

Master's Programme in Film and Television

the intersection of technology and aesthetics in contemporary cinema:
an exploration of the impact of lighting advancements on the visual narrative

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abstract

The continuity of change in the film industry is evident, with cinematographers seeking new forms of lighting expression and production efficiency while manufacturers aim to sell. However, the rapid pace of technological development means that professionals often rely on personal preferences and recommendations from colleagues to create appropriate lighting setups that serve the needs of the story. Since content and form of expression are interlinked, technology enables new practices of emulating lighting for cinematographers. Although, there is a disconnect between the needs of cinematographers and manufacturers, which can result in the oversaturation of just one type of lighting that the industry focuses on, such as the soft light of LED lighting. It is important to remember that there are multiple ways of emulating lighting, even if newer practices have surpassed older ones. New technology should not necessarily replace old ways of working but should instead be an addition to the already plentiful ways of expressing through light.

One aspect of this research is examining the impact that technological advancements in camera equipment have had on the art of lighting. The historical origins of the symbiotic relationship between camera and lighting technology are traced back to the late 19th century with the invention of the first moving image camera, the Kinetographe. Moreover, this thesis highlights significant lighting inventions which remain ubiquitous on contemporary sets. These fixtures have been adapted and developed over the years, offering more possibilities for contemporary filmmaking than they did in early cinema.

It is essential to recognise that new technologies continually drastically influence how we perceive, and just as we make the technology, technology guides our decisions. By observing the details and paying attention to the connections between lighting technology and productions in contemporary cinema, we can create a working method that aligns with the vision of storytellers and avoids the negative impacts of technological advancements on film as an art form. This is not a study that can be completed and forgotten; rather, it requires continuous exploration throughout a cinematographer's life to facilitate contemporary and authentic expression through lighting in cinematography.

Keywords lighting, cinematography, lighting technology, LED, cinema, aesthetics

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preface & acknowledgements

Philosopher Marshall McLuhan's media theory suggests that any new technology or media created is an extension of ourselves. McLuhan often uses the terms "media" and "technology" interchangeably, emphasising that they are extensions of who we are. At the dawn of humanity, humans didn't have any extensions, but the moment someone invented a hammer and realised it was far more efficient at breaking rocks than smashing your head at it – life changed completely. These tools bring us new options, and who wouldn't want that? However, McLuhan also prompts us to consider that the tools we create also shape who we are. When a new technology or media is introduced, it makes some human practices outdated, and it is impossible to return to the previous state. Moreover, creators often fail to anticipate the full impact of new technology or media on society. Humans are historically poor at predicting the consequences of introducing something new, yet we continue to do so at an accelerated pace.

The point is that impact of technology on how we perceive the world cannot be overstated. McLuhan's goal wasn't to make value judgments on media and technology but to prompt the public to think. He suggests that we should be aware of what is changing because only then can we step outside of the norms we've inherited at birth. We should observe the details and make connections rather than cling to the ship and ride along (West, 2021a).

Completing this thesis was a monumental undertaking for me, and there were moments when I thought it would never be finished. However, thanks to the nudges and encouragements I received along the way, I was able to push through, even if it meant dedicating just fifteen minutes a day. I want to extend my deepest gratitude to my advisor, Jonathan Harvey, and my professor, Rauno Ronkainen, whose guidance and support proved invaluable throughout this journey. Their advice and suggestions always seemed to arrive just when I needed them most, giving me direction when I felt lost. While I wish I could have come to a more conclusive point in my research, I take comfort in the fact that this is an ongoing learning process.

It is my pleasure to acknowledge the contributions of the Finnish film industry professionals and the Finnish Society of Cinematographers (F.S.C) without whom this thesis would not have been possible. First and foremost, I am deeply grateful to the interviewees who generously gave their time to share their insights on lighting and technology, including Rauno Ronkainen, Matleena Kuusela, Meri Proud, Mika Orasmaa, Tuomo Hutri, Ville Penttilä, Karri Pöykiö, Jani Lehtinen, and Kaisa Mäkinen. Their perspectives formed the backbone of my thesis, providing a wealth of personal experiences that helped me better understand how technology impacts the

aesthetics of film. I would also like to thank the F.S.C for awarding me the student grant in 2023. This recognition and support came at a critical point in my writing and allowed me to fully focus on the thesis when I needed it most.

Finally, I must express my heartfelt thanks to my family and friends for their unwavering support and encouragement throughout this journey. While not everyone understood the intricacies of my research, they were always there to listen, offer a shoulder to lean on, and celebrate my victories with me. I cannot thank you all enough.

1 introduction

1.1 background & motivation

In my daily routine as a cinematographer, I am constantly reminded of the impact of lighting on places and objects. I often capture intriguing lighting phenomena and collect recordings to use as inspiration for future projects. This practice is not unique to me, as many cinematographers find that emulating real-life experiences adds a naturalness to the look of their films. Therefore, it could be argued that lighting is a time-consuming passion for cinematographers. My thesis centres on lighting, particularly the freedom and/or limitations of lighting technology and its development over the years.

This topic has been on my mind since the start of my master's education in the fall of 2019. At the time, I was uncertain about my lighting skills, which motivated me to learn more about the technology and characteristics of the equipment. I believed that writing a thesis on this topic would help me gain confidence in my ability to light a scene perfectly. While my motivation has shifted since then, the subject remains relevant, as there is always more to learn about lighting. However, it has become increasingly difficult to find reputable sources that discuss the impact of technological advancements in lighting equipment on contemporary film aesthetics and lighting practices. This gap in the literature is what I aim to address in this thesis.

One concern is that the history of cinema technology may be misrepresented if approached as a linear and homogeneous chronology. As such, it is important to acknowledge that the history of cinema is complex, and individual projects can lose their identity when forcefully connected to a particular movement. Instead, my thesis is informed by an approach that considers multiple perspectives and viewpoints rather than a singular factual truth.

Lagny defines the history of cinema in the following way: *"Should we say that the current development of research is leading us to the era of the history (histories) of cinema (cinemas)? Or, maybe, to a history which is thinking of itself in terms of 'perspectives', multiple viewpoints instead of 'factual truth', multi-temporality instead of linear and homogeneous chronology."* (Lagny, 1994, p. 36). This approach to the history of cinema, as defined by Lagny, allows for a more nuanced understanding of lighting practices and technology, which have developed at varying paces around the world.

While my thesis will primarily focus on American and European developments in lighting technology, it is important to note that this perspective is just one of many and should not be considered the only objective perspective. This thesis aims to contribute to a more comprehensive understanding of the impact of lighting technology on the history of cinema and to encourage further research in this area.

1.2 objective

The primary objective of this thesis is to explore the impact of technological advancements on the limitations and freedom of lighting practices in the field of cinematography. Although cinematography encompasses numerous facets, the focus of this thesis is confined to the exploration of lighting practices in isolation, to the limit of what is reasonable or attainable in the given circumstances. However, it is worth noting that certain factors, such as the sensitivity of sensors and film stock, play a significant role in lighting and thus cannot be disregarded. It is also significant to acknowledge that technological innovations have widened the scope of lighting practices, enabling filmmakers to break away from traditional academic conventions and embrace novel modes of expression with lighting.

One means of measuring the influence of lighting technology is to analyse the evolution of lighting set-ups over time. Since the advent of filmmaking, lighting techniques have undergone various transformations. This study aims to examine these trends and explore the influence of technology on the aesthetic of lighting, charting its evolution through the years. This investigation will review lighting practices, as mentioned, considering the impact of various elements, such as film stock, camera sensors, monitors, and lighting equipment and innovations, among others, on lighting practices up until the present day.

1.3 research question

Formulating a research question that accurately encompasses the focus of this study has proven to be a formidable challenge. While uncertainties persist regarding the precise words that best capture the intended scope of the thesis, the following question has been identified as the most suitable:

To what extent have advancements in cinema lighting equipment influenced the contemporary aesthetic of films?

In addition, a complementary sub-question has been proposed to explore the potential impact of camera technology on lighting practices in the context of a trend towards naturalism and realism:

What significant developments in cinema camera technology have facilitated a shift towards more naturalistic lighting practices in contemporary filmmaking?

1.4 structure

This thesis presents an interdisciplinary inquiry into the impact of lighting technology developments on contemporary film aesthetics. The study incorporates academic research, personal experience, and professional perspectives to analyse the research topic comprehensively. As a cinematographer, I provide my viewpoint and expertise on the matter, contextualised within the broader scholarly discourse. Additionally, the academic research serves as a foundation for a template of questions used to guide interviews with professional filmmakers. This template allows for consistency and structure in the data collection process while providing the flexibility to adapt questions during the interviews. The rationale for selecting this topic is explained, and the thesis demonstrates its significance within the field of film studies. The thesis is structured to thoroughly investigate the subject matter, with the conclusion summarising the key findings and insights gleaned from the research.

