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Vision and Order: A Study of Gombrich's Theory of Design Psychology

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Abstract: The visual effects of a design are influenced not only by objective factors such as texture and color, but also by subjective factors of the viewer, such as familiarity and taste. Gombrich identifies some explanations from the internal mechanisms of vision to illustrate the basic responses of vision to patterns (forms). He combines the design principle of 'framing and filling' with the notion of the limited perceptual capacity of the visual center to analyze the mechanism of visual perception, and also demonstrates the role of vague vision in forming the overall impression of patterns. In addition, through the study of the sense of order, interruption mechanisms, redundancy, and continuity mechanisms, he analyzes how visual mechanisms affect the impact of patterns. These theories provide new perspectives for understanding the creation and appreciation of visual art and offer theoretical guidance for the practice of pattern design and decorative art.

Keywords: Design Psychology; Gombrich; Visual Mechanism; Sense of Order.

1. Introduction

Contemporary psychologist Nicholas Humphrey proposed that when people describe visual experience, their experience contains two components, one is the propositional component and the other is the phenomenal component. The propositional component refers to the appearance of things and the different concepts that people have about the things in front of them, including various beliefs, opinions, feelings, etc. [3] Humphrey calls it a "propositional attitude" in viewing. The phenomenal component refers to a kind of "phenomenal consciousness" that people have in the process of watching. This consciousness is related to the visual sense of human beings, which is the basis of the existence of their subjectivity. Humphrey's explanation of human visual experience is divided into two parts, one is the phenomenal component, that is, the real experience obtained by vision; The other part is the propositional component, that is, the ideas obtained from real experience, which together constitute visual experience. Gombrich adheres to this attitude towards visual experience, believing that "the factors affecting the visual effect of a design work include not only actual objective factors such as texture, color, and color, but also subjective factors such as the viewer's familiarity with it and his appreciation interest." However, it is precisely because of this subjective factor that Gombrich does not believe that a complete and comprehensive set of design aesthetics can be established by psychology. Because of the influence of these subjective factors, visual effects such as order, balance, and dynamics cannot obtain a definite standard. Therefore, Gombrich took a different approach, not to explore the inherent characteristics of the pattern (form), but to find some explanations from the internal mechanism of vision to explain the basic response of vision to the pattern (form).

2. Consistency between Perceptual Processes and Pattern Formation

What a painting looks like when it is finished is a question that is easy to ask but not easy to answer.[4] Gombrich often spoke of things like this in his books. In a conversation, when he asked Wolfgang Köhler, 'What activities are taking place in our minds when we look at a painting?', the founder of Gestalt psychology gave Gombrich a similar response. He stated: 'This question is too complex; we cannot solve it at the moment.'

In his book *Ordered Perception: A Psychological Study of Decorative Art*, Gombrich delves deeply into the mechanisms of visual processing of images. He distinguishes between two basic stages of observing patterns: first, the direct activity of visual perception, and second, the mental activity during the act of looking.[1] Through an in-depth analysis of visual perception mechanisms and image composition, Gombrich proposes a central idea: there is a consistency between images that are easily perceived and those that are easily composed. This idea not only reveals the cognitive rules of visual art but also provides a new perspective for understanding the creation and appreciation of visual art.

In the process of exploring visual perception, Gombrich proposed a viewpoint: the perceptual ability of the visual center is limited. He divided the contents of visual perception into the 'resolving field' and the 'blurred field,' corresponding to the clear and blurry parts of vision, respectively. This theory was inspired by William H. Hogarth's research in visual psychology, particularly Hogarth's case regarding the 'reading eye.' Hogarth found that when observing complex forms, the eyes conduct 'arbitrary pursuits,' meaning the eyes are constantly moving while viewing. Gombrich used this finding to support his argument that only a small portion of the visual center can perceive a clear image while looking. To construct a comprehensive understanding of the entire image, the eyes must keep moving, combining the images of a series of small areas to form a complete visual representation. Modern physiological studies have further confirmed this view, noting that the human eye's area of best vision is about 1.5 degrees, while the clear area is around 15 degrees. This indicates that the reason the eyes need to move continuously is that the human eye can only discern details within a very small angular range, while contents beyond this range become blurry and cannot be clearly recognized.

Visual physiology reveals that only the central region of the

eye can provide image clarity. This phenomenon is crucial for our understanding of pattern perception because it directly relates to the construction of visual images. Based on this physiological feature, our eyes cannot capture a complete clear view of an image all at once. Therefore, our visual impression is gradually pieced together from multiple small image fragments observed during continuous movement, indicating that a visual impression is actually composed of a series of visual fragments.

