Itten's seven colour contrasts – a review

Part II. The seven contrasts as described in Kunst der Farbe (The Art of Color)

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In the first part of the article, we describe the origins of Itten's contrast theory and the road leading up to the seven contrasts as it took its final form in The Art of Color[1]. In the second part we shall discuss in detail Itten's seven contrasts. Finally, in the third part, we shall present the problems caused by students and teachers mechanically memorising and then blindly following the colour contrast canon without consideration for the core concepts which underlie it.

Received 27 December 2022; revised 9 April 2023; accepted 12 May 2023
Published online: 21 June 2023

Of course the character of everything
is best manifested by Contrast *[1-2].*

Introduction

In the following we shall discuss the seven contrasts as presented in Itten's The Art of Color. Most of the discussion shall be based on the first edition of The Art of Color [3-4]. Where there are significant differences between this and the second edition of 1973 [5-6] or the Study Editions[2] [7-8], we shall note it. All the quotations come from the respective English editions. It is interesting to note that the illustrations for the first editions (in both German and English) were carefully supervised by Itten himself. He went to great pains to ensure the fidelity of the colour reproductions, as he himself acknowledged at the end of the first edition. We know from a note written to the second edition by his widow, Anneliese Itten [5 p.6], that in 1961 the highest quality of the reproductions could only be achieved by having the reproductions printed by three different printers in three countries and then having the illustrations individually tipped in[3]. By 1970, for the Study Edition, this did not seem to be necessary, and both this and the 1973 second full edition were produced by 'more modern' printing technology. There are significant differences in the reproductions between these editions, so any careful analysis of the colours is only valid for each particular edition.

[1] In this article we've been using British spelling, but, when referring to the English edition of The Art of Color, and also in all the quotes from the English edition, we have maintained the original spelling.
[2] Studienausgabe in the original German, and Elements of Color in the English edition.
[3] Which was the case for both the first (1961) and the second (1962) printing of the first edition.

 ISSN 2227-1309

Contrast of hue

"*Contrast of hue is the simplest of the seven. It makes no great demands upon color vision, because it is illustrated by the undiluted colors in their most intense luminosity.*" [4 p.36]

When Itten says "contrast of hue" he is simply referring to combinations of vivid colours, and here he commits the basic mistake of thinking only in general colour categories (particularly in only hue categories). This point has been stressed over and over again by Schwarz [9-10] and more recently by Divers [11], and this, in our opinion, is one of the major problems in accepting and simplistically adopting Itten's contrast theory.

Figure 1: Itten's illustration of the Contrast of Hue *[Based on 7 p.35].*

Light-dark contrast

"*Gradations and brilliances of achromatic colors are easily distinguished, and so are those within each chromatic hue. Difficulties arise when gradations of unlike hues are to be compared. It is most important to be able to identify colors of equal brilliance accurately.*" [4 p.53][4]

In The Art of Color Itten illustrated this point with the impressive chart shown in Figure 3, top left.

The greyscale rendering of the two reproductions show that Itten's claim of showing equal lightness colours in the same rows as their grey partners is far from being achieved. Also, if we compare the two figures, we may see some striking and some subtle differences. The overall impression of the figure from 1961 is more balanced, there are no sudden jumps or shifts, unlike in the later, 1973 illustration. In the first edition the 12-grade lightness scale goes from nearly black to white whereas in the second edition it goes from very dark colours (not really fitting into the sequence) to very light colours. The adjacent hues of the vertical constant hue columns are nicely gradated in the first but have some sudden jumps, such as between GY and Y or O and RO in the second. Another basic difference is the presence of dividing black frames in the first vs. no frames in the second, which may account for some of the perceptual differences. It must be emphasised here that the images are not colour rendered so they may be used only as approximate illustrations.

[4] True as these sentences are they do not come from Itten himself. They are quoted here from the English edition but cannot be found in the original German text. The translator uses the term "brilliance" in the sense of lightness.

Figure 2: Light-dark contrast illustrated by Itten [Based on 7 p.39].