1.5 method

A hybrid methodology that combines academic research and qualitative interviews with industry professionals was employed to answer the research question. Given the complex and diverse nature of lighting techniques in filmmaking, a qualitative approach was deemed most appropriate. This allowed for open-ended discussions with interviewees about their experiences, as there is no one-size-fits-all solution to lighting challenges. The semi-structured interview format was used, with academic research guiding the development of the interview questions. Nevertheless, the questions were flexible and could be modified to elicit specific information as necessary. Quantitative analysis was not utilised, as it was unsuitable for the research question. Instead, this study's findings were synthesised from various sources, including academic literature, personal experience, and professional perspectives. The interviewed participants were individuals from the Finnish film industry, so they communicated most comfortably in Finnish. Consequently, the interviews have not been included in the appendix. Including them would not be appropriate since their language is different, and they would not serve any meaningful purpose in this thesis.

1.6 glossary

To enhance the readability and accessibility of this thesis, a glossary of select terminology has been provided to clarify and contextualise key concepts. Furthermore, certain terms utilised throughout this work have varied interpretations contingent upon contextual usage. To alleviate potential confusion, the definitions provided in this glossary are intended to serve as a standardised reference for readers when encountering these terms within the present thesis.

Apple box: Apple boxes are wooden boxes or crates of varying sizes with holes on each end used chiefly in film production. These boxes are specialised equipment belonging to the grip department and should not be confused with simple crates, other boxes, or boxes for apples.

ASA: The American Standards Association scale is a standardized rating system used to measure the sensitivity of photographic film or digital image sensors in cameras to light.

CCD: CCD stands for Charge-Coupled Device, which is an electronic device that converts light into electrical charges and then into digital signals, commonly used in digital cameras and other imaging devices.

Cinema: the business and art of making films.

CMOS: CMOS stands for Complementary Metal-Oxide-Semiconductor, which is a type of technology used to create integrated circuits and image sensors. It is commonly used in contemporary digital cameras and other electronic devices due to its low power consumption and high noise immunity.

CRI: The colour rendering index is a measurement of the ability a light source has to reveal colour of various objects faithfully in comparison with a natural or standard light source. The CRI is measured on a scale from 0-100.

Digital Intermediate (DI): The process of digitizing and manipulating film footage to create high-quality, digital versions that can be edited, colour-corrected, and enhanced using digital tools and software. It is often used in post-production to produce the final version of a film or video.

Fresnel: a type of light that uses a stepped lens to focus and control the beam of light, allowing for adjustments in the size and shape of the light output.

Gaffer: The gaffer is the chief lighting technician, one of the cinematographer's lieutenants. They plan lighting equipment, rigs and discuss lighting with the cinematographer to fulfil the director's vision. On set, the gaffer oversees implementing lighting schemes and organising and delegating the lighting crew.

Grip: The grip is a technician the cinematographer relies heavily on, just like a gaffer. The grip operates and maintains rigging and equipment that supports the camera, such as dollies, cranes, tracks, jibs, tripods, process trailers etc., to achieve the desired shot.

Irising: Open or close, in the manner of an iris (in this context aperture)

ISO: International Organization for Standardization scale is a standard for measuring the sensitivity of a camera's image sensor to light.

Kelvin: temperature measurement unit used to measure the colour temperature of light; a lower Kelvin temperature represents a warmer light, while a higher Kelvin temperature represents a cooler light.

LED: A light-emitting diode, a semiconductor diode which glows when a voltage is applied. These diodes are found in LED light fixtures.

Logarithmic curve: Logarithmic curve in film maintains the dynamic range of the captured image and creates a natural-looking image by mapping the input signal to an evenly distributed output signal.

Look Up Table (LUT): A mathematical table used to transform input values into corresponding output values. LUTs are used to adjust colour and tone in images or videos instantaneously, by mapping the original colours to new ones based on a specific desired "look" or style.

Negative: the developed film strip or sheet that contains an inverted version of the original image captured by the camera. The negative has a reversed tonal range, with light areas appearing dark and vice versa.

RGB: RGB (red, green, blue) refers to a system for representing colours used in lights, screens or other technology that utilises the RGB system. Levels of R, G and B can range from 0-100.

Parabolic Aluminized Reflector can (PAR): a type of stage lighting instrument that uses a sealed beam lamp and a parabolic reflector to produce a bright, directional beam of light, often used for highlighting specific areas or objects on a stage or in a performance.

Positive: A print or slide that has the same tonal range and colour values as the original image captured by the camera. Positives are created by exposing light-sensitive paper or film to light projected through a negative, resulting in an image that appears like the original subject. Positives are commonly used for projection, viewing, and display purposes.

Sound Blimp: A soundproof, camera housing device used in film and video production to reduce the noise generated by the camera's mechanical movements and other sound sources during filming.

Shutter: A mechanism that controls the duration of time that light is allowed to enter the camera and reach the image sensor or film.

The classification of the grip and lighting department varies significantly between Europe and America. This thesis adopts the European standard of the grip or its department, like the role of a dolly grip in America. The most significant disparity between the two styles lies in flagging and rigging. While the European departments collaborate on speciality rigging or setups, they are generally divided into two distinct departments to accomplish the following tasks:

Grips: The grip department is responsible for ensuring the safe rigging and construction of all camera setups, including but not limited to car rigs, cranes, dollies, and bird's-eye-view rigs.

Lighting: The lighting department, on the other hand, is responsible for anything that affects the characteristics or quality of light within a set, such as flags, lighting units, and rigging lighting equipment. The lighting department independently rigs their own lights and does not depend on the grip department for assistance.

2 technology

2.1 significant developments in camera technology

Although the central focus of this thesis concerns lighting, it would be remiss to disregard the impact that technological advancements in camera equipment have had on the field of lighting. The camera serves as the medium through which lighting is captured, processed, and projected onto screens. As such, it plays an integral role in developing and applying lighting techniques for film. The present chapter thus seeks to explore the historical origins of this symbiotic relationship between camera and lighting technology, tracing its roots to the invention of the first moving image camera, the Kinetographe, by Thomas Edison and William Dickinson in the late 19th century. Despite its limited technical capacity by contemporary standards, this early camera was a ground-breaking achievement, laying the groundwork for the technological innovations that would follow and revolutionising the field of visual storytelling.

"This was a hand-cranked camera that recorded sixteen distinct photographic frames per second using toothed gears to advance the film down and hold it in front of the gate while simultaneously moving and replacing a shutter to create exposure. Accompanying this was the kinetoscope, which was a single person viewing box that played the shot moving pictures." (Rosenblatt, 2010, p. 12)



In contemporary times, the kinetographe and kinetoscope's functionality and design would be considered sluggish and impractical. Nevertheless, the advent of moving image capture marked a seminal juncture to initiate the development of film technology. Over a century has elapsed since the inception of the motion picture camera and the motion picture projector. The role of the cameraman in the filmmaking process was both technical and creative, providing personal camera equipment and overall technical guidance throughout the recording process. The cameraman's duties included setting up the camera, loading and unloading the film, setting the exposure functions, framing the action, cranking film through the camera at a given rate, setting fades and dissolves

and iris-ing. During the early stages of story films, the cameraman also served as the editor, splicing scenes together and printing the result for projection. The role of the cameraman entailed a multifaceted skill set that would be distinct and specialised in modern-day filmmaking practices.

In 1899, storytelling techniques for film had been developed, with presentations lasting one reel at 16 fps. By 1904, the static camera was no longer used exclusively, with intentional placement at varying distances and eventually mounted on a mobile platform for panning and tilting shots. The first cameraman was responsible for lighting adjustments, assisted by a chief electrician known as a "gaffer." With the introduction of sound in 1926, the first cameraman was separated from operating the camera and became the director of photography. The director of photography's focus was on lighting, monitoring both the lighting and action while the camera operator framed the action and ensured that the microphone and boom shadows were controlled. The heavier, bulkier precision production sound cameras required assistance to move, set up, and operate, which birthed the titles first assistant camera and second assistant camera. The camera operator determined whether the take was pictorially acceptable until dailies were reviewed the following day (Hines, 1993, pg. 6).

The advent of sound in cinema marked a significant milestone in the evolution of cinema technology, prompting a range of new developments in camera equipment to address the loud noise produced by cameras in the early days of cinema. This topic is discussed briefly in the seminal work *Masters of Light: Conversations with Contemporary Cinematographers* (2012):

"The camera, by this time, had become quite bulky and it was made even more unwieldy by the additional equipment necessary to deaden the camera noise. In fact, in the thirties, many cameramen, working within the restraints of sound-recording needs, were resented by directors and producers forced to bow to the technical requirements of the camera set-up rather than the dramatic elements of the particular scene" (Schaefer, 2012, p.19).

