# Colour harmony in the context of teaching

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This paper addresses the problem of normative aesthetics and how it can play out in the teaching of colour in the creative field of art and design. A brief historical overview of a representative selection of different theories of colour harmony is given, showing clearly how heterogeneous such theories are. Some examples of critical voices and alternative views on the notion of colour harmony are provided, as well as an examination of the concept of colour harmony in the context of modern and contemporary art. The conclusions of this study are that objective and universally applicable criteria of colour harmony do not exist, and that most theories of colour harmony are restrictive and normative and therefore questionable in the field of art and design pedagogy.

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## Introduction

We do not not claim to present a complete historical outline of all colour harmony doctrines, nor do we aim to provide the latest research on the aspect of colour harmony – and certainly not to implement yet another new theory of colour harmony. It is rather our intention (both of us having a long history of teaching colour at schools and universities) to provide colleagues with guidance on how colour harmony can be addressed within the teaching of colour and art. For despite all modern individualism, self-realization, and self-confidence, there is still widespread uncertainty as to whether the pleasing composition of colours is a mere matter of taste or whether there are objective, scientifically based rules according to which colours harmonize with each other, and whether following such rules makes sense. In order to gain clarity in this matter, a brief historical overview of the emergence and development of the most important colour harmony theories is first given. The overview shows clearly how heterogeneous these theories are. We conclude by providing some examples of critical voices and alternative views on the notion of colour harmony. The paper is to be seen in the context of the recent activities of the Colour Literacy Project, which strives for a contemporary approach to the complex phenomenon of colour in the pedagogical and didactical field.

## What is meant by colour harmony?

The concept of colour harmony is rooted in notions of the agreeable, apt or pleasing combination of colours reaching back to antiquity. But unlike in Western music, there is no single universally accepted theory or system of harmony in the art and science of colours [1 p.21-31, 2 p.242–249]. Harmony is often also linked to the concept of beauty, which in itself has been in the centre of discussion among artists and philosophers for centuries. In the case of colours, both standards of beauty and standards of harmony have fluctuated with time and differ from one culture to the next; and attempts at unifying aesthetic standards have met with increasing criticism in our own times.

The use of the words harmony and harmonious are not limited to the spheres of colour pedagogy, aesthetics and philosophy of art. In everyday usage, the words are often used to indicate subjective feelings of contentment, satisfaction, pleasure, comfort, etc., when viewing works of art, natural scenery or man-made artefacts and spaces. Thus, harmony and harmonious are entirely valid as words for indicating subjective experiences. Our study, however, focuses on attempts to ascribe a universal applicability and an objective theoretical status to the concept of harmony in relation to colours.

## A selection of ideas of colour harmony

### *Classical roots*

Western ideas of harmony are rooted in Greek philosophy and mathematics, which may be one reason why colour harmony has kindled the imagination of scientists for centuries. Among the writers on this subject the philosophers and scientists (including physicists, chemists, physiologists and printing technologists) have always outnumbered the artists. The Greek philosopher and religious leader Pythagoras (ca. 570–495 BC) is attributed with first linking harmony with numbers. None of his original texts have survived and his philosophical ideas were largely kept secret by his followers, the so-called Pythagoreans. It is therefore difficult to know which of the Pythagorean theories are Pythagoras's and which are later interpretations and elaborations [1 p.21–24, 2 p.242–243, 3]. They have nevertheless greatly influenced Western thinking on the relationship between mathematics and aesthetics. Pythagoras is attributed with discovering the mathematical principle of musical harmony. According to tradition, he first noticed the relation between pitch and quantity when he compared the weights of blacksmiths' hammers to the different sounds they made (see Figure 1). The mathematics underlying the harmonic relationship of consonant sounds produced by a stringed instrument, such as a simple monochord, to the lengths of the divisions of the string is also attributed to Pythagoras. He is likewise believed to have formulated the concept of "universal harmony" or the "music of the spheres" which allegedly describes the regular movements of the heavenly bodies [2 p.247, 3]. The Pythagorean idea of the mathematical foundation of harmony was picked up by Aristotle (384–322 BC), who applied it cursorily to colours [2 p.189–190, 242–244]. "The harmony of the spheres" was later elaborated upon by Johannes Kepler (1571–1639) in his *Harmonice Mundi* (1619) [2 p.247], and Sir Isaac Newton (1642–1726/27) discussed the correspondence of musical harmony and colours in his *Opticks* (1704) [4 p.120–121]. Thus, the idea of the harmony between mathematics, music and colours has been reinforced and handed down the centuries by famous authorities.

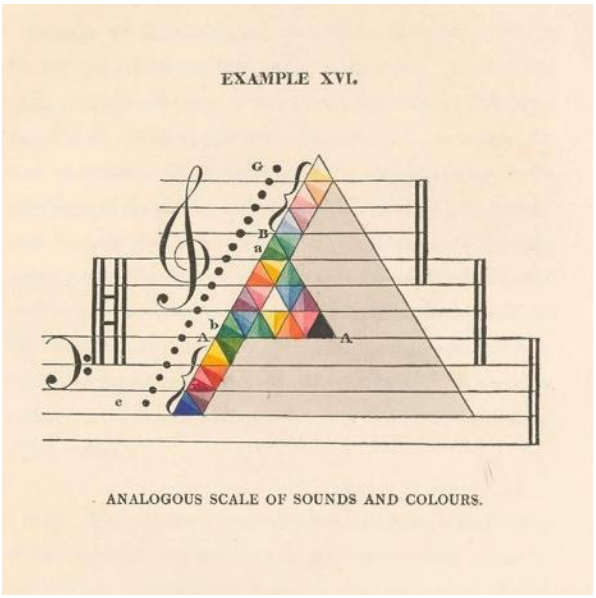




*Figure 1 (left): Woodcut showing Pythagoras blacksmith's hammers, bells, a kind of glass harmonica, a kind of lyre or cimbalom and (organ?) pipes in Pythagorean tuning of harmonic series 4, 6, 8, 9, 12 and 16.*[1]

*Figure 2 (right): Diagrams from George Field's 1817 book Chromatics: or, an essay on the analogy and harmony of colours.*[2]

## Philosophers of the 17th and 18th centuries

Ideas of colour harmony vary from culture to culture and are affected by the prevailing tastes and fashions of each era, society and cultural enclave. Colour is seldom treated as a separate subject in the aesthetics and philosophy of art of the 17th and 18th centuries; it appears instead as an element of painting, where its role and status were examined in late 18th century France as a subject of the querelle de coloris or the quarrels between the poussinistes, the advocates of the primacy of drawing and composition, and the rubenistes, the advocates of the primacy of colour [5]. In the writings of such 18th century philosophers as Lord Shaftesbury (1671–1713), Francis Hutcheson (1694–1746), David Hume (1711–1776), and Immanuel Kant (1724–1804), harmony is variously related to concepts of taste, virtue, beauty, pleasantness and the sublime [4 p.121–123]. In his Miscellaneous Reflections (1737), Lord Shaftesbury wrote:

> "*...what is BEAUTIFUL is harmonious and proportionable; what is harmonious and proportionable, is TRUE; and what is at once both beautiful and true, is, of consequence, agreeable and GOOD.*" [6 p.111–112].

