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Application of Gestalt psychology in product human-machine Interface design

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Abstract. Objective Studying the application of Gestalt psychology in product human-machine interface design. Methods The 5 principles of proximity, similarity, closure, continuity and symmetry in Gestalt psychology are analyzed by different human-machine interface design cases. Conclusion The proximity principle and the similarity principle are related to the tendency of trying to group the objects. The closed principle and the continuity principle are related to the tendency to try to give the object a complete form. And the symmetry principle is related to the attempt to simplify the figure to make it conform to the human visual habits. The Gestalt principle allows the information on the interface to be presented in groups and in a complete way. It helps designers to understand the visual rules of human beings, to grasp the perception structure of things on the whole, and to organize, simplify and unify the display and operation devices in the design of the human-machine interface, so that the interface is more coordinated and easy to understand, so as to facilitate user operation and improve the efficiency of human-machine system.

1. Introduction

Product interface is a medium for transmitting and interacting information between users and products [1]. Users usually understand the function of the product and use the product through information interaction with the product interface. Therefore, the interaction design of product human-machine interface is directly related to the success of product design. Psychology is about human science. Mastering the psychological laws related to design can effectively capture user psychology. Gestalt psychology emphasizes the overall cognition and simplification of the things seen by the human visual system, which can help designers to recognize the key problems and innovation points of the design, so as to effectively adjust and improve the product design.

1.1. A summary of Gestalt Psychology

Geshita is the transliteration of German "Gestalt" and the transliteration of "holistic" in German. In China, gestalt is defined as Gestalt according to the connotation of Gestalt, so Gestalt psychology is also called "Gestalt psychology" [2]. Gestalt psychology was born in 1912, emphasizing the integration of experience and behavior. The core of Gestalt psychology is to find the simplest and direct way to unscramble the incomplete visual information. It emphasizes that the perception in visual thinking has the ability to understand, and can choose, simplify, abstract, analyze and synthesize activities. Gestalt psychology puts forward five basic principles of perception based on people's psychological model, namely, proximity principle, similarity principle, continuity principle, closed principle and symmetry principle [3].

1.2. Product human-machine interface design and Gestalt Psychology

Product human-machine interface is a medium for interaction between people and products, and also a

bridge for users and products to transmit information. It includes the input and output of information. The first problem to be solved in the study of human-machine interface is display and control. "display" is how the product transfers its information to the user. "control" is the user how to operate and control the product. This will undoubtedly involve the size, shape, color and operation flow of the product. The main purpose of the research on product human-machine interface is to optimize human operation and improve the efficiency of human-machine interaction. It should let the user know how to operate the product at a glance, let the consumer enjoy the product, rather than suffer setbacks.

Broadly speaking, the interface of products generally refers to the human-machine interface of industrial products; it includes hardware interface and software interface [4]. The hardware interface refers to the product interface of the hardware material in the interactive process. It is the basis of the human-computer interaction, such as the arrangement of the mobile phone keys, the operation keys of the digital camera, the layout of the computer keyboard and so on. The role of hardware interface in products is mainly to beautify the shape of products, optimize product functions and facilitate user operation. In a narrow sense, the product interface refers to the software interface, that is, the information interface when people interact with products. At present, Gestalt psychology has been widely used in the design of product software interface, such as mobile UI design, PPT design, interior design, logo design, landscape design, advertising design, book binding design and even clothing design. However, there is little research in the field of product hardware interface design. Therefore, this study aims to combine the classic principles of Gestalt psychology with the design of human-computer interface to explore the value of its usability in product usability, so that the user can experience a simple, harmonious, friendly and natural interface.

2. Application of Gestalt psychology in product human-machine interface design
Gestalt psychology is based on five basic principles of perception judgment: the principle of proximity, the principle of similarity, the principle of closure, the principle of continuity and the principle of symmetry. The following cases are analyzed in detail.