In the field of pattern design, Gombrich proposed the innovative concept of 'framing and filling.' He emphasized that the scientific nature of pattern design is closely linked to the development of geometry. Early practices of graphic drawing provided a rich empirical foundation for geometric theories, and in turn, geometric theories offered solid theoretical support for pattern making. Theoretically, the combinations of geometric shapes are infinite, which means that the possibilities for patterns are also limitless. Since the time of Kepler, scientists and mathematicians have been fascinated by the ways geometric shapes can be combined, and by the 19th century, designers also began to focus on this issue. They attempted to classify shapes starting from the basic elements of points and lines according to Euclidean patterns. Although designers followed the rules of geometry in their study and classification of forms, they struggled to establish a unified design principle when faced with the challenge that the same form could be applicable to different classification criteria. Gombrich, after reading K. Lothar Wolf and Robert Wolf's *On Symmetry*, was disappointed by the limitations of morphological systems. Although the book had value, it failed to break free from traditional constraints.

Therefore, Gombrich shifted his focus to the methods of design themselves. Based on design practice and theory, he proposed the design principle of 'framing and filling,' which is not only a method for pattern design but also a design procedure. He believed that pattern design is hierarchical, with each level of construction involving two distinct steps: framing and filling.[1] 'Framing defines the boundaries of a region, while filling organizes the compositional elements within those boundaries.' By repeatedly applying these steps, the design gradually develops an increasing complexity at each level. Unlike the infinite patterns in geometric theory, decorative patterns in the real world are finite; they exist either as independent patterns or as decorations attached to other objects. Therefore, decorative design cannot do without the fundamental step of framing, followed by filling to enrich the pattern's content. These two steps together constitute the hierarchical structure of pattern design, and through the continuous repetition of framing and filling, pattern design gradually becomes more elaborate and refined.

In the examination of the pattern-making process and the process of visual observation, the formation of pattern impressions appears as a combinatory method due to the limited clarity of visual observation. The composition of formal patterns involves two steps, 'framing and filling,' which continuously create layers of progressively increasing complexity. Therefore, the issue of how images that are easily perceived align with images that are easily constructed is resolved within both the process of visual cognition and pattern-making.

3. The Role of Blurred Vision in the Overall Impression of Patterns

In exploring the formation of the overall impression of patterns, the role of blurred vision should not be overlooked. Edgar Wind pointed out: 'Our initial perception of a painting often arises from the overall impression, and only afterwards do we pay attention to artistic details such as composition, proportion, color, techniques, and gestures.'[2] This sequence of observation from the whole to the parts reveals the hierarchical nature of visual perception. Gombrich believed that this sense of hierarchy in visual perception stems from the different visual effects provided by different areas of vision. The clear areas of vision are responsible for the concrete construction of the image, while the blurred areas influence the overall impression of the image. Based on this, he introduced the concept of 'perceptual generalization,' which is a psychological impression formed on the basis of visual blur.

Gombrich classified visual blur into two situations: perspective disappearance blur in space and edge visual blur on a plane. He pointed out, "Although Leonardo da Vinci and Jay De Feer discussed these two types of blur separately, they did not realize the difference between them." Leonardo da Vinci conducted in-depth studies on the application of perspective rules in art, believing that visual blur originates from perspective depth; due to distance, vision becomes blurred, which he referred to as "perspective disappearance." Roger De Feer, on the other hand, explored visual blur on a plane. His experiments were similar to those of Hoggs, except that while Hoggs aimed to demonstrate the pursuit of different focal points on a plane, Roger De Feer focused on the perceptibility of blurred areas on a plane. Through his own research and experience, Gombrich clarified that edge visual blur areas can be identified at a glance, whereas perspective disappearance blur areas do not have this characteristic. He said, "It is precisely the possibility of confirming impressions that clearly distinguishes the experience of edge vision from the visual experience of viewing from a distance."

Gombrich believed that whether it is peripheral vision or the disappearance in perspective, they both provide vague images, and how to handle these images falls within the realm of psychology. He emphasized that vague images, after being perceptually generalized, are transformed into understandable images based on an individual's knowledge and expectations. Importantly, this mechanism of perceptual generalization is crucial for us to gain an overall impression when viewing complex patterns. He further pointed out: when people view decorations, there is a characteristic that we usually do not look at each pattern one by one; therefore, perceptual generalization of vague images becomes an important source of visual imagery.