Platonic idealism and Cartesian notions of the separation of mind and body dominated much of the 17th century discourse on harmony, taste and beauty. But from the early 18th century onwards, many philosophers of the Enlightenment emphasized the role of empiricism and inductive reasoning and began to cast doubts on a priori first principles as a primary source of knowledge about the world [7]. Descartes's idea that all human knowledge depends on metaphysical knowledge of God was challenged

[1] From "Theorica musicae" by Franchinus Gaffurius (Franchino Gaffurio), 1492. Image: Wikipedia/Gallica Digital Library.
[2] Image: Smithsonian Libraries.

by the Empiricists, who emphasized the role of the faculties of human reason, cognition and perception in acquiring knowledge. In the field of British aesthetics, the role of human intuition, taste and the senses began to overshadow abstract notions of the divine origins of beauty and harmony [7]. Philosophers such as Francis Hutcheson, David Hume and Joseph Addison concluded that beauty could not exist entirely independent of the human observer [8]. Addison, for example, wrote that "[t]here is not perhaps any real beauty ... more in one piece of matter than another" and that "beauty—and also greatness and novelty, presumably—exists in the mind merely" [8]. At the end of the century Immanuel Kant, while adhering to idealism with his notion of transcendental subjectivity, came to the same conclusion: if there are laws that govern beauty and harmony, they must in some way also involve the perceiving subject. Michael Rohlfs summarises Kant's idea of objective beauty and its relation to the subject, according to which

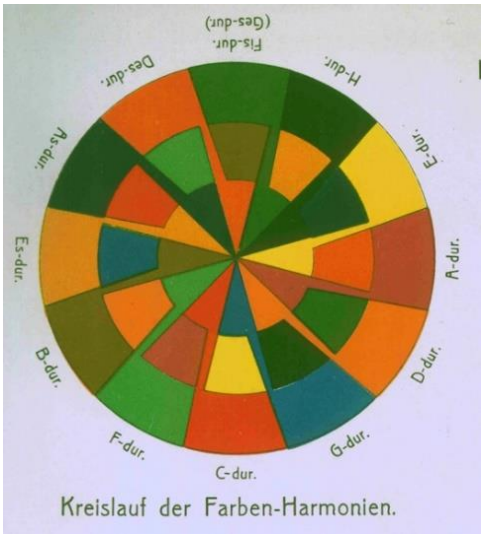
> "*... beauty is not a property of objects, but a relation between their form and the way our cognitive faculties work. Yet we make aesthetic judgments that claim intersubjective validity because we assume that there is a common sense that enables all human beings to communicate aesthetic feeling*." [9].

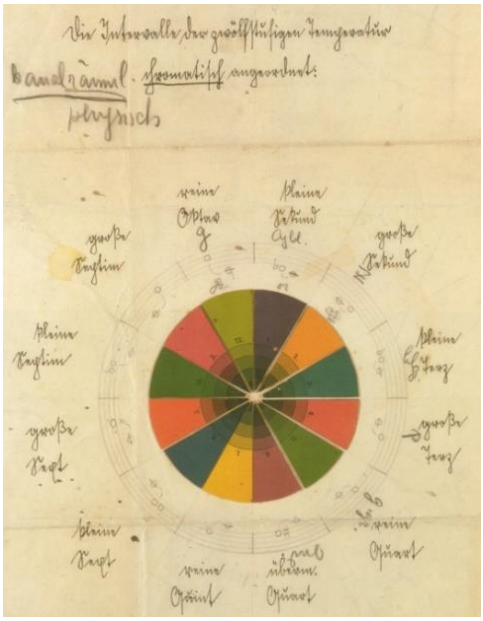
The philosophers of the Enlightenment—especially the so-called Empiricists in England and Scotland—gave much thought to the nature and origin of our experiences of beauty and harmony. Towards the end of the 18th century, they increasingly began to doubt the existence of absolute, universal and mind-independent principles of beauty and harmony.

## The music analogy

The ancient Pythagorean notion of the correspondence between numbers and sounds has continued to motivate, until recent times, theories of colour harmony. The possibility of an analogy between musical sound and visual colour has caught the imagination of many artists, musicians and scientists. Before the discovery of the physical phenomena of the wave-motions of both sound and light, theories of corresponding harmonies between colours and music were explained by relating musical scales and keys to variously construed scales of colours (see Figure 2). Musical pitch had been related to the physical phenomenon of vibration since at least Aristotle, but the relation of spectral colours to vibration frequencies remained unknown until Thomas Young around 1800 and Augustin Fresnel some ten years later provided experimental proof of the correspondence [10]. This discovery, together with subsequent scientific discoveries concerning electromagnetism, inspired artists, musicians and theorists of the late 19th and early 20th centuries to relate colours to musical tones and to construe colour harmonies based on musical harmonies [11 p.35–38, 12 p.8]. Among proponents of such ideas were the 19th-century art-historian Friedrich Wilhelm Unger (1810–1876), the artist and theoretician Theodor Seemann (1837–1898), the composers Alexander Scriabin (1872–1915), Josef Matthias Hauer (1883–1959) and Alexander László (1895–1978) and the Swiss-German musicologist Hans Kayser (1891–1964) [13 p.83]. (See Figures 3, 4 and 5). Among painters, the Swiss Charles Blanc-Gatti (1890–1966), the Ukranian Vladimir Baranoff-Rossiné (1888–1944) and the American Stanton Macdonald-Wright (1890–1973) sought a direct correspondence between colours and music. Blanc-Gatti may have been motived by being synesthetic (see below). It is worth noting that none of the afore-mentioned (or any other two colour-music theorists) have related colours to musical tones, scales or keys exactly in the same way.