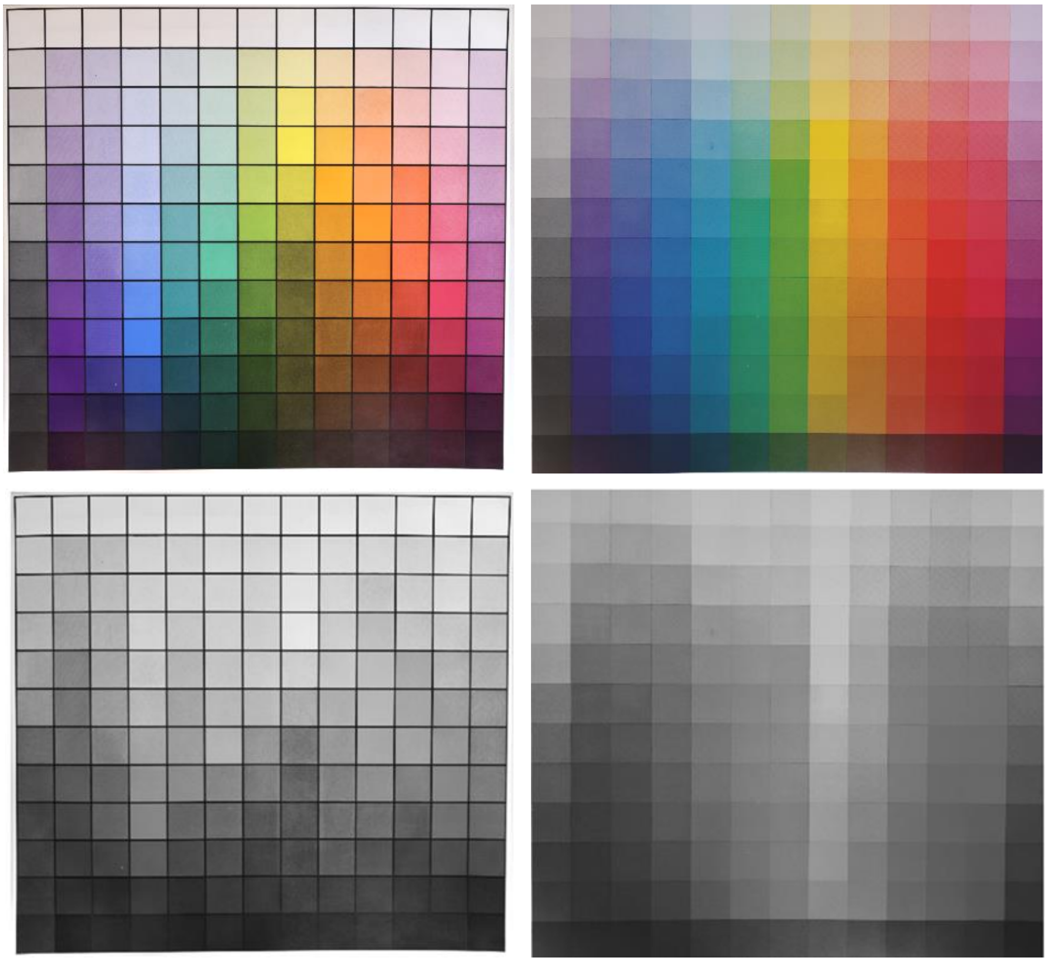

Figure 3: Lightness charts (top row) reproduced from the 1961 first edition [3] (top left) and the 1973 second edition [5] (top right) of Itten's Kunst der Farbe. The same images rendered in greyscale showing only lightness differences (bottom row); courtesy Glenn McArthur.

Most vivid colours at different lightness levels

Itten observed the well-known fact that the most vivid colours can only be produced at different lightness levels, depending on the hue.

 ISSN 2227-1309

"*If we prepare a sequence of as many as eighteen gradations, instead of twelve, and connect the points of highest purity, we can see that the curve is parabolic.*" [4 p.54].

This curve is not to be found in The Art of Color, but it is included in the 1940 Wattwill course material (Figure 7 in Part I). This is a crucial point, and not very well explained by Itten. He merely explains, referring to the lightness table (Figure 3, top left) that the most vivid yellow is the fourth lightest (using the 12-step grey scale), orange the sixth, red is the eighth, blue the ninth and violet the tenth [4 p.54] The problem is that Itten's colour sphere (derived from Runge), which is Itten's three-dimensional colour model, does not show that, depending on the hue, the most vivid colours are available at different lightness levels. This was well known already in 1915 (Itten's formative years) when Munsell published his colour atlas (Figure 4).

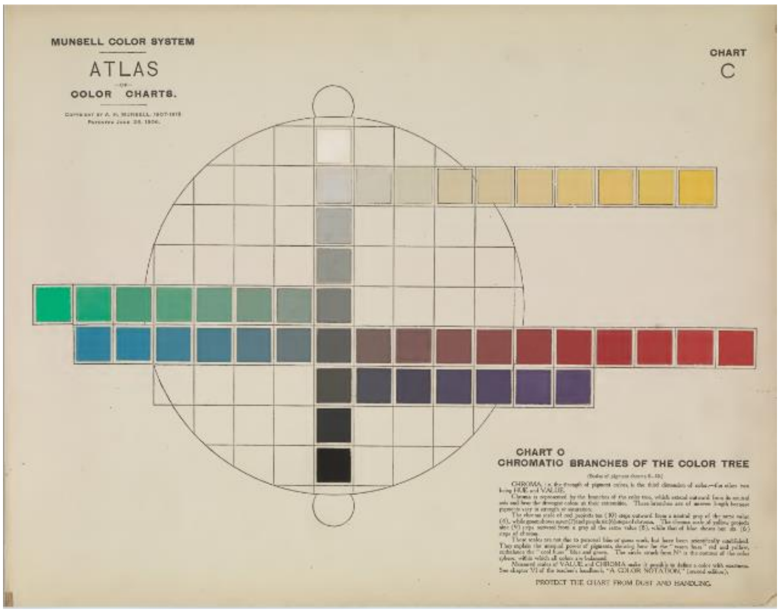

Figure 4: Chromatic branches of the colour tree from Munsell's 1915 Atlas [12].

A more scientific representation of the chroma limits at different lightness levels for different hues in CIELAB space can be found in [13].

Cold-warm contrast

"*It may seem strange to identify a sensation of temperature with the visual realm of color sensation. However, experiments have demonstrated a difference of five to seven degrees in the subjective feeling of heat or cold between a workroom painted in blue-green and one painted in red-orange.*" [4 p.64].

Briggs, on his Dimensions of Colour web site [14] states:

"*In traditional colour theory the adjectives "warm" and "cool" are very commonly used to label distinctions of hue, for example "warm yellow" for reddish yellow and "cool yellow" for greenish yellow. These associations of hue with perceived temperature clearly refer to psychological perceptions rather than physical*[5] *properties.*"

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[5] So much so that the physical meaning is exactly the opposite of the psychological one. A "warm white" bulb may have a colour temperature (a psychophysical term) of say 3000 K, whereas a "cool white" lamp can have 5000 K or more, i.e. the "cool" is significantly hotter (physically), than the "warm".

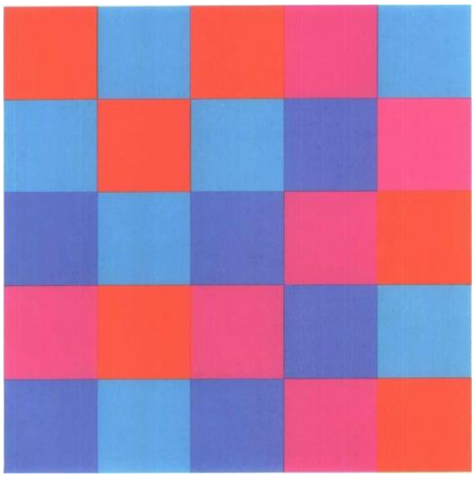

Figure 5: Cold-Warm contrast illustrated by Itten [Based on 3 p.71].