Ultimately, in his examination of visually blurred areas, Gombrich proposed the theory of visual perception as a whole, suggesting that during viewing, the clear parts of the visual center and the generalized parts of the blurred areas together form an overall visual impression. This theory not only provides a new perspective for understanding visual art but also offers theoretical guidance for the practice of pattern design and decorative art.

4. Visual Mechanisms and Pattern Effects

Gombrich's art research and the development of cognitive psychology complemented each other, and his analysis of visual perception mechanisms benefited from the theories and methods of cognitive psychology.[5] This interdisciplinary research approach opened up new perspectives and directions for the study of art history, aesthetics, and visual culture. From the late 1960s to the early 1970s, psychologists gradually shifted their focus from overt behavior to internal cognitive processes. They began to explore the role of internal cognitive mechanisms in behavior regulation, a shift influenced by the tradition of rationalism. In 1967, the renowned American psychologist Ulric Neisser published the book 'Cognitive Psychology,' which, within the framework of information processing theory, provided a historical summary of previous work in cognitive psychology, marking the formal establishment of cognitive psychology as an independent discipline. Neisser's work not only summarized the cognitive research achievements of the time but also provided theoretical guidance and research methods for later researchers, and his views were frequently cited by Gombrich.

Cognitive psychologists believe that cognitive mechanisms play a crucial role in the acquisition, storage, and use of knowledge. They focus their research on internal cognitive mechanisms, holding that behind people's overt behavior, there exists a complex 'cognitive mechanism.' This internal cognitive mechanism is responsible for receiving incoming information, processing it, and outputting the processed results, in a manner similar to a computer's information processing. Gombrich agrees with the view that compares brain cognition to computer thinking. He believes that 'besides the structure of the eye, the brain performs different stages of selection, or what can be called information filtering and processing, along the nerves from the retina to the cerebral cortex.' Psychologists regard the core task of psychology as discovering and exploring this cognitive mechanism that exists between stimulus and behavioral response, revealing its characteristics and laws. Guided by the theory of cognitive psychology, Gombrich believes that during the process of viewing, there exists a visual mechanism, and these mechanisms produce various visual effects in the course of viewing. As he stated in *The Sense of Order*, 'What we wish to explore is not the inherent properties of form, that is, not the constant features of visual images, but the potential of decorative design to elicit specific responses in people.'

(1) A sense of order as a framework for understanding

Gombrich believed that the sense of order is a cognitive framework. In the preface to the second edition of *The Sense of Order: A Study in the Psychology of Decorative Art*, he stated: 'Organisms develop a sense of order in the struggle for survival, not because their environment is orderly as a whole, but because intuitive activity requires a framework as a reference to distinguish deviations from a plan.' In other words, vision understands the external world through a cognitive framework of the sense of order, starting from this instinctive 'sense of order.'[4]

The sense of order is a cognitive framework, and its cognitive process relies on Popper's methodology. Popper's epistemology emphasizes the process of hypothesis and testing, and how we approach the truth through continuous trial and error. Gombrich applied Karl Popper's methodology to the visual domain, proposing a series of theories related to visual perception. Firstly, Popper believed that scientific progress is achieved by raising questions and attempting to solve them. Gombrich applied this pattern to visual perception, suggesting that our visual system constantly formulates hypotheses and tests them against sensory input, ultimately seeking what fits the 'sense of order.' Secondly, Popper advocated using the trial-and-error method to develop scientific theories. Gombrich argued that the problem-solving process of vision is a continual trial-and-error process. In this process, our visual perception is not merely passive reception of information but an active endeavor. Our visual system interprets visual input according to expectations and provides feedback when encountering information that does not match these expectations. This process relies on the framework of the 'sense of order.' The visual system distinguishes unsuitable images and information based on the sense of order; what aligns with the sense of order is comfortable for people, while what does not is difficult to accept. Through continuous visual experimentation, it ultimately identifies images or information that fit the 'sense of order.'

Based on visual cognitive activities, Gombrich proposed a series of perceptual mechanisms, and it is the existence of these intuitive mechanisms that leads to different effects in vision.

(2) Calm and Chaos: The Visual Effects Caused by Machine Interruptions

Cognitive psychology believes that behind explicit behavior there is a cognitive mechanism. Therefore, when studying visual psychology, there is likewise a logic of viewing behind the effects of observation. Gombrich believes that the calmness or disorder of a visual effect depends on the 'interruption mechanism' of vision.

