

Property Exploration of Analogy Conceptual Development with Case Design Studies as the Example

Kuen-Meau Chen*, Ying-Sin Lin**, Kuan-Ting Chian***

* *Department of Industrial Design, National United University, Taiwan, kmchen@nuu.edu.tw*

** *Department of Industrial Design, National United University, Taiwan, M0118001@ nuu.edu.tw*

*** *Department of Industrial Design, National United University, Taiwan, M0018001@ nuu.edu.tw*

Abstract: This research was conducted through a literature review and case studies. In this study, the conception property factor of imagination is extracted through interactions in expert meetings and interviews with winning works full of imagination in international competitions. The study results show that analogy relation association is not a straight line, but requires thoughts to jump several times, leading to association results that are quite different from the original concept. With good thought jumping ability, a divergence from the generating stage of creative design concepts can effectively link design concepts with a wide range of creative thoughts. These results are expected to contribute to design education in the encouragement of imagination and creativity with specific practical application reference value.

Keywords: *design imagination, creativity, analogy relation, case studies*

1. Introduction

Imagination is an important element in design process. On the level of concept development, a wide range of brainstorming of imaginative designs is a necessary step in the design process. However, the differences of design imagination decide the pros and cons of a way to solve the problem. This article focuses on the formation concept between analogy relations and other association, as well as the differences among imagination associations. Meanwhile, a case study is performed to discuss the design idea flow of the cases, in which two cases are exposed and compared in detail to enable the understanding of the pros and cons of analogy relationship association and provide specific practical application references.

2. Literature Review

2.1 The Implications of Creative Design

Relevant scholars believe that whether new concepts are generated after conceptual combination is determined by a number of factors, for example, similarity between concepts, physical types of concepts, whether there are obvious properties between the concepts and the order of different concepts in conceptual combination. The higher the degree of similarity between concepts is, the easier finding an identical property in a conceptual combination will be. If property correspondence tends to be used for interpretation, the chance to generate a new will be lower. In other words, the greater the concept similarity is, the less imagination will be presented [4, 16]. Creativity research derived from cognitive processes can be generally divided into the following three theories:

stage theory, association and divergent thinking. In stage theory, creating process are divided into four stages for exploration; in association, creativity is explored with an association point of view to link creative thinking with things in order to meet certain needs or achieve certain practical purposes.

Regarding stage theory in creativity, Wallas (1926) believed that creators' cognitive process during creative thinking to solve problems could be divided into the following four stages: preparation, brewing, insight and validation [15]. For association theory, Mednick (1962) defined creativity as "the process to associate something in order to achieve certain needs and practical purpose." The more distant the relation between the associated things is, the more creative the answer to such a question or process will be [12]. In cognitive structure, there is a fixed level in subject association and coupling strength, and the total generated association number has a negative correlation. Once the connecting level is steeper in individual cognitive structure, the coupling strength of the individual response to specific advantages becomes stronger, the response becomes faster and the reactions be generated less. On the contrary, if the individual connecting level is gentler, the connection strength of the reaction will be relatively weak and the reaction rate is slower, but generated reactions can be richer and more diverse. Mednick believed that this gentle type of link level is like distance association and more easily brews rare creative thinking [12]. Conceptual combination appropriately combines and connects two or more original concepts to derive a new concept in line with the overall situation demand [3, 14].

Divergent thinking considers creativity as an ability generated from divergent thinking. Regarding divergent thinking, Guilford (1988) proposed the principle of "smart structures", in which divergent thinking and creativity are the most relevant structures [6]. Divergent thinking does not aim to seek only an answer to a question but to identify a variety of ideas, concepts and as many answers as possible. From this point of view, creativity contains the four characteristics of fluency, flexibility, originality and elaboration. Fluency refers to the rapid response capacity toward problems that includes the ability to quickly generate a lot of ideas and insights toward the question or the ability to rapidly generate different associations, as well as the ability of expression. Flexibility refers to the ability to think openly and change the direction of thinking, as well as to have a variety of considerations on the nature of the problem so as not to just think of the way to solve the problem from a single perspective, but to be able to rethink other possible ways if failure or setbacks are encountered in the problem-solving process. Originality is the capability to produce distinct and unique ideas. There are two kinds of elaboration capabilities, which are the ability to complete or implement a project and the ability to retouch, add details or envisage [5].

