# A Study on the Actual Implementation of the Design Methods of Ambiguous Optical Illusion Graphics

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Abstract: Optical illusion graphics are featured by the design characteristics of distortion of space, decomposition of objects, and deformation of shape. The objective of design education is to establish the concept of plane composition, which can be achieved by understanding the design of optical illusion graphics. The design education of the past mainly investigated optical illusion graphics of visual interest from the perspective of visual psychology. However, to enable students to actually implement the designs of optical illusions, they require design methods. The purpose of this study is to propose the design methods of ambiguous graphics using the object allocation method of graphic design. This study is divided into two stages. Stage 1 analyzed the object allocation method to propose the design methods of ambiguous optical illusion graphics. Stage 2 analyzed the actual implementation of design, and divided the subjects into an experimental group and a control group, in order to verify the practicability of the design methods of optical illusion graphics, as proposed in this study. Research results: 1) the design methods proposed in this study can define three composition methods, as based on location, direction, and shape combinations of objects: (1) separation; (2) adjacency; (3) overlapping. The results of the actual implementation of design showed that “adjacency” (56.7%) was most frequently used as the composition method in the control group, while “overlapping” (63.0%) was most frequently used in the experimental group. Moreover, compared with the control group, who were not instructed in the design methods of composition, the actual designs of the experimental group were featured by diversified design characteristics and types. The practicability of the application of the three composition methods, separation, adjacency, and overlapping, as proposed in this study, to art education was verified. In addition, they can be used as assessment methods for analyzing optical illusion graphics.

***Key words: Optical illusion graphics, Actual design, Design methodology, Composition***

## 1. Introduction

Exhibiting complex and interesting visual effects, the composite ambiguous graphics, which is a type of optical illusion graphics, can attract viewers and hold their attention simply through the communication of the message. As such, the technique has been widely used in commercial applications, including advertising design, illustration art, clothing design and environmental spaces. Optical illusion graphics contain design elements such as, but not

limited to, layout plane splitting, object combination and decomposition, space distortions and shape creation exploration. Through an understanding of optical illusion graphics design, the educational significance of constructing plane composition concept designs can be better understood. Therefore, the purpose of this study is to propose a design method for ambiguous graphics using the object configuration method for plane design. This study is conducted in two stages. In the first stage, the samples of the ambiguous optical illusion graphics are collected to analyze the graphic object configuration methods and propose the ambiguous graphic design method. The second stage involves an experiment using the optical illusion design implementation to analyze the implementation designs, employing experimental and control groups. By comparing the differences between the two groups of subjects after training them in optical illusion design, this study explores the feasibility of applying the proposed design method to optical illusion graphics in art and design education.

## 2. Literature Review: optical illusion design methods

Optical illusion graphics uses visual design elements such as shape, proportion, color and shading to create 'illogical' images in order to present untrue existing conditions. Specifically, this is done to elicit an emotional reaction [5, 8, 18]. This study summarizes the relevant literature and proposes optical illusion design methods: (1) placement and combination: segmentation, encircling, entanglement of two shapes, assembled schema, direction and shape crossing; (2) in-depth space: perspective transformation, wrong perspective, and limitless space; (3) shaping: lines creating shapes, contours or edges, boundary connections, the gradient of shape, and realistic shapes; (4) image connotation expression: double meaning, the subject-background compatibility and interchangeability[8,17, 18]..

The recognition of optical illusion graphics must be based on the viewer's cognitive abilities. Graphics recognition obtains when the human nervous system picks out meaningful images from a large sampling of information [8, 9, 10] . As such, in designing optical illusion graphics, recognition is an important factor. In summary, this study proposes to create optical illusion graphics, by which the composition arrangement can be understood through the placement of the composition objects.

## 3. Research Method

The research method involves a two-stage investigation. The first stage discusses the graphic design methods, drawing from different data sources throughout the literature as well as an expert review. The second stage aims to design and implement the method and explicitly define the operational steps.

### 3.1 Survey I: construction of the design method for optical illusion graphics

#### 3.1.1 Method

A survey of the literature is used to explore the graphic object configuration method and the development of the composition method.