Itten considered BG the coldest and RO the warmest hues but acknowledged that "*the hues intermediate between them in the color circle may be either cold or warm according as they are contrasted with warmer or colder tones*" [4 p.64]. On Figure 6 we can see that that the concept of cold and warm colours is extremely subjective, which explains that it is subject to bitter (and perhaps fruitless) controversies. Most of the colours (not just the intermediate ones mentioned by Itten) may be considered either cold or warm depending on which other colour ("warmer" or "colder") it is contrasted with.

Of course, when speaking of cold-warm contrast, it inevitably involves most of the other contrasts, and conversely, examples of contrast of hue and complementary contrast will nearly always involve cold-warm contrast.

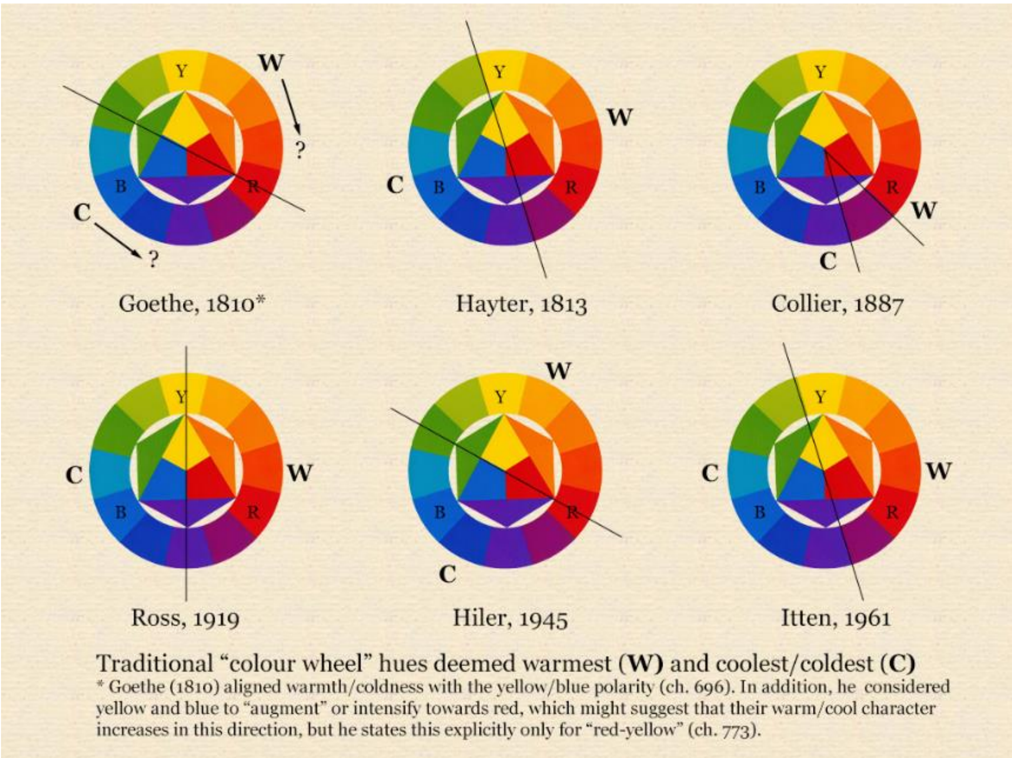

Figure 6: Six warm/cool classifications of the hues of a traditional 12-hue colour wheel (from Itten), showing the hues deemed warmest (W) and coldest/coolest (C) by their authors [14 Fig.7.18].

Complementary contrast

According to Itten "*We call two colors complementary if their pigments, mixed together, yield a neutral gray-black. Physically, light of two complementary colors, mixed together, will yield white.*" Then he adds: "*In our color circle complementaries are diametrically opposite each other.*" [4 p.78]. Unfortunately, colorant (pigment, dye) mixing is much more complex than that and trying to make mixing rules based on hue (as Itten does) is a misleading, futile exercise. The main problem of "traditional colour theory" is interpreting Itten's "rules" literally. As Ross wrote already in 1919: "*In saying that certain colors, Red and Green for example, are complementaries we must recognize the fact that these colors are variable under their terms or names…We must be careful not to be influenced by the words or names we use and the effects which may be associated in our minds with those words or names.*" [15].

This advise, from the year when Itten started his Bauhaus career and more than forty years before the publication of The Art of Color, should have been accepted by Itten, and should be emphasised, accepted, and taught everywhere, and not only in the context of complementary contrast.

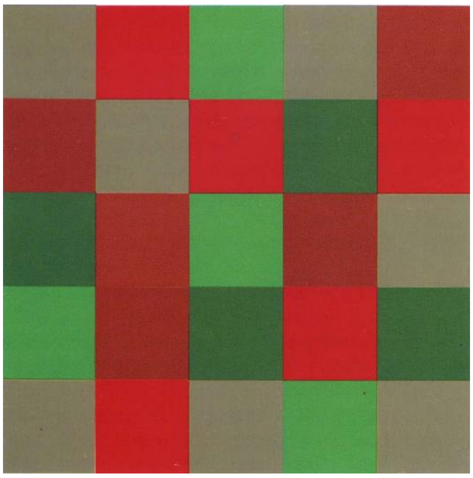

Figure 7: Complementary contrast illustrated by Itten [Based on 7 p.51].

According to modern science there are five ways to produce / evoke complementary colours.

a. Additive mixing of complementary lights obeys Grassman's laws: the sum of the (psychophysical) tristimulus values corresponds to the perception of white.