2.1. Principles of proximity
The so-called proximity principle means that "in comparison, objects with close proximity to each other look more related than objects far away, and are more likely to be considered as a whole" [5]. As in Figure 1, the shapes and sizes of the stars are exactly the same, but in the human visual perception, the nearer and parallel stars will naturally become a whole, so the user will think that the star in the left map is arranged in three lines, and the star in the right picture is arranged in three columns.

In the example of the proximity principle, as shown in Figure 2, in the design of air conditioning remote control shown on the left side of Figure 2, the functions of adjusting the temperature of the air conditioning are implemented with the triangle buttons with "+" and "-" symbols respectively. There is a certain distance between the two buttons, and the distribution of "+" and "-" is also not consistent with the cognitive characteristics of the human. There is no doubt that it will bring a lot of inconvenience to the users. And the air conditioner remote controller shown on the right side of Figure 2, its temperature setting function is realized by a group of buttons connected together with left and right arrows. The buttons with similar functions are placed together, and their arrows are arranged in accordance with the cognitive rules of human beings, so the operation is naturally convenient and quick.

Figure 1. A brief illustration of
the principle of proximity.

Figure 2. Case of proximity principle----
air conditioner remote controller.

As mentioned above, distance is very important when designing a human-machine interface to show whether there is a correlation between one object and another. In most cases, the interfaces with similar functions are put together and separate a certain distance from different functional interfaces, so that the human-machine interface of the product will be more convenient and humanized.

2.2. Principle of similarity

The so-called similarity principle refers to "graphics with common features, such as the same shape, the same color, the same direction, are easy to be considered a class" [5]. As shown in Figure 3, the distribution distances of each color block are the same, but because of the different shapes and colors, they are visually divided into 4 groups of figures.

Figure 4 shows the local layout of the operation panel of a numerical control machine. In the design of the panel, the letter keys and 0~9 numeric keys are used in different shapes and colors respectively. It is clear and easy to distinguish, and it brings great convenience to the operation. Similarly, the four arrow keys on the bottom right side of the panel are also distinguished from the buttons around the shape and color. This is the typical application of similarity principle in product human-machine interface design.

Figure 3. A brief illustration of
the principle of similarity.

Figure 4. Case of similarity principle --
CNC machine operation panel.

As a result, if the shapes, colors, and structure features of a number of operating objects in an interface are similar, users will see them as a class of components that meet the requirements of the same task. To enable users to quickly and efficiently divide the operating objects of different functions, it is necessary to set unique shapes, colors, and structural features for different operating objects[3].

2.3. Closed principle

The so-called closure principle refers to the "closed space formed by a graph will contributes to the composition of a whole" [5]. The holistic nature of human vision determines that the human visual system can close the open figure and perceive it as a complete image instead of scattered fragments. The closed principle is briefly illustrated in Figure 5. The figure is composed of 3 incomplete circles, and the 3 circles have blanks in the middle, but the human visual system will automatically fill the blank into a white triangle. At the same time, the vision system will automatically judge that a circle is blocked by a triangle rather than it is incomplete.

Figure 6 is shown as a microwave oven operating panel on which the 12 functional modules commonly used in the microwave oven, such as "milk / coffee" and "roast meat", are designed with an icon, name, and an incomplete round angle rectangle that surrounds it. But because of the integrity of human vision, when people perceive these 12 functional modules, each incomplete rounded rectangle is automatically made up in the brain, as shown in the red line frame in Figure 6, and the same design is also embodied in the two functional modules below the panel.
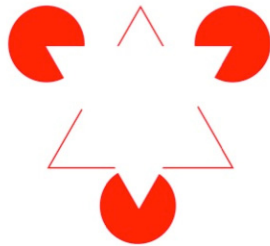

Figure 5. Brief illustration
of the closed principle.

Figure 6. Closed principle case --
microwave oven operation panel.

