PRO COR
Associação Pró-Cor do Brasil

HOW MUCH COLOUR SCIENCE IS NOT TOO MUCH

Robert Hirschler[1], Paula Csillag[2], Pablo Manyé[3], Mônica Neder[4]
[1]PróCor, [2]ESPM, [3]Universidade Regional do Cariri, [4]Universidade Federal de Juiz de Fora

ABSTRACT

Artists, designers and architects learn about colours, but the question is how much colour science (covering much more than just colour physics) should be included in their curricula.

The authors of this paper (a chemical engineer, a designer, a visual artist and an architect/designer) present a brief survey of the literature, including a review of the text books written for this public audience. With examples taken from their own respective teaching practice they describe and discuss the main topics they consider important to be included in the curricula of future visual artists, designers and architects.
.

CONTACT

Dr. Robert Hirschler
Associação PróCor do Brasil
Email: robert.hirschler@yahoo.com
Phone: +36-30-620-1290
Website: http://www.procor.org.br/

INTRODUCTION

During a short course for designers one of the authors was demonstrating additive mixing using three projectors. Suddenly one of the students exclaimed: “now I understand what RGB means on my computer”. Another time, doing the same demonstration for a different group of students one of them interrupted the show: “don’t talk about light, talk about colours”.

This, of course, raised a host of questions. Is additive and subtractive mixing really too much for artists, designers and architects, or would they survive hearing about colour order systems, the trichromacy of vision or even (gasp!) the CIE system and colour measurement? Then came more profound questions. Obviously, colour theory must be taught in these courses. Or must it?

There are intriguing colour demonstrations which may raise the interest of even the most devoted anti-scientist – but you should not spoil the effect by pouring mathematical equations onto the students.

COLOUR SCIENCE FOR NON-SCIENTISTS

Although Alberti maintained that “*it is enough for the painter to know what the colours are and how to use them in painting”,* we rather accept Leonardo’s view: *“practice must always be founded on good theory.”*

In any profession, skilled workers **know how**. In the same profession, high level professionals (be they artists, architects, designers) also must **know why**.