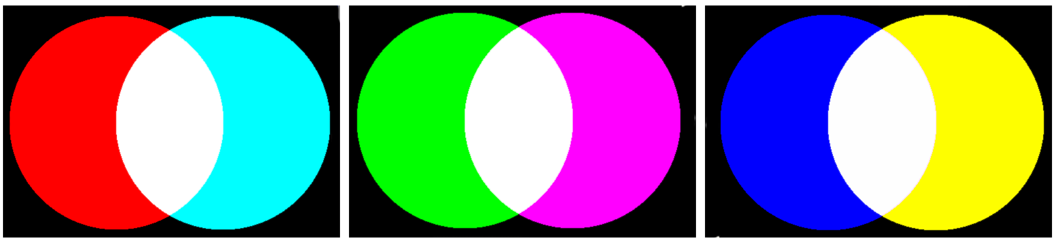

Figure 8: Additive complementaries.

b. Partitive ("optical") mixing of lights (such as when spinning Maxwell's discs) obeys Maxwell's laws: the temporal or spatial average of the (psychophysical) tristimulus values corresponds to grey. When the two colours are of equal lightness and chroma they will each occupy half of the area of the disk;

when they are of different lightness and/or chroma they will occupy an area inversely proportional to their lightness and/or chroma.

Figure 9: Partitive (optical) complementaries.

c. Subtractive mixing follows the Bouger-Lambert-Beer law (in the case of transparent filters or liquids) or the Kubelka-Munk law (in the case of scattering media such as paints or dyes on textiles): the result of the mixing process can only be calculated at the physical level (spectral transmittance or reflectance) – there are no simple "rules" based on the colours of the components. The colour of the mixture can be black or grey. As pointed out in [16], the mere fact that the subtractive mixture results in black does not necessarily mean that the colours of the two filters or paints are complementary. As shown in Figure 10 (left) the superposition ("mixing") of yellow + blue, green + magenta or red + cyan dichroic filters[6] results in black. However, with these filters of extremely steep transmittance curves we shall find that green + red also results in black (which will not make them complementaries) just as green + blue and red + blue also result in black, although they are obviously not complementaries.

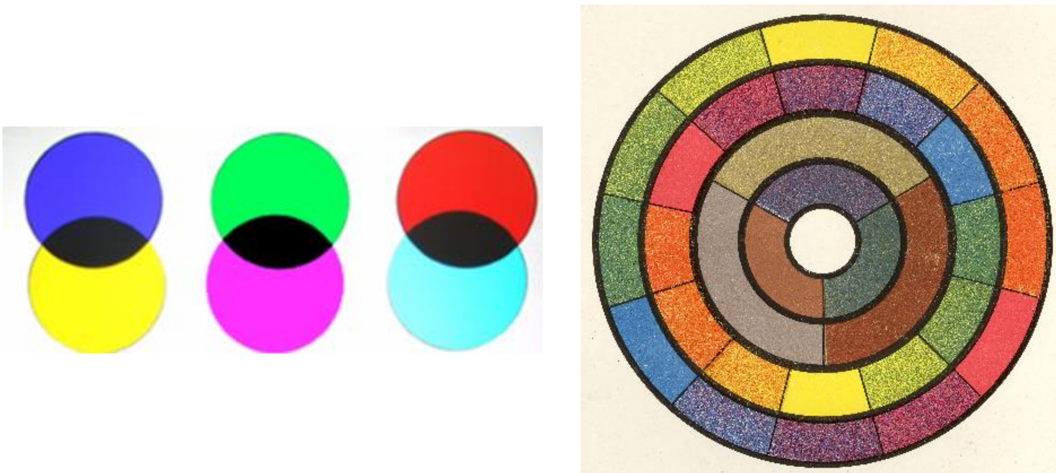

Figure 10: Subtractive complementaries. Dichroic filters (left) and Schmidt's "painters' colour circle" (1901) [17] with the corresponding complementaries (right). Depending on the spectral composition of the components, subtractive complementaries may be significantly different.

d. After-images are considered perceptual complementaries. The colour wheel in Figure 11 shows one of the attempts to illustrate this phenomenon.

[6] Dichroic filters have very steep transmittance curves and are therefore excellent in demonstrating in practice the theoretical extremes of subtractive mixing.

Figure 11: Wilson's colour wheel with after-image complementaries [18].

e. Coloured shadows are yet another way to evoke complementary colours (Figure 12). Here the coloured light and the coloured appearing light are perceptual complementaries. Some more on this phenomenon see later (under simultaneous contrast).

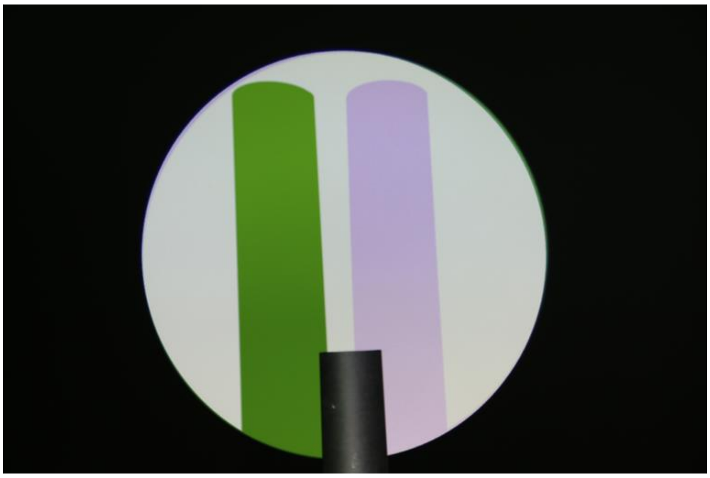

Figure 12: The coloured shadows phenomenon. The shadow on the left is illuminated by green light from a projector, the magenta/violet appearing (in the real-life experiment much more vivid appearing) shadow on the right is a shadow illuminated by white light.