#### 3.1.2 Tested samples

The research samples are taken from the series of books written on visual perception by Al Seckel [12, 13, 14,15], who focuses on optical illusion design. After deleting the non-figurative, photo-style graphics, designs of geometric optical illusions and repetitive optical illusion graphics, a total of 115 samples remained.

### 3.1.3 Procedure

(1) The literature review defines the optical illusion graphics in the context of visual psychology[8, 9 10] , art and design application. The graphic composition design method helps to develop the optical illusion graphics using coordinates from the layout grid, geometric proportional composition, drawing composition methods and the relationships of the object combinations in graphic design [1, 2, 3, 4, 6, 7, 16].

(2) Eight experts with relevant backgrounds in graphic design and education were invited to judge the 115 optical illusion graphics samples. There was a consensus of the panel members according to the proposed composition method of the optical illusion graphics and in regard to determining the validity of the method.

## 3.2 Survey II: design implementation

Here, teaching experiments were undertaken with respect to the ambiguous graphic composition method. The implementation designs were analyzed through the use of an experimental group and a control group before exploring the feasibility of applying the ambiguous graphic composition method within the context of art education.

### 3.2.1 Experimental design

Independent variable: the teaching method is the independent variable of this study. The experimental group uses the teaching method of the proposed design and the control group uses the general teaching methods.

Dependent variable: the drawing expression content differs within the design implementations.

Control variable: to avoid the impact of the external variables on the experimental results, the student characteristics, teaching progress, teaching content and testing procedure are controlled throughout the experiment.

### 3.2.2 Research subject

This study treated 68 students who were taking elective courses in the third and the fourth year of a commercial design program at a university in northern Taiwan as the subjects by purposive sampling. The subjects were put into either the experimental group (32 people) or the control group (36 people). Their ages ranged from 20~22.

### 3.2.3 Implementation steps

**(1). The design implementation steps for the experimental group**

(A) The researcher explains the definition of the optical illusion graphic design.

(B) Use 20 samples of optical illusion graphics help to explain the categories of the optical illusion graphics, including 15 composite graphics, and five impossible graphics.

(C) To illustrate the optical illusion design's operational methods using the graphic examples, use the grid tool to define the placement of the composition objects to understand the compositional arrangement of the optical illusion graphics; also use the image connotations communicated by the graphic visual expressions and content in thinking about the design.

(D) Invite the tested students to present the optical illusion graphics using specific images with limitations on theme, medium and color.

(E) Explain the design implementation contents.

**(2). The design implementation steps for the control group**

For the survey steps of the control group, 20 graphic samples were used to elaborate upon the optical illusion graphics without applying the proposed operational method. The remaining teaching implementation steps and design implementation norms are identical to those of the experimental group.

### 3.2.4 Data analysis method

After the design implementation, four teachers from the design department were invited to form an expert focus panel (Table 1). According to the operational method for the optical illusion graphics as defined in this study, the experts adopted the content analysis method to classify the optical illusion graphics and select the most representative samples. The classified samples of this survey were output on 19.5x13.5 cm color cards by a computer which scans the design implementation. The expert panel members could discuss each one. In cases of differing opinion, the majority prevailed.

Table 1 List of Panel of Experts

| Name | Title | Years of Design | Name | Title | Years of Design |
|---|---|---|---|---|---|
| A | Senior high school design teacher | 14 | C | Art teacher/illustrator | 6 |
| B | Art design | 13 | D | University design department teacher | 7 |

## 4. Results

### 4.1 Optical illusion graphics' composition method

According to the placement and distance relationships of the object and its neighboring objects, and using the concept of coordinate axis, this study divides the object element composition for the design of optical illusion graphics into: separation, adjacency and overlapping.

**(1) Separation**: when objects are the entire image, each major object has no intersection or contact with the shaping contours of other adjacent objects and the objects maintain their original shapes. The mutual placement of the objects exhibit distance in between.

**(2)Adjacency**: when more than two objects make up the entire image, the shapes of the objects are adjacent and the edge contours are shared. However, the shapes of the objects are not mutually overlapped and there is no distance between the objects.

**(3)Overlapping**: more than two shapes can be identified in a single graphic. The graphic composition method is used to overlap more than two images. One shape shades another; as such, some parts of the objects are shaded. However, the two shapes have a common overall shape.