During the studio era of filmmaking, most films were produced within the confines of a studio, where the studio often dictated the aesthetics of cinema. The studio's function in the early studio era of filmmaking was akin to that of the cameraman after the inception of the film medium. Typically, an in-house cinematographer was delegated to shoot a director's film in the established style of the studio's films. However, with the advent of television, independent filmmaking, and commercials in the 1950s and 60s, there emerged a shift from sound stages to actual locations, placing greater demands on smaller, more flexible, and more powerful equipment for shooting in compact spaces (Schaefer, 2012, p. 21).

The studio era eventually ended with the help of a shift toward digital filmmaking. The emergence of digital technology in the film industry has provided opportunities for many novice filmmakers to realise their creative visions. It is worth noting that the standards to which digital video aspires are rooted in those of traditional film. As Katz remarks:

“Since the earliest days of experimental television in the 1920s, the theatrical 35mm motion picture has served as the paradigm of “perfect” image reproduction – the ultimate technical goal towards which video technology should advance” (Katz, 1989, p. 3).

Similarly, Salvato and Schaefer write:

“To boil it down to its essence: 35 mm is the gold standard of filmmaking; nothing else looks quite like it (Schaefer, 2012, p.16)

With the ideal of technology serving the art rather than the art being controlled by the technology in mind, the initial years of digital film technology failed to meet the standards of motion pictures. They had minimal impact on blockbuster productions still shot on film stock. However, this began to shift in the early 2000s, as Hollywood productions increasingly employed digital cameras, with digitally shot films surpassing celluloid-shot films in the top 100 grossing films released in 2013 (Follows, 2017). It took time for digital cameras to perfect the aesthetics expected of cinema-quality cameras. Still, by present-day 2023, they have become more widely used due to lower production costs, and the sensors have surpassed expected aesthetics. Today, the market offers a wide range of digital cinema cameras from manufacturers such as Arri, Sony, Canon, and Red, providing cinematographers with a plethora of options in terms of aesthetics and quality.



2.1.1 film stocks

the early days of film stock

Kodak has been a trailblazer in film stock innovation since the inception of filmmaking, and it has dominated the market for several years. Although still photography existed before motion picture stock, the latter required faster stock to capture moving objects.

Moving image film stock captures a sequence of still images on a strip of celluloid film through light-sensitive emulsion layers coated onto a transparent base. The film is exposed to light through a camera lens, causing a chemical reaction in the emulsion layers as a shutter opens and closes rapidly to capture each frame. The frame rate is determined by the speed at which the film is advanced through the camera and the frequency of the shutter opening and closing. After exposure, the film undergoes development in a lab, converting the latent image into a visible image through chemical processing. The film is then spooled for projection or editing, with individual frames projected onto a screen at a standard rate of 24 frames per second. Sound is recorded separately and synchronised with the film during editing and played back through a separate sound system during projection. This innovation marked the beginning of the evolution of film stock.

the invention of negative film & evolution of colour film stock

The invention of negative film revolutionised the film industry and laid the foundation for the development of colour film. Moving image film stock had its origins in photography, where William Henry Fox Talbot is credited with creating the first photographic negative, a crucial innovation in the development of modern photography. Using a process, he called "photogenic drawing," Talbot coated a sheet of paper with a silver nitrate and potassium iodide mixture, which would darken when exposed to light. He then placed objects on top of the paper and exposed them to light, producing a silhouette image. But Talbot's real breakthrough came when he discovered that using this negative image could produce multiple positive prints. By placing the negative on top of a fresh sheet of paper and exposing it to light, he could create a positive image that was an exact replica of the original. This process is the basis of how negative film works: the film is coated with a light-sensitive emulsion that darkens when exposed to light, creating a negative image that can be used to produce multiple positive prints (Thorpe, 2023).

From the invention of negative film to the development of colour film, the film industry has come a long way in creating realistic and vibrant images on the screen. With technological advancements, faster-speed film stocks like the Eastman Colour

Negative film were introduced in the 1950s, followed by various types of colour negative and positive films, such as the Kodachrome and Ektachrome films. The introduction of these new film stocks also gave rise to new considerations for lighting.

With the advent of colour stock, lighting became more complex, and cinematographers' focus shifted from producing enough light to exposing film to creating the correct coloured light for complementary film stock. The introduction of colour stock, therefore, expanded the storytelling tools for cinematographers, enabling them to convey a narrative through a broader range of colours. As filmmaking progressed, cinematographers evolved from simply creating technically correct images to using nuanced visuals and lighting to tell stories, highlighting the importance of the development of film stock and its impact on the art of cinematography.

The introduction of faster film stocks revolutionized the field of cinematography. In its early stages, film stock had low sensitivity to light, ranging from 16 ASA to 100 ASA, necessitating a significant amount of light to achieve correct exposure. However, with the advent of faster stocks, lighting became more flexible. Faster stocks shifted the focus from producing enough light to expose an image to using light as a tool to tell a story, essentially "painting with light." Presently, Kodak is widely considered to have the most extensive range of film stocks available on the market, ranging from 50D to 500T for 35mm and 16mm film. Nonetheless, despite some of its film cameras still being in use, Kodak's primary focus remains on the production of film stock, which has been the cornerstone of its success.

The advancements in film stock and its production have not only impacted the way cinematographers work but have also influenced the transition from traditional film workflows to digital ones. In the past, it was customary to create a print for the purpose of projection from a negative when transitioning from a traditional film workflow to a digital one. However, in contemporary times, this practice has been largely replaced by scanning the negative digitally. This enables postproduction work to be carried out digitally and the final product to be projected using a digital projector, even if the film itself has been shot on traditional film stock. Overall, the evolution of film stock and its processes has provoked filmmakers to continually adapt and innovate to achieve their desired visual aesthetic with colours and lighting.

2.1.2 sensors

Digital recording of movies first began to appear in the 1970s, but it didn't become a viable option for commercial work until the mid-1980s. The industry adopted the use of digital workflow after it had proven its ability to outperform film photography. Though, digital systems before the 2010s were often considered inadequate for cinematography due to low resolution, limited latitude, and insufficient colour depth. Initial digital systems provided freedom for independent filmmakers, but studios had conservative requirements for image quality and were hesitant to adopt new technologies.

In 1990s Sony and Panavision, engaged in a collaboration to discover how digital technology could be used in a film-style way. The first camera to be manufactured through this collaboration was the Sony HDW-F900. This camera recorded onto a brand-new type of tape-deck called the HDCAM. The camera also initiated the beginning of digital sensors by utilizing a charge-coupled device (CDD) sensor for the first time.

Many filmmakers were sceptical about digital sensors ever being able to truly supplant film especially since during this time, the digital cameras and workflow was not significantly cheaper than film productions. Partially, the reason for the scepticism comes from the CCD sensors themselves since the look vastly differs from the look of 35mm film. Cinematographer Wally Pfister commented on this with the following:

"The range of colors that you can record with the best digital cameras is also a joke when put head-to-head with 35mm negative . . . Why anybody would replace a proven image capture system with vastly inferior technology is beyond my comprehension" (Fisher, 2009 as cited in Mateer, 2014, p. 6).

the development of sensors

Film stock and digital sensors process light differently. Film stock records light chemically, while sensors convert it to digital signals using binary code. Among contemporary digital sensors, complementary metal-oxide-semiconductor (CMOS) sensors are the most prevalent type of image sensor in contemporary digital cameras and are also highly popular for professional filmmaking. CCD sensors, the first digital camera sensors, have been replaced by CMOS sensors due to their higher power consumption and slower speed. However, CCD sensors remain in use in some high-end cameras for their excellent image quality in low light.

CCD sensors work by breaking down an image into small sections, or pixels, and recording the amount of light in each pixel as an electrical charge. The charges are then read out and converted into a digital signal, which can be stored or processed. In camcorders, filters control exposure and colour behind two disks that can be accessed by removing the lens. A beam splitter divides the image into its red, green, and blue components and directs them to the appropriate sensor through a prism system. However, the use of glass in the splitter block can cause dispersion of light energy, leading to flare, decreased contrast, and gamma in the captured image.

A CMOS sensor uses photodiodes to convert light into electrical charges, with each photodiode corresponding to a pixel in the final image. These charges are then converted to digital signals for processing. CMOS sensors use transistors integrated into the sensor and consume less power, generate less heat, and noise, and have faster readout speed than CCD sensors, allowing for higher frame rates and faster data transfer rates. They are also more cost-effective to manufacture and are now more commonly used in the film industry than CCD sensors.