Considering the aforementioned, the design process is carried out primarily through the data collection stage, brewing stage, creation stage, design verification and modification stage with constant repetition. Meanwhile, design also contains many new and imaginative concepts. Design emphasizes a process that not only drafts a single product containing imagination, but also contains consideration and design of the whole system, which is not simply confined to a certain part. Design requires the concept of participation and action and can have mutual consensus with public participation to lead to decision-making. At the same time, design has the qualities of imagination to inspire the formation of creativity.

2.2 Analogy Relation

An analogy is the course of reasoning that allows a concept to increase and generates new meanings or answers some corresponding qualities in a concept to another concept based on the similarities between them. A metaphor

is a special type of analogy that is often considered an important medium for scientific discoveries [1,11]. Chambers Twentieth Century Dictionary defines an analogy as “different things identical or similar in some respects but different elsewhere”. The biological significance is the functional commonality [2]. In the scientific discovery process, certain characteristics of known problem concepts or answers often correspond to another question concept, and the existing answer or knowledge of the previous question or concept is often borrowed to solve the unsolved part of the question [1].

An analogy is a mode of reasoning and thinking because a common point or an object will be regarded as a different object. It is suitable to apply analogies to the development or exploration of a new function, feature or usage of a product in order to create new solutions or in combination with different situations [13]. Analog is one of the associations that is often regarded as problem-solving technology for designers. Its core includes four kinds of analogy: personal analogy, direct analogy, symbolic analogy and fantasy analogy [7]. The similar application of analogy relations in product design includes bisociation proposed by Arthur Koestler, who believes that it is the unexpected association generated by two unrelated thoughts after combining them together in certain form [8]. Therefore, analogy is understood as a cognitive process with characteristics that transform the attached message of specific things or objects to other specific things. It can also generate new meanings from a concept. For example, the trajectory composed by the waving of shot players can be analogized to the way a merry-go-around in an amusement park revolves around the center. In addition, metaphor law also contains an analog relationship in rhetoric, such as to analogize the sun as a red ball.

3. Research Method

This project has been carried out with the use of literature and case interviews. In this study, the conception property factor of imagination is extracted by interactions in expert meetings and interviews with winning works full of imagination in international competitions. The study is mainly divided into four stages. First is the collection and exploration of literature to define imagination and creativity, as well as the understanding of the possible development and the importance of the process of imaginative and creative ideas carried out in product design.

During the first stage, in-depth interviews are held by expert meetings of work creators. We integrated a variety of award-winning works from international competitions in 2007-2009 from national education units to gain 35 cases through sampling, excluding five designers who were not able to cooperate, for a total of 30 winning entries. First, we conducted a basic survey of the designers, including the qualifications and experience of the designer, as well as the years engaged in R&D and work outlines.

Then, we asked about the creative process for the work and conducted in-depth interviews with the main contents, including the following:

- (1) Where did the design concept of the project come from?
- (2) What was the required prior knowledge engaged in the design project?
- (3) What difficulties were encountered within? How were they fixed?
- (4) What manpower was involved in this design project? What exactly did they do? What were their backgrounds like?
- (5) What are the results of this design project? What are the solved problems or innovations (contributions)?
- (6) Where did the innovation (contribution) come from?

During the second stage, a total of six project team members discuss and summarize the association and thought process of design conceptual combination based on the creation data from the full-discussion in-depth interviews. The case authoring process is divided into four stages: literature collection, gestation, creation, validation. [9], while there are the following nine components of design conceptual combination: attribute intersection, property transfer, property inheritance, thematic relationship, causal relationship, analog relation, the upper and lower level consisting relationship, opposite meaning interpretation and interpretation failure [10].

In the third stage, expert meetings were organized (consisting of six domestic experts with creative and research-related background) to discuss and confirm the process correction of the 30 creation cases. The final stage mainly focused on the exploration of differences between analogies and other kinds of association in imaginative association through case study for discussion of design thought flow of the cases. After that, two of the cases received detailed comparison and discussion.

