



# **HISTORY OF TECHNOLOGY AND COLOUR IN FILMS**

## **INTRODUCTION**

Colour has formed a significant part of film history; it is key to achieving certain aesthetics and realism. However, colour is also used to enhance the narrative through psychological stimulants and cultural connotations. The importance of how colour is defined in film will be explored, before outlining how, historically, the available technology has influenced how colour is utilised and viewed within film.

## WHAT IS COLOUR?

The term 'colour' is used daily; however, it is yet to receive a definitive definition (Kuehni, 2013; Elliot and Maier, 2014). It, therefore, is necessary to specify what is meant when referring to 'colour', and distinguish between two definitions of colour:

1. **Physical:** the possible physical variations of visible light.
2. **Perceptual:** the perceptual response to visible light

If colour is defined as physical, the defining factor would be how many physical variations of light there can be in the world, and hence it could be argued there are infinite colours. If defined as perceptual, then colours are differentiated through their visual appearance, regardless of the physical variation in light; hence the number of colours is limited by our ability to distinguish between different light variations light (Hunt, 1978).

This essay will refer to colour as perceptual: perceived colour is the most relevant definition for the visual arts and communications. Humans understand the colours we look at through the experience of visual sensation, irrespective of the physical properties of colour: seeing is not just passive processes, but the eye and brain analyse the image cognitively, meaning colours are essentially generated within the head (Maxwell, 1871; Zeki and Marini, 1998). The rods (sensitive to brightness levels) and cones (with peak sensitivity to either red, green, or blue light) in human eyes, together allow the determination of a visual spectrum of colours (Andersson and Geyen, 2015). While film colourists can follow specific technical and theoretical rules, their colour decisions rely primarily on what they see and determine to be visually desirable.

Additionally, although black, grey and white are still in fact colours (they are just achromatic colours), 'colour films' usually refers to films containing chromatic colours of a specific hue.

## COLOUR PROPETIES AND TERMINOLOGY?

Colorimetry and colour properties are considered in many areas of film production, where by colour is understood in a three dimensional space of the Munsell system (Fig. 1):

1. **Value(lightness):** a scale from black to white or the relative brightness, of a colour percept i.e. how much an area appears to reflect diffusely or transmit a fraction of incident light.
2. **Hue:** the similarity of a visual stimulus' a "saturated" or "pure" spectral colour (red, orange, yellow, green, blue, indigo, violet) or extraspectral colour (magenta) formed when mixing opposite ends of the spectrum.
3. **Chroma:** the visual difference of a colour from a grey of equal value (sometimes intensity or saturation used to mean chroma).

(Hunt, 1978; Briggs, 2017)

