

Psychology Documentation

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COLOUR

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Introduction

Colour can affect our emotions and take on psychological meaning (Elliot & Maier, 2014). Exposure to certain colours can even produce a physiological response.

Within virtual reality design, much like video games we have the ability to manipulate colours, ranging from objects or focal points, to the broad colour ranges of our surroundings. As such we can use colour to guide attention to areas of importance, establish realism (if that is the goal), create atmosphere and most importantly we can use colour to guide users towards desired cognitive and emotional states.

We can combine colour with a storyline or objective to enrich the user experience. Also we can create experiences without a story to follow or specific tasks to complete. In which case colour can be used with greater freedom, as an artistic medium in itself to engage the viewer and create an emotional impact.

The key is to understand the emotional associations we have to certain colours, and what components of colour are most important to our emotional response.

The Beauty of Color - Can color influence us? GameLogic's Des...

The beauty of colour – Can color influence us? (GameLogic)

Understanding colour

Understanding Color

Munsell colour system

This system separates colour into dimensions of hue, value, and chroma. Colours can be represented by three-dimensional space. Changes in each dimension have implications for the emotions associated with a colour (see [the importance of colour saturation](#)).

Value is measured up and down a central vertical, 0 (black) to 10 (white). Hue is measured in degrees around the central vertical. Chroma is measured outward from the central vertical.

Munsell colour system

(Jacob Rus © 2007)

Three-dimensional representation

(Michael Horvath © 2009)

Hue

Hue is what most people mean when they say 'colour'. It refers to the colour name, for example red, green or purple. Munsell divided colour into the five principal hues of Red, Yellow, Green, Blue, and Purple. He also created 5 intermediate hues, Yellow Red, Green Yellow, Blue Green, Purple Blue, and Red Purple. These hues fall between adjacent principle hues.

People associate colour hues with emotions. Researchers assessed the emotional reactions to fully saturated principle and intermediate hues, and 3 achromatic colours (white, grey and black) (Kaya & Epps, 2004). The four colours most commonly associated with calm were green, blue, purple-blue, and purple.

Value

Value refers to the brightness of colour. Brightness can be light or dark. A colour seen in full sunlight will have high brightness and be light. A colour seen in shade will have low brightness and be dark.

Researchers have found that the brightness of visual scenes can affect people. They found that brighter values – whites, light greys, and lighter colours – are more pleasant and less arousing than darker values, such as dark greys, blacks, and darker colours (Valdez & Mehrabian, 1994).

Researchers also found that darkness in visual scenes consistently evoked anxiety and arousal in participants (Felnhofer, 2015). Darkness in colours can be perceived as threatening as humans have an innate fear of darkness which evokes thoughts of vulnerability, threat and danger (Toet, 2009).

Chroma

Chroma refers to the purity of a colour. The purity of a colour can be measured by how saturated or desaturated it is. Saturated colours appear full and rich. Desaturated colours appear dull and pale.

Researchers have found that saturated colours are associated with alertness, while desaturated colours are associated with calm (Palmer et al, 2013).

Colour and emotion

Positive and negative colour associations

A study by Kaya and Epps (2004) identified the most common positive and negative emotional associations to various colours. Green and yellow are distinctly positive compared to yellow-green, black and grey which have mostly negative associations attached.

Ecological valence theory

Preference for certain colours is based on our learned associations between objects and colours. We prefer colours that are associated with objects and environments that we like. We dislike colours that we associate with objects and environments that are unpleasant (Palmer & Schloss, 2010).

Certain colours have strong associations with nature (e.g. green) and therefore produce similar relaxing effects to those caused by natural scenes (Kaya & Epps, 2004). Alternatively, red, orange and yellow have associations with objects of intensity and energy which may produce a lively response.

The importance of colour saturation and lightness

Palmer et al. (2013) examined the associations between colour hues and emotions when colours are presented at different saturation and lightness levels. Comparisons were made between saturated-muted and light-dark versions of 8 different colour hues.

Saturation

Desaturated colours are most likely to induce feelings of calm. Saturated colours induce a more lively response.

Although reds and yellows are often associated with energy, saturation levels were found to be far more important. Red is normally a highly arousing colour, yet a desaturated red was found more closely associated with calmness.

Lightness

Although not as strong as saturation, lightness was also closely associated with liveliness. Dark colours shared some association with calmness but also maintained negative connotations with sadness and dreariness.

The most calming and lively colours displayed below were rated as such in isolation. For this reason they should be treated only as a guide. A greater user experience and emotional response will be achieved by also choosing complementary colour schemes which match the context of the experience.

Most calming colours

(Adapted from Palmer et al., 2013)

Most lively colours

User driven colour choice

Johnson and Toffanin (2012) exposed participants to colour in the 'Lightshower' to determine the effect of coloured light on relaxation.

This preliminary evidence suggests that by allowing people to choose which colours they find most and least relaxing for themselves, this will encourage enhanced relaxation and energising effects.

Blue and green hues were the most popular choices for relaxation. But this was not always the case. Pink, purple and orange light colours were also chosen as most relaxing. In contrast, a range of colours around the red-pink colour spectrum were chosen most often as least-relaxing.

Following 2.5 minutes exposure to each colour, the colours chosen as most relaxing were associated with a significant increase in alpha wave activity in the brain (reflective of relaxation) compared to the least relaxing colours.

It is important to highlight that exposure to the colours chosen as least relaxing were also associated with enhanced alpha wave activity and relaxation. We would normally associate these colours with an energised response.

Participant experience of using the Lightshower was assessed. Regardless of colour, the experience was rated as nice, comforting, pleasant, relaxing and calming. What we can infer is that exposure to colours we deem non-relaxing or energising is insufficient in counteracting the relaxing nature of sitting still in a peaceful closed off environment with no further stimulation.

Version of the 'Lightshower' used by Johnson and Toffanin (2012). Coloured light is emitted via RGB LEDs above and below a cylindrical dome to create a uniform field around the user.

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