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Colour harmony: The ideality of pleasurableness

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ABSTRACT: The search for the essence of colour harmony has a long tradition that, being a quest for aesthetic values, remains a contemporary question insofar as it addresses the interrelated issues of both beauty and pleasure. Colour harmony has been discussed in terms of two different points of view. As a measurement of aesthetics, the researches of colour harmony are based on the discovery of its systematic rules by identifying the relationship between colours and its aesthetic value in beauty and harmony. The proportional and orderly arrangements of colours and their relations to mathematics are the main concerns of this first approach. As a measurement of emotion, colour harmony is regarded as subject matter of pleasure, subjective feeling which is peculiar to an individual. Relying on the second approach, many studies have been conducted to identify the reasons behind why colour combinations are perceived as beautiful, pleasant, and harmonious. Thus, this paper is a retrospective review of the literature of colour harmony, its theories, and principles considering the two approaches. The assumption is that, in either case, colour harmony is grounded in a search for the ideality of pleasurableness.

Keywords: Colour Harmony, Complementary Colours, Colour Order Systems, Pleasantness, Aesthetics

1 INTRODUCTION

> "The enjoyment of colours, individually or in harmony, is experienced by the eye as an organ, and it communicates its pleasure to the rest of the man."
> Johann Wolfgang von Goethe

In 'The Principles of Psychology', James states that the primary layer of emotional responses involves subtle feelings like pleasure which is elicited by harmonious combinations of colours, lines and sounds (apud. Cupchik 1994). According to O'Connor (2010), the general acceptance of colour harmony, upon the definition of Burchett (2002: 28) is "Colours seen together to produce a pleasing affective response are said to be in harmony." Depending on the pleasing effects of colours, searching for the essence of colour harmony has a long tradition throughout the history and scientific world by addressing the question, which colours in combination are harmonious, beautiful, and yield pleasure. Some Greek philosophers, according to whom beauty and harmony were inseparable notions that could only be explained by mathematics, held debates on the evaluation of the nature of colour, its beauty, and harmony. The utilisation of mathematical order to describe the notion of beauty forms the basis of colour harmony theories from ancient periods towards contemporary times (Holtzschue 2011). The thinking of colour in earliest times was largely based on the hypothesis of Aristotle (350 B.C.), who assumed that "Whatever is visible is colour and colour is what lies upon what is in its own nature visible." (Macadam 1970: 2). Aristotle also asserted that, "[…] sunlight always becomes darkened or less intense in its interactions with objects." (Nassau 1998: 4) thus "[…] what is seen in light is always colour." (Macadam 1970: 3). In accordance, he believed that "[…] white and the black could be juxtaposed in quantities so minute that (a particle of) either separately would be visible, though their combination […] would be visible; and they could thus have the other colours for resultants." (Macadam 1970: 6). In other words, all colours were the mixtures of black and white, or darkness and lightness, and derived from the four elements; i.e. earth, air, fire and water. According to Aristotle, the element fire was considered as white and the earth was black. The elements of air and water had no colours of their own; however, the air had the ability to make the colour whiter and the water made the colour darker. In his work, 'Sense

and the Sensibilia' Aristotle asserted that, between black and white, there existed five colours which were red, violet, green, dark blue and grey (for the alternative was yellow) (Kuehni 2003; Sorabji 1972; Zollinger 1999). The total number of seven in Aristotle's colour scale would later influence Newton's adoption of 'seven' perceived colours of the spectrum (Zollinger 1999). Aristotle's ideas were later employed to develop the modern understanding of science of colour and colour harmony theories (Taft 1997).