In the years just before the first World War, when artists such as Wassily Kandinsky (1866–1944), Robert Delaunay (1885–1941), and František Kupka (1871–1957) were seeking a rationale for the newly-invented abstract art, music was seen as the obvious paradigm [12 p.181–187, 13 p.43–44,].



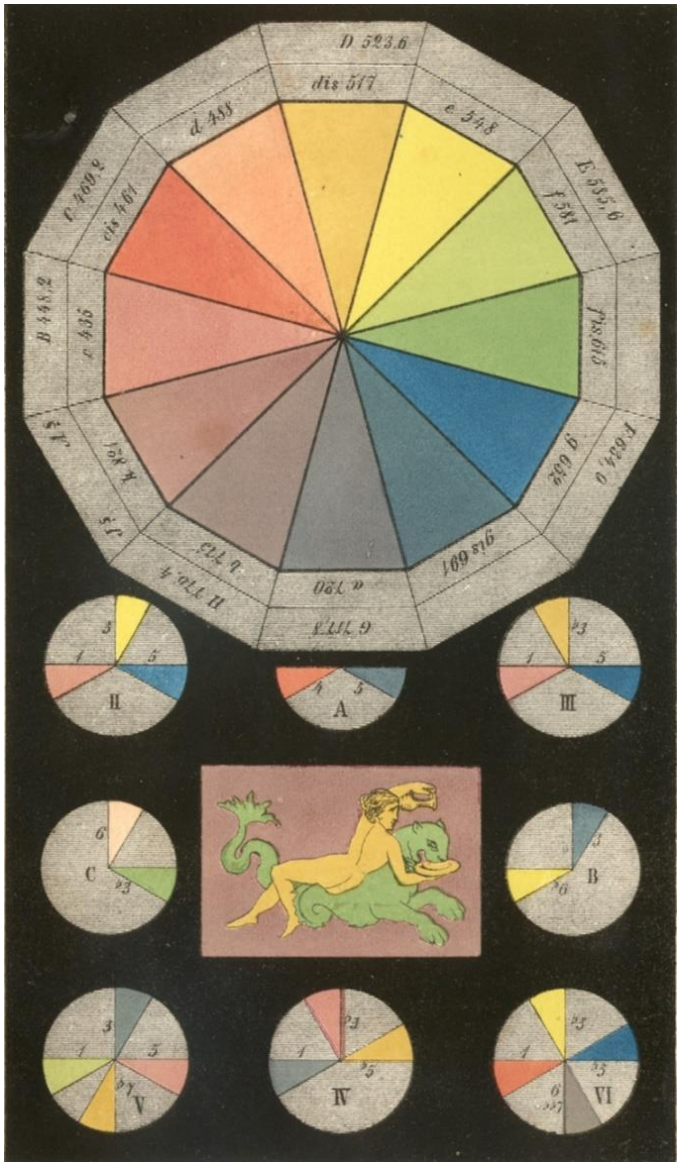


*Figure 3 (upper left): Theodor Seemann's "Circular progression of colour harmony" based on the circle of fifths in music.*[3]

*Figure 4 (lower left): Josef Matthias Hauer, 12-part colour-sound circle sent to Johannes Itten (1919-1920). The Dieter and Gertraud Bogner Collection, mumok Museum moderner Kunst Stiftung Ludwig Wien.*[4]

*Figure 5 (right): Friedrich Wilhelm Unger's "Chromharmonic disc".*[5]

More important than any direct correspondence between frequencies of sound and light, though, was the general notion of "vibration" representing the energy permeating the universe. As Kupka wrote in *Creation in the Plastic Arts* (1923), "*The radiation of vital energy in nature, and of the same energy*

[3] Seemann, T. 1881. 4th ed. 1909. Die Lehre von der Harmonie der Farben. Leipzig. Weimar: B. F. Voigt.

[4] Image: Sound Colour Space – A Virtual Museum, Zurich University of the Arts, 2017, http://sound-colour-space.zhdk.ch.

[5] Unger, F. W. 1858. Die bildende Kunst. Aesthetische Betrachtungen über Architektur, Sculptur und Malerei für Künstler und Kunstfreunde. Göttingen: Georg H. Wiegand.

*which dwells inside us, always manifests itself through the relationships between different vibrations and, therefore, between different colours*." [11 p.43]. But even Kupka denies in the end any direct objective relationship between the arts of music and colours:

> "*Now the fact is that listening to a musical work evokes different images in everyone, an accompaniment that each draws from his own visual memory. That is, chromatism in music and musicality of colours has validity only as metaphor*." [11 p.41].

The idea of the correspondence of colours to musical tones is sometimes linked with the phenomenon of synaesthesia – an idea which also was popular with the early abstractionists. Among the most common forms of synaesthesia is colour hearing, the spontaneous firing of visual sensations by auditory stimuli or vice versa. Synaesthesia is a real, but at the same time entirely private experience. No two synaesthetes have been known to experience the linking of sensory perceptions in exactly the same way [14 p.66–74]. There are many and very interesting metaphorical and cultural parallels in, for example, the arts of painting and music. For a thorough overview of the subject see von Maur 1999 [13], Brougher et al. 2005 [11] and Vergo 2010 [12]. However, so far there is no evidence – either physical or neurological – of an objective connection between auditory pitch and perceived colours, [14 p.66–74] and linking of colours with tones or keys as a basis for colour harmony deviates considerably from author to author and remains thus a random choice [1 p.87–140].

## The rainbow

The beautiful phenomenon of the rainbow has long inspired artists, not only as a symbol of a connection between earthly and celestial realms (as in the Covenant between God and man in Judaic and Christian mythology), but also as a manifestation of transcendent beauty and harmony. The Newtonian sequence of the seven hues red, orange, yellow, green, blue, indigo and violet has today become such a byword, that it may seem surprising to think of the colours of the rainbow as anything different. However, historical records and illustrations show that they have been depicted as anything from the two colours red and green in mediaeval illustrations to the thousand hues mentioned by Ovid and Pliny [15 p.93]. Aristotle's three "unmixed" rainbow colours, red (*phoinicoun*), green (*prasinon*) and purple (*halourgon*) were widely regarded as fact until Newton's time and even after, and three-colour depictions of the rainbow are among the most common [1 p.71–86, 15 p.93]. The number or the sequence of the rainbow's colours was not always the starting point for creating harmony; in accordance with the ancient Greek concept of *harmogen*, the smooth transition or sfumato of one hue to the next—as exemplified in the rainbow—was likewise seen as a model for creating harmonious colour combinations in painting [15 p.108].