According to the consensus of the eight panel experts, the validity of the composition method was determined. The four composition methods could be applied in the object composition of the 115 optical illusion graphic sample objects: 30 samples using separation composition (26.1%), 54 samples using adjacency composition (47%) and 31 samples using overlapping composition (26.9%). This supports the notion that the proposed composition method could be rationally operated.

### 4.2 Design implementation results

The purpose of this study is to use plane design composition to explore the design methods for optical illusions by means of design implementation, in order to better understand the feasibility of applying the design method through the design instruction of optical illusion graphics. Therefore, after the design implementation, the data from the experimental group and the control group were processed to conduct a comparative analysis of the design implementations, using different teaching methods.

#### 4.2.1The control group’s design implementation results

The control group adopted the general teaching method without experimental processing. In this stage, 36 students participated in the control group and a total of 36 works were recovered. Six of them were deleted without being discussed as their contents did not present the visual effects for an optical illusion. Hence, there were 30 valid samples from the control group. Four focus members classified the samples according to the operational methods of the optical illusion graphics as proposed. In cases of differing opinion, the majority prevailed.

This study classified the optical illusion design works based on object configuration, finding that 17 of 30 works showed adjacency (56.7%), followed by seven samples showing separation (23.3%) and six samples showing overlapping 6 (20.0%).

#### 4.2.2 The experimental group’s design implementation results

The experimental group was given the optical illusion design method. A total of 32 students participated in the experimental group and 32 works were recovered. Five of them were deleted without being discussed as their contents did not present the visual effects for an optical illusion. Therefore, there were 27 valid samples. Four

focus members classified the samples according to the operational methods of the optical illusion graphics as defined in this study.

This study classified the optical illusion design works based on object configuration, finding that 17 of the 27 works showed adjacency (63%), followed by seven samples showing overlapping (25.9%) and three samples showing separation (11.1%) (see Table 2).

Table2 The experimental group's design implementation results

| Object Configuration | Separation | Adjacency | Overlapping |
|---|---|---|---|
| Illustration |  |  |  |
| | Drawing by Y. Yang | Drawing by C.R. Huang | Drawing by Y. J. Liu |
| Quantity (percentage) | 3 (11.1%) | 7 (25.9%) | 17 (63.0%) |

### 4.3 Summary

The purpose of this stage of this research was to understand the feasibility of applying the design operation of optical illusion graphics in design education, through the implementation of the design method for optical illusion graphics. By comparing the design implementation of the control group and the experimental group, the results are summarized as follows:

In terms of the object configuration comparison, the control group has the most samples exhibiting adjacency (56.7%) and the experimental group has the most samples exhibiting overlapping (63.0%). Most of the tangent composition samples show graphic-ground reverse illusions and most of the overlapping composition samples show impossible graphic illusions. The changes in the optical illusion design expressions can be found by the operational design of the object configuration.

Based on the optical illusion design-related books and the design implementation of the control group that adjacency composition accounts for a relatively higher percentage among the three composition methods. Most of the illusion content comprises graphic-ground reverse illusions; it can be inferred that the latter are the type of illusion with which the general public is more familiar. Therefore, adjacency composition is more adapted for the students with training in optical illusion design. The students who have been trained by the optical illusion design method may also attempt to use other optical illusion composition methods.

## 5. Conclusions

Many past studies have been based on the viewer's interpretation of the meanings of the graphics. However, the majority of such observations and similar classifications of description methods are insufficient for design

implementation. This study combined research and design implementation to clearly define the design rules, and proposed that the composition method of the optical illusion graphic design can define three types of composition methods: separation, adjacency and overlapping. These are understood through the concept of the coordinate axis, according to the distance and direction relationships of objects. By using expert methodology and a design implementation survey, this study confirmed that the proposed composition method can be rationally operated. From the perspective of design practice, the proposed composition method can serve as a reference for teaching curriculums and for designers.

Designers often process graphics using intuition and perception. From the design practice perspective, this study proposes the operational rules for the optical illusion design without undermining the relevant research findings regarding graphic design, and without attempting to replace individual design creativity. Instead, from the perspective of composition, the designer establishes the graphic design method to allow the plane design educators and designers to have concrete design methods from which they can draw upon.

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