Colour science is conventionally accepted to begin with the experiment done by Sir Isaac Newton in late 17th century. He was interested in the physics of colour, the relationship between light and colour, and the mixtures of colours (Zollinger 1999). In his experiment, Newton discovered that when the sunlight passed through a triangular glass prism the light was bent and refracted. This refraction of the light resulted in an array of different colours. Newton stated that "[…] Light [white light or sunlight] is a heterogeneous mixture of differently refrangible Rays, and a mixture of colours" (Apud. Nassau 1998: 5). He distinguished red, orange, yellow, green, blue, indigo (blue-violet), and violet in the visible spectrum. Kuehni states that, Newton nominated seven colours of the spectrum not only because he was in agreement with the spacing of musical scale but also since it was a classical number in ancient periods (Kuehni 2003; Kuehni 2005). More importantly, he believed that there was a strong analogy between musical harmony and colour harmony. In his book 'Opticks', Newton mentioned that the two ends of the colour spectrum, i.e. red and violet, had a correspondence with the two ends of the octave in music (Zollinger 1999). Thus, according to him, whenever the notes and colours were in combinations, their relationship could be harmonious (Green-Armytage 1996).

Although the search for relationships between colour and its aesthetic value in beauty and harmony dates back at least since Aristotle, Newton's work not only on the nature of light as well as on the nature of colour, forms a philosophical and scientific understanding of the colour and colour harmony. Beginning in the 18th century, after Newton's 'Opticks', theories on colour harmony developed and have been discussed throughout the years.

This paper, thus, is a retrospective review of literature on colour harmony, its theories, and principles. Colour harmony is considered both measurement of aesthetics and measurement of emotion (O'Connor 2010), and the underlying assumption of this paper is that, in either case, colour harmony is grounded on seeking for the ideality of pleasurableness.

2 HARMONY IN COMPLEMENTARY COLOURS

Green-Armytage states that "In colour theory, according to a long tradition, a combination of complementary colours will be harmonious and, therefore, pleasing." (1996: 205). In the 15th century, Leonardo da Vinci dealt with the idea of colour contrast. According to him, the most beautiful combination of colours was the pair of contrast colours (Xiao-Ping 2007). Da Vinci claimed that (apud. Green-Armytage 1996: 206) "A direct contrary is […] black with white, […] blue with a yellow as gold, green with red […] and yellow with blue." However, writing on colour being rare, da Vinci's idea was not established. As has already been stated, the milestone for the scientific world on colour is considered the results of the experiments of Newton in the 18th century. Newton, however, dealt with more on the additive mixture of light colours. In about 1730, LeBlon suggested the first concept of subtractive mixture of the pigment colours. He discovered that the three primary hues red (magenta), yellow, and blue (cyan) could not be produced using any other colour and all other colours were the result of the mixtures between these three primaries. (Holtzschue 2011; Westland 2007). With his CMY approach, LeBlon provides a basis for mixing pigments of today printing. In the mid-18th century, Harris used LeBlon's approach of the three primary colours in a colour circle which was based on the subtractive mixing of the pigments (Zollinger 1999). According to Harris, the primary colours red, yellow, and blue were so dissimilar that, they should be positioned at a very far apart from each other on the circle. Later, in the early 19th century, Goethe adopted Harris's circular organisation and suggested that completing colours was pleasing (Green-Armytage 1996; Holtzschue 2011).

In his book, 'Zur Farbenlehre' (On the Doctrine of Colours), Goethe claimed that the complementary relationship of colours was based on after-images of the colours. This effect was called successive contrast. Both successive contrast, and the detailed studies on simultaneous contrast, formed his theory of colour harmony (Green-Armytage 1996; Zollinger 1999). Goethe developed his idea with his six-colour circles that comprised of two sides; the positive side (i.e. red, orange, yellow) and the negative side (i.e. green, blue, and violet). According to him, the analogous pairs of colour combinations did not have a character and their combinations were not fully harmonious (Kuehni 2005; O'Connor 2010; Ou 2004). Kuehni explains Goethe's statement as follows;

> There is a scale of declining harmony from perfection to character to without character. Lightness and darkness complicate harmonious relationships […]. Active colours (yellow, orange, red) [positive side of the colour circle] gain energy when combined with black or dark colours, but loose energy when combined with white or light colours. Passive colours (violet, blue, green) [negative side of the colour circle] look dark and foreboding when combined with dark colours, but gain cheerfulness when combined with light colours (apud. Kuehni 2005: 166).