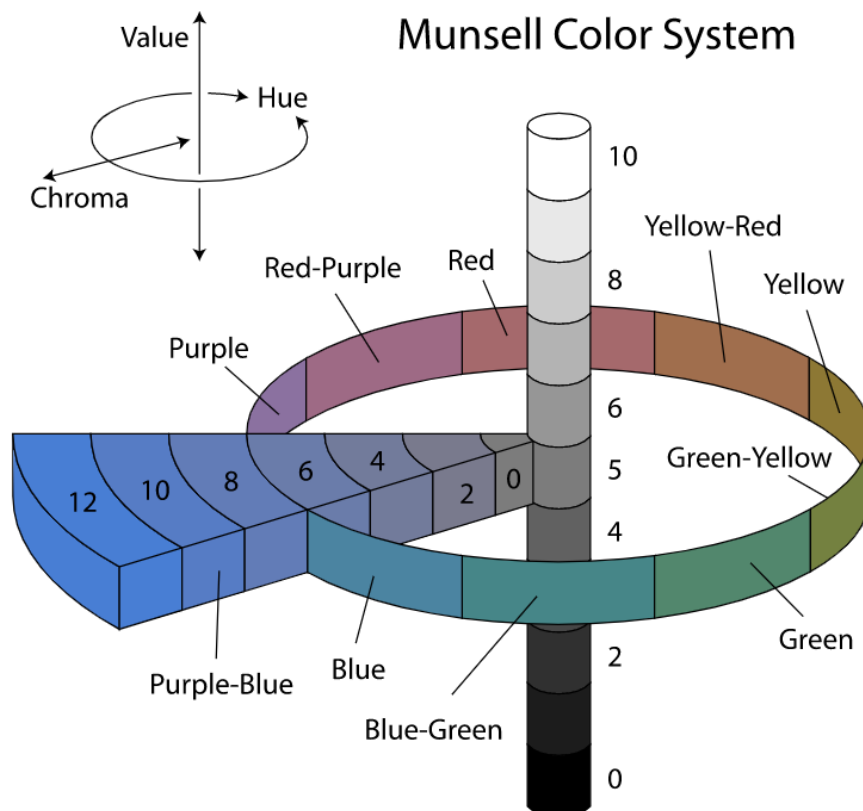


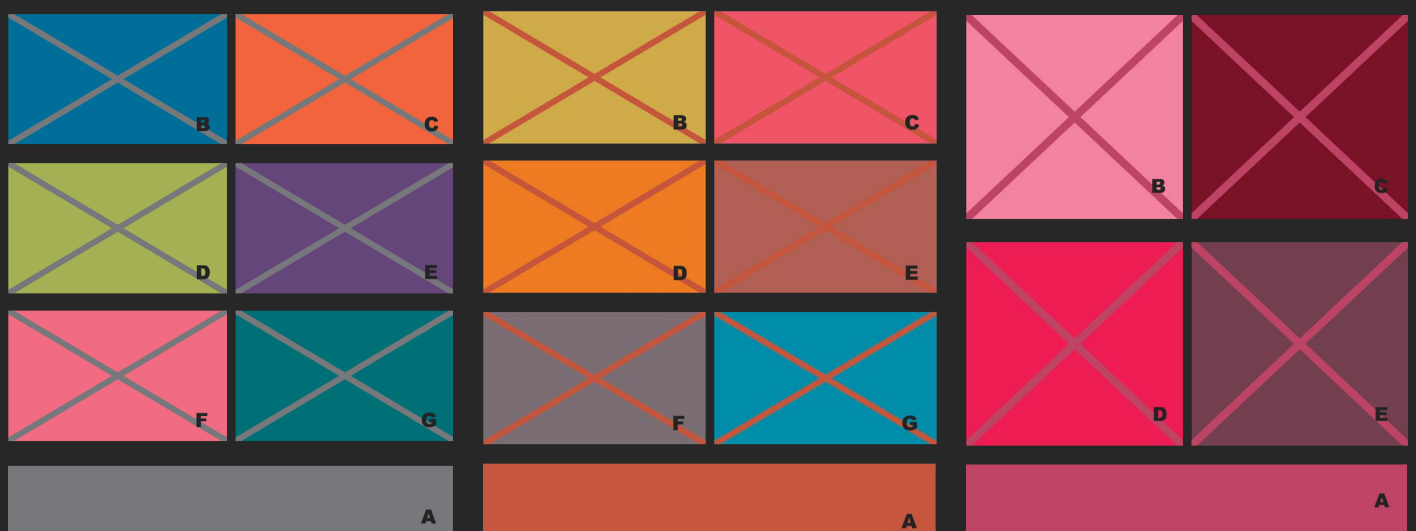
Figure.1 The Munsell colour system (Russ, 2007)

## WHY IS IT IMPORTANT TO UNDERSTAND COLOUR FOR FILM MAKING?

Understanding colour properties in the above terms is important for colour use in film.