4. Case Studies

This study initially found that a significant difference occurs between analogy and other properties. To better understand the differences between analog relations and other imaginative methods, as well as the amount and proportion of case factors, we conducted in-depth discussions in the cases that use the analogy relation. By analyzing the case design brainstorming process, we were able to more clearly see not only the use of a variety of imaginative methods and their effectiveness, but also the subsequent impact of the brainstorming process after using each method and the importance of concept evolution.

Two types of cases, a traffic aid and a graphic design, were selected for conducting detailed comparison and discussion, including the introduction of the design concept, concept usage of the design case analysis, road map of design imagination case analysis and a detailed explanation of concept usage in the process. Finally, we summed up the difference between analogy relation and other concept properties, as well as the importance of a variety of related attributes.

4.1 Case study: A Traffic Light

A Traffic Light design won both domestic and international design awards between 2009 and 2010: Silver at the Lite-On Award, the Red dot Concept Design Award, the iF Concept Design Award, the iF Product Design Award, and Silver for the IDEA Design Awards' Eco Design Award. A Traffic Light (Figure.1) is an environmental traffic light design that uses maturing color LED technology instead of traditional incandescent bulbs and monochrome LED traffic lights. It has “one Light” instead of “three lights” with “electrical energy” replaced by “solar power” to significantly reduce manufacturing costs and energy consumption.

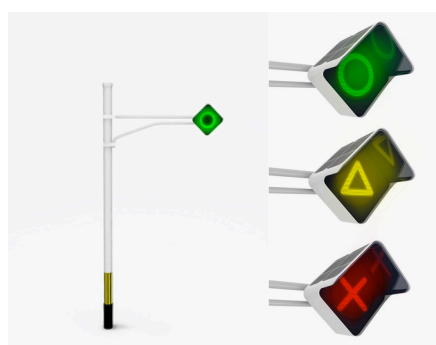


Figure.1 A Traffic Light-(From Fan, Cheng-Zong)

This design imagination case is a traffic light design that is indeed “a traffic light” that uses maturing color LED technology to replace traditional incandescent bulbs and monochrome LED traffic lights, “one light” instead of “three lights” and “solar power” instead of “electrical energy”. As daily-used public facilities, manufacturing costs and energy consumption are significantly reduced to realize green concepts. Through path analysis, the case mainly includes the following several relations in concept formation analysis after investigation. The analysis process is shown in Figure 2.

(1)Property transfer: such as associating “LED yo-yo” with “LED traffic lights”

In the initial concept generation stage, the designer used LED technology as the starting point of association to think about what the existing products of LED technology are. The designer thought about the yo-yo as the technology application product since many yo-yos include LED luminous bodies in their structure for dazzling effects of light and shadow in the rotation of the body in order to increase entertainment. Proceeding from this LED technology application, the product can be deconstructed as the “LED luminous body” and the “product” while the yo-yo can be deconstructed as the “LED luminous body” and the “yo-yo” itself. In this way, the designer took advantage of property transfer to have other objects replace the part with the identical nature to convert the “yo-yo body” to a “traffic light ”. Through property transfer, a new concept, the “LED traffic light” emerged.

(2)Property Inheritance: as “LED light/indicator color” and “power generation/ light generation”

There are two examples of property inheritance in this case, which are the “LED light is converted into an indicator color” and “power generation is converted into light generation”. Property inheritance refers to the new concept using the nature of the front-end concept. In this case, the most obvious feature of LED is the conversion of electrical energy into light energy with different shades. Similarly, LED traffic lights are also able to convert electrical energy into light energy and use the reaction of converting different shades to correspond to the three colors of a traffic light.

(3)Causality: Associate: “three-in-one lamp holders” with “blending technology”

The causality application comes from LED technical support. The designer understands that current LED technology is able to do more shade changes through color blending to extend to the three colors of red, yellow, and green. Pursuant to the cause, the designer realized that traffic lights in the past had three lamp holders to each display a different shade. Now, because of LED color blending technology, the lamp holders of red, yellow, and green are able to be merged.