2.4．Continuity principle

The so-called continuity principle refers to "The elements with continuity are easy to be considered as a class [5]." In continuous graphics, the composition of a graph continues along a defined direction to form symmetrical, balanced or extended trajectories. The user's vision has certain activity inertia, so tends to see the continuous form, and will fill the omission when necessary. As shown in Figure 7, two cross slashes of different colors, though disconnected by a circle in the middle, will be perceived as two complete slashes in perception because of their continuity in color.

The typical application of continuity principle is the vehicle dashboard shown in Figure 8. In the design of the dashboard, taking into account the limitations of the interior space of the vehicle and the characteristics of the human field of vision, the three commonly used instrument "engine tachometer", "car speed meter" and "oil level and temperature meter" are arranged together in the middle of the vehicle. Except that the middle car speed meter is a more complete circular complete round instrument, both the "engine tachometer" and "oil level and thermometer" are all incomplete round instruments. It looks like they are blocked by the middle instrument, but under the principle of continuity, the human perception will automatically be regarded as the one. A complete circular instrument is shown in the Yellow circular line box in Figure 8. The continuity principle can make the human-machine interface of the product more concise in visual performance.
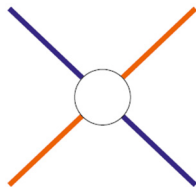

Figure 7. A brief illustration of
the principle of continuity.

Figure 8. Case of continuity principle –
automobile dashboard.

2.5．The principle of symmetry

Symmetry, also known as "homogeneous", seeks change in unity. Symmetrical forms can be seen everywhere in nature, such as the wings of birds, foliage of flowers and facial features. Symmetrical graphics have simple, concise aesthetic and static stability. Symmetry itself has a sense of balance. It is the best embodiment of balance, in line with people's visual habits.

In real life, there is more than one possible resolution in the user's visual area, but the user is

usually more inclined to decompose complex scenes to reduce complexity. The user's visual system automatically organizes and parses data, thus simplifying these data and giving them symmetric properties. As in Figure 9, the complex shape of the left map will be seen by the user as the two superimposed diamond in the right, not the "L" or the eight edge of a small diamond in the top. This is because the user's visual system thinks that a pair of overlapping diamond is more symmetrical, simpler and easier to understand than the other two interpretations.

As shown in Figure 10, the design of the remote controller is very concise, and it is free from the complex design of the traditional TV remote control. The only 5 groups with a total of 7 key layouts adopted the left and right symmetrical structure centered on the red vertical line in the map, giving people a concise, balanced and stable visual aesthetic and extremely humanized operation experience.
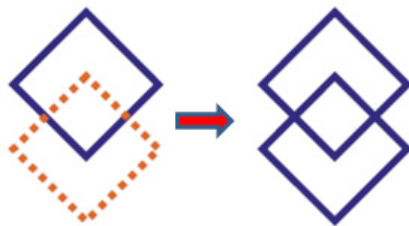

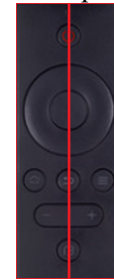Figure 9. A brief illustration of the principle of symmetry.

Figure 10. Case of the principle of symmetry – a TV remote control.

3. Conclusion

Gestalt psychology shows how the human visual system is optimized to perceive the structure. The visual system constructs a structure through active visual information in the environment, so that people can understand objects and events faster.

In the above case analysis, it is obvious that the five principles of Gestalt psychology do not exist independently, but interactively. The principle of proximity and similarity are related to the tendency to try to group the objects. The closed principle and the continuity principle are related to the tendency to try to give the object a complete form. And the principle of symmetry is related to trying to simplify the figure to make it fit the human visual habits. Gestalt principle enables information on the interface to be presented in groups and in a complete way. Therefore, in the process of designing the human-machine interface of the product, if the designer is able to organize the structure according to the Gestalt principle in the sense of perceptual attention, the user will get the corresponding information of display and operation more easily, so that the interactive process of human-machine can be accomplished more quickly, efficiently and accurately. And the efficiency of human-machine system will be improved.

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