Colour percept is relative to the surrounding colours; otherwise referred to as simultaneous contrast and assimilation; Hence surface colours may be influenced by different surrounding colours, and for surface colours to appear consistent on screen different physical RGB values may be required. In simultaneous contrast the appearance of surface colours contrasts against the surrounding colour in all three colour dimensions - hue, value and chroma (Briggs, 2017) (Fig. 2). For film colour grading and colour correction, the relative nature of colour is crucial: ultimately, the film's images will be perceived as a whole rather than as isolated colours. Furthermore, the relative perception is often manipulated to what the colourist desires the viewer to notice most in a shot. Films tend to have the background of the scenes lower contrast than the foreground because the visual power is highest where the contrast ratio is highest as human eye more easily recognises contrast variations (Andersson and Geyen, 2015).

*Figure 2. Simultaneous contrast of hue, chroma and value (adapted from Briaas, 2007)*



*(a) Hue For each background hue the appearance of identical grey crosses appear more similar to the hue of the background colour's additive complement.*

*(b) Hue and chroma: the identical red-purple crosses (A): appear more purple against red, and more red against purple(B,C); and progressively intense against bright red-purple, dull red-purple, grey, and green respectively (D,E,F,G).*

*(c) Value and chroma: identical red-purple crosses appear darker against a lighter colour(A) of similar hue and chroma to a darker colour(B); when combined with a contrast in chroma (C,D) the appearance of the colour intensifies*

## HISTORY OF COLOUR FILM TECHNOLOGY AND AESTHETICS

Whilst the technical evolution of colour film has been well studied and categorised (Askari, 2014; Higgins, 2007), the aesthetic and expressive use of colour increasing receives attention (Dalle Vacche and Price, 2006; Coates, 2019; Brown et al., 2013; Cowan, 2015). As the technology of colour film has evolved so has the purpose and application of colour and film style (Dalle Vacche and Price, 2006) 11. Initially colour was simply used to attain greater realism or novelty and lacked recognition as a dramatic story telling tool (Neale, 2006; Mitry, 1997). However, colour has been increasingly used as an artistic or cinematographic tool, expanding the creative possibilities of film beyond merely to satisfy people's desire to be amazed or observe an accurate depiction of reality. Use of colour in film increasingly follows various artistic principles similar to how cinematography and sound design follows particular principles. Currently the majority of films follow various cinematographic principles regarding colour, and meticulous design colour arrangements to produce an impression that enhances the meaning and narrative of the film (Cowan, 2015).

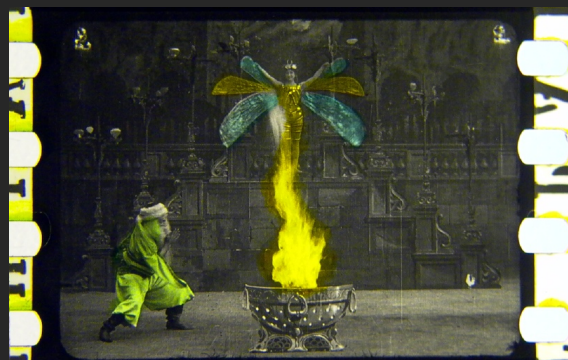
Initially the uses of colour in film were expensive and labour intensive; hence colour was often associated with spectacle and fantasy. Eventually the value of realism began to increase as colour was used in more news and current affairs programmes (Neale, 2006). However, using colour to simply to portray life and nature as it really is, was criticised by merely being limited to an accurate record of certain events (Kalmus, 2006). The use of colour is increasingly recognised as a significant creative and constructive element of a scene that can create mood, emotion, meaning, sensation, or perceptual cues, alongside lighting, sound, editing, performance, framing and camera movement (Price, 2006).