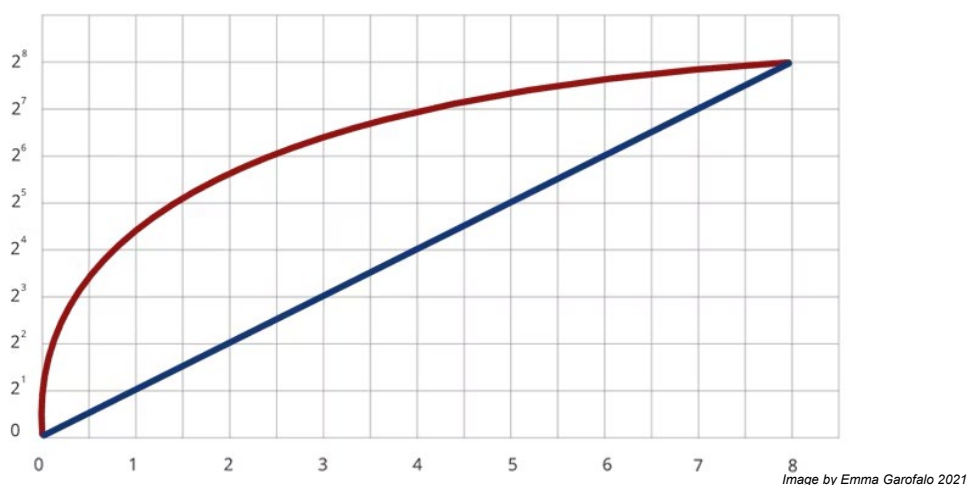
In recent years, the advancement in digital camera technology has brought about the widespread use of full-frame sensors, which are now extensively used in professional filmmaking and many high-end DSLR cameras. A full-frame sensor is a type of digital camera image sensor that is similar in size to a 35mm film negative. It is called "full frame" because it captures the entire image area that a 35mm film camera would capture without any cropping or resizing. Like other digital camera sensors, a full-frame sensor is composed of millions of tiny pixels that convert light into electrical signals. One key advantage of a full-frame sensor is that it allows for a wider angle of view than smaller sensors, as it can capture more of the scene in front of the camera. Full-frame sensors also tend to have better low-light performance, as the larger sensor area allows more light to reach each pixel, resulting in less noise in the final image. However, full-frame sensors can be more expensive to produce and can result in larger and heavier cameras than those with smaller sensors. They also require lenses that are specifically designed for full-frame cameras, which can also be more expensive.

In summary, full-frame sensors are a specific size of sensor, while CMOS and CCD are two different technologies used to produce image sensors. Each has its own advantages and disadvantages, and the choice of sensor technology depends on the specific needs and requirements of the application, though generally speaking within the film industry CMOS sensors are preferred.

logarithmic curve

The most common and used system under which high-end, industry-standard digital sensors decide how colour and light are captured is called logarithmic. In a digital camera log (short for logarithmic) curve is a way of recording an image in a logarithmic format rather than a linear one. A logarithmic curve compresses the brightness range of an image, allowing it to capture more details in both the shadow and highlight areas of the scene. This means that more information is stored in the darkest and brightest areas of the image, allowing for greater flexibility in post-production colour grading.

Figure 1.3



This cartesian graph displays the red logarithmic curve and the blue linear curve side by side, illustrating the differences in how each curve assigns values to the 256 levels of exposure provided by 8-bit encoding.
From "What is a Log Gamma Curve in Cinematography?" by Garofalo, E. 13 October 2021. Make Use Of. Retrieved 8 May 2023 from: <https://www.makeuseof.com/what-is-log-gamma-curve-cinematography/>.

When it comes to lighting in cinematography, shooting in a log curve can have significant benefits for cinematographers in terms of capturing a wider dynamic range and giving them more control over the final image during post-production. Log curve captures a wider range of colour and brightness information, allowing for more natural-looking colours and contrast in the final image. However, this approach requires a different approach to lighting on set compared to shooting in a traditional linear format. The log curve is designed to capture as much information as possible, which can be less forgiving when it comes to overexposed or underexposed areas of the image. As a result, cinematographers need to be more careful with their lighting setups, ensuring that the light levels are balanced across the scene and that the brightest areas are not blown out or clipped. This requires more attention to detail and more nuanced lighting setups than shooting in a linear format, where the camera records the image data in a one-to-one correspondence between the amount of light hitting the sensor and the resulting digital value.

Furthermore, because the log curve compresses the brightness range of the image, the resulting image may appear flat and desaturated when viewed on set. This can

make it difficult to judge the final look of the scene while shooting, as the image may not look as vibrant as it will appear in post-production. As a result, cinematographers frequently use on-set monitors with specialised lookup tables (LUTs) to assist them in visualising the final image while exposing the logarithmic image, with the help of exposure tools like waveforms, false colour, and histograms. In summary, shooting in the log curve allows for greater flexibility and control over the final image during post-production, but it requires a different approach to lighting on set and may require specialised equipment and monitoring to achieve the desired results.

Selecting the appropriate camera brand is crucial for obtaining the intended outcome, particularly when capturing footage logarithmically. Since the advent of the Sony HDW-F900, numerous cameras with digital sensors have been developed. Variants of every model have been created, with even the slightest changes made by technicians. In contemporary filmmaking, Arri, Red, Sony, Blackmagic, and Canon are some of the most popular digital camera brands, each offering unique benefits. Choosing the right camera for a specific project is critical despite the similarities in digital sensor principles. While each brand may differ in how it renders colour, Arri is often considered the best by many in the field, as its cameras are believed to produce colours that are closest to those rendered by 35mm film stock. This is evidenced by examining the cameras used in Academy Award-nominated films from recent years, which shows that Arri has consistently been the most frequently used camera among the nominees (Harvey, 2023). Nonetheless, digital grading allows for the achievement of various looks in post-production.



The development of sensors has significantly increased camera sensitivity to light, which has clear implications for how light is perceived by the camera. Contemporary sensors can often perceive light better than the human eye, and this development

has impacted lighting practices and how cinematographers and gaffers approach lighting. Newer cameras like Sony Venice 2 and Arri Alexa 35 have been made to be extremely sensitive to light, with the Sony Venice 2 having a dual base ISO of either 800 or 3200 providing plenty of range in the highlights and the lowlights of the image in even dim conditions. In addition, how the colour is rendered by the sensor also affects the decisions on lighting. Cinematographers and gaffers need to consider not only the level of light required for the shot but also its quality and colour temperature to ensure that the camera captures the intended look.

Rauno Ronkainen (2023), a cinematographer who will be introduced in the aesthetic chapter of this thesis, has described the need to train his eyes to adapt to new formats. As he explains, understanding the nuances of each format has always been a learning process, and while there are mathematical ways to calculate how a sensor perceives light, practical experience is crucial. With film stock, the battle was always about capturing enough light to produce a quality negative. However, when digital sensors such as the first Arri Alexa camera with a base of 800 ASA were introduced, Ronkainen noticed that certain tones in the sky that he thought would not be picked up well were distinctly visible in practice when he used the camera. This spurred him to adjust his perspective and learn to view light and colour as the digital camera does, compared to, at the time, the more familiar 500 ASA film stock. Ronkainen even recalls, more recently, being in a bar after using the latest Arri Alexa 35 on a film shoot and being surprised at how much light was suddenly present when a mere few candles were lit in the dimly lit space. His eyes had adjusted to the new format, and he reiterates that this sensitivity to the way sensors perceive light is something that must be seen and experienced to fully understand.

This adjustment in working with digital sensors does not negate the importance of contrast in achieving the desired aesthetic for a film, but it does affect how contrast is perceived and must be considered when lighting a scene. As will be discussed later in this thesis, the highly sensitive new formats have prompted gaffers and cinematographers to adapt their techniques to achieve their desired visual aesthetic. Ronkainen's experience highlights the importance of understanding the nuances of each format and how the introduction of new camera technologies can challenge and expand our perceptions of light, lighting practices and colour in visual storytelling.

2.1 significant developments in lighting technology

The evolution of lighting in cinema has undergone significant advancements since its inception. Given the vast scope of cinema technology history, this thesis focuses primarily on the initial technology of early cinema, notable inventions, and the recent progression of technology. Jake Rosenblatt's thesis, *The Path of Light* (2010), provides a comprehensive account of cinema technology evolution from early cinema until the early 2000s and serves as a valuable resource for readers interested in an in-depth recollection of cinema technology.

To understand the evolution of lighting in cinema, it is important to consider the early days of cinema when all filming was conducted outdoors due to the inadequacy of artificial light for slow filmstock. However, the advent of the first studio with a retractable roof made of glass enabled indoor shooting with exterior light sources. The initial film lights introduced were mercury vapour lights, which were subsequently replaced by sodium vapour lights, and then by arc lights.

The silent era of cinema marked the shift from experimenting with the ability to shoot film to utilising this capability (Rosenblatt, 2010, p. 23). While significant advancements in lighting technology occurred later, there were numerous inventions that are now obsolete due to being outdated or too hazardous for contemporary film production. As such, this thesis focuses only on notable inventions that are commonly used on modern film sets.