(4)Analogy Relation: Associate “green-circle symbol” with “red-cross symbol”

The meanings of traditional traffic light colors are: green light for go, yellow light for a buffer warning that the semaphore is about to convert to a red light and red light for stop. By analogy, the designer changed the three colored lights into three symbols: a circle for the green light, a triangle for the yellow light and a cross for the red light. This ascendant concept of the conception period has taken people with visual color weaknesses or color blindness that are not as sensitive to the conversion of the three colors into consideration. If symbols are used to strengthen light color instructions, more people will be allowed to more accurately receive the changes and alerts of traffic signals.

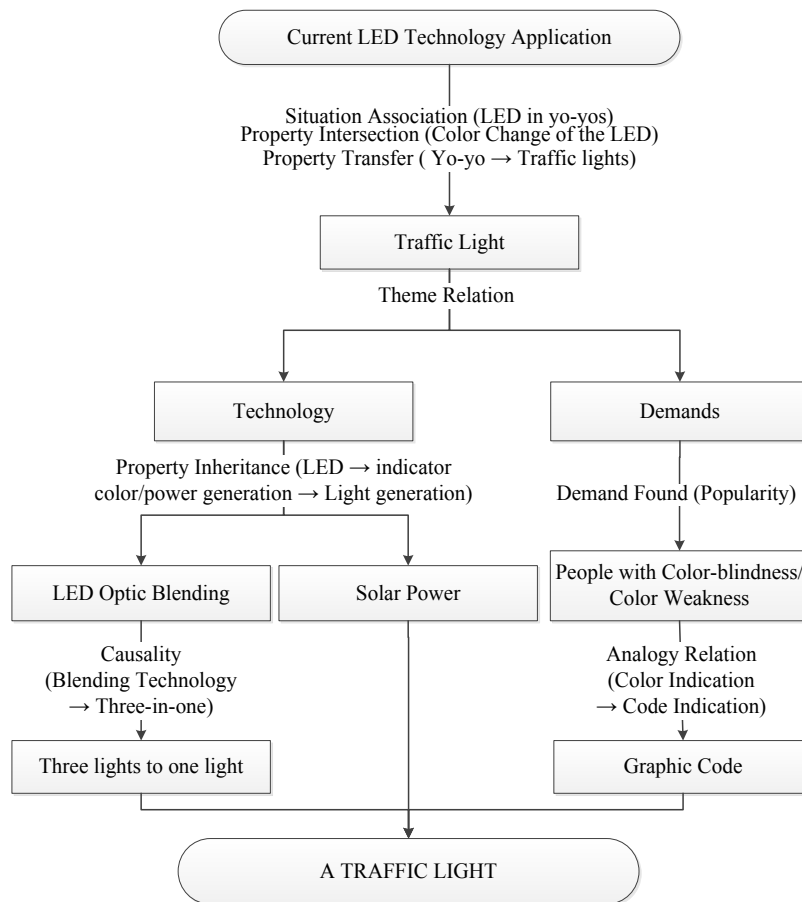


Figure. 2 Path analysis of design imagination for Traffic Light

4.2 Case Study: Shoe Book

This is a LIMITED Edition in Roman font with the content consisting of six English fonts and eight different kinds of shoes. Each of the shoes conveys different moods such as elegant, formal, light and movement. These emotional symbols can also be seen in the English fonts, as the text with serifs conveys a classic delicate beauty and fonts without serifs are on behalf of youth and sports. Both words and images have been woven into the special edition of this book. The Shoe Book shown in Figure 3.

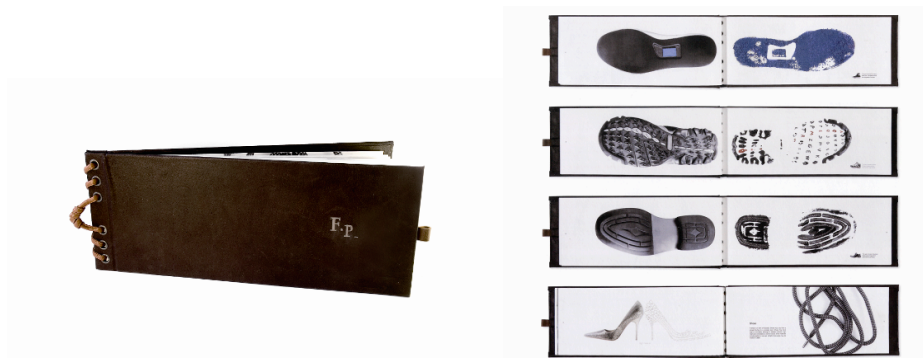


Figure. 3 Shoe Book (From Chen, Yan-Ting)