Through Newton's influence, the scientific phenomenon of refraction of light and the seven proverbial colours began to be associated with the rainbow after the publication of his *Opticks* in 1704. The theory was not accepted by all artists; the main bone of contention being the Newtonian seven pure hues' incompatibility with the painter's subtractive primaries. Throughout the 18th and 19th centuries the rainbow continued to be depicted by artists in varying arrays of colours. The lack of agreement about the precise sequence and number of hues of the fleeting spectacle did not deter artists and scientists from creating harmony rules based on the rainbow. Thus, Henry Howard told his Royal Academy students in the 1840s:

"*The simplest rule of harmony is where one of the primary colours is pure, and the other two are combined… The fullest and richest harmony is where the seven prismatic hues are all displayed together. In either of these cases there is a just proportion of cold colour necessary to counter balance the warm. It would seem to follow, that, to produce an agreeable effect of light in painting, the same proportion of warm and cold colour should be adopted as we see in a dissected solar ray; but… these proportions do not appear to have been accurately ascertained.*" [15 p.110].

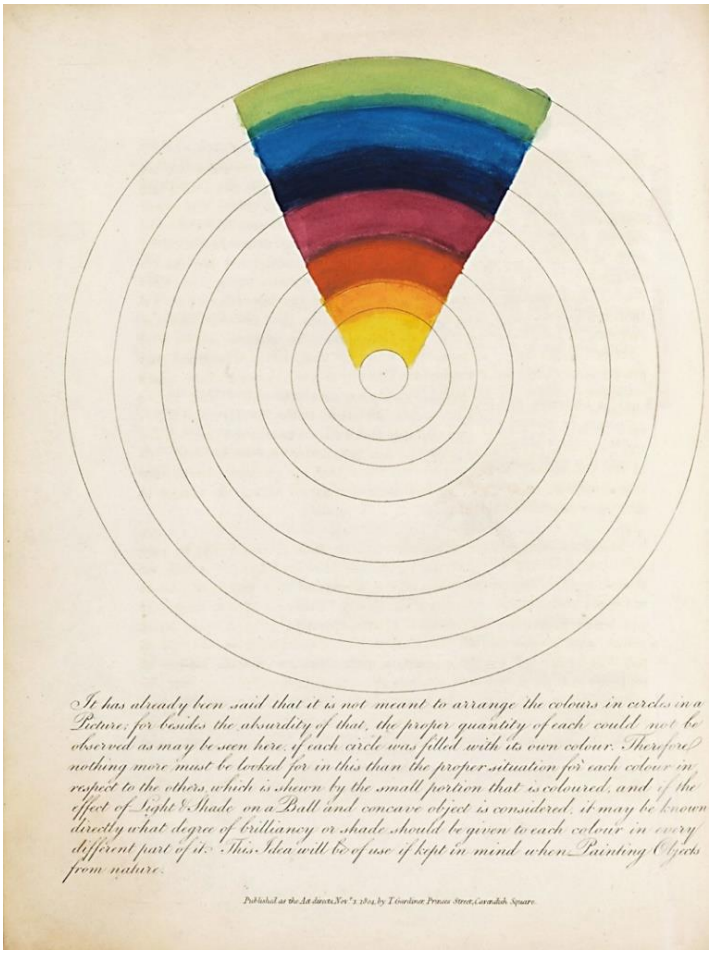



*Figure 6: Page 28 from Mary Gartside's book "An essay on a new theory of colours, and on composition in general: illustrated by coloured blots shewing the application of the theory to composition of flowers, landscapes, figures, &c" (1808).*[6]

In his *Opticks*, Newton had calculated relative proportions for the seven "homogeneal" spectral hues, illustrating the proportions also in the form of a circle which became the prototype of all subsequent hue circles and colour wheels. Mary Gartside's (ca. 1755–1819) *Essay on Light and Shade on Colours and Composition in General* (1805), where she provides colour harmony rules for flower painting, is an example of a theory of harmony based on rainbow colours (see Figure 6). Influenced by Newton, she refers to both the prismatic spectrum and the rainbow alike. She is less interested in the order of hues displayed, than in their mathematical proportions, which provide a supposedly objective basis for her

[6] Printed by J. Barfield, Wardour-Street, for T. Gardiner, Princes-Street, Cavendish-Square, W. Miller, Albemarle-Street, and I. and A. Arch, Cornhill. First published in 1805 as "An essay on light and shade, on colours, and on composition in general".

theory [16]. Her assignment of colours to numbers which add up to 360 (degrees in the colour circle) is, however, just as random as the assignment of colours to the tones of the Dorian scale or any other scale of music [1 p.71–86].

## The so-called complementaries

The principle of harmony through balance of opposites or of complementaries is an integral part of numerous colour harmony theories (see e.g. Figure 7). The term *couleurs complémentaires* (complementary colours) was first used in 1802 by the French physicist Jean Henri Hassenfratz (1755–1827) in his paper on coloured shadows [1 p.147]. What is meant by opposites or complementaries however varies from one theory to the other and thus necessarily affects the interpretation of harmony in those theories. Most colour theorists have built upon notions of "complementary colours" as identified by the diametrically opposite positions on a colour wheel.