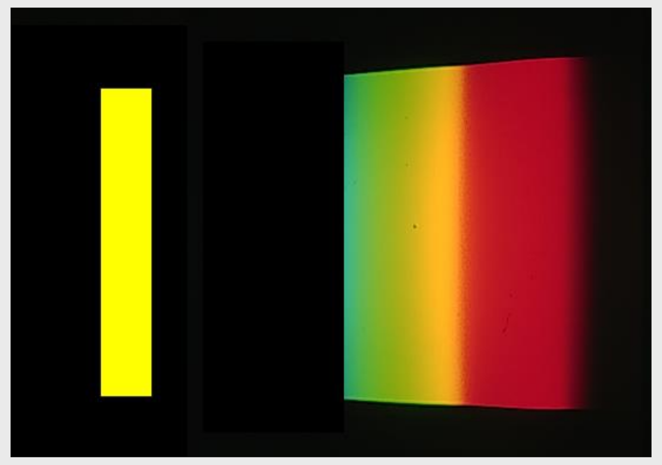

Figure 1.
Spectral composition of yellow light

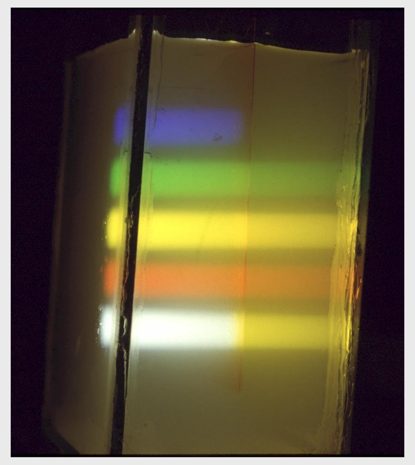

Figure 2. Spectral transmittance of yellow filter

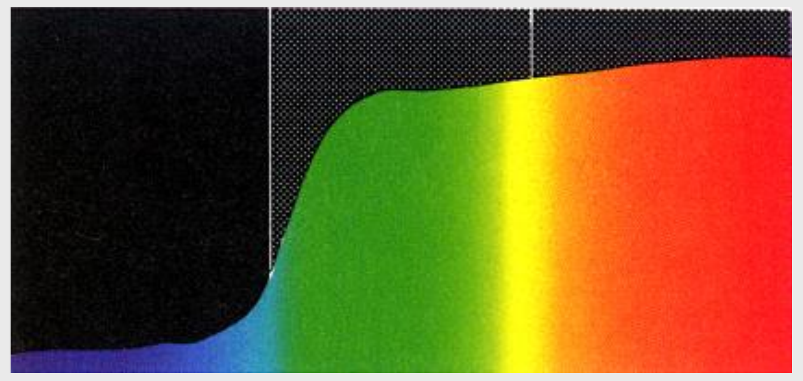

Figure 3.
The spectral curve of a yellow light or object

We have found it useful to start explaining the basics of colour physics with demonstrations (such as those illustrated by **Figures 1. and 2.**) and on this basis introducing the concept and the use of spectral curves (**Figure 3.**) Figure 1. shows how yellow light is composed of all the components of the full spectrum minus blue; Figure 2. shows why yellow objects appear yellow (by selectively absorbing the blue component of white light); and Figure 3. how to quantify this with a spectral curve.

In **colour physics** we should continue with the demonstration and the explanation of *subtractive mixing*, at the same time indicating that *additive mixing* is already in the realm of **psychophysics**, trichromatic vision cannot be explained only by simple physical concepts.

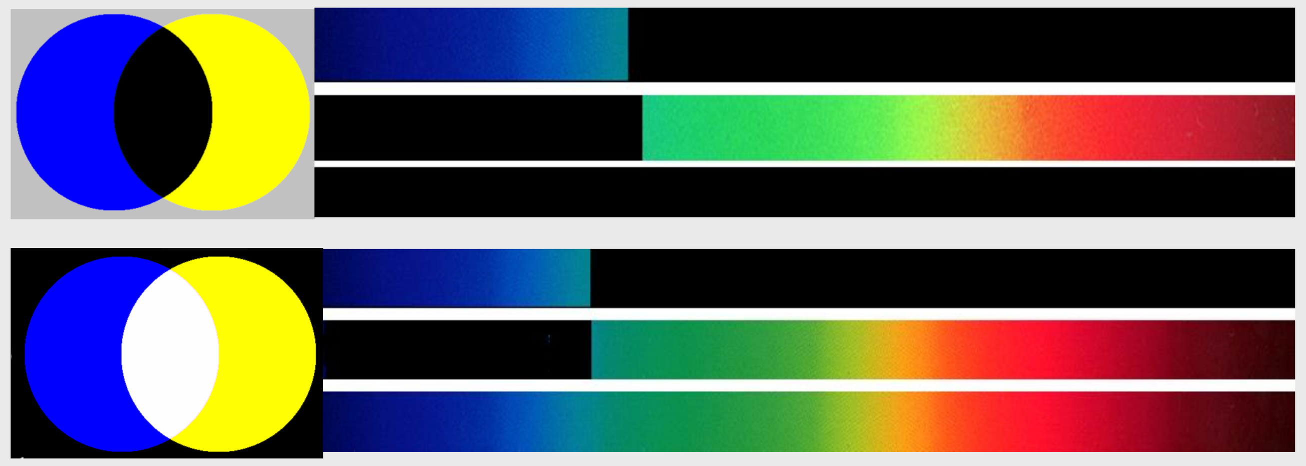

Figure 4.
Comparison of subtractive resp. additive mixing of complementary colours

We maintain that when talking about additive mixing the CIE system of colour measurement should briefly be introduced and explained even for non-scientists. In this age of computer literacy among designers and architects (and maybe to a lesser degree even among artists) the correct interpretation of tristimulus values and later L*a*b* and DE* (without going into the mathematical details) may not be amiss.

Colour order systems (at least Munsell and NCS) should not only be explained but exercises performed using the respective student sets, and the implications (and contradictions) of **colour wheels** discussed in detail.