## HAND-COLOURING AND STENCILLING

Early coloured films, of the mid-1890s – early-1900s, strived to reflect reality, however the style of films, they were utilised in, such as dance and fantasy, formed the association to fantasy and spectacle, (Bottomore et al., 2016; Fowkes, 2010). Frame by frame hand colouring and appeared in many fantasy films as the elaborate colouring and spectacle suited the fantasy genre such as Georges Méliès fantasy production, *A Trip to the Moon* (1902) (Fig. 3) (Gunning et al., 2015). As hand colouring was very labour-intensive; stencilling, developed by Pathé Frères, provided a more sustainable technique for the industrial production of longer films (Fig. 4). The semi-mechanical process involved cutting stencils for a target area in each frame and then applying colour. Hence it was still an intensive process and only around six colours were commonly added. As stencilling technology was developed Pathé moved away from fantasy and trick genres, and moved towards more narrative driven pieces such as historical dramas (Yumibe, 2015).



*Figure 3 Hand coloured film: Frame from A Trip to the Moon (Le Voyage dans la lune) (1902) - restored colour version (Lobster Films, 2011 )*



*Figure 4 Pathécolor / stencil colouring film: frame from The Golden Beetle (1907) (Willeman)*

## TINTING AND TONING

The easier techniques of tinting and toning (Fig. 5) were, however, the most common from the early 1900s. Tinting involves dyeing the entire frame of the shot or sequence in different hues; although similar toning coloured only the dark areas of the print and was a more complex chemical treatment (Yumibe, 2015). These techniques produced more

unnatural imagery. Hence, realistic depictions in films became less of a focus, and the trend of expressing colour-mood associations in films proliferated, with many tints given names that express colour emotion associations (Fig. 6) (Read, 2008; Winokur and Holsinger, 2001). Jones (1929) describes the tint named 'inferno' as red with a magenta tinge that literally suggests fire or burning, with a subjective or abstract association too panic, anarchy, war, and unrestrained passion. Jones argues to that colour is linked with sensory experience and has important emotional associations.



Figure 5 Tinting and Toning of Eastman Positive Motion Picture Film. (Flueckiger)

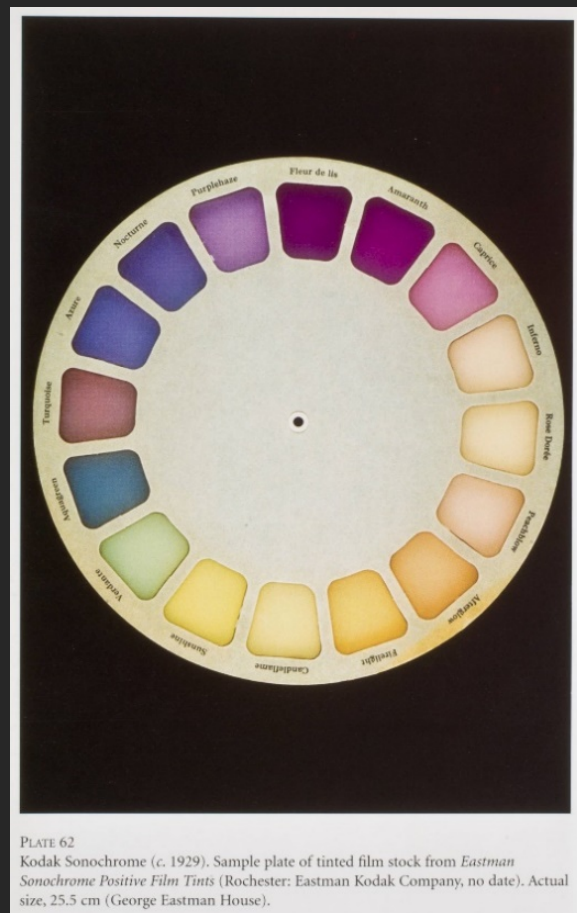


Figure 6 Kodak Eastman Sonochrome Positive Film tints and names (Cherchi Usai, 2000)