These five situations are basically different, and Itten's misconception is defining e.g., complementary contrast in physical terms (paint mixing) and then interpreting the results in perceptual and even aesthetic terms. In The Art of Color, he explains:

> "*Figs. 73-75 show three complementary pairs and their gray-black mixtures. A little white may be added to the mixture for a more delicate test of the gray. If the mixtures of the two colors in all proportions fail to include a neutral gray, it follows that the two colors are not complementary.*
> *Figs. 76-78 show three mixture series for as many complementary color pairs. These scales are prepared by adding more and more of the complementary to a given color. In the center of each series, we get a neutral gray.*" [4 p.79]

If we compare the microscopic views of e.g. the Yellow to Violet series from the first and the second editions (Figures 76 in both editions) we can see that the reproductions – contrary to what many advocates of Itten's "colour mixing" theory think – are probably visually adjusted matches produced, as it were, by two different printing technologies: multi-colour printing in 1961 (Figure 13 top two rows) and four-colour printing in 1973 (Figure 13 bottom two rows).

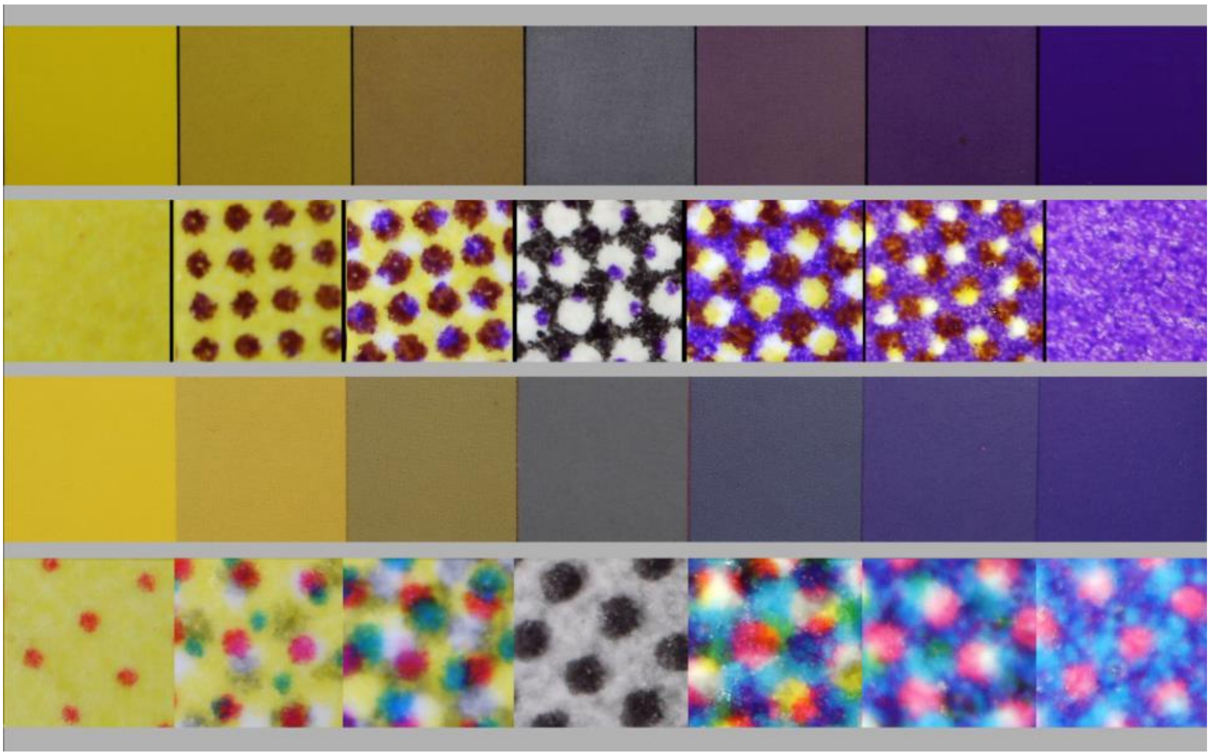

Figure 13: Microscopic view of the Yellow to Violet complementary contrast series in two editions of Itten's Kunst der Farbe [Top two rows 3 p.78; bottom two rows 4 p.78].

It seems quite obvious that the greys in the reproductions are not mixtures of the yellow and violet pigments but produced by black inks (in the case of the first edition with a touch of violet).

Simultaneous contrast

Itten's definition of simultaneous contrast comes directly from Goethe:

> "*Simultaneous contrast results from the fact that for any given color the eye simultaneously requires the complementary color and generates it spontaneously if it is not already present. By virtue of this fact, the fundamental principle of color harmony implies the rule of complementaries.*" [4 p.87]

This is a very poetic (albeit not very accurate) description of a phenomenon which has been noticed and recorded since antiquity. Aristotle (more than twenty-two centuries before Chevreul!) is quoted by Ross [19 p.3]: "*In woven and embroidered stuffs the appearance of colours is profoundly affected by their juxtaposition with one another (purple, for instance, appears different on white and on black wool), and also by differences of illumination*". Since then, dozens, if not hundreds of famous and not so famous authors debated the phenomenon of simultaneous contrast, arguably the most famous debate on the nature and mechanism of simultaneous contrast was that between Helmholtz and Hering [20]. Despite the tremendous advances since the 19th century [21], O'Shea *et al.* [22] argued even a few years ago that "*simultaneous colour contrast remains unexplained, presenting a challenge to any comprehensive theory of colour vision*".

Itten illustrates simultaneous contrast with small uniform squares on differently coloured backgrounds, which is vast simplification of the phenomenon. His Bauhaus colleague, Albers [23] went way beyond it and showed a large range of simultaneous contrast and related effects.

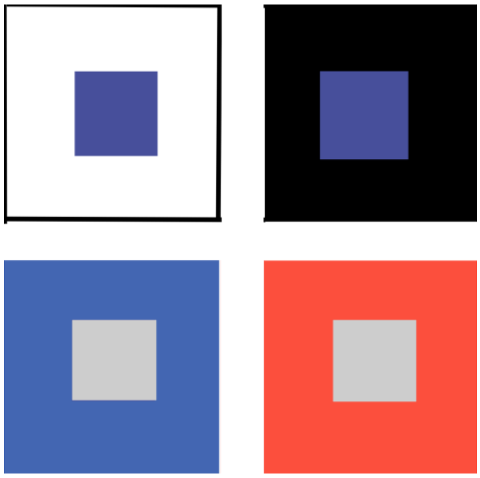

Figure 14: Simultaneous contrast illustrated by Itten [Based on 3 p.4].