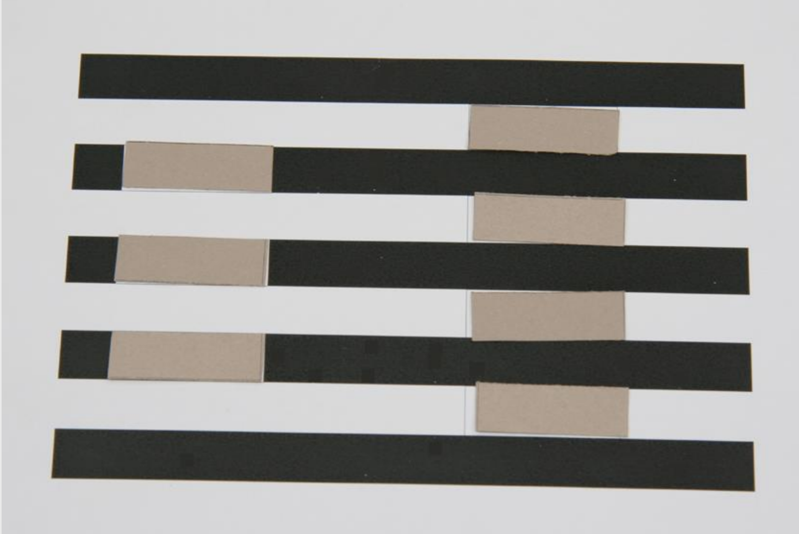

Figure 5.
Demonstration of the White illusion with pieces of paper

The illustration, demonstration and discussion of the **interaction of colours** should go beyond merely repeating the Albers exercises, and here again the **why** should also be discussed.

FIGHTING MISCONCEPTIONS

In many of the books on colour written for non-scientist you will find one or more chapters on the basic ‘facts’ of colour science – unfortunately many of them will be misconceptions. In modern colour education one of the most influential teachers was Johannes Itten, whose colour circle, so often reproduced and cited, is simply impossible to construct along the lines he explained.

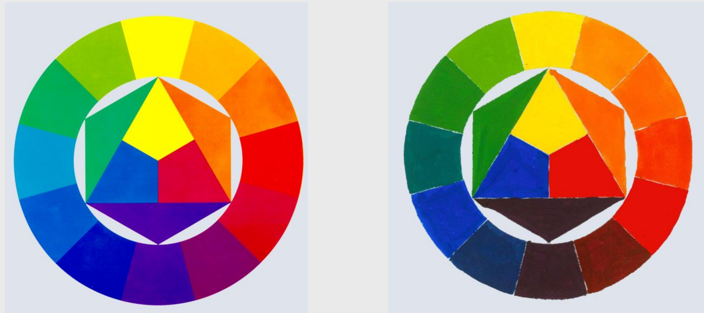

Figure 6.
Itten’s colour circle based on The Elements of Color (left) and as reproduced by a student following Itten’s instructions (right) (Hirschler, 2008)

What is even worse is that authors of these books (let alone web sites) do not listen to constructive criticism. Berns (2006) listed a number of errors in the third edition of the (beautifully produced) book on colour by Holtzschue. The fifth edition (published in 2017) continued with the very same errors. We must quote Kuehni (1979), who wrote about another beautifully produced book (by Küppers), also full of errors: “[it] will set color education and bridging-the-gap efforts back for decades.”

CONCLUSIONS

Colour science – physics, psychophysics, psychometrics, colour order, colour perception and possibly some psychology and maybe philosophy – should be taught also to non-scientist. These professionals also need to know **why** colour phenomena behave the way they do, it is not enough for them to learn the ‘cook-book’ – i.e. to know only **how**.

Teaching advanced concepts does not necessarily involve the use of complicated rules and formulae, to make teaching efficient it needs to be interesting and demonstrative, using simple charts, demonstrations and exercises.

REFERENCES

1. Berns, Roy S. (2006): Understanding Color: An Introduction for Designers, Third Edition, by Linda Holtzschue. Book Review. Color Research and Application, **31**, 6, pp. 511-512.
2. Hirschler, Robert (2008): Teaching Colour Wheels and Complementary Colours. Paper presented at the AIC 2008 Interim Meeting *Colour Effects and Affects*, Stockholm, 15-18 June, 2008.
3. Kuehni, Rolf G. (1979): Das Grundgesetz der Farbenlehre (The Fundamental Law of Color Science), by Harald Küppers. Book Review. Color Research and Application, **4**, 1, pp. 49-50.