However, some lighting sources invented during the early days of cinema remain ubiquitous on modern sets such as Tungsten sources. Tungsten-filament bulbs have a colour temperature of 3200K (kelvin), making them ideal for tungsten-balanced film stock that reproduces colours accurately when the subject is lit with tungsten light. However, early tungsten lamps were relatively simple, and various attachments, lenses, and other attributes have since been added to make them more versatile and efficient for modern productions. These include fresnels, soft lights, open face, parabolic aluminized reflectors (PARs), ellipsoidal spotlights (Lekos), beam projectors, area lights, cyclorama lights, and small specialty lights. Each fixture serves a specific purpose in designing a desired look, primarily determined by its beam characteristics, such as brightness, focusability, evenness, punch, softness, size, shape, and colour.

In the history of lighting technology for film and television production, the Fresnel lens stands out as a notable invention created in 1934. This flat lens, composed of several concentric rings, provides a flexible light source that can be adjusted to produce a relatively uniform, even field of light with adjustable intensity and size. With the ability to spot and flood, the Fresnel lens is a versatile lighting fixture that has remained a popular unit in contemporary film sets. One of the key advantages of

the Fresnel lens is its ability to make clean, hard shadows and light actors' faces directly or through diffusion. This flexibility has made it the most common fixture in film and television production, with a range of wattage options from smaller 100W fixtures to 20k fixtures. In the industry, lighting fixtures are often referred to by their wattage, with the 'k' standing for kilowatt. For instance, a 1k fixture represents a 1kW or 1000W fixture.

figure 2.1

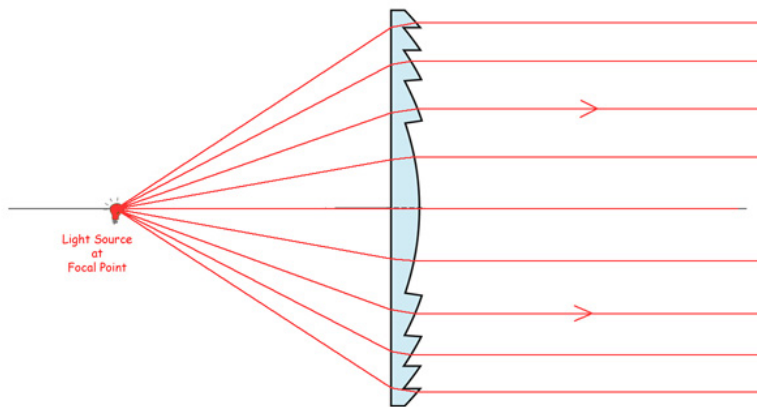


Image by Jim R.

The diagram illustrates how a Fresnel lens can focus a single point of light, resulting in a more intense and concentrated beam of light.

Adapted from "Fresnel Lenses | How They Work" by Jim R. 19 April 2015. *How I See It*. Retrieved 8 May 2023, from <https://jarphys.wordpress.com/2015/04/19/fresnel-lenses-how-they-work/>.

figure 2.2

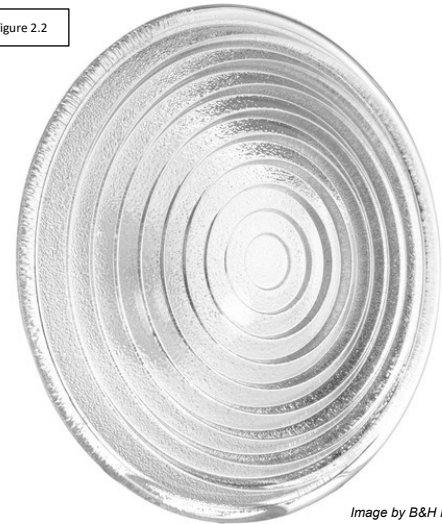


Image by B&H Photo.

An image of the replacement fresnel lens designed for the Arri 650 Plus Fresnel.

From "ARRI Replacement Lens for Arri 650 Plus Fresnel" by B&H. N.d. B&H. Retrieved 8 May 2023, from https://www.bhphotovideo.com/c/product/153597-REG/Arri_L4_79404_E_Replacement_Lens_for_Arri.html.

Another significant invention in the evolution of lighting technology for film and television production is the HMI bulb, developed in the 1970s. This bulb can emit a lot of power at 5500K (kelvin), from a smaller and lighter lamp, which makes it ideal for shooting on location. However, HMIs are known for flicker, which can be resolved by using a frequency-regulated generator or adjusted ballasts. Along with tungsten and Fresnel fixtures, HMIs continue to be widely used in contemporary filmmaking. Over time, manufacturers have developed Fresnel fixtures not only for tungsten bulbs but also for HMI bulbs.

While there have been many other inventions in the history of lighting technology for film and television production, some fixtures have become outdated, while others remain fundamental. Tungsten, Fresnel, and HMI fixtures are among the latter, and as a contemporary cinematographer, I have personally encountered these fixtures frequently on set and during my education at various universities and work experience in film productions. These fixtures have been further adapted and developed over the years, offering more possibilities for contemporary filmmaking than they did in early cinema. With the rapid pace of technological development in the industry, professionals often rely on their personal preferences and recommendations from colleagues to create appropriate lighting setups that serve the needs of the story.

In addition to tungsten, Fresnel, and HMI fixtures, other lighting technologies have undergone significant evolution over the years. Historically, cinematographers viewed fluorescents as problematic due to their poor colour rendering, low light output, flickering and other issues. However, in the 1980s, gaffers began to develop their own fluorescent systems using better ballasts, lamp harnesses, and colour-correction gels. Kino Flo, a company founded by Freider Hochheim and Gary Swink, created fixtures, ballasts, and lamps specifically designed for film production, leading to ground-breaking advances in fluorescent technology and becoming known for their fluorescent kinoflo tubes. Today, fluorescent lighting has become an efficient and versatile option for filmmakers, offering soft, controllable light that is ideal for creating eye-catching effects and lighting sets. Additionally, fluorescent lighting is energy efficient, generates less heat, and provides a cooler work environment, making it a popular choice for filmmakers (Box, 2013, ch 9). Although LED technology has become more popular, fluorescent tubes remain a valuable alternative tool for many lighting scenarios in contemporary filmmaking.

figure 2.3

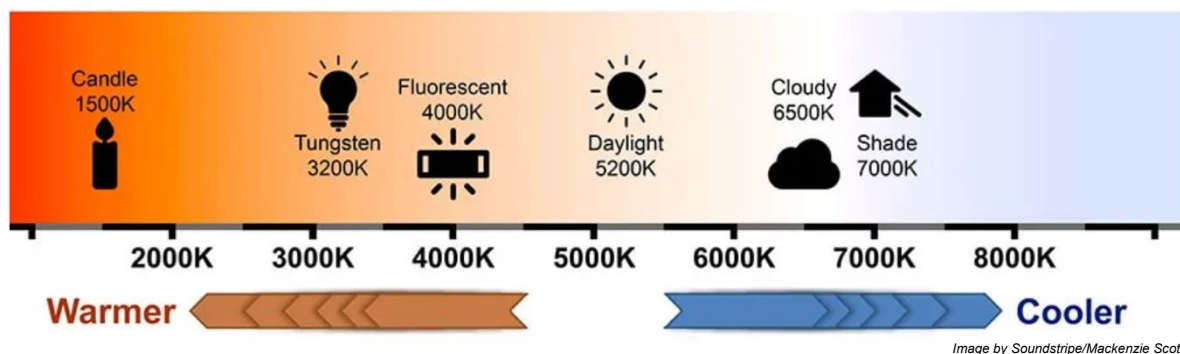


Image by Soundstripe/Mackenzie Scott

Kelvin colour temperature scale.

Adapted from 'What Every Videographer Should Know About the Colour Temperature Chart' by Mackenzie Scott. 25 January 2021. Soundstripe. Retrieved 8 May 2023, from <https://www.soundstripe.com/blogs/what-every-videographer-should-know-about-the-color-temperature-chart>.