"Interruption" is a key concept in Gombrich's theory of visual perception. Interruption refers to any significant change in a visual pattern or stimulus stream that disrupts the observer's expected pattern and draws attention. An interruption creates a visually salient point. Gombrich stated: 'The effect of interruption is the shock we experience when transitioning from order to disorder, or from disorder to order.' Gombrich used an image of a pyramid to explain the existence of this mechanism. The regular decreasing width of the pyramid steps does not attract attention, but when the visual system detects two steps in the middle breaking the continuous pattern, the eyes are drawn to that point. In visual perception, an interruption can be a sudden change in color, shape, texture, or any visual element that contrasts with the surrounding elements, thereby capturing the observer's attention. The presence of interruptions allows the visual system to quickly recognize changes in the environment, which is crucial for survival and adaptation. For example, in a pattern arranged regularly, a sudden change in shape or color can be immediately spotted because it breaks the expected pattern. Thus, in visual perception, the interruption mechanism helps us identify and focus on significant changes or discontinuities in the environment.

A calm visual effect refers to a high degree of regularity and predictability in visual design. It does not have too many visually salient points, meaning there are few interruptions in the pattern, allowing the observer to easily understand and absorb visual information without visual stress, making it possible to view the image comfortably. Elements in designs that convey a sense of calm are arranged and combined according to certain rules and symmetry, enabling the eyes to

follow the pattern effortlessly, without unexpected interruptions or irregularities disrupting the visual flow. For example, regular repeating patterns and orderly color gradients can create a calming effect. Calm design usually gives a sense of stability, harmony, and order.

Chaotic visual effects refer to a lack of clear order and regularity in visual design, characterized by an excess of both order and disorder. In such patterns, there are numerous visual focal points that constantly draw the eye, causing it to chase various points of interest, making it difficult for observers to understand and absorb visual information, thereby creating psychological tension or unease. Chaotic designs typically include irregular patterns, disorderly color combinations, abrupt interruptions, and incongruous elements. The elements in this type of design seem to lack a clear organizational principle, making it hard for the eye to find a stable focal point or visual pathway. Chaotic effects can lead observers to experience visual fatigue, distraction, or confusion.

The visual effects of calmness and chaos are manifested under the influence of interruption mechanisms. Firstly, when the elements in a pattern are arranged according to a certain order and regularity, our visual system can quickly recognize these patterns and perceive them as resolved information, creating a sense of visual calm. This sense of order reduces the amount of information we need to process, allowing us to easily scan and understand the pattern. Secondly, when elements in a pattern appear irregular or unexpectedly interrupted, our visual system is forced to devote more attention to deciphering this complex information, which can lead to a chaotic and tense visual experience. This sense of chaos arises because our visual expectations are violated, requiring additional cognitive resources to process these inconsistencies. Overall, when the interruptions in a pattern align with our expectations, we experience harmony and calm; when the interruptions conflict with our expectations, we feel chaos. Artists and designers often use interruption mechanisms to create visual focal points and guide the viewer’s gaze. By intentionally introducing interruptions into regular patterns, they can create striking effects within a calm visual background, thereby increasing the visual interest and dynamism of their work.

(3) Balance and Instability: The Visual Perception Caused by Redundancy

Redundancy is a concept in information theory that describes the repeated or superfluous parts of information. In information theory, redundancy is related to the uncertainty and predictability of information. Highly redundant information implies low uncertainty because most of the content can be predicted. Gombrich introduced the concept of redundancy into the process of visual information processing. He believed that during observation, vision can use redundant information to help verify ambiguous information. He gave an example: in an image with several words, if one word is mostly obscured by ink, the information it conveys is hidden. Despite the missing parts, the process of reading or recognizing it is not greatly affected. This is because the other words serve as redundant information for that word, making it easy to infer the meaning of the obscured word from the surrounding words or sentence, demonstrating the power of redundancy.

Balance refers to creating a sense of stability and harmony through the orderly arrangement of visual elements. Balanced patterns can be symmetrical or asymmetrical, with the key being how they produce a sense of equilibrium in the viewer's visual perception. Symmetrical balanced patterns usually have a central axis, with shapes, forms, and spatial distribution on both sides being equal, thus creating an intuitive sense of balance. This symmetry is commonly found in nature and man-made designs, such as the wings of a butterfly or the façade of classical architecture. Asymmetrical balanced patterns achieve balance through the clever arrangement of visual weight and space, rather than simple mirror replication. This type of balance is more dynamic and complex, as it involves assessing and arranging the relative importance of different visual elements. The visual effect created by balanced patterns is not only a matter of visual stability; it can also influence the audience's emotional response. Balanced patterns typically give a sense of calm and tranquility, whereas unbalanced or overly complex patterns may evoke feelings of tension or disorder.