Itten is mistaken when he says, "*As was shown in Figs, 2-4, white weakens the luminosity of adjacent hues, and darkens them, black causes them to seem lighter.*" [4 p.36] The figures he is referring to are the simple yellow, red and blue squares of white resp. black background (such as illustrated in Figure 15 left) and, indeed, in this situation simultaneous contrast comes into effect. But here he seems to have forgotten what he had learned from Bezold. In his Stuttgart diary of 1914 [24] Itten noted (referring to Bezold): "*A blue appears darker when there is a black ornament in it and lighter when there is a white ornament in it*". This can be illustrated as in Figure 15 right.

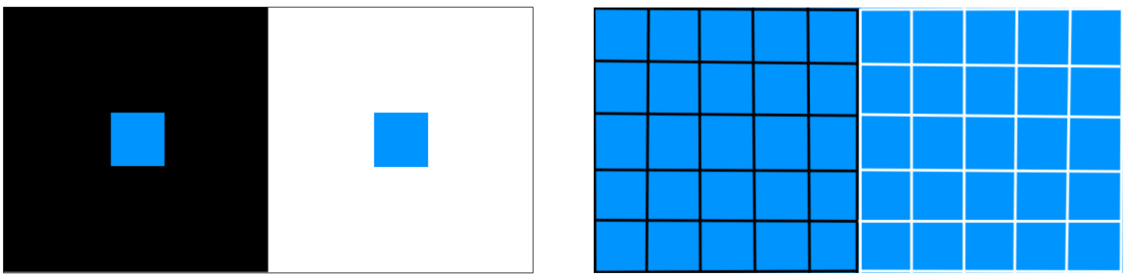

Figure 15: Simultaneous contrast illustrated by Itten [Based on 4 p.4] (left) and the Bezold effect (right).

If we look at Itten's own "contrast of hue" exercises from his 1940 Wattwill course (Figure 8 in Part I) we can clearly see the Bezold spreading effect: the coloured squares with the white frames appear lighter, while those with a black frame appear darker than those without frames, quite contrary to what would be expected from the simultaneous contrast "rules".

A very convincing, simple demonstration of the Munker-White illusion [25] can easily be performed by placing squares cut from a sheet of coloured paper on white resp. black background (à la Itten) and then cutting narrower strips from the same sheet and placing them in a black and white grid as shown in Figure 16.

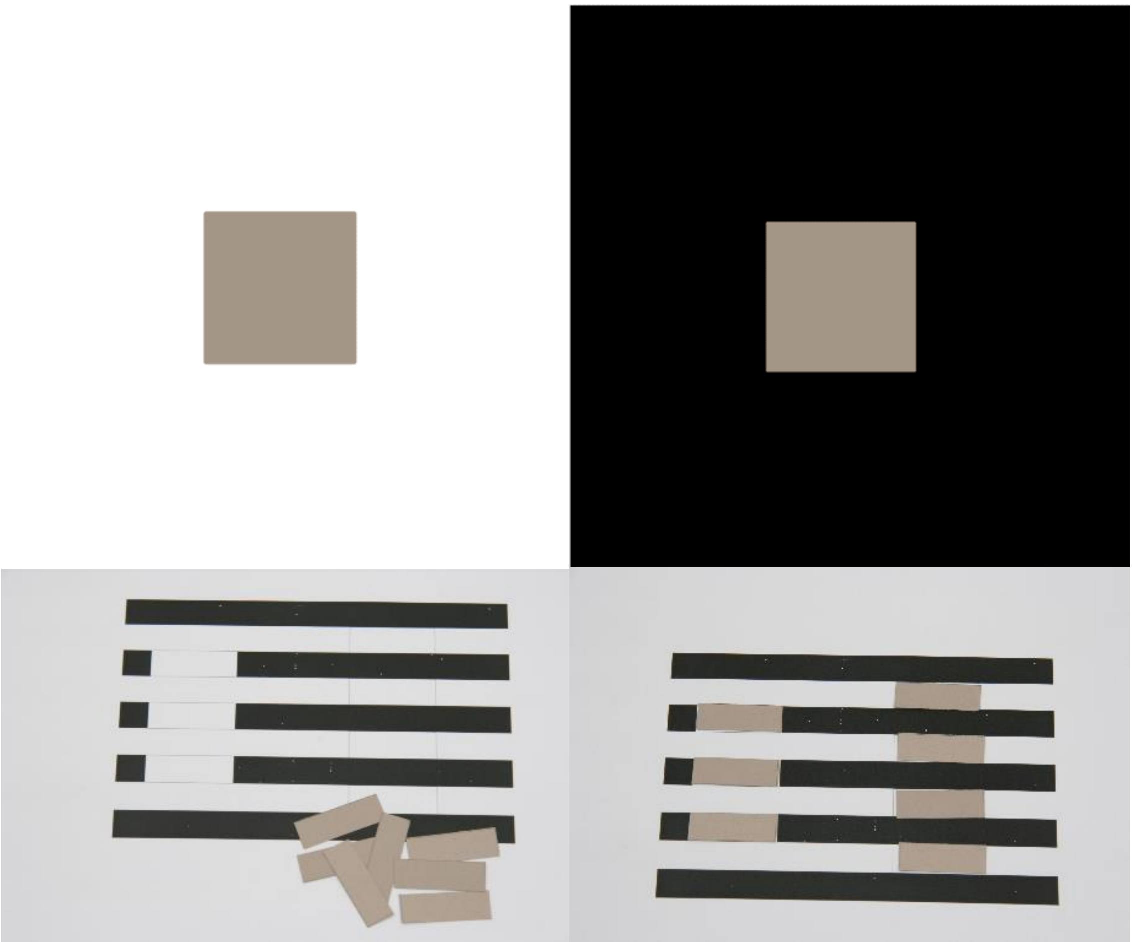

Figure 16: Illustration of the Munker-White effect with paper chips.