## TECHNICOLOR

Tinting and toning was still labour-intensive with the results often not producing the natural colour imagery that audience and the industry desired (Read, 2008). Herbert Kalmus invented Technicolor, a two-strip additive process (Fig. 7) that produces an approximation of the colour spectrum by mixing two colours on screen. This was

replaced in the 1930s by the three-strip subtractive process (Fig. 8) through which three-strips of film run simultaneously, allowing each to emphasise a different colour of the spectrum therefore giving a more realistic colour image (Winokur and Holsinger, 2001). However, rather than Technicolor technology being used to represent naturalistic colours, it was often used to illustrate a heightened world of colours similar to the novelty of hand-coloured. Cowan (2015) claims that this is demonstrated by films such as the fantasy world of the *Wizard of Oz* (1939), the cartoon world of Disney (Fig. 9), and the romantic world of *Gone With the Wind* (1939)

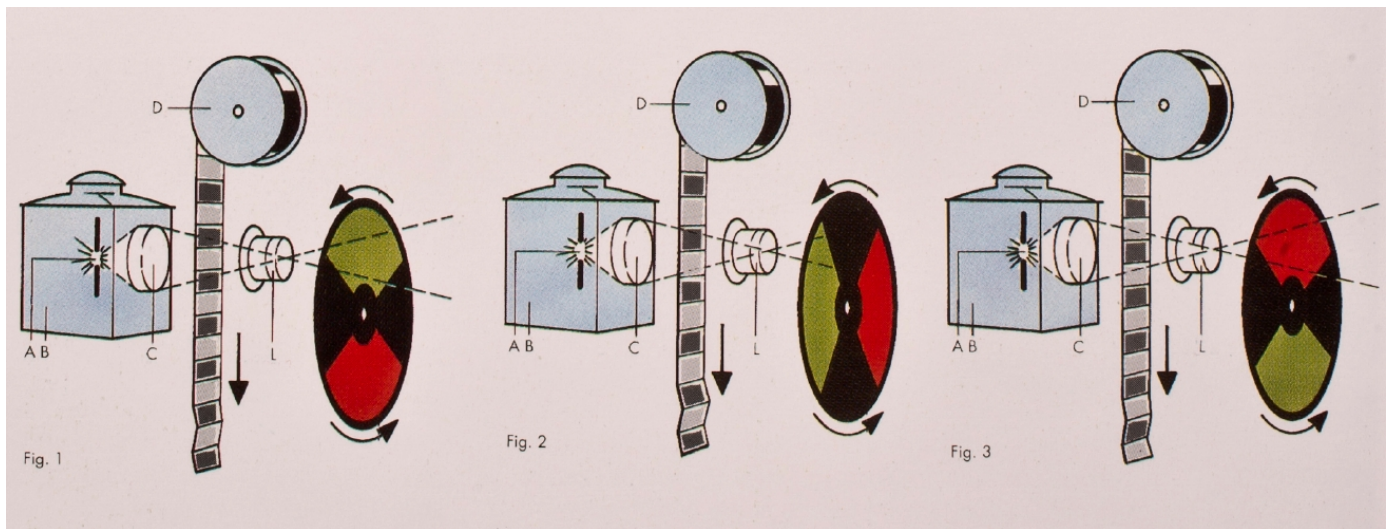


Figure 7 Schematic series of how the two-strip Kinemacolor additive filming process operated.(Coote, 1993)