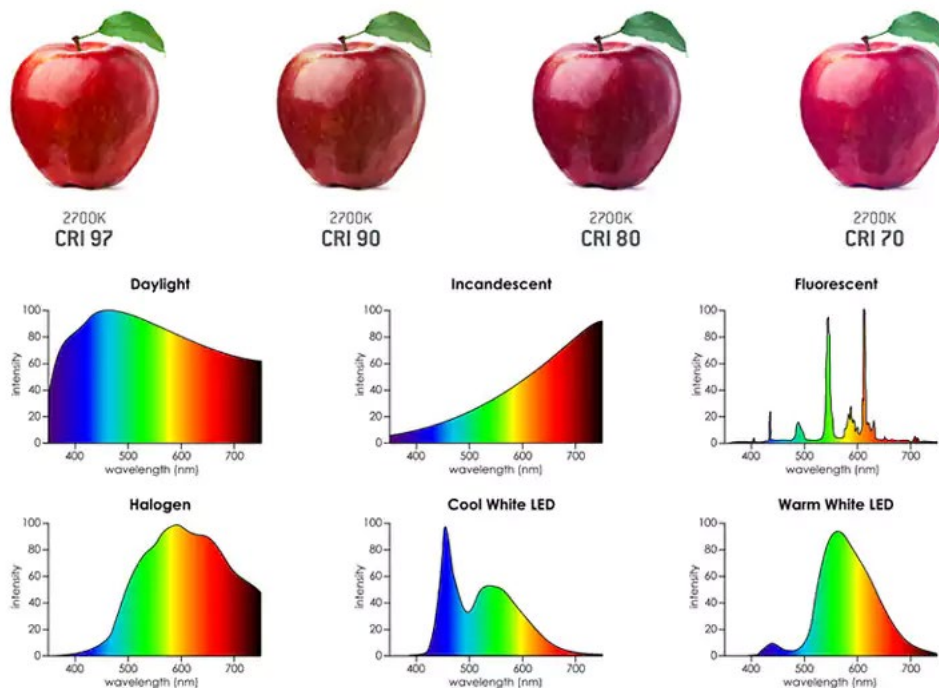
The evolution of lighting technology in the film industry has been rapid, and professionals often rely on recommendations or personal preferences to choose suitable lighting setups. After fluorescent lights, the introduction of LED technology marked a significant development. In the 1990s, blue LEDs became more efficient, leading to the development of RGB and phosphor LEDs. Early LED fixtures were known for their poor-quality light, but they offered the advantage of dimming without the need for scrims or fabric. LED fixtures were also known for their portability, simplicity, low power consumption, and ability to change colour temperature without gels. Additionally, LED fixtures emit little heat and have a long lifespan.

The development of RGB fixtures has increased the popularity and diversification of LED technology in the film industry. RGB fixtures are highly attractive because they can render various colours without the need for gels, and they can theoretically

produce millions of colours using additive colour mixing. However, the colours produced by RGB lights are limited to the RGB colour space, which does not include some popular colours. To address this issue, manufacturers have introduced RGBA and RGBW fixtures, which expand the range of colours that can be produced by RGB lights. The addition of an amber or white channel increases the ability to create pastels and tints, with the amber channel being particularly useful for rendering warm whites.

However, the manufacturing process of LED fixtures can lead to variations in quality, particularly in the Colour Rendering Index (CRI) of the unit. The CRI value of a light source indicates its ability to accurately reproduce the colours of an object compared to an ideal or natural light source. Incandescent and halogen lights, such as HMI or tungsten fixtures, have a CRI of 100, enabling cinematographers to rely on them for colour accuracy. LED fixtures are the closest technology to incandescent and halogen lights in terms of achieving a CRI close to 100, with high-quality modern LEDs reaching CRIs in the high 90s. Although the CRI of high-quality LEDs may fall slightly short, their flexibility, efficiency, lightweight, and in some cases, RGB spectrum compensate for this limitation.

figure 2.4



An example of how the CRI value can impact the accurate rendering of colours in an apple is provided, alongside a set of spectrum graphs illustrating the colour render of different light sources. These graphs highlight how certain light sources may fall short of replicating the full spectrum of daylight, potentially resulting in colour inaccuracies.

From "Color Rendering Index (CRI): The Significant Metric for Color Critical Lighting Applications" by ProLampSales. 13 December 2019. Pro Lamp Sales. Retrieved 8 May 2023, from <https://www.prolampsales.com/blogs/specialty-architectural-lighting/color-rendering-index-cri-provides-useful-information-for-lighting-buyers-and-specifiers>.

The emergence of LED lighting technology has transformed the lighting industry and brought various benefits such as energy efficiency, durability, and versatility. Over the years, LED technology has advanced rapidly and expanded its application

beyond lighting fixtures to LED screens/walls. This technology has revolutionised the field of visual effects and virtual reality, creating new opportunities and challenges for lighting design.

“The introduction of LED walls into the virtual-production landscape has opened up a new world of lighting possibilities, empowering cinematographers to continue to do what they do best: leverage technology to create images that serve the story” (Kadner, 2021).

One of the most significant impacts of LED screens is their ability to serve as real-time backgrounds for actors, eliminating the need for location shooting and green screens. As a result, interactive LED screens are becoming increasingly popular, which may eventually lead to a decline in green screen studio spaces. This development highlights the potential of LED screens to transform traditional production processes and create more immersive experiences for viewers. However, due to its high cost, the widespread adoption of this technology may require significant investments, limiting its accessibility in certain contexts.

Despite the revolutionary nature of LED walls, lighting remains a crucial element in interactive LED environments as it has been in traditional filming practices. Cinematographers are still developing and discovering new techniques to illuminate these environments. The fundamental premise of LED walls is to display images on LED panels that generate varying levels of emissive lighting, which can be combined with additional LED lighting, practical lights, or cinema lights to create highly realistic outcomes that rival those achieved by filming on-location. Although LED walls produce a significant amount of interactive light solely from the screen content, the lighting can still be customised.



The two images depict the set of the series "The Mandalorian", which predominantly utilised an LED stage/wall to construct the story's environment. Notably, the sets also feature additional lighting units that have been employed to light the scene.

From "How the Mandalorian LED Video Wall Modified Film Productions by Yuchip LED. 29 August 2022. Industrial Light & Magic. Retrieved 8 May 2023, from <https://www.yuchip-led.com/mandalorian-led-video-wall/>.

One of the drawbacks of using LED screens in filming is the high cost of production, but advancements in technology may make LED screens a preferred option in the

future. There is a vast amount of literature discussing the implications of lighting technology on film aesthetics leading up to the advent of LED stages that remain unexplored. Therefore, the focus of this thesis is restricted to lighting technologies prior to LED stages. Nonetheless, it is important to acknowledge the potential influence that LED stages may have on the future of filmmaking, and as such, their significance has been briefly discussed. Future productions will provide insight into the impact of this technology on the aesthetics of contemporary cinema.

Given the significance of lighting in conveying emotions, moods, atmosphere, tone, character development, and plot points, it is important to understand how lighting technology has evolved over time, providing a wider range of options for filmmakers to achieve their desired aesthetic. By manipulating light and shadow, filmmakers can create depth and dimensionality and focus attention on specific elements within a scene. The ever-growing number of lighting options allows for greater creative expression through lighting.

While lighting technology has opened a wide range of creative possibilities, professional opinions on the subject can be contentious. Some filmmakers prefer natural light and minimalist setups, while others prefer more complex and stylised arrangements. The debate over whether artificial lighting can replicate the organic quality of natural light highlights the subjectivity of lighting preferences in filmmaking.

The evolution of lighting technology has provided filmmakers with a vast array of options to express their creative vision, from incandescent bulbs and tungsten fixtures to the emergence of LED technology. As technology continues to advance, it will be interesting to see how filmmakers use these tools to craft unique and captivating visual experiences for audiences. The next chapter of this thesis will delve deeper into the aesthetic impact of lighting technology by drawing from personal experience and the expertise of professional gaffers, cinematographers, and a production designer.

3 aesthetics

The previous chapter provided an analysis of the technological advancements in lighting equipment within the film industry. However, since lighting is fundamentally an art form, it would be incomplete to solely focus on technological advancements without considering their aesthetic implications. Therefore, the purpose of this chapter on aesthetics is to examine how technological advancements in lighting have influenced the aesthetics of cinema throughout history.

To achieve this, the following chapter will explore the principles of lighting and how they have been applied in the lighting practices of early cinema and contemporary cinema. Professional cinematographers and gaffers have been interviewed to gain their valuable insights on the topic, and to consider how they have witnessed the development of lighting equipment impact their work and style over the course of their careers. By analysing the intersection of technology and aesthetics in lighting, this chapter aims to provide a comprehensive understanding of how technological advancements have shaped the visual language of cinema.

Throughout this chapter, I will make references to these interviews that I have had with professional cinematographers, gaffers, and a production designer. They are all experts in their respective careers, having worked in the film industry for multiple years in Finland and outside of Finland in international productions. Please find below an introduction to the esteemed professionals who were interviewed for this project, listed in alphabetical order by their surname.

Tuomo Hutri F.S.C | Cinematographer

Tuomo Hutri is a highly respected cinematographer and a member of the Finnish Society of Cinematographers (F.S.C). He has extensive experience in the film industry, having worked on numerous feature films, documentaries, and television productions. Hutri is known for his distinctive visual style and innovative use of lighting techniques, which have earned him critical acclaim and industry recognition.

Tuomo Hutri has worked as a cinematographer on several notable films, most recently Erik Stoneheart (2022), Invisible Demons (2021), The Red Ring (2021) and television series Helsinki-Syndrome (2022) and Deadwind (2021). Hutri's opinion carries significant weight in the discussion surrounding how technological advancements in lighting contribute to the contemporary aesthetics of cinema, owing to his extensive experience and membership in the F.S.C. Founded in 1983, the F.S.C. provides further education for its members and only accepts cinematographers who have shown great artistic skills in their work as Director of Photography. Hutri's expertise and insight into the use of lighting in cinema make him an invaluable resource for this thesis.

