The creation of an artwork with simultaneous contrast

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ABSTRACT
The project described in this paper aims to illustrate the phenomenon of simultaneous contrast through a piece of artwork. The artwork is created with painted gomito pasta and Canson paper of different colours to exemplify the perception of small image elements (pixels) on different coloured backgrounds. Two colours, side by side, interact with one another and change our perception of the colours accordingly. The effect of this interaction is generally called simultaneous contrast. The colours in terms of physics and colorimetry are not altered; only human perception of them changes. Furthermore, the artwork also displays other phenomena; variations of simultaneous contrast, such as colour induction and colour assimilation. In real life, the colours we perceive generally do not remain the same when the background and viewing geometry changes, the proposed artwork provides a thought-provoking illustration of this to fact to the viewer.

1. INTRODUCTION
The human eye perceives colours from the spectrum of the light reflected, emitted or transmitted on or through the surface of an object. The mechanism of how colours are perceived has long been researched by scientists, and the physical colours as well as the perception of them are quantified and measured in many ways. The appearance of colours perceived by the human is a combination of various factors and conditions (Fairchild 2005). Different colour appearance phenomena have been introduced; examples include the Hunt Effect, where the colourfulness or the chroma of a constant chromatic colour appears to increase when the luminance is increased (Ohta and Robertson 1997; Fairchild 2005); the Helson-Judd Effect which occurs when a constant monochromatic colour, aka grey scale is illuminated by a coloured light resulting in the hue of the illuminant taken by the light grey, whilst the complementary colour is taken by the dark grey (ibid); and the Crispening Effect that refers to the different lightness perceptions of the scaled patches produced by the changing background (Logvinenko 2002).

Throughout the history of art, explicit or implicit knowledge of colour appearance phenomena has been used by artists to create their desired appearances and effects. For instance Georges de La Tour (1593-1652) used frequently the technique of light/dark contrast (chiaroscuro) to amplify the contrast between bright reddish colours of objects in the foreground and dark neutral colours in the background. Furthermore Jean-Baptiste Camille Corot (1796-1875), the French pre-impressionist, relied on the Bezold-Brücke and chromatic adaptation effects to transcribe the progressive reddishness of the evening light on the bricks of his “Le Forum, vu du Jardin Farnèse” (Hardeberg et al. 2004).

The artwork presented in this paper concentrates on exemplifying the simultaneous contrast and is inspired by the style of Andy Warhol’s artworks, particularly his pop art painting “Marilyn Monroe”. However, the related colour appearance phenomena such as colour assimilation and colour induction are also visible in the artwork.
2. METHOD

Simultaneous contrast is one of the properties of human vision, it occurs when the brightness or the colour of a test stimulus is influenced by that of its background. Usually, if the presented test stimuli are surrounded by a dark background they would appear brighter than when they are presented on a lighter background.

2.1 The theory behind simultaneous contrast

This phenomenon can be explained by lateral inhibition (or lateral interaction). When we look at a lighter background, the photoreceptors on our retina are illuminated to a greater degree. The illumination causes greater stimulation of the relevant photoreceptors. Subsequently, it produces a larger level of lateral inhibition. A darker background results in less illumination to the retinal photoreceptors, thus a smaller amount of inhibition is sent to the photoreceptors corresponding to the spot on the right. Therefore, the brightness of the spot we perceived as being usually lighter than its actual brightness.

On the other hand, chromatic (colour) induction is changed from chromatic contrast (aka colour induction) to assimilation at a certain level in terms of simple square wave patterns (Bodkin 2008). Colour induction occurs when two or more colours are perceived at the same time, the appearances will be influenced. In Figure 1(a) and Figure 1(b), the identical patches in the centre appear to have different colours under the influences of surroundings with different colours. Figure 1(c) shows the colour assimilation effect. The red tiny squares from the check board are identical, whilst they are perceived very different because of the colours of the immediately surrounding squares. They are variations of simultaneous contrast. The artwork in this paper therefore is based on the simultaneous contrast with its varied phenomena of chromatic induction and assimilation.

2.2 Selection of materials

The selection of the specific gomito pasta is based on the fact that each piece is small enough to be considered as a pixel when arranged systematically in a frame with limited size. According to the colour phenomena mentioned above, one same colour can produce different colour sensations under different surroundings; the initial intent for the choices of the colours therefore was inspired to achieve the same colour perception with particular spatial arrangements.

2.3 Simulation and implementation

In order to achieve the desired effect, a computational simulation was conducted before commencing the actual artwork. After numerous trials on the colours, it was considered

![Figure 1 Colour Induction and Assimilation](http://www.colourcube.com and Kaiser 2013)
that yellow hue could produce visible colour variations and pleasant colour perceptions when it was seen on different backgrounds as shown in Figure 2(a). In order to achieve aesthetic as well as to display maximum simultaneous contrast phenomenon, yellow was eventually considered as the principal hue for the main part of the artwork (Marilyn Monroe’s face and hair). It was observed that yellow and orange colours could produce almost the same colour perception if the available red and dark-yellow Canson paper were considered as their backgrounds respectively. Therefore, the combination of yellow pasta and red paper as well as orange pasta and dark-yellow paper is arranged for the face and hair in the top left and bottom left regions. Based on the same principle and available materials, the blue and purple hues are selected for the border of the artwork (the background of the portrait).

The painted pasta were arranged accordingly so that the central horizontal band of the pasta elements covering the 50% of the vertical height is mirrored along a vertical line of symmetry that passes through the centre of Marilyn’s nose. The remaining top and bottom bands have a line of symmetry running through the middle of the frame as seen in Figure 2(b). The combination of asymmetric and symmetric arrangements of the painted pasta on different backgrounds produces a 3D illusion and further colour sensations when the point of view is changed.

Figure 2 Stages of development of the artwork
“When Andy meets CIMET” © Ailin Chen, 2012
3. RESULTS AND DISCUSSION

Figure 2(a) displays the materials used before the commencement of the artwork. It is observable that the colour of yellow pasta appears brighter with purple background (bottom) than that of the pasta with red background (top), which illustrates the simultaneous contrast. The corresponding pasta elements and Canson paper from Figure 2(a) can be found in the 2\textsuperscript{nd} and 4\textsuperscript{th} quadrants of Figure 2(b) and Figure 2(c), which are two exemplary angles of the final work.

It is visible from Figure 2(c) that the same purple pasta appear darker on the background of dark yellow paper in the 3\textsuperscript{rd} quadrant than red paper in the 2\textsuperscript{nd} quadrant. The yellow colours in 2\textsuperscript{nd} and 4\textsuperscript{th} quadrants and the orange colours in 1\textsuperscript{st} and 3\textsuperscript{rd} quadrants perceived in Figure 2(b) are clearly distinct colours. Nevertheless they appear to be almost the same colour in Figure 2(c). The overall view of the final work in Figure 2(b) and Figure 2(c) exhibits the phenomena of simultaneous contrast, colour induction and assimilation according to the explanation described in Section 2.1.

4. CONCLUSIONS

The interaction of colour elements side by side exemplifies the phenomena of simultaneous contrast, colour induction and assimilation, and changes the colour perception. The results of the presented artwork exhibit that the colours we perceive can be altered when the background and viewing geometry change.

REFERENCES


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