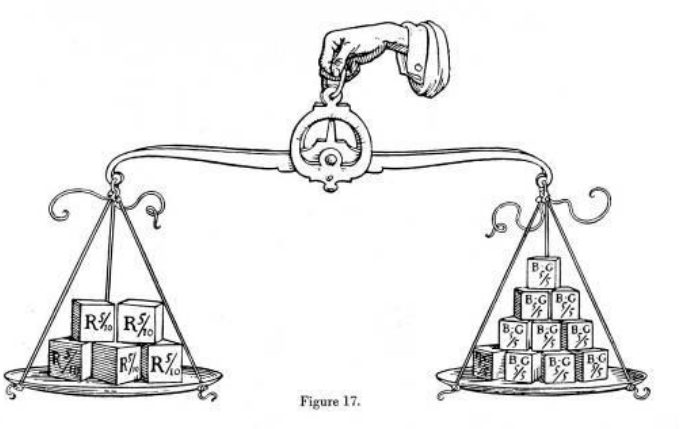
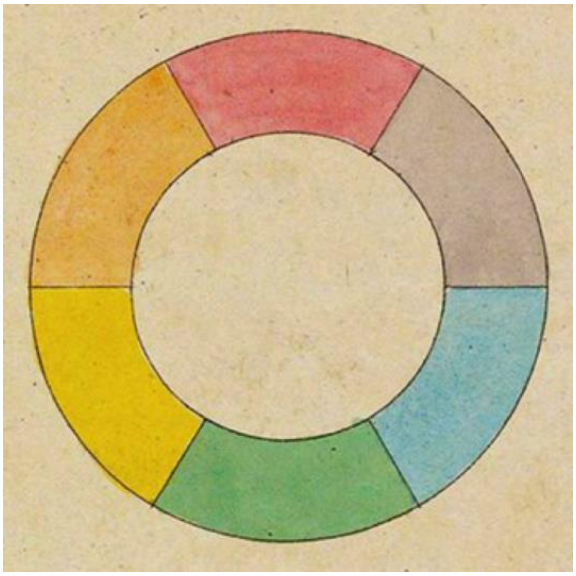



*Figure 7: Harmony through balance of opposites.*[7]

Among the most prominent representatives building their colour harmony theories around "complementaries" is Benjamin Thompson (Count Rumford) (1753–1814). In 1797—even before the term was coined—he formulated the following rule, basing it on his observations on coloured shadows: "*Two neighbouring colours are then, and only then, in perfect harmony, when the intimate mixture of both would produce perfect whiteness.*" [17 p.66].

For Johann Wolfgang von Goethe (1749–1832), however, the complementary colours (Goethe uses the term *geforderte Farben*, demanded colours) are not derived from additive mixture, but from the way the eye works. Based on observations of after images, he claims that each colour requires its "complementary" in order to achieve a "totality" of the colour circle (Figure 8). Combinations meeting this requirement are then regarded as harmonious [18 p.299–300]. In the same year, 1810, as Goethe published the above thoughts in his *Zur Farbenlehre* (Theory of Colours) the German artist Philipp Otto Runge (1777–1810) published his famous colour order system "The colour sphere" (Figure 9), resulting from a complex interaction of subtractive mixing experiences, religious thinking and pantheistic ideas. These same aspects had an influence on his views on colour harmony, in which the "complementaries" are the most prominent combinations [1 p.167-180].

[7] In A.H. Munsell's "A Grammar of Color: A Basic Treatise of the Color System", 1921. Illustration by T. M. Cleland.



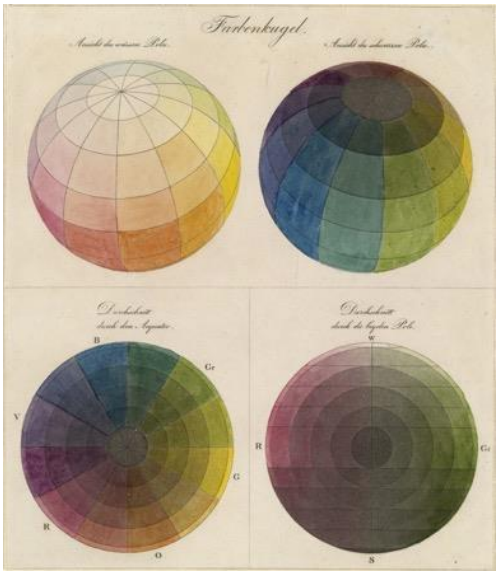



*Figure 8 (left): Johann Wolfgang von Goethe's colour circle.*[8]
*Figure 9 (right): Philipp Otto Runge's colour sphere.*[9]

The English chemist and paint manufacturer George Field (ca. 1777–1854) founded his theory of colour harmony on complementaries which he called "chromatic equivalents" (1817/1835); the latter being derived from subtractive mixture using scaled coloured wedges. The scales allowing for a numerical determination of harmonious colour combinations [1 p.190–202].

The colour harmony concept of the French chemist Michel Eugène Chevreul (1786–1889) comprises analogous and contrasting harmonies (1839). His theory is also centred around the complementaries (see Figure 10) which have a close connection to Chevreul's famous observations on simultaneous contrast but are just as well related to relations of subtractive paint mixing [1 p.202–212].

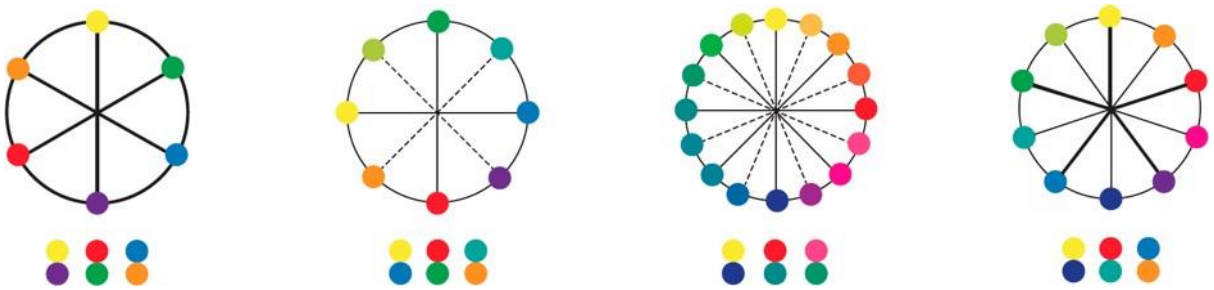


*Figure 10: Schematic illustration of some colour wheels and their complementary hues. From left to right: Delacroix/Chevreul/Blanc; Hering; Ostwald; Munsell.*[10]

Emily Noyes Vanderpoel (1842–1939) was an American artist and writer and the author of *Color Problems: A Practical Manual for the Lay Student of Color* (1903) [19]. Colour harmony is treated in chapters IV, "Contrast and Complements", and V, "Color-Harmonies". Instead of presenting any novel theories of colour harmony, Noyes Vanderpoel's manual is an adaptation of the findings and theories of Johann Wolfgang von Goethe, Michel Eugène Chevreul and Ogden Nicholas Rood. The British

[8] Johann Wolfgang von Goethe's colour circle from "Zur Farbenlehre", 1810.
[9] Image: Philipp Otto Runger's "Farben-Kugel oder Construction des Verhältnisses aller Mischungen der Farben zueinander, und ihrer vollständigen Affinität, mit angehängtem Versuch einer Ableitung der Harmonie in den Zusammenstellungen der Farben", Hamburg: Friedrich Perthes, 1810.
[10] Image: Harald Arnkil.

chemist A. H. Church's manual on colour and Owen Jones's *The Grammar of Ornament* (1856) are also cited. Noyes Vanderpoel's harmony rules (in essence an annotated repetition of Chevreul's maxims) consist of long lists of verbal descriptions of the effects of combining two or more colours. The most attractive part of the book are the colour charts illustrating these combinations as well as some historical examples of colours. The book nevertheless serves as an example of how much the concept of "harmony" in colours is time- and culture-dependent:

> "*Harmonies of the dominant hues of red, orange or yellow—warm colors—are much more generally liked than those of blue, green, or violet, the cold ones. Age has done much for old pictures by darkening and mellowing the paints and varnish so as to give them harmony of the dominant hue.*" [24 p.99–100].