The sense of balance in vision is formed through the combined effect of peripheral vision and visual redundancy. Firstly, the basic characteristic of symmetrical patterns is their mirror reflection around a central point or axis. When observing a symmetrical pattern, the visual focus concentrates on the salient points, and the sequences of information at both ends of these salient points are identical, so the vision is no longer pulled in different directions. This establishes approximate redundancy in the elements, meaning the repetition at both ends of the pattern is the same, and these repetitions do not contain additional information. Moreover, the visual system does not rely solely on central vision to process visual information; peripheral vision also plays an important role. As Gombrich stated, 'Once the interrupter detector forms the hypothesis of this redundancy spanning the two sides, peripheral vision immediately confirms it.' When observing symmetrical patterns, central vision focuses on the pattern's salient points, while peripheral vision allows the overall layout and structure of the pattern to be perceived without directly focusing the eyes, thereby quickly grasping the overall pattern. The redundant parts on both sides of the center, as formed by impressions in peripheral vision, constitute the balanced pattern. Additionally, peripheral vision provides a blurred impression, so in the overall visual impression, people tend not to notice minor deviations in the symmetrical forms.

In addition, Gombrich believed that the sense of calm from a single symmetrical design becomes chaotic when repeated. This view comes from the interruption detection mechanism. He gave an example using letters to illustrate this point: the sequence ATA is symmetrical, but if ATA is repeated, it becomes ATAATAATAATA, in which new symmetries like TAAT and AATAA emerge. These new symmetries compete with each other, disrupting the calm of the original single symmetry. This happens because repetition generates new interruptions, which in turn create new visual focal points, causing the eyes to wander across each interruption. The visual focus is continuously pulled, and the sense of calm from a single axis of symmetry disappears, while the sense of balance also weakens through such repetition.

(4) Pattern movement caused by the continuation mechanism

The continuation mechanism refers to our visual system's tendency to seek continuity and coherence in visual scenes. This mechanism allows us to naturally perceive a series of visual elements as a continuous path or pattern, even if these elements are physically separate. The continuation mechanism is key to our understanding of complex visual

scenes, helping us construct an organized and meaningful visual world.

Visual dynamics refers to our perception of motion and change in a visual scene. This perception is not only a reaction to actual physical movement but also includes the interpretation of the arrangement and organization of visual elements, which generates a sense of dynamics in our brain. Visual dynamics can be produced by real motion, such as the movement of objects, or by visual illusions, such as the sense of motion created through specific visual arrangements and designs.

The continuity of vision guides visual tracking to generate visual dynamics. The continuity mechanism enhances our perception of visual motion by directing our gaze along continuous paths. For example, a wavy line or spiral line can guide the observer's eyes along its curves, creating a sense of visual movement. Beyond mere observation, the continuity mechanism also affects visual prediction, as our visual system anticipates what might appear next based on current visual information. This predictive ability allows us to perceive dynamic changes, even when these changes are generated through visual illusions. In summary, the continuity mechanism is a fundamental component of our visual system, enhancing our perception of visual dynamics by providing continuity and smoothness. This mechanism not only helps us interpret and understand visual information but also influences how we perceive and interpret motion and change in visual scenes.

5. Conclusion

Gombrich's theories in the field of the psychology of form design reveal the complexity of visual experience and its application in design aesthetics. Through the analysis of visual perception mechanisms, he emphasized the perceptual limitations of the visual center and the critical role of the peripheral visual blur in forming the overall impression of patterns. Gombrich's proposed design principle of 'framing and filling,' along with his discussions on the sense of order, interruption mechanisms, redundancy, and continuity, provide profound theoretical support for design practice. These theories not only enhance our understanding of the creation and appreciation of visual art but also offer guidance to designers in their creative processes.

Future research could further explore the application of visual perception theories in different cultural and aesthetic contexts, and how these theories influence cross-cultural design practices. In addition, with the development of cognitive science and neuroscience, advanced technological methods can be used to validate and deepen Gombrich's theories, exploring the direct connection between visual perception and brain activity. At the same time, practitioners in the design field can use these theories to innovate design methods and enhance the aesthetic value and functionality of their work. Ultimately, such research is expected to advance the theoretical development of design psychology and provide new perspectives and tools for design education and practice.

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