In accordance, Goethe claimed that, when colours were selected from both sides of the colour circle, opposite to each other, their combinations produced a splendid effect, thus, this resulted in full harmony (Ou 2004). Afterwards, in the mid-19th century, Chevreul developed a more systematic theory of colour harmony.

Chevreul's theory of colour harmony consisted of two principles, harmony of analogy and harmony of contrast (Ou 2011). He also accepted the three pigment primary colours, red, yellow, and blue, and developed his theory of colour harmony according to a 72-hue circle (Kuehni 2003). The first principle of the harmony of analogy included the analogous/adjacent/nearby colours of the same hue, saturation, or lightness. The second principle of the harmony of contrast not only involved the opposing hues, but also the contrast of lightness or saturation within the same hue (Kuehni 2005). O'Connor states that "Chevreul championed 'complementary' colours and their contribution to colour harmony and he equated maximal contrast of the complementaries with maximum harmony." (O'Connor 2010: 268). Chevreul believed that, "In the Harmony of Contrast the complementary assortment is superior to every other." (Green-Armytage 1996: 206). In his book, 'The Principles of Harmony and Contrast of Colours and Their Applications to the Arts', Chevreul classified four types of rules for the harmonies of colour contrast which were direct complementary, double complementary, split complementary, and triad schemes (Xiao-Ping 2007). He also suggested that when colour combinations were seen as dark, the use of white helped them to make lighter; when they looked bright black could be used to balance them; and also when two colours were perceived as disharmonious, white or black could be used as a separation colour. Chevreul's principles of colour harmony have been regarded as the most important guidance for colour education in the departments of architecture, design, fine arts, and etc. (Ou 2004).

3 HARMONY IN ORDERLY ARRANGED COLOURS

Other colour theorists (i.e. Munsell, Ostwald, Itten) later followed Goethe and Chevreul's works on harmony of complementary colours in the late 19th and early 20th century. The major scope of these latter researches was to find out the laws of colour harmony by using rules, control, and order. The measurement of aesthetics of colour harmony was the main subject matter of this period which could only be solved by creating colour order systems with the use of mathematical-balanced representations (Holtzschue 2011). Alongside the hue of a colour, the other two attributes, lightness and saturation of that colour were considered and three-dimensional colour solids or models were presented by many of the theorists (Xiao-Ping 2007). Although Runge developed the first colour solid in the late 18th century, Munsell and Ostwald's colour solids are considered the most important colour models.

Munsell claimed that "What we call harmonious colour is really balance." (apud. Holtzschue 2011: 142) and also stated that "Visual comfort is the outcome of balance." (apud.Arnkil 2008). In 1905, he published a book, 'A Color Notation System', to describe his rules of colour harmony by developing a three-dimensional model. Munsell systematically arranged the colours due to their three perceptual attributes, hue (Munsell hue), value (Munsell value), and chroma (Munsell chroma), in equally graded steps (Kuehni 2005). In his system, the geometric arrangements of the three attributes of colour were in a cylindrical form that is called the Munsell colour space. Munsell hue (H) was placed on an equal numerical interval with an equal perceived difference of attribute that was represented along a circle. This circle consisted of five elementary hues, i.e. red (R), yellow (Y), green (G), blue (B), and green (G); and five intermediary hues, i.e. YR, GY, BG, PB, and RP. These ten Munsell hues were again divided into ten to give 100 hues. On the other hand, the scales of Munsell value (V) and Munsell chroma (C) were based on the ratio scales. Munsell value had ten equal steps from zero (absolute black) to nine (absolute white) where the achromatic scale was represented vertically along the axis of the circle. Munsell chroma represented the chromatic intensity/strength/purity of colours that started from the value scale axis in the centre. Then it radiated in equal steps starting from 0 (zero chroma) and reaching at the brightest hues to a maximum of 17 outward to the periphery of the circle. The complete notation of a colour in Munsell system is expressed as H V/C (Choundhury 1996; Mahnke 1996).

