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Article

Properties of Colors and Their Effect on Human Psychology

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Abstract: Color is a fundamental element of visual experience and plays a crucial role in human perception and interpretation of the world. As a physiological and psychological phenomenon, color influences cognition, emotion, and behavior, shaping how individuals interact with their environment. While historically explored by philosophers and physicists such as Aristotle, Newton, and Einstein, modern research increasingly emphasizes the psychological and symbolic dimensions of color. The discipline of color science intersects with optics, design, fine arts, and consumer behavior. Despite interdisciplinary interest, a comprehensive understanding of how specific color properties affect human psychology, particularly in artistic, marketing, and socio-cultural contexts, remains underdeveloped. This study aims to investigate the formation, classification, and perception of color and to analyze its psychological and symbolic impact in diverse practical domains including fine arts, advertising, and social identity. The findings reveal that chromatic and achromatic colors have measurable effects on emotional states, purchasing decisions, and aesthetic experiences. Warm colors evoke intensity and urgency, while cool tones induce calmness and trust. Artists strategically use color combinations to convey mood, symbolism, and cultural identity in visual narratives. The article offers a synthesized perspective on the physical, psychological, and cultural dimensions of color perception, integrating historical theories with contemporary applications. Understanding the psychological functions of color supports its effective use in design, marketing, and art, enhancing emotional resonance and communicative impact in various human-centered disciplines.

Keywords: contrast, spectral colors, fine arts, achromatic colors, chromatic colors, mathematics, optics, gamma rays, X-rays, ultraviolet rays, infrared rays, Isaac Newton, Aristotle, Albert Einstein, physics, marketing

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1. Introduction

All objects visible to our eyes in the world around us have a certain shape, size, color, etc. These properties distinguish them from each other. Now we will talk about the reasons for their appearance[1]. Human efforts to understand colors date back to the era of primitive society. The study of colors and their analysis were initiated by ancient Greek philosophers. Plato : "Color is formed from a mixture of light and darkness, its nature is transparency. It exists only where there is light, and does not exist in darkness," he said[2].

How are colors formed? So, in order to have a complete understanding of the science of "Colorology", it is necessary to be aware of the concept of light that creates it. In nature, colors are mainly formed under the influence of sunlight or artificial light. Sunlight cannot be captured or weighed. The sun simultaneously emits the following light waves:

1) gamma rays;
2) X-rays;
3) ultraviolet rays;
4) infrared rays;

5) radio waves;
6) electromagnetic radiation.

Most of these rays cannot reach our planet because they cannot pass through the layers of the atmosphere[3]. Only electromagnetic radiation waves, which travel at very high speeds in space, reach the Earth and, as white, transparent light, allow us to see colors in nature and see everything. There are several sources of light, including the following:

1. The most powerful, unlimited source of natural light is the sun, which is the basis of heat and life. The more light there is, the more clearly we see the shapes and colors in nature[4].
2. The second source of natural light is the moon, which does not emit light, but reflects the sunlight that falls on it. Since the light emitted by the moon is several million times weaker than sunlight, we do not clearly see the small details and colors of natural forms.
3. Artificial light sources include oil lamps and electric lamps invented by fire and human thought. The light they emit is very weak and limited compared to the light emitted by the sun[5].

Depending on the strength of the light, colors appear clearer and more diverse. Debates about sunlight, that is, how light is formed, how it moves, and what it is made of, have been going on for centuries. Sunlight was first studied by Abu Ali al-Haytham al-Basri , one of the famous scientists of the Muslim world[6]. He conducted experiments and concluded that sunlight falls on the Earth in a straight line. More than 300 years later, physicists are still debating how the sun's electromagnetic radiation is formed and moves.

2. Materials and Methods

This study applies a theoretical-analytical approach grounded in interdisciplinary research that intersects physics, psychology, design, and the fine arts. The research methodology is based on a systematic review of primary and secondary sources, including classical theories of light and color proposed by figures such as Plato, Newton, Huygens, and Einstein, as well as contemporary scientific literature. Textual analysis of scientific and historical literature was conducted to understand the evolution of color theory from a physical and perceptual standpoint. Particular attention was paid to the properties of electromagnetic radiation, the composition of visible and invisible light spectrums, and how these interact with human sensory and psychological responses[7]. The method also includes interpretive analysis of practical applications of color in design, marketing, and visual art, assessing how chromatic and achromatic colors influence human behavior, mood, and perception. Observational insights from the applied arts were incorporated to evaluate color symbolism in both traditional and contemporary contexts[8]. Additionally, comparative examples were drawn from industrial and commercial sectors—such as architecture, advertising, and retail—to demonstrate how specific colors elicit emotional responses and behavioral tendencies. This multi-perspective methodology allows for a comprehensive evaluation of color as both a physical phenomenon and a psychological instrument, supporting the article's aim of informing artists, designers, and educators about the complex interplay between color properties and human cognition[9].