Matleena Kuusela | Gaffer

Matleena Kuusela is a highly experienced gaffer who has been working in the film industry for over a decade. As one of the few women gaffers actively working in Finland, she brings a unique perspective to her work and on the development of light technology. She has worked on a wide range of productions, including spots, television shows, and feature films, demonstrating her versatility and adaptability in the field. Alongside her work as a gaffer, Kuusela also serves as the chairman of SET ry, Suomen elokuva- ja mediatyöntekijät, an organisation representing a broad range of professionals in the film and television industry.

Kuusela's extensive experience and contributions to the industry make her well-suited to comment on the topic of how developments in light technology have influenced the modern aesthetic of films. Her works include Natatorium (upcoming), Kikka! (2022), Girl Picture (2022), Eden (2020) and Aktivistit (2019), among many others. Through her work and leadership, Kuusela has established herself as a respected and accomplished member of the film community in Finland and internationally.

Jani Lehtinen F.S.C | Gaffer

Jani Lehtinen is a well-versed gaffer in the film industry, having worked for several decades on a variety of productions such as Cold Courage (2021), Helene (2020), How it Ends (2018), Devil's Pride (2016), The Midwife (2015), and The Girl King (2015), among others. His extensive experience and versatility make him a valuable asset in the field of lighting, particularly when it comes to understanding how the development of lighting technology has influenced the modern aesthetic of films. As the CEO of The Light House, a reputable film gear rental house in Finland, Jani remains up to date with the latest advancements in lighting equipment, which enables him to adapt to the unique demands of each production.

In addition to his impressive professional background, Jani Lehtinen is one of the few honorary members of the Finnish Society of Cinematographers, a cultural and professional society that provides further education for its members. While traditionally only cinematographers join the FSC, Jani's exceptional skills as a gaffer have earned him this distinction. As a member of this prestigious society, Jani is recognized for his remarkable contribution to the artistic community and respected for his keen eye for visual storytelling. With his wealth of experience and expertise in lighting technology, Jani Lehtinen is well-suited to offer valuable insights into the complex relationship between lighting technology and the modern aesthetic of films.

Mika Orasmaa F.S.C | Cinematographer

Mika Orasmaa is a highly respected cinematographer with over 30 years of experience. He is known for his visually stunning work across film and TV and is recognised for his versatility and ability to work across a range of genres. Orasmaa has extensive experience working on high-profile commercial shoots, including advertisements for major brands such as OnePlus, McDonalds, Finnair, Avon, Snickers, OLW, Bancpost, Cialis, Leaf, GoMobile, Unisef and Nokia. He has also worked on numerous notable film and television productions, such as Big Game (2014), Iron Sky (2012), Omerta 6/12 (2020), Unknown Soldier (2017), and Why Didn't They Ask Evans? (2020), among many others. These projects showcase his exceptional talent and expertise in lighting and cinematography and have made him a sought-after cinematographer in the industry.

With his extensive experience, Orasmaa is a reputable source to provide insight into how the development of lighting technology has influenced the contemporary aesthetics of film. He is also a member of the F.S.C., which is a remarkable distinction in the artistic community. Only the members of the society are allowed to use the three letters F.S.C. after their name, and the membership is a sign of appreciation and respect by the artistic community. Orasmaa's membership in the F.S.C. is a testament to his outstanding skills and contributions to the field of cinematography.

Ville Penttilä F.S.C | Gaffer

Ville Penttilä is a highly respected gaffer in the film industry with over two decades of experience. He has worked on several acclaimed films, including One More Time (2023), Tenet (2020), The Girl with the Dragon Tattoo (2009), The Mother (2023), and The Eternal Road (2017) to name a few. Penttilä's expertise lies in lighting design, and he has a keen eye for detail that has earned him a reputation as a master of his craft. His work has been praised for its ability to enhance the visual storytelling of each film he has worked on. Penttilä's contributions to the art of lighting in film are particularly significant, given the increasing importance of visual effects in lighting in modern filmmaking.

In addition to his extensive experience in the film industry, Penttilä is a member of the International Cinema Lighting Society (ICLS). As a non-profit organization, the ICLS provides a space for education, networking, and professional growth within the lighting community. Through his involvement with the ICLS, Penttilä has access to a global network of lighting professionals, which has enabled him to stay up to date on the latest trends and technological advancements in lighting design. Furthermore, Penttilä's excellent knowledge and work as a gaffer has earned him the status of honorary member of the F.S.C, making him one of the few non-cinematographer members. Penttilä's affiliation with the ICLS and FSC further adds to his credibility as

an expert in the field of lighting design in film, and his insights on the development of lighting technology and its influence on contemporary aesthetics in film would be of great value to anyone studying the evolution of lighting design in film.

Meri Proud | Gaffer

Meri Proud is a highly respected gaffer in the film industry, having worked since the 80s and witnessed first-hand the technological changes that have influenced the modern aesthetic of films alongside the growth of the Finnish film industry. Her extensive experience and ability to adapt to new lighting technologies make her a valuable asset to comment on the topic of how development in light technology has influenced the modern aesthetic of films. Proud's unconventional background, which includes a personal transgender experience coupled with years of professional experience, imbues her perspective with a unique and valuable quality that is currently underrepresented in discourse within the lighting community.

Consequently, she is able to provide a comprehensive overview of a broad range of experiences that might otherwise be overlooked.

As an artist at heart, Proud uses the tools available to shape light and bring the vision of the director of photography and herself to life. She is also skilled in lighting technology and keeps herself updated by working as a lighting technician for other gaffers. Her portfolio includes a variety of productions, from spots and TV series to feature films, such as *Aalto* (2020), all *Onneli ja Anneli* films (2014-2018), *Stars Above* (2012), *Kristal* (2020), and *Joulukalenteri: Tonttuakatemia* (2019), among many others. With her extensive experience, passion for lighting, and hands-on experience with updated lighting equipment, Proud offers valuable insights into the influence of light technology on modern film aesthetics.

Karri Pöykiö | Gaffer

Karri Pöykiö is a highly qualified professional Gaffer with a remarkable background in the film industry, making him well-suited to comment on the topic of how the development of lighting technology has influenced the modern aesthetic of films.

Pöykiö's experience working on over 40 feature films and more than 200 commercials worldwide since 2000 has given him a profound understanding of the importance of reliable, versatile, and high-quality equipment that can adapt to different production needs. As a member of the International Cinema Lighting Society (ICLS), Pöykiö stays up to date with the latest advancements in lighting technology, which is critical in understanding how it has influenced the aesthetic of contemporary films.

Pöykiö's impressive portfolio includes working on well-known productions such as *All the Sins* (2019-2023), *Renki* (2023), *White Wall* (2020), *On Thin Ice* (2022), and

currently in production for Stormskerry Maja (2024). His adaptability to various production environments and meticulous attention to detail has earned him a reputation as a reliable and versatile gaffer. With his expertise and extensive experience, Pöykiö is an asset to any production, and his insights into the relationship between lighting technology and the modern aesthetic of films is highly beneficial.

Rauno Ronkainen F.S.C | Cinematographer

Rauno Ronkainen, a Finnish cinematographer and professor in cinematography at Aalto University's School of Arts, Design, and Architecture, brings a wealth of experience and expertise to the table. As a member of the F.S.C., Ronkainen has established himself as a prominent figure in the film industry, having worked on a wide range of films and television series including Bullets (2018), The Eternal Road (2017), Helene (2020), Omerta 6/12 (2021), and Mobile 101 (2022). Currently, he is working on Stormskerry Maja (2024). Ronkainen's outstanding success in the field, which includes winning three Jussi Awards for best cinematography and a Silver Frog award from the Camerimage cinematography festival, makes him an invaluable source of insight in discussions regarding how advancements in light technology have influenced the aesthetics of contemporary cinema.

Ronkainen's role as a professor of cinematography further highlights his in-depth knowledge and understanding of the art and technical aspects of filmmaking, contributing to his extensive knowledge on the thesis topic. His expertise and recognition in the field of cinematography are evidenced by his numerous awards, which attest to his valuable input in the thesis discussion. As a member of the F.S.C. and an active cinematographer, Ronkainen is also well-versed in the latest developments in the field of cinematography, including advancements in light technology, which further supports his position as a valuable resource in the discussion of how these developments have influenced contemporary cinema's aesthetics.