Munsell suggested a set of practical principles in order to attain colour harmony. According to him, colours should be found in a specific path in his colour space. These paths should include the following principles;

a. The grey scale;
b. Colours of the same hue and the same chroma;
c. Complementary colours of the same value and the same chroma;
d. Colours of diminishing sequences, in which each colour is, dropped one-step in value as chroma go down one-step;
e. Colours on an elliptical path in the colour space (Ou 2004: 67).

Munsell also recommended the use of colour strength (chroma) in order to balance colour areas "[…] a small area of high colour strength would balance a large area of low colour strength, […] a strong colour should occupy a smaller space to balance a weak colour." (Westland 2007: 9). Today, the Munsell colour system is widely known as a uniform colour order system. Alternative to the Munsell system, the Natural Colour System (NCS) was developed by Hård, Sivik and Tonnquist in late 20th century (Hård, Sivik and Tonnquist 1996). The NCS was based on Hering's phenomenological opponent-colour theory from 1874. Hård et al. claim that the NCS as a colour system is based on the relationship between the visual properties of colour precepts and the human sense of colour vision (Hård, Sivik and Tonnquist 1996). O'Connor states that

> while the opponent-process theory of human vision involves pairs of complementary colours […], there is no evidence to suggest that physiological balance in the human visual system is associated with positive esthetic response of colour harmony. (O'Connor 2010: 268).

However, the two systems have been used as a method of universal colour communication and a tool for colour harmony in colour industries, colour researches and colour education (Holtzschue 2011; Westland 2007). Moreover, several perceptive colour order systems have been developed in late 20th century, i.e. the CIE system, the OSA-UCS system, the DIN, the Coloroid and the Colorcurve system and today they are used for different purposes by different professions.

Ostwald stated that "Colours appear to be harmonious or related if their properties are in certain simple relationship." (Kuehni 2005: 167). In 1917, he began to publish several textbooks on colour science, the first of which was called 'Mathetische Farbenlehre' (Theory of Logical Ordering of Colours). In this book, he described a three-dimensional colour solid in a form of double-cone where the achromatic colours were presented along the axis and chromatic colours were placed along the circle. The idea behind his system was based on spinning-disk mixture of full colour, white and black. Oswald's colour circle consisted of four basic hues; i.e. red, yellow, green, and blue. In circle, yellow and blue were located opposite to each other as red and green. The additional hues were found in equal spacing between these major four hues. According to Ostwald system, opposing hues were complementary when the spin-disk mixture of the proper proportions of colours produced a neutral grey (Holtzschue 2011; Kuehni 2005; Ou 2004; Westland 2007; Zollinger 1999). Ostwald developed some colour harmony principles based upon his ring star shaped colour solid. These principles were explained as follows:

1. Colours harmonise if they are located at the equal white and equal black circle in the solid;
2. Colours harmonise if they have equal white content;
3. Colours harmonise if they have equal black content;
4. Colours harmonise if they have equal hue content (Westland 2007: 9).

He believed that order was the basic law of colour harmony. The Ostwald system was accepted and used by several artists and designers. The Ostwald solid was based on equilateral triangles and was seen much simpler that the structure of the Munsell solid (Choundhury 1996).

Itten followed Goethe's principles of colour harmony and developed a contrast-based theory. He stated that "two or more colours are mutually harmonious if their mixture yields a neutral grey." (apud. Ou 2004: 68). Itten's ideas of colour harmony were based on his 12-colour wheel. He took the idea of three-pigment primary colours, red, yellow, and blue and placed all subtractive complements opposite to each other (Westland 2007). According to Itten, colour harmony was equilibrium and he explained it as follows;

> [Colour] harmony in our visual apparatus then would signify a psychophysical state of equilibrium in which dissimilation and assimilation of optic substances are equal. Neutral grey produces this state. I can mix such a grey from black and white; or from two complementary colours and white; or from several colours provided they contain the three primary colours: yellow, red and blue in suitable proportions. (apud. Holtzschue 2011: 268).

In accordance, Itten developed some colour chords in order to show the complementary relationships of the colours. According to him

> […] all complementary colour pairs and all triples in relationship of an equilateral triangle, a square, or a rectangle [or a hexagon] in the twelve-colour circle are harmonious." (apud. Kuehni 2005: 167).