The idea analysis process of this design case is shown in Figure 4 with analysis of the following concepts of property inheritance, causality, attribute transfer, technology use and so on. Meanwhile, further analysis of the creative design thought mode is broadly integrated through the following:

(1)Property Transfer: Associate “personality” with “font type”

This refers to the newly generated interpretation after transferring certain properties of a concept to another in conceptual combination. The font type represents a different style and thus a different personality of a person. Therefore, different styles are under the conversion shift of different personalities.

(2)Attribute Transfer: Associate “clothes and shoes” with “personality”

This refers to the newly generated interpretation after transferring certain properties of a concept to another in conceptual combination. Clothes and shoes can show a person's personality and style. At the stage of transferring personality of a person to the different styles of clothes and shoes, two directions of the conceptual path are derived.

(3)Topic Relations: Associate “personal representative” with “clothes” and “shoes”

This refers to the possible relation of a new concept interpretation from different concepts after conceptual combination. The theme is the expression that individuality, people, shoes and clothes can represent different manifestations.

(4)Causality: This refers to associating two nouns through an established causal relationship, such as associating “shoes” to “distinctive personality”.

Finally, the designer decided to continue the development with shoes since there is significant difference between male and female shoes. Therefore, the personality representative is even more distinctive, clearer and more easily felt by the reader.

(5)Property Transfer: This refers to the newly generated interpretation after transferring certain properties of a concept to another in conceptual combination, such as associating “shoe kind” with “font type”.

The author believes that different types of shoes are able to represent different types of fonts.

(6)Property Intersection: This refers to the new concept, whose interpretation depends on the common property between concepts after conceptual combination, that is, taking the intersection of different concepts as the significance of the new term to generate the concept of “binding holes” from “shoe holes”, since both of them have holes as a common property.

(7)Analogy Relation: The last new concept is an analogy of the relationship expressed by the two terms to analogize “shoe material” with “book cover” and analogize “shoelace” with a book’s “binding line”.

In the usage of the last two conceptual analogy relations, books need a cover, while the body of the shoe also needs a variety of materials for production. The analogy is to analogize “book cover” to “shoe body material”, as well as “book binding line material” to “shoelaces”.

