

True Colours

debunking the colour myths.

Summary – this paper:

- Looks at the science of colour
- Challenges some common colour myths
- Identifies universal colour associations
- Makes recommendations for your classroom

How it all started.

We often go down some very interesting rabbit holes at our Furnware Research Department and this is a classic case in point.

Our new head of design wanted to know if colours could influence learning. He asked us to research the psychology and physiognomy of colours in classrooms so we could create a colour palette at Furnware to potentially assist better learning outcomes.

Great brief for an important project – but we quickly found there's a mass of contradictory information and research out there around colour psychology. We quickly put up our hand for help. We contacted Callaghan Innovation, the New Zealand government department responsible for innovation. They ran a global expert search to find someone to guide us through the maze and put us in touch with Professor Marilyn Read of the Oregon State University, who became a major source of guidance and expertise.

Let's start with the science.

Colour originates in sunlight and is perceived through subtractive colour theory. White light includes all colours – the various wavelengths of light shine on an object and the surface absorbs all coloured light rays except for the ones reflected from the object. Objects that absorb all colours are seen as black.

This is the interesting bit – men have three cones for colour reception, animals and a small percentage of women have four cones and can see a greater range of colours. Try this colour differentiation test online and compare your score – it's fascinating. <http://www.xrite.com/en/hue-test>

Referential versus embedded meaning.

Different cultures apply different meanings to colour. This infographic maps colours and their associations against different cultures around the world. It requires a bit of focus but the differences it presents are dramatic:

<http://www.informationisbeautiful.net/visualizations/colours-in-cultures>.

This shows the dangers of associating any particular colour with a fixed meaning. A colour association may be true for one culture but wildly different for another. For instance, in Western/American culture, yellow is the colour of happiness but not in Hindu, Native American or Chinese, where it's green, white and red respectively. White is the colour of purity and marriage in Western culture, but in Hindu and Chinese it's the colour of death - could be awkward to get that wrong. But what does this all mean? These are all social constructs and change with culture. The meanings are referential, not embedded, or universally experienced.

Do universal colour meanings exist?

We were relieved to find there are indeed some universal certainties with meanings associated with colour.

Any meanings derived from nature are universally experienced. In terms of our natural environment, there are some derived natural meanings - blues, greens and white are associated with water, plant growth and snow and are thus cooler. Similarly, reds and yellows have universally understood connections to the sun and its associated heat and dryness. Children's preferences are for lighter, brighter colours - again this makes sense with the link to nature. The lighter it is, the easier it is to see - the known is always less scary than the unknown. The darker it is, the more difficult it is to see and the scarier it is. In bright sunlight, you can see for miles and miles - there are no hidden dangers and unless a sabre tooth tiger leaps out, there's no need for fight or flight.

Shining a light on the myths.

1. Red increases blood pressure, makes the heart beat faster and increases sense of smell.

Engelbrecht's paper, *The Impact of Color on Learning*, was delivered to Neocon at Chicago in 2003 and, paraphrased, stated that exposure to red increased blood pressure, made the heart beat faster and increased sense of smell. In contrast, blue lowered pulse rate, body temperature and suppressed appetite. So we went searching for other research to back this up and, guess what - couldn't find any. Well, that's not strictly true. We did find research from Wohlfarth and Sam, who used a sample size of just 14 children. Not only a small sample size but the study was based on a mixture of blind and sighted children. Hmmmm. Another study by Gerard in 1958 found that when red or blue lights were shone directly into students' eyes, electrical brain activity as measured by an electroencephalogram (EEG) was higher with red light than with blue. There are two problems with this - (i) this is a highly artificial situation; and (ii) they found that people habituate to colour - a colour that may initially arouse a person can lose its arousal effect levels with time and continued exposure.

Frank Mahnke, author of *Color, Environment & Human Response*, warns against over-simplification:

"Human reaction depends on a multitude of factors. First we must consider that in choosing appropriate surface colors much depends on the specific hue, its value, and intensity. Also where color is placed, how much of it [...], for what purpose, and for what length of time should all be taken into account.

It would be erroneous to think that color design [...] can or should be geared to a specific physiological effect — such as lowering the blood pressure of a person suffering from hypertension. Let me emphasize: Specific physiological effects should not be the designer's objective.

When designing with color we must always see it in context, and not apply it through generalities."