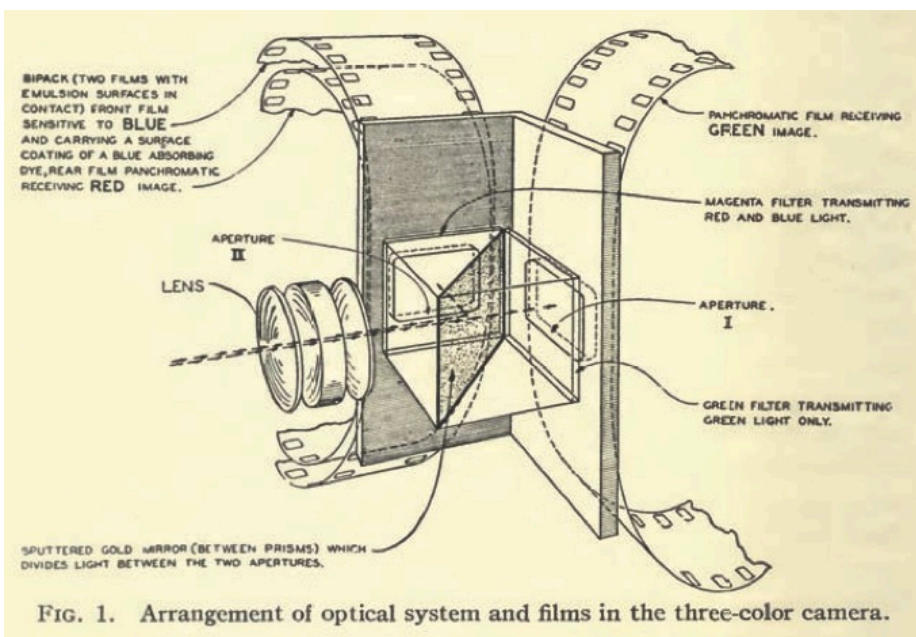


Figure 8 three-strip Technicolor camera system (Ball, 1935)

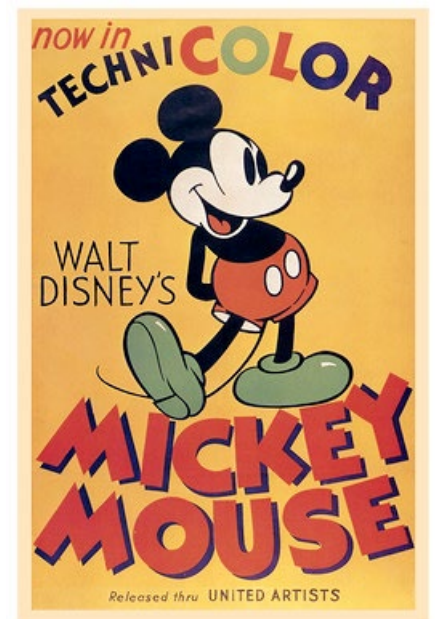


Figure 9. The Technicolor Mouse (1935) (Malon, 2013).



## FROM NOVELTY TO CINEMATIC TOOL

With the introduction of Technicolor, lighting requirements had to adapt from standard black-and-white lighting; increasingly the significant influence on colour appearance of lighting was recognised. The colours we see are a result of the interaction of light with object colours, their colour temperature, and spectral properties; coloured lights are also associated with the moods and characters psychological states (Flueckiger, 2017). A desire to take Technicolor beyond novelty led to adjusting the tone through low-key lighting effects such as chiaroscuro lighting of American Film Noir were utilised to accentuate drama and mood (Higgins, 1999).

In the 1940s there was a move from high-contrast lighting that emphasised tonal contrast, towards hue and chroma. However colour usage was more restrained and aimed to enhance the story; a move that Natalie Kalmus advocated for (Higgins, 1999). Similar to Jones (1929), Kalmus (2006) argued that filmmakers should carefully consider colour psychology and utilise colour to reflect certain dramatic moods and manipulate audience emotions. Kalmus refers to how colours can be organised into broad categories of 'warm' (red, yellow, and orange) and 'cool' (green, blue, and violet) colours. While warm colours connote excitement, activity, and heat, cool colours may suggest rest, ease, coolness. In addition colours could be grouped by, whether they were mixed with white, black, and grey colour which may suggest youth, strength, refinement, respectively.

Furthermore, Kalmus' justifications for specific connotations to single colours occasionally differ: whilst some associations are literal, for instance green with nature, other associations are cultural, for example, green with jealousy (Cowan, 2015). To separate the different types of association and meanings Kalmus (2006) employs, Cowan (2015) proposed three functions of colour within a projected image: realism, psychological and cultural.