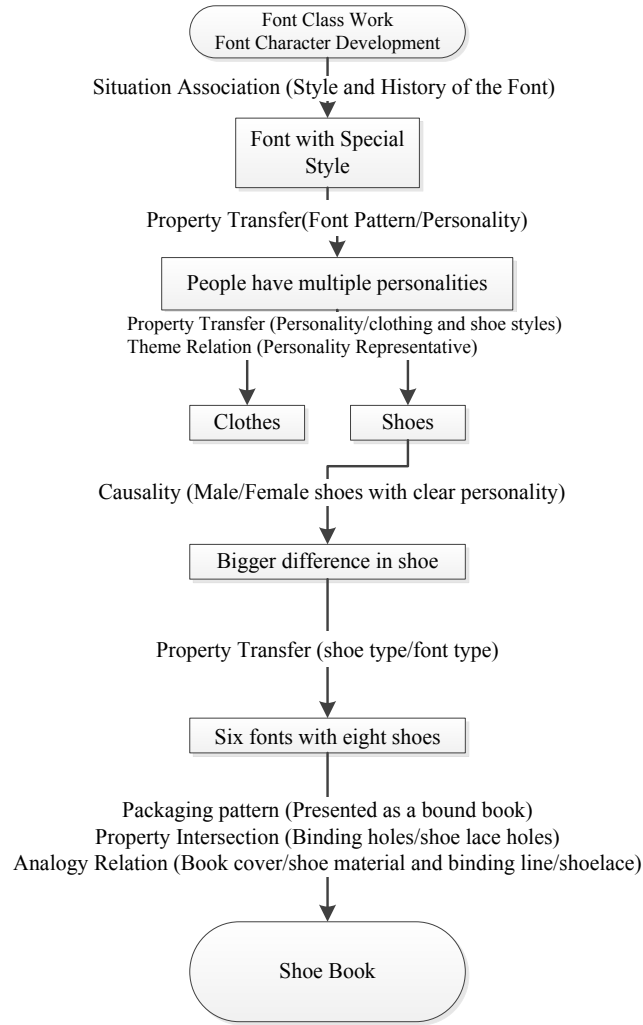


Figure.4 Path analysis of design imagination for Shoe Book Design

4.3 Discussion

This study has observed two cases that used analogy relation property to conduct in-depth analysis and discussion. The relationship between analogy relation and design and creativity is the main direction discussed in this paper. In the first case, the characteristics of the concept significantly reduce manufacturing costs and energy consumption. At the beginning of the whole idea of the development process, concept generation was performed by the spindle. In the middle and late stages, idea blending technology derived an all-in-one lamp holder from causal relationship usage and a conceptual thought process and from a direct logical thought process in addition to the core concepts of continuing to reduce costs and energy consumption. Through technical support, the number of lamp holders can be reduced to reduce the difficulty of the production process. At the back end of the concept, the designer used analogy relation association to escape the idea of the front-end concept and impaired cognitive difficulties of people with color recognition weaknesses by using symbols. This step is difficult to consider when compared to the causality property. Since there are a total of three light colors and symbols in each set, the difficulty of concept generation is substantially upgraded. However, the group with color recognition difficulties is helped by the conversion of “lights” into “symbols”. The whole concept is enriched by taking the needs of the

disadvantaged into consideration, making the whole product more competitive and the thought process more comprehensive to stand out in international competitions.

The second case is a graphic design concept with considerable use of the concept of property transfer. Points of disagreement can be found in the middle of the development process. With the properties of causality, the designer made the decision to choose one for the follow-up development and identify the thoughts of the spindle concept. The analogy relation property created a complete end and packaging for the whole design concept. Since this case is a plane-based conceptual design that focuses on the full interpretation of the features of the whole book, the designer successfully associates the theme (text and shoes) through the analogy relation of the “shoes” and “books” to make the whole concept of packaging more consistent. We can see that the front-end idea uses associations as property transfer and causality to express the association of fonts and shoes. By using analogy and other property concepts, the features of the entire book are under complete interpretation of a finishing touch effect.

The two cases mentioned in this paper initially found that the range of the analogy relation association of other concepts is larger and usually has less relation with the initial theme. They show the significant difference between the two concepts; however, they are successfully linked up with analogous thinking, developing unexpected creative effects. Other properties are more dependent on the front-end concept and make it harder to produce a wide range of links through step-by-step association.

5. Conclusion

After further analysis of analogy usage and its effect in design cases, it is believed that analogy relation runs not in a straight line but through multiple leaps of thought compared to other types of conceptual combination. The association result is thus quite different from the original concept. Good thought jumps and diverging at the idea generating stage of creative design concepts can be helpful to effectively widen the range of creative thinking for design ideas. Meanwhile, the jump process of analogous thought is closely related to the mental activity and life experience of the creator who also has the impact on the differences between the old and the new concept. The larger the difference between the association result and the original concept, the more likely it can jump out of traditional thought and generate new concepts with more innovation and design value.

The advantage of analogy relation is that the new concept derived from the logic thinking contains good thought jumps and divergence compared to other types of associations at the idea generating stage of creative design concepts. It is able to effectively produce a wide range of creative thinking for design ideas. However, the reason why analogy relations needs two times of thought jumps is what makes analogy relationship associations so difficult to manage. The larger the number of the thought connections, the harder it is to completely derive a new concept. If other kinds of association can be used along with this concept and the idea generating method, it could be helpful for the development of design concept processes.

Finally, this study suggests that imagination is a potential ability that everyone possesses. It can be developed as design imagination with the combination of aesthetics and science through good design concept development, as well as through education and training. The future results will be exciting. The results of this study are expected to contribute to the generation of imagination and creativity in design education with a specific practical application reference.

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