3. Results

Over time, the emergence and development of physics served to further enrich the knowledge about the incidence and properties of sunlight. Many physicists were engaged in this field. The first to study the nature of light was the Dutch physicist Christiaan Huygens. He wrote the work "Treatise on Light" , in which he tried to prove that light rays move in a wave-like (spherical) manner, like sound. Huygens put forward the idea that "each point reached by a light wave is in turn the center of the next wave." However, the theory of the English scientist Isaac Newton, who had a high reputation among physicists at that time, "Light rays consist of tiny particles moving in straight lines," prevailed for centuries.

By the 19th century, the English physician and physicist Thomas Young conducted research on the study of light rays and in 1803 founded the concept of "interference of light"[10]. He placed a light source in the first part of a three-part box. The light scattered from it passes through a narrow hole in the first barrier and falls on the next barrier with two holes. After passing through them, it forms successively illuminated and non-illuminated lines on the surface of the third wall. With this experiment, T. Young established the concept of diffraction, which is the deviation of light from a nearby obstacle during its movement along a straight line. This experiment of his solidified the idea that "Light propagates in the form of waves, each wave starts from the center of the previous one".

At the beginning of the 20th century, the German physicist and international scientist Albert Einstein proposed the theory that "light consists of tiny particles carrying energy, photons, quanta, which are separated from the source and move at high speed." Today, among physicists, there are also ideas that "light behaves both as a wave and as a corpuscle." Although several centuries have passed, how weightless transparent light is formed and moves remains a mystery[11]. Now, let's look for answers to the main questions of our article, such as colors, how they are formed, and their properties. What is color? What is its nature, meaning, and properties? Here are a number of questions that interest every creative person, regardless of their creative experience and professional specialization. Modern science defines color as a product of the emotions that people experience under the influence of light[12]. In the science of color, light is considered to be the movement of electromagnetic waves. There are visible and invisible electromagnetic rays (infrared and ultraviolet). In the spectrum of sunlight visible to our eyes, the colors are located in the following sequence: red, orange-red, orange, orange-yellow, yellow, green-yellow, yellow-green, green, blue-green, blue, indigo, violet. In addition to spectral colors, there are also violet colors in nature that are not in the spectrum, but we perceive them as the result of a mixture of red and violet. Each person can distinguish up to 120 colors, which are called chromatic. Achromatic colors include black, white and all intermediate colors. From the variety of colors around us, we can distinguish three chromatic colors, namely red, yellow, blue, as well as two achromatic colors, namely black and white. These colors alone are enough to provide a rich palette for a creative person. In addition, colors have different properties[13].

Color gradation is the color quality that can be equated to one of the spectral colors.

Brightness is the degree to which a given color differs from black, measured by the number of thresholds.

Relative brightness is the process by which a given shade is measured by comparing it with grayscale samples.

The concept of color is a complex concept, and saturation is the degree of difference between a chromatic color and an achromatic color of the same lightness, measured by the number of thresholds of difference from a given color to an achromatic color.

Color purity is the ratio of the pure spectrum to the total brightness of a given color[14]. The purest colors are spectral colors.

The concept of color is a complex concept, and scientists have given it different definitions. The ancient Greek philosopher Plato expressed his opinion by saying, "The nature of color is transparency, it is a product of light. Color is visible only where there is light, and does not exist in darkness. If we consider light to be white and darkness to be black, then the primary colors are white and black." He also said, "chromatic colors are mixtures of light and darkness in varying amounts."

Today, the following definitions are given to the concept of color:

1. Color (physics) is a component of electromagnetic waves visible to the eye in sunlight.
2. Color is a sensation that awakens in the human eye under the influence of light.
3. Color is a gift of nature, its mysterious miracle.
4. Today, the properties of color are still studied in such fields as physics, chemistry, medicine, and fine arts.