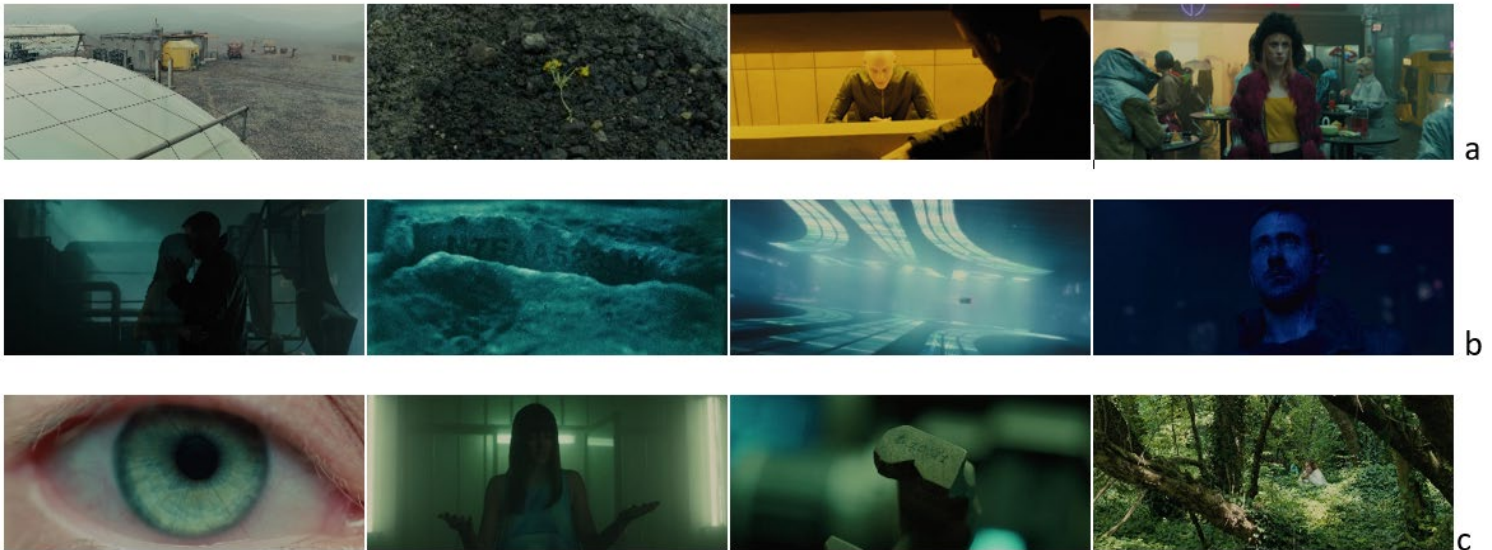
Cowan argues that compared to the psychological and emotional effects of colour, the cultural meanings of colour are more subjective as they require awareness of an

intellectual symbolism within different contexts. For example whilst black is connotative of mourning in many western cultures for Asian cultures white is symbolic of mourning. It is therefore argued that the uses of colour in film are 'subjective impressions' as colour has diverse cultural connotations (Russell, 1981, p.47).

However the specific contextually led use of colour within the text can also effect the meaning as well as the psychological and cultural led colour uses. Kracauer (1965) and Mitry (1997) both support this point, describing the need to maintain a balance between a colours contextual use and the psychological or cultural connotations; Kracauer, when referring to the use of white hoods for the Teutonic Knights, in the film *Alexander Nevsky* (1938), outlines how 'white usually suggestive of innocence here is made to signify scheming ruthlessness' (1965, p.68). Furthermore, cinematographer Vittorio Storaro, utilizes colour to try to represent the film's story and emotions (Storaro and Gentry, 1994). *The Last Emperor* (1987) colour was used to structure the narrative of the film for example green is specifically associated with knowledge and rebirth, such as when the Emperor's Tutor arrives at the Forbidden City (Storaro, 1998, cited in Cowan, 2015, p.145).