On the top of Figure 16 (“classical” simultaneous contrast) the physically identical coloured chips appear to be darker on white and lighter on black background, as would be expected. Below the effect is reversed; the physically identical chips over white background appear lighter and over black background darker. This is very similar to the Bezold spreading effect as illustrated on Figure 15.

Simultaneous contrast and related effects are much more complex than suggested by Itten, and, of course, they always involve most of the other contrasts (particularly hue, light-dark and complementary).

A very special case of simultaneous / complementary contrast is that of the coloured shadows. Itten describes his experiment as follows:

> “*A white object was illuminated, in daylight, with red light; a green shadow resulted. Green light produced a red shadow, yellow light a violet shadow, and violet light a yellow shadow. In daylight, each colored light produced a shadow of the complementary color…Color photos showed that the colored shadows were really present, and not due simply to simultaneous contrast.*” [4 p.126]

When reproducing this experiment (which is very easy to perform) you can see that if the object (white or not) casting the shadow is illuminated by red light, then the cast shadow (illuminated only by daylight) will appear cyan (and not green); green light produces magenta (and not red) as illustrated on Figure 16; and violet/magenta light produces green (and not yellow).

These combinations are about the same as the afterimage complementaries (see the Complementary contrast section and Figure 11), although the perceptual mechanisms are different. Itten probably wanted to describe the same complementary pairs as in the case of pigments and was using generic colour terms, not describing the situation with any precision. Once again, the use of generic colour names is imprecise and misleading. As for his statement that "*Color photos showed that the colored shadows were really present, and not due simply to simultaneous contrast*", he was very much mistaken (just like many others before and even after him). For a detailed description of coloured shadows and why they can be photographed see [26].

Contrast of saturation

"*Contrast of saturation is the contrast between pure, intense colors and dull, diluted colours.*[7]" [4 p.96]. According to Itten, "pure" colours may be diluted in four different ways: with white, black, grey and also by admixture with the corresponding complementary colours. Just as all throughout his book, here also Itten speaks of "mixing colours" when, in fact, he meant (and should have said) mixing pigments of this or that colour. Itten suggests that "*basic exercises in contrast of saturation can be performed on a checkerboard of twenty-five squares*[8]*. We place a pure color in the center, and a neutral gray of the same brilliance in each of the four corners. We then mix gray with the pure color step-by-step, obtaining four more or less diluted intermediates. To comprehend contrast of saturation, we must eliminate light-dark contrast; hence the brilliances of all squares must be the same.*" [4 p.97]

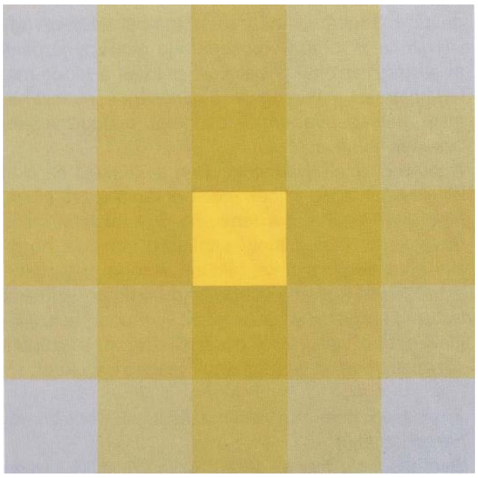

Figure 17: Contrast of saturation as illustrated by Itten [Based on 7 p.57].

This advice of eliminating light-dark contrast (i.e. to use colours of the same lightness when illustrating contrast of saturation) is not easy to follow. For the untrained eye establishing equal lightness for colours of different hues can be very difficult; "saturation" (vividness) differences in this case are often confused with lightness differences.

[7] For some clarification and the usage of different terms see the Appendix in Part I.

[8] Just like the ones from his 1940 Wattwill course shown in Figure 9 in Part I.

Contrast of extension

"*Contrast of extension involves the relative areas of two or more color patches. ...we should inquire what quantitative proportion between two or more colors may be said to be in balance, with no one of the colors used more prominently than the other. Two factors determine the force of a pure color, its brilliance and its extent.*" [4 p.104]

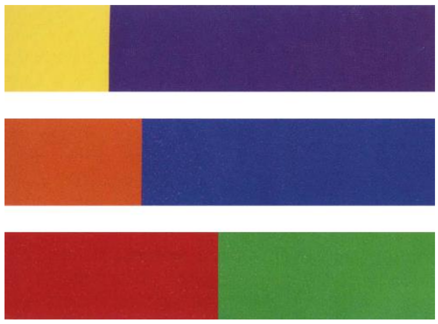

Figure 18: Contrast of saturation as illustrated by Itten [Based on 7 p.61].

There are several problems with Itten's "contrast of extension". The numerical ratios he attributed to Goethe come from Schopenhauer (through Schreiber and Hölzel). Goethe himself never spoke of these ratios, and Schopenhauer, who was thoroughly familiar with Goethe's *Farbenlehre*, never even mentions Goethe's name in this context[9].

An interesting article was published in 1968 (i.e., only a few years after the publication of The Art of Color) in a not widely circulated students' magazine [28], in which Elsasser explains in detail why Itten's (in fact, Schreiber's) calculations of the relative areas are wrong. According to him the correct area ratios should be as illustrated in Figure 19.

