oneself. As a result, all cultures can be found to be systematically based on codes, and design development is considered to be a code development by itself. ²¹ It is very important for this code development to be arranged and analyzed systematically into processes. This study adopted the theories of Perth, Morris, and trichotomy as the analysis sample. The metrics model used in this study is shown through a form of three divisions.

7.3.1. Trichotomy of Semiotics

Peirce suggested icon, index, and symbol as the three forms of codes. It is preferable, but compatible with the theory of dichotomy proposed by Saussure. Peirce shows how codes imply their relationship meanings. It shows that a code forms a trinism relationship of representation, object, and interpretant. By studying the trinism division suggested by Peirce, it can be determined that all code definitions can be found to have a relationship with visual communication. A code indicates itself, i.e., something other than an object, and is understood by someone. In other words, the code has a certain effect on the mind of the user or interpretant. It must be understood that an "interpretant" is not a code user, but a mental concept

Moon, Yeong Ae.(1999). Dress Modeling by Synesthetic Color and Ratio Formed by Jazz Image. Doctorate dissertation, Yeonsei University, p.121.

based on the code and interpretation of the user and experience concerning the code and object. ²² These three types appear in the visual trope of advertisement designs, and the use of the signifiant and symbol among them are gradually increasing as a means to provide a high-dimensional message. In today's world, a direct and sensitive appeal is considered more important than indirect and reasonable appeal. By emphasizing the aspect of using service or product as a way of materializing fractionized customer desires and individual characteristics according to the purpose, the use of the signifiant and symbols as a mean of providing a symbolic and fantastic message is in demand.²³ This proves that the sensitive appeal is settling in human lives since society, culture, economy, and life are improving. Morris' semiosis was developed from semiosis aesthetics to semiotics based on Peirce's semiotics; in other words, it is the code procedure in which one thing replaces another by the arbitration of a third party. Here, "semiosis" is a set divided into 3 categories of a sign vehicle, designatum, and interpretant, and is similar to the structure of Peirce's code.²⁴ Here, the subject of indication is a group decided upon by the unique regulated property.²⁵ Morris first called the relationship between code media and the indication subject a "semantics dimension," and the field studying this relationship as "semantics." Secondly, the relationship between the code media and interpretant is termed as "pragmatics dimension" and the field studying this relationship is termed as "pragmatics." Lastly, the relationship between code media is known as "syntatics dimension," and the field studying this relationship is termed as "syntatics." The general science including the subordinate fields of these 3 dimensions is known as "semiotics"; this term was coined by Morris. Therefore, a complete analysis of codes is possible only when the relationships at the abovementioned dimensions are clarified.²⁶ Figure 6 illustrates the trichotomy of Morris and the syntatics that describe the syntatic rules regulating the relationship between codes. The relationship between the indication subject in the relationship and the material, i.e., what one code and another code means is known as the "semantics dimension" of semiosis and this is called "semantics."

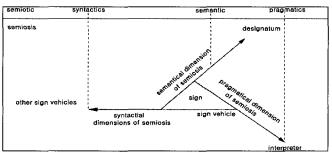


Fig. 6 richotomy of semiotics

Semantics is what regulates the semantics rules that decide the conditions under which a code can be

²² Lee, Kang Soo.(2003). Mass communication and Sociology, Nanam Publications Seoul, p.279.

²³ G.Dyer, (1982) .Advertising as Communication, New York: Methuen, p.126.

²⁴ So, Do Young (2002). Symbol and Science Semiotics, Ingan-Sarang, Seoul, pp.57-58.

²⁵ Morris, C., (1938) 'Foundation of the Theory of Signs,' *International Encyclopedia of United Science*, Vol. 1, No. 2, (Chicago; University of Chicago Press), p.20.

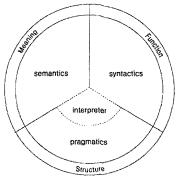
²⁶ Park Il Woo.(1993). 'Aesthetic Semiotics of Morris', Association Coreenne D'etudes Françaises, p. 67.

applied to a certain subject in a situation. Other types of codes such as index, icon, and symbol are applied with other types of semantics rules. From a code user's viewpoint, the relationship between interpretants who interpret the codes is that of a pragmatics dimension.

7.3.2. Analysis Metrics of Visual Communication

Figure 7 is equal to the structure of the trichotomy of semiotics. The relationship of pragmatics, semantics, and syntatics is clearly expressed in the trichotomy theory of

Morris's semiotics.



7.3.3. Analysis Metrics of Design Process

Analysis metrics of a design process in Figure 8 is Analyzed since it provides the following meanings.

First, pragmatics implies the level of capturing the type of design task process that it is in the form of a type, which is the initial stage of a visual trope. This can be understood as a process of delivering different rooses for Fig. 7 Semiotic analysis metrics each design type to the interpretant. Second, semantics is a relationship between a code and the subject implied by the code. The form is applied and analyzed, and each form has an expression idea. Third, layout is a technique based on the principles of design, which is a functional form; in other words, the syntatics to indicate the type of composition.

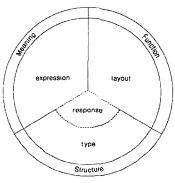


Fig. 8 Analysis metrics of design process

7.3.4. Metrics Applied with Analysis of Metaphor Meaning

Figure 9 is a case where the form of analysis metrics of a design process is applied on each factor. We were able to provide a practical method for achieving a constructive and clear significance interpretation through this analysis.

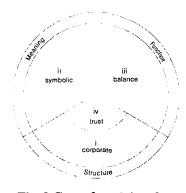


Fig. 9 Case of applying the metaphor semantic analysis of a visual trope

8. Results and Further Study Fig

The following are the results of this study. First, the metaphor of a visual trope is the operation and development of a code. In other words, the mythical condition that interpretants believe is caused by a visual trope as visual communication is a process that is the result of a provider completing a message systematically and in a constructive form. In addition, the expression and composition forms create an organic relationship within each other's range. Second, the metaphor significance of a visual trope—form in pragmatics, expression in semantics, composition in syntatics—creates a

close relationship with codes and provides meanings as a trichotomy analysis of semiotics. Third, we Journal of Korean Society of Design Science Vol. 20 No. 2 87

provided a guideline for producing and analyzing a visual trope through a metaphor analysis metrics of visual communication as indicated in Figures 12–14. Until now, there were more very specific, theoretical interpretation of metaphor rather than this quantitative and pragmatic approach to the analysis of metaphor. I believe that future studies can achieve more constructive results if they consider actual cases, since such consideration could provide stage for the proof of the analysis metrics proposed as a result of this study.

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