2. Yellow either makes us happy, tired, bad-tempered or makes babies cry.

Conflicting studies claim that yellow makes us both happy and unhappy. According to Carlton Wagner, director of Wagner Institute for Colour Research in Santa Barbara, babies cry more in yellow rooms. Other studies state that yellow helps to release a chemical in the brain called Serotonin, essential for triggering a happy mood. Some studies have suggested that yellow enhances concentration and gives the brain and nervous system a "wake-up call".

As Bakker et al. (2013) argue, much colour research analysing the influences of colour on human beings is being conducted in an artificial setting by employing students performing artificial tasks, using different test materials and measuring different effects by using questionnaires. The results are often conflicting and it's impossible to come up with the same results each time.

The research on the supposed effects of yellow is conflicting, but we do know too much use of bright colour is definitely damaging - as is too little.

3. Are prisons pretty in pink?

Sports teams often use pink as the colour in locker rooms for the opposing team. It's claimed to be beneficial in reducing anger and anxiety, which is why prisons in the US are painted pink to keep the prisoners calm.

A study by Dr Alexander Schauss in 1988, from the American Institute of Biosocial and Medical Research, explained that, "Even if a person tries to be angry or aggressive in the presence of pink, he can't. The heart muscles can't race fast enough." However, Schauss' study has never been successfully replicated, but the myth persists and prisons still apply it today.

Faber Birren, highly influential US colour theorist, famously set out to disprove the theory of "paint the asylum red and drive the prisoner mad." He painted his whole house red - walls, floor, curtains, even light bulbs and lived in a red immersion environment for months, claiming it was actually quite soothing. At Furnware we weren't quite prepared to go that far to prove a point.

4. Green aids concentration.

There are extremely well backed studies that do show huge benefits through the introduction of nature, both in classroom and in social housing. Work by Nancy Wells - *At home with nature - effects of "greenness" on children's cognitive functioning* - shows that green views improve cognitive functioning.

Closer to home, a great designer friend of Furnware's, Al Mackie at Band in Hawke's Bay, New Zealand, recently designed the colour scheme for the new mental health unit at Hawke's Bay Hospital. He worked with another connection of ours, David Trubridge who designed the light shades and reception counter. The purposeful use of colour and nature by these two designers has created a beautifully calm and peaceful environment.

Every room featured three plain or neutral walls and one wall with colour and a stylised nature pattern. A picture of Lake Waikaremoana is printed onto the walls along a corridor, a thoughtful use of nature as inspiration. The overall effect is picturesque and serene.

So, we can conclusively say that balance and harmony are everything. Too much colour and pattern information can be as harmful and distracting as too little.

Tips for your classroom.

We have collated all the research, done all the reading and can recommend the following - the majority of the colour in a classroom - floors, walls and ceilings - should be warm neutrals, such as tan or sand. Furniture can then provide 'pops' of colour, focal points and areas of interest. You can use colour to designate zones, to give visual clues for an area's use.

To ensure that children feel connected to their space, co-design it with them. Discover children's individual colour preferences and plan displays carefully to complement the room. However, do not rely upon displays of children's work to provide accent colours in an otherwise neutral setting - this will not necessarily provide the learning benefits of careful design.

Lighting is a huge factor as well since this affects how the colour is perceived. It is important to determine the ratio of natural light vs fluorescent light vs LED light as all of these can change the hue. If the classroom is designed with neutral, light colours on the walls and ceiling to keep the light reflection high in the room, the flooring and furniture can add pops of colour. There is a great learning opportunity here - children can now do their own discovery learning about their environments, using apps on their phones to measure light and noise levels and compare with the recommended levels.

Bear in mind...

- Context is everything - use colour with purpose
- How will the space be used? Technology/Reading/ Presentation?
- How is the space lit? Natural vs artificial lighting. LED vs fluorescent. Crucially, colours look different in different lights.
- Light meters - students using their own phones can measure light levels in a room. Anything less than 250 lux is insufficient.
- Colours need to be used in harmony - balance neutrals and vibrant colours

In summary.

- There are some decidedly colourful theories on colour. Don't believe everything you read.
- Always use colour with purpose.
- Less is more - but too little can be as bad as too much.
- Context is everything. Choosing colours can be complex. Your Furnware account manager can help talk through the challenges and options.

Sources, resources and further reading.

Bakker et al. (2013)

<http://www.informationisbeautiful.net/visualizations/colours-in-cultures/>

Online colour differentiation test <http://www.xrite.com/en/hue-test>

Nancy Wells [At home with nature](#) - effects of "greenness" on children's cognitive functioning

Frank Mahnke., *Color, Environment & Human Response*

Kathie Engelbrecht's paper *The Impact of Color on Learning*, delivered to Neocon at Chicago in 2003

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