Today museums all over the world endeavour to restore the colours of old paintings to their original state by removing the accumulated layers of yellowed varnish and dirt. It is to Noyes Vanderpoel's credit, though, that after pages and pages of strict rules on combining colours she admits that:

> "*[b]y comparing the art of one country or of one period of one country with that of another, we find that throughout them all, certain pairs of colours have been preferred to certain others and we feel that æsthetic taste, which cannot be explained, influences us greatly in our liking for certain combinations. Beside taste, inheritance, training, environment, and contrast all have their unconscious effect upon these preferences.*" [19 p.83].

Noyes Vanderpoel finally comes to a correct conclusion which rather undermines the dozens of harmony rules offered. Mentioning examples from flower arrangement, interior decoration and women's dress, she stresses the importance of context, the taking into consideration of surrounding colours, the direction and tone of illumination, light and shade, complexion and hair colour, etc. "*... but is it not seen that the answer must be different in each case?*" [19 p.104–106].

## Colour wheels and hue circles

In these few prominent examples, the complementaries are represented by similar looking colour wheels which are, however, rather different expressions of individual views or reasonings. The problem is that all colour wheels are wholly arbitrary creations. They have been developed to successfully serve many artistic, technological and industrial purposes, but none of them represents a universal truth about colour relationships. Some are based on visual relationships (Munsell 1905), some on subtractive pigment primaries (Blanc 1879; Itten 1961), on additive light mixtures (Brücke 1866; Helmholtz 1871/73), on the optical mixtures of spinning discs (Rood 1879; Ostwald 1917), and some are even linked to philosophical views (Goethe 1810; Runge 1810; Field 1817/35; Itten 1961) [1 p,214–228, 255–268]. They all contain different primaries and different "complementaries", and therefore the "harmonies" of balance, totality, equivalence, or just contrast derived from them cannot represent any universally applicable truth. (See Figures 10, 11, 12 and 13.)

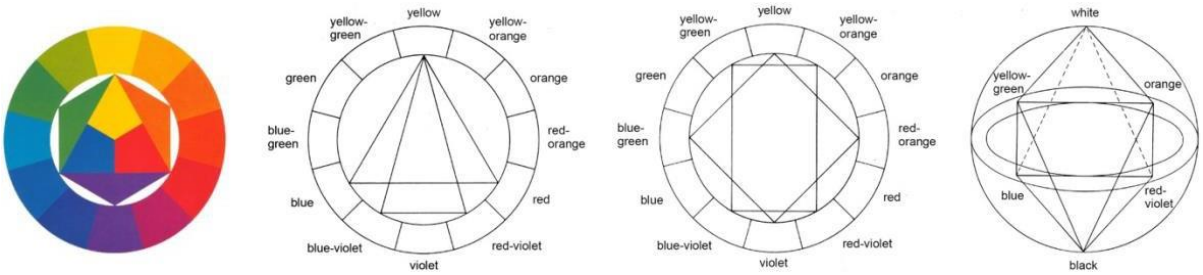



*Figure 11: Johannes Itten's colour wheel with harmonies based on triads and tetrads. The diagram on the far right illustrates the principle transferred to three dimensions in a colour sphere.*[11]

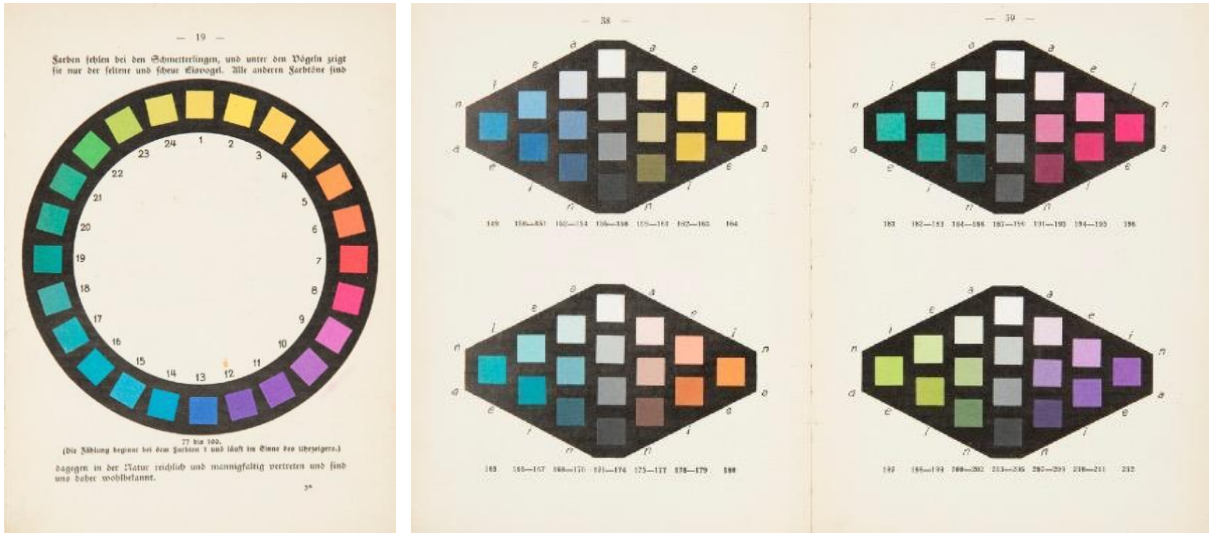


*Figure 12 (left): Colour circle from Wilhelm Ostwald's Die Farbenfibel.*
*Figure 13 (right): Cross-sections of Ostwald's colour space showing "complementary hues" and harmonious colours.*[12]