*Blade runner 2049* (2017) is a more recent example of a digitally coloured film using colour theory to convey a story and narrative themes. Going beyond the mere cultural and universal themes of colour outlined by Tham et al. (2020), colour represents themes that are specific to the films individual vocabulary. For example yellow, normally associated with brightness and happiness, is used throughout the film to indicate clues and enlightenment (fig.10c). Blue is used throughout the film to indicate the themes of artificialness and technology (fig.10b), whereas cultural associations may include sadness, freedom, peacefulness and trustworthiness. In the film green represents realness (fig.10c); for example when Joi, an artificial being, experiences the outside world for the first time she is surrounded by a green light and wears a blue top. The use of green therefore seems inspired by the universal themes of organic life, but through the

specific theme of realism green is used to contrast the artificial theme of blue which often appears in the same scenes as green (Baker, 2020).



*Figure 10 The Cinematography of Blade Runner 2049 4K (2017) (Richards, 2018): (a) Scenes where yellow used to represent a clue or enlightenment. (b) scenes where blue indicating the technological and artificial city. (c) scenes where green is used to represent the real in contrast to the artificial.*

## CONCLUSION

While initially the use of colour was viewed as a novelty and a spectacle, this gradually transitioned to primarily aiming for realism before the carefully considered use of colour as a dramatic and cinematographic tool emerged. At first this drew on the tonal routes of the non-chromatic films and then the hue and value gradually came back into play, leading to the more refined and carefully considered and narrative enhancing use of colour we see today, uses colour to both convey the narrative, manipulate audience emotions and produce a impactful aesthetic with contrast providing both depth and

balance. Finally, specific colour vocabulary has emerged within individual films which expands beyond the typical cultural or literal associations of colour.

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### Declaration of Academic Integrity

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#### Itemised List Of Components Handed In:

Figure.8 Ball, J.A. 1935. *Beam-splitter in the Technicolor camera*. [online]. Available from: <https://filmcolors.org/timeline-entry/1301/#/image/2834>

Figure.2 Briggs, D. 2007. *Simultaneous contrast and assimilation*. [online]. Available from: <http://www.huevaluechroma.com/035.php>

Figure.6 Cherchi Usai, P. 2000. *Kodak Eastman Sonochrome Positive Film tints and names*. [online]. Available from: <https://filmcolors.org/timeline-entry/1330/#/image/33923>

Figure.7 Coote, J.H. 1993. *A schematic series showing how the two-colour Kinemacolor additive motion picture process operated*. [online]. [Accessed 20 May 2021]. Available from: <https://filmcolors.org/galleries/kinemacolor-illustrations/#/image/3153>

Figure.5 Flueckiger, B. *Tinting and Toning of Eastman Positive Motion Picture Film*. [online]. Available from: <https://filmcolors.org/timeline-entry/1330/#/image/33923>

Figure.3 Lobster Films. 2011 *Frame from A Trip to the Moon (Le Voyage dans la lune) by Georges Méliès (1902) - restored color version*. [online]. Available from: [https://en.wikipedia.org/wiki/A\\_Trip\\_to\\_the\\_Moon#/media/File:Trip\\_to\\_the\\_Moon\\_Selenite\\_on\\_Shell.jpg](https://en.wikipedia.org/wiki/A_Trip_to_the_Moon#/media/File:Trip_to_the_Moon_Selenite_on_Shell.jpg)

Figure.9 Malon, P. 2013. *The Technicolor Mouse (1935)*. [online]. Available from: <http://www.flickr.com/>

Figure.10 Richards, E.E. 2018. *The Cinematography of Blade Runner 2049 4K (2017)*. [online]. Available from: <https://www.evanerichards.com/2018/4843>

Figure.1 Russ, J. 2007. *Munsell Color System*. Available from: <https://commons.wikimedia.org/wiki/File:Munsell-system.svg>

Figure.4 Willeman, G. *frame from The Golden Beetle (1907)*. [online]. Available from: <https://filmcolors.org/timeline-entry/1218/#/image/2550>