The optics department of physics studies the formation of various colors from white light. When a glass prism is placed in the path of the sun's white electromagnetic rays, the light is refracted through it and a rainbow of colors is formed that smoothly pass into each other without boundaries. We call these colors spectral colors. Physicists believe that by spectral colors we should understand the purest, brightest, most saturated colors in nature, which do not contain achromatic (white, black, gray) and brown. Spectral colors can be seen in nature in a rainbow formed in the sky after rain or in waterfalls and fountains in streams from time to time. Today, colors play an important role in almost every field and are used in the form of paints for various purposes. Paints are important as a very necessary product in construction, architecture and design, the textile industry, various branches of painting and folk arts, in heavy industry, and in a number of other areas. In addition to providing a variety of colors in industrial products, colors also serve as advertising to attract customers. This is a process related to the symbolic or psychological properties of colors. Colors have the property that they can convey positive or negative emotions to people, reveal the inner world and character of people, or at least interpret them as a symbol of some ideas and views. The red color has been reflected on the flags of some countries in the history of statehood as a symbol of wars, various conflicts and complex political processes. For example: after the Bolshevik Revolution in Soviet Russia in 1917, until 1991, the red color was reflected on the flag of the Soviet state as a symbol of communism and socialism. This is one example of how colors are used separately, depending on why and for what purposes[15].

4. Discussion

Colors are very important in industrial production, marketing, modern advertising, and similar alternative business sectors. The reason is that colors have a strong effect on our emotions and psychology. According to research, 93 percent of buyers give color to a product before its appearance, smell, sound, taste, and smell. And 85 percent of buyers cite color as the main condition for buying a product. Understanding how the mind interprets colors can help you create a retail environment that resonates with your target audience and encourages them to buy your product. For example: Red Restaurants and food businesses also use red a lot, because it increases appetite and metabolism. Blue, on the other hand, has been found to be the most popular color in Western culture in surveys. It creates a sense of trust and security, which is why it is often used by banks and insurance companies. Orange is an energetic color in many ways, evoking excitement, enthusiasm, and warmth. It also creates a sense of value, which can be effective in calling to action to make a purchase decision. Orange was used by the ancient Egyptians in chromotherapy to increase energy levels and treat the lungs. Another area where colors are widely used is fine and applied arts. Colors are the main material that is widely used in fine and applied arts in the form of various paints. Because the main essence of these types of art is to give people aesthetic pleasure, to expand their worldview. Artists reveal the artistic content and essence of the work of art they create through colors and lines. Let's say we want to create a work in the genre of battle. So, what colors can we use? Imagine a battlefield. A sad and gloomy scene of wounded and dead soldiers, destroyed buildings or military transports, black smoke, flames or ordinary people covered in blood appears. The artist depicts this scene using contrasting colors. For example, if he uses warm colors such as red, orange, yellow, and yellow to show blood, fire, the intensity of war, and anger, he uses dark gray, black, and brown to express evil, ignorance, sadness, and darkness. This is a process that requires the artist to be able to correctly choose the color scheme that suits the subject.

5. Conclusion

Color (in fine arts) is the main means of expression and image in painting. Through color, the artist truthfully reflects the existing world with its unique characteristics. In the development of world art, various styles and systems of reflecting the colors of existence have been formed, but the basis of all of them is the method of mixing colors with each other to create new colors. By mixing 7 different rainbow (spectrum) colors, more than

280 color shades can be created. Color is a powerful tool that can influence the human psyche, it can evoke feelings of joy and sadness, cheerfulness or sadness, calmness or anxiety in a person. For the artist, this power of colors is an important factor, they play an important role in the ideological plastic solution of the work. In the history of fine arts, the use of color has developed along with the development of society. The artist of the primitive community created his "work" using available natural colors (charcoal, fire moth), and with the development of society, pigments and binders increased. At the end of the Middle Ages, watercolor technology appeared, and from this period, color shading also increased, and the previous local, flat colors were replaced by a system of colors that changed, changing with the help of light and shade. The desire to reflect the full-fledged volumetric appearance of objects and master spatial space through colors increased. From the 60s and 70s of the 19th century, paintings began to be created based on the juxtaposition of colors close to bright (spectral) colors. Such works should be observed from a certain distance. In avant-garde art (abstract art, symbolism, surrealism, etc.), colors acquired a figurative, symbolic meaning, and in many cases constituted the main content and idea of the work. The size, shape, and position of colors were focused on illuminating the mysterious, philosophical content. We believe that the information we have provided above: Knowledge about the influence of colors and their properties on human life and psyche will be useful for students and independent researchers.

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