## Theories based on colour systems

Colour order systems which are based on perception endeavour to exhibit a visual logic of colour relationships. It is therefore no surprise that many of them have been used as a basis for colour harmony rules. In most colour systems colours are ordered according to three visual parameters [1 p.229–281]. These variables are basically the same in all perception-based systems, although their definitions may differ slightly. For instance, in the Munsell system they are identified as Hue, Value and Chroma and in the German RAL Design as Hue, Lightness and Chroma. The NCS system contains the four variables of hue, whiteness, blackness and chromaticness similarly to the system of Wilhelm Ostwald where white-, black- and full colour content are strictly based on the Weber-Fechner law. All these systems form three-dimensional colour spaces. A colour space can be divided or sliced to reveal sections of equal hue, lightness or chroma or series of evenly spaced steps of increasing blackness, whiteness, lightness or chromaticness. Such colour samplings, following a natural visual logic, can be of use to designers who are seeking unified colour combinations based on perceptual uniformity or similarity of colour variable.

[11] Image: Johannes Itten. 1973. The Art of Color: The Subjective Experience and Objective Rationale of Color. New York: Van Nostrand Reinhold Company.
[12] Die Farbenfibel, Verlag Unesma, 1928.

Artists, whose aim has seldom been to merely please the eye or induce a feeling of comfort in the viewer, have only limited use for such principles of visual unity. Wilhelm Ostwald's miserably failed attempt to promote his theory of colour harmony at the first "Colour Day" of the *Deutcher Werkbund* in 1919 in Stuttgart is a case in point. At the meeting Ostwald gave a talk entitled "Die Grundlagen der Farblehre und Farbkunst" (the fundamental principles of colour theory and the art of colour) in which he advertised a model of colour harmony based on his colour system, showing also paintings he had made according to the harmonic principles. The artists and art teachers Adolf Hölzel and Oscar Schlemmer and the art historians Paul Ferdinand Schmidt and Hans Hildebrandt did not like what they saw and heard. Ostwald's attempt to apply his theory to his own paintings of "fussy little flowers" with "hideous colours" got the most scathing reception [20 p.19]. So appalled were the artists present at the meeting that they threw Ostwald out of the *Freie Gruppe für Farbkunst* (the free group for the art of colour), which Ostwald had formed a couple of years earlier, and placed Hans Hildebrandt as the new chairman [20 p.20]. Afterwards Paul Schmidt wrote for the influential Cicerone-magazine an extremely critical report of the meeting. In the report, which carried the headline "Crisis at the Werkbund", Schmidt called Ostwald's colour system "militarism in art". In October 1920, Hölzel, Klee and other members of the reformed *Freie Gruppe für Farbkunst* published a special "colour issue" where they expressed their opposition to Ostwald's views [20 p.20]. The whole affair came to a climax when Hans Hildebrandt organised a petition, which was sent to all the ministries of education in the German Republic, to ban the use of the Ostwald system in school education. Many of the Bauhaus teachers joined the over 500 educational establishments, associations and individuals who signed the petition [20 p.20, 21 p.53-54].

Gropius, nevertheless, later invited Ostwald to give lectures and even to join the board of trustees of the Bauhaus. The lectures were met with mixed feelings and the final lecture on harmony again gathered the most opposition. Paul Klee, who had regarded Ostwald's theories with derision all along, did not attend. Joost Schmidt and Hinnerk Scheper were the only Bauhaus teachers who embraced the system with enthusiasm [22 p.4845–4846].

## Josef Albers and Aemilius Müller

When it comes to teaching colour, one should take a look at the works of the German-American artist and pedagogue Josef Albers (1888–1976) and the Swiss colour researcher, painter and printmaker Aemilius Müller (1901–1989). Josef Albers has demonstrated how creating with colours has very little to do with rigid rules and much with alertness, flexibility and tactical skill, with "thinking in situations" [23 p.42, 68]. He also referred to theories of complementary colours, but never asserted that they were a guarantee of harmony. In fact, harmony was for Albers no more desirable than disharmony: "We emphasize that color harmonies, usually the special interest or aim of color systems, are not the only desirable relationship. As with tone in music, so with color-dissonance is as desirable as its opposite, consonance." [23 p.67].

In contrast to his former teacher and colleague Johannes Itten, Albers had a deep distrust of formal rules of colour harmony – mainly because they did not address the relational and situational nature of colour design [23 p.42]. Albers was well acquainted (not least through Itten) with the music analogy and the theory of complementaries as well as with colour systems. After discussing all of these, he says that no such concept of harmony works because in practice there are always too many contingencies involved.

> "*Our conclusion: we may forget for a while those rules of thumb of complementaries, whether complete or 'split', and of triads and tetrads as well.*
> *They are worn out.*
>
> *Second, no mechanical color system is flexible enough to precalculate the manifold changing factors, as named before, in a single prescribed recipe.*
>
> *Good painting, good coloring, is comparable to good cooking. Even a good cooking recipe demands tasting and repeated tasting while it is being followed.*
> *And the best tasting depends on a cook with taste.*
>
> *By giving up preference for harmony,*
> *we accept dissonance to be as desirable as consonance.*" [23 p.42]

To prove his point Albers continues with exercises which demonstrate that by adjusting the proportions of colour areas in a composition, the entire character, mood or atmosphere of the composition can be changed (see Figure 14):

> "*Such quantity studies have taught us to believe that, independent of harmony rules, any color "goes" or "works" with any other color, presupposing that their quantities are appropriate. We feel fortunate that so far there are no comprehensive rules for such aims.*" [23 p.44].

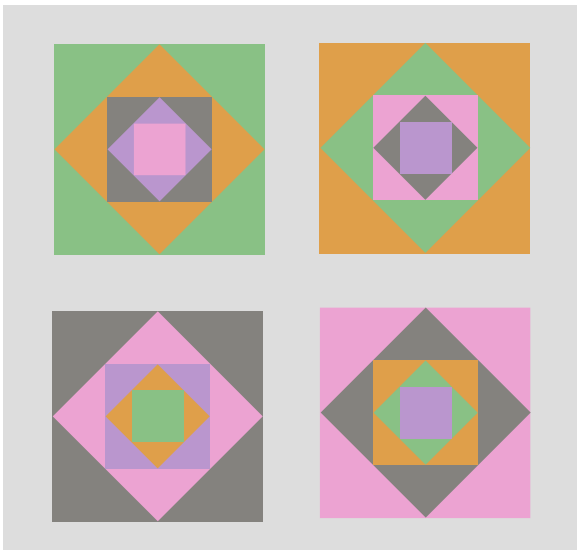



*Figure 14 (left): Study according to Josef Albers's Interaction of Color XVI: Color juxtaposition–harmony–quantity.*[13]
*Figure 15 (right): An example of colour inversion.*[14]

[13] Image: Harald Arnkil (with acknowledgement to Paul Green-Armytage).
[14] From Aemilius Müller's "Die moderne Farbenharmonielehre". Winterthur: Chromos-Verlag, 2nd ed., 1959.