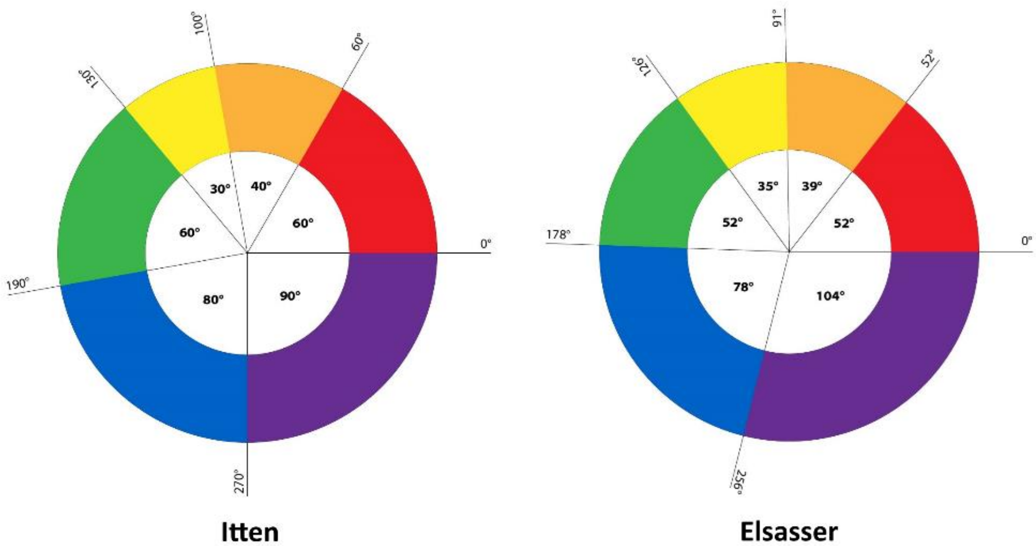

Figure 19: Itten's original 'harmonious" area relations [based on 3 p.105] and as corrected by Elsasser [28]. Design by Gisela Costa Pinheiro Monteiro.

[9] After a thorough search through different editions of Goethe's *Farbenlehre,* Bendin [27] arrived at the conclusion that Schoppenhauer's *Lichtwerte* (the numerical ratios) possibly didn't originate from Goethe.

As can be seen, these are only minor modifications, and they are of far less consequence than Itten's failure when he takes only the lightness and the area into consideration disregarding vividness.

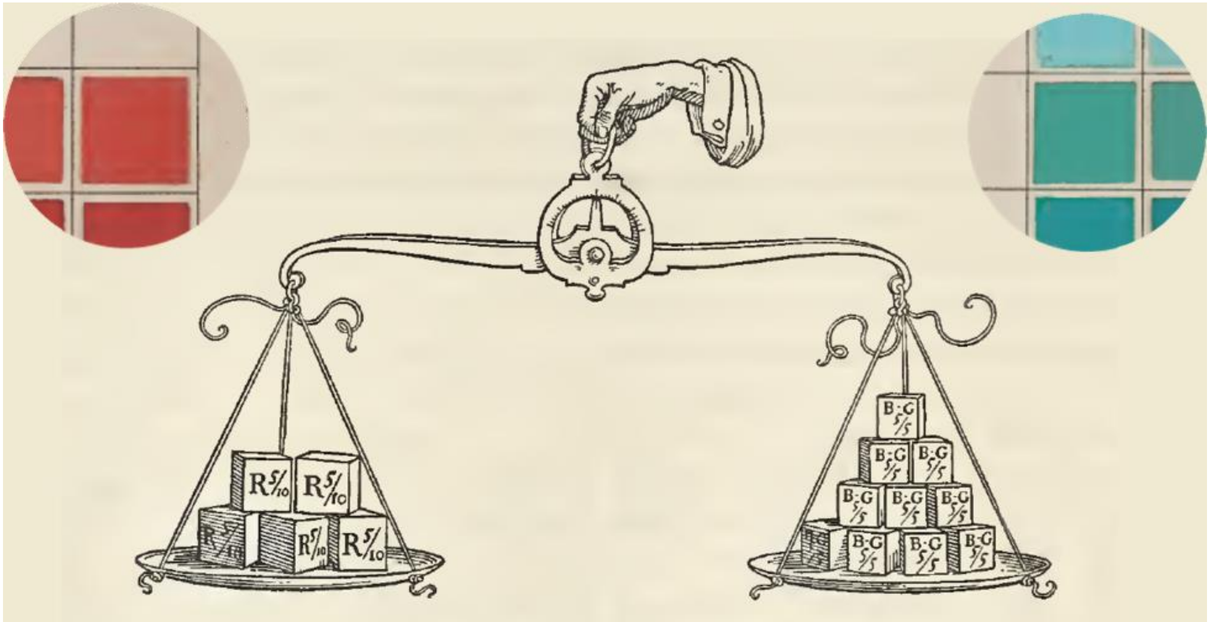

Figure 20: Munsell's equilibrium taking both Value and Chroma weights into consideration [Based on 29].

In Figure 12. the visual weight of a medium Value (V=5) and high Chroma (C=10) red is balanced by twice as much (e.g., twice the area in a composition) of the complementary blue-green of same Value (V=5) but only half of the Chroma (C=5). It must be emphasised though, that these ratios are extremely vague (as warned already by Schreiber, see p. 16. in Part I), and very much depends on the exact hue, lightness and vividness of all the areas in a composition. The way in which surface area is perceived is a purely aesthetic problem for which there are no scientifically valid studies.

Conclusion

Itten's seven contrasts, as they are discussed in The Art of Color, are a strange combination of physical and perceptual phenomena. The main problem lies exactly in Itten not having distinguished between these different levels, and he manages to change the meaning of the word "colour" within one sentence. For instance, when discussing complementary contrast, he said: "*If the mixtures of the two colors* [i.e., paints – physical] *in all proportions fail to include a neutral gray* [perceptual], *it follows that the two colors* [paints? perceptions?] are not complementary." [4 p.79]. The explanations of the various types of "contrasts" are very often misunderstandable, or even downright erroneous from the point of view of modern colour science.

Further complications arise from the inconsequent usage of colour terms both in the original German Kunst der Farbe and in the translated The Art of Color. The translator sometimes took the liberty of changing or even including new sentences, and was not consequent in the way the colour-related terms were translated. Some notes on the terminology and usage are included in the Appendix to Part I.

The consequences of these errors for colour education (with particular reference to art education) shall be discussed in detail in Part III.

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