Although his developed chords were mathematically based, Itten also had an attitude towards individual perception. However, Itten asserted that "The concept of colour harmony should be removed from the realm of subjective attitude into that of objective principle." (apud. Holtzschue 2011: 142). He divided his objective principles of colour harmony into seven contrasts; Hue, Value, Saturation, Extension, Warm and Cool, Complementary, and Simultaneous Contrast. Itten was one of the most important teachers of Bauhaus who made influential contributions to colour harmony and colour education. Today, his book 'The Art of Color' is the most widely used books on colour theory in the departments of architecture, design, fine arts and etc. (Green-Armytage 1996; Westland 2007).

The complementary relationship of colours and their mathematical-based aesthetic measures by developing colour order systems were the main concerns of colour theorists from Goethe through Itten. The general acceptance was that balance between complementary colours was the main and the most important principle of colour harmony. However, Albers who was the colleague of Itten in Bauhaus made an end of the traditions of colour order systems (Holtzschue 2011). According to him, the systematic approaches to colour harmony was inappropriate. He further stated that "no mechanical colour system is flexible enough to pre-calculate the manifold changing factors in a single prescribed recipe." (apud. O'Connor 2010: 269). Albers believed that the visual experience was much more significant than theory. In 1963, he published 'The Interaction of Color', and said about his book that it

> […] does not follow any academic conception of theory and practice. It reverses this order and places practice before theory, which after all, is the conclusion of practice." (apud. Zollinger 1999: 219).

In the late 20th century, after Albers's contributions to colour, the subject of colour studies moves more into psychological effects of colour, considering colour harmony as a measurement of emotion.

4 CONCLUSION

Green-Armytage states that although some of the colour harmony principles have been widely accepted, these principles are based upon the theorists' own peculiar ideas (Green-Armytage 1996). Kuehni claims that "It is quite evident that there are no universal laws of colour harmony." (Kuehni 2005: 145). In accordance, Burchett asserts that there are not specific models accepted to define the concepts of colour harmony (O'Connor 2010). Judd and Wyszecki define colour harmony as "when two or more colours seen in neighbouring areas produce a pleasing effect, they are said to produce a colour harmony." (apud. Ou 2004: 60). Cupchick, in accordance, indicates that (colour) harmony is a reactive level emotional response which is based on a subjective feeling and peculiar to an individual (Cupchik 1994). This peculiarity not only depends on the individual differences but also is influenced by cultural, contextual and perceptual factors (Hård, Sivik and Tonnquist 1996). Relying on the subjectivity in colour harmony, many studies have been conducted in order to find out the underlying reasons in which colour combinations are perceived as pleasant and harmonious.

Guilford (1931) and Lo (1936), in their studies, tried to determine preference values of colour combinations over individuals' preference ratings. The results revealed that pleasurableness was comprised of its components as a preference value. Hogg (1969) classified 40 bipolar adjectives into four factors in his study of colour pairs which were labelled as strength, pleasantness, warmth, and usualness. Sivik (1983), Sivik and Taft (1989), Sivik and Hård (1989), Sivik and Taft (1992) in their studies aimed to find out the colour harmony judgements of individuals in two or more colour combinations by using semantic variables and also to identify the reasons behind why colour combinations were perceived as beautiful or ugly. In their study, Sivik and Taft (1989) conducted a study to search for the variables of meaning for judging colour combinations and extracted five factors, i.e. general evaluation, articulation, brightness, warmth, and originality. On the other hand, Ou et al. (2004) and Ou and Lou (2006) intended to construct a colour emotion model for colour combinations and defined their model with three factors, colour activity, colour weight, and colour heat.

Ou states that, although accompanied by emotions, "[…] the concept and underlying reasons of colour harmony are still far from definite." (2004: 60). Upon past theories and studies, researches and experiments need to be conducted in order to bring a better understanding to the notion of colour harmony with the motive to discover pleasurableness of ideality.

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