Kaisa Mäkinen | Production Designer

Kaisa Mäkinen is a highly experienced production designer, who has worked on several acclaimed films such as Power of Love (2023), Omerta 6/12 (2021), Dogs Don't Wear Pants (2019), One Last Deal (2018), The Secret Society of Souttown (2015), and is currently working on pre-production for a feature film. With an impressive portfolio, Mäkinen is well-suited to comment on the topic of how the development of lighting technology has influenced the modern aesthetic of films from a unique perspective. As a production designer, she understands the critical role of lighting in creating a specific mood, atmosphere, and visual style in a film, and how it can enhance or detract from her own work. Mäkinen can provide insight into how

lighting affects the art department's choices, from selecting colours, materials, and textures to creating sets and props that will complement the lighting design.

Furthermore, Mäkinen's perspective as a production designer will provide a more comprehensive collection of insights for the thesis. While gaffers and cinematographers are integral to understanding the technical and creative aspects of lighting design, the art department's perspective is also essential. In addition to her successful career, Mäkinen is also a professor of production design at Aalto University, where she shares her wealth of knowledge and experience with future designers. Her role as a professor highlights her dedication to the industry and her ability to teach the next generation of filmmakers. Mäkinen's vast experience and unique perspective make her an asset to any film production and a reliable source for commentary on this thesis topic.

3.1 the principles of lighting

Cinematography encompasses a variety of tasks that must be fulfilled to capture the image that the entire crew is working hard to achieve. According to Jake Rosenblatt's senior thesis *The Path of Light*, cinematography is essentially "*the control and manipulation of how light reacts chemically with the emulsion of the film stock*" (2010, p. 5), affirming the significant role that lighting plays in cinematography. Additionally, with the introduction of digital camera technology in 1975, Rosenblatt's definition of cinematography can be broadened to how light is interpreted by a digital sensor.

The cinematographer oversees the camera, grip, and lighting departments on set. Lighting plays a significant role during shooting because it can only be taken so far in pre-production. Camera equipment and lenses are tested before shooting, with little reason to alter them during filming. Grip equipment is often decided upon before shooting and requires little time to set up. Special circumstances such as cranes or car rigging require advanced technical setup, but these days typically make up a fraction of the shooting period, with extra time allocated for rigging. Moreover, complex camera movement often involves complex lighting.

The execution of lighting is unique, as the task is only completed seconds before the last take of the shot. In many cases, it is common for a cinematographer and gaffer to make minor changes to the lighting, even after the first take, and continue until the last take of the shot. Whether this involves adding an eye light at the last minute or using a reflector to bounce a rim light, these changes are significant in the moment and are typically hurriedly added to the shot.

In the old school way of making films, the cinematographer was not next to the camera at all, as the Hollywood system used camera operators separate from the cinematographer. In union jobs in the United States of America (USA), contrary to the European approach, this practice is still common, but with the rise of digital filmmaking, this tradition is not as prominent even in USA. As a result, the forefathers of cinematography did not touch the camera at all and instead focused on cultivating the image with designs of light and movement. Cinematographers are known to carry their light meter around their neck and measure light from every direction. On set, finding the desired lighting takes priority over many other minor tasks, which are delegated to the operator, grip, or assistant camera.

Lighting principles are the foundation upon which cinematographers and gaffers build their craft. Understanding these principles is essential to create a cohesive visual story that conveys emotion, tone, and style effectively. The principles include the position, direction, quality, and colour of light. Position refers to where the light is placed in relation to the subject, while direction relates to the angle of the light in

relation to the subject. Quality refers to the hardness or softness of the light, which can be modified through diffusion or reflectors. Lastly, colour is an essential aspect of lighting as it can convey mood and emotion using gels or different types of light sources. By mastering these principles, cinematographers and gaffers can manipulate light to create their desired aesthetic and convey their intended message to the audience.

In the book *Lighting for TV and Film*, Millerson connects gaffers, cinematographers, and technicians of light with visual artists, explaining their role in creating an experience for the audience through the chosen medium. Millerson states that *"Visual artists of all kinds are manipulators. They deliberately arrange line and form, light and shade, texture, and colour to create carefully designed effects. They learn to recognize how features can be adjusted and controlled to create an illusion and influence their audience"* (2013, ch. 4). Cinematographers draw inspiration from traditional visual art forms, such as paintings, to inform their lighting decisions. This reinforces the parallel between cinematographers and visual artists, as these art forms can guide their choices on the light's position, direction, quality, and colour.



Portrait of Journalist Sylvia von Harden by Otto Dix 1926
Film still from Cabaret (Fosse 1972)

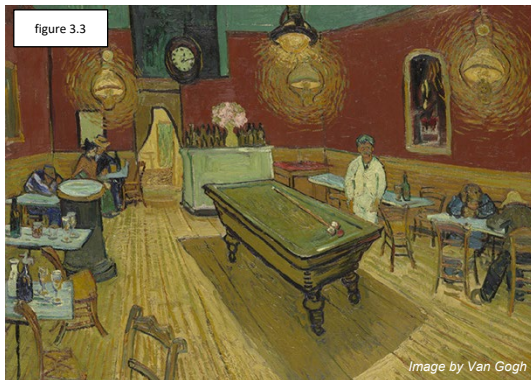


Image by Van Gogh



Image by Russell Harlan & F.A. Young

Le Café De Nuit by Van Gogh (1888)
Film still from Lust for Life (Minelli 1965)



Image by John Singer Sargent



Image by William H. Clothier

El Jaleo by John Singer Sargent (1882)
Film still from The Alamo (Wayne 1960)

Cinematography and traditional visual artists share a strong connection through the use of light. Just as a painter composes a scene by controlling the placement and intensity of light, the cinematographer does the same through the position, direction, quality, and colour of light, as seen in the examples provided. The principles of lighting provide a solid framework for both traditional and modern cinematography, allowing for endless possibilities in creating compelling visual narratives. It is essential to consider these principles when discussing the impact of lighting on the contemporary aesthetic of films, as lighting plays a pivotal role in shaping this aesthetic. As technology continues to evolve, it is crucial to remember the foundation upon which the craft is built and build upon the principles of light to further push the boundaries of cinematography and visual storytelling.

3.2 lighting practices

The lighting strategy, determined during preproduction and on set, plays a critical role in the execution of lighting schemes by a cinematographer and their team. To a degree, in contemporary filmmaking, there seems to be a strong emphasis on naturalism with a focus on enhancing existing light in a space in an unadulterated manner. Nevertheless, the aspiration for naturalism in cinematography has been a long-standing objective. Recent technological advances have made it increasingly possible to reproduce lifelike lighting with a higher degree of accuracy than ever before. The Set Lighting Technician's Handbook, 4th edition, contains a concise chapter on naturalism.

"To create natural-looking lighting and keep things consistent, one must control the existing light sources and utilize or invent techniques to recreate realistic, natural lighting using artificial sources" (Box, 2013, ch. 4).

The chapter further highlights that when strategizing lighting, one of the two most critical factors to consider is the motivation behind the lights. Box notes that "identifying the motivation for the light brings realism to the lighting" (2013, ch. 4).

The concept of lighting in film and its technological advancements have evolved significantly over time, with each era bringing a distinct approach to lighting. Thompson's book on German director Ernst Lubitsch, elaborates on his move to the United States of America. Thompson comments that this move "came at a crucial point in the history of lighting in the two countries, both in terms of the actual technology and of approaches to the placement of equipment in sets" (Thompson, 2005, p. 35). Lighting in film is not merely a technical process but an art form that combines lighting practice and technology. It requires creativity, skill, and a deep understanding of how light can affect the visual language of a film. With this in mind, it is worth exploring some significant lighting practices and how technology has influenced them, including whether certain techniques are outdated or still relevant in contemporary cinema. The principles of lighting have been continuously applied in practice to achieve the desired visual aesthetic in cinema. Consequently, knowledge of these practices is relevant to the thesis topic, as the principles of lighting and their application are closely interlinked and have influenced the aesthetic of cinema both historically and in contemporary cinema.

v-pattern lighting

In the early days of cinema, studios were constructed with retractable glass roofs to allow natural light to illuminate the sets for capturing moving images. However, as

technology progressed, lighting practices evolved, and new techniques emerged. One such technique was the v-pattern lighting technique, which was popular among German cinematographers before the widespread adoption of the three-point lighting approach.

The v-pattern technique involved the use of flood lighting to supplement the diffused daylight that entered the studio through the glass walls and roof. This technique resulted in a flattened image due to the diffused light. The v-pattern lighting could be either balanced or unbalanced, depending on whether the light sources were placed on one or both sides of the frame. The light sources were positioned in a V-shape, directed towards the set just outside the frame, and guided by the triangular field of view as visualised by the diagram below.

Despite its popularity among German cinematographers, the v-pattern lighting technique eventually became outdated and was replaced by the three-point lighting approach. The rather flat, frontal wash of light in the v-pattern was no longer considered effective in creating depth and adding visual interest to the frame. Thus, adopting the three-point-lighting technique marked a significant shift in lighting practices in the film industry, particularly in European filmmaking (Thompson, 2005, p. 39).

figure 4.1