Aemilius Müller's approach to colour was, just like Albers's, based less on theory and instead grounded in visual experience. He improved Ostwald's colour system by rearranging and selecting colours visually. He discovered the phenomenon of "colour inversion" (combinations of colours with inverted lightness levels, e.g., lilac-olive) which on first sight many people find discordant (Figure 15). His aim was colour literacy for everybody, and he worked on providing every Swiss schoolchild with a small colour atlas containing removable colour samples for training the colour sense and colour taste [24]. Although not completely free from normative views, Albers and Müller can be regarded as early didactics who wanted to teach colour literacy based on direct visual experience.

## Colour harmony in today's context

Albers's statements against colour harmony were the logical conclusion of a reassessment of formalistic colour theory which had started even before the founding of the Bauhaus. In their search for an autonomous function of pictorial elements, artists began to avoid colour harmonies based on formal unity, balance, "visual comfort" and pleasantness. Wassily Kandinsky wrote in his *On the Spiritual in Art* (Über das geistige in der Kunst, 1912, Second edition):

> "*Clashing discords, loss of equilibrium, "principles" overthrown, unexpected drumbeats, great questionings, apparently purposeless strivings, stress and longing (apparently torn apart), chains and fetters broken, (which had united many), opposites and contradictions—this is our harmony. Composition on the basis of this harmony is the juxtaposition of coloristic and linear forms that have an independent existence as such, derived from internal necessity, which create within the common life arising from this source a whole that is called a picture… our harmony is based mainly upon the principle of contrast, the most important principle in art at all times. Our contrast, however, is one of internal opposition, which stands alone and excludes the possibility of all help (which would today be disturbance and superfluity) from any other harmonizing principles.*" [25 p.193–194]

Thus, for over a century now, dogmatic principles of harmony (as well other formal principles of art) have motivated artists less and less, and such principles have today been discarded by most artists as irrelevant and redundant [26 p.55–56, 27 p.139-140]. The rapid globalisation of the art market has exposed artists to an increasing diversity of artistic ideas and influences. Also, the focus and role of art and design has shifted from questions of aesthetic sensibility, beauty and the sublime to conceptual, political, environmental, societal and gender issues. The function of art is to stir our emotions, intellect and imagination. To have this effect, it needs to deviate from the expected, from the 'normal'. Harmony is very much in the comfort zone of normality, whereas contemporary art and design aim at being mostly out of it (see e.g. Figure 16). To have any useful meaning for artists and designers today, a theory of colour harmony would need to address at least the following issues: 1) harmony has lost its status as a universal concept in art and needs to be re-examined, 2) art and design have become alienated from the formalistic ideas of visual coherence that dominate modernism, 3) colour should not be regarded separately, but in relation to all the sensory, cultural and conceptual factors constituting an artwork, 4) rather than being passive reception, colour perception is a matter of involvement, interaction with the

world, 5) the history and intentions of the perceiving subject influences his/her colour experiences. This fact undermines the validity of rigid universal theories of colour harmony.

*Figure 16: Katharina Grosse: "Untitled Trumpet, 2015", installation at Venice Art Biennale 2015.*[15]

## Colour harmony as a normative strategy of art education

Thus, when it comes to (art) education it is more profitable to create situations in which, rather than bring told what to choose, learners can discover freely their own experiences when creating and assessing colour combinations. Victor d'Amico (1904–1987) was The Museum of Modern Art's (New York) first director of education and an enthusiastic follower of John Dewey's experience-based concept of learning. D'Amico has written:

> "*The teaching of the theory of color by means of the color wheel, color harmonies, and scales, as an end in itself, is of very doubtful value in art education, and the progressive teacher has abandoned this method as harmful since it tends to inhibit the use of color, rather than to develop color consciousness. The reason is that it does not depend on visual experience, but on logic. The memory, and not the emotions, control the process. It is like giving a child the answer to a problem and then asking him to work it out. The zest has been taken out of the experience because the child already knows the answer. Most teaching of this type is merely memorization and is not actual experience. In color, as in any other form of expression, the personal and unexpected are to be prized; they distinguish the individual response from the commonplace, and the unusual from the average.*" [28 p.46].

[15] Photo: Harald Arnkil.

## Conclusions

It has become clear that there is not just one, but numerous different colour harmony doctrines which have emerged over the course of many centuries. They show very different characteristics both in their respective sets of rules and in their justifications, which all have a pseudo-scientific character. This becomes especially clear in the group based on musical analogies; they all display considerable differences in their assignment of colours to tones or scales, which is the foundation of their respective sets of rules. The individual colour harmony theories, be they based on musical or mathematical ideas, are thus strongly influenced by the personal choices and preferences of their originators. All in all, a picture emerges, where for centuries there has been a latent need to capture certain ideas of taste, be they individual, temporal or social, in rules and to provide them with an objective foundation and theoretical framework. This, however, does not stand up to scientific scrutiny. In addition, a consideration of the totality of empirical studies conducted since the last century on preferences of individual colours and colour combinations reveals that uniform ideas of taste, whether individual or socially determined over time, are not based on objective criteria, and that unified and axiomatic taste conceptions simply do not exist [1 p.17*f*].

Colour harmony theories are valuable testimonies of the intellectual life and cultural creativity of different epochs and societies. They are cultural achievements that have persisted with astonishing tenacity at least since the Renaissance up to the present, and they should be regarded and appreciated as such. However, due to their limitation to assessing isolated colour combinations – often mere colour categories – with their complex requirements and their respective dependence on function and context, they do not represent reliable guidelines for designs. Because of their normative character, their use is equally questionable in the field of pedagogy. Victor d'Amico has summed up the related problem for teaching in his quote (see above). The latest results of a seminal qualitative empirical study fully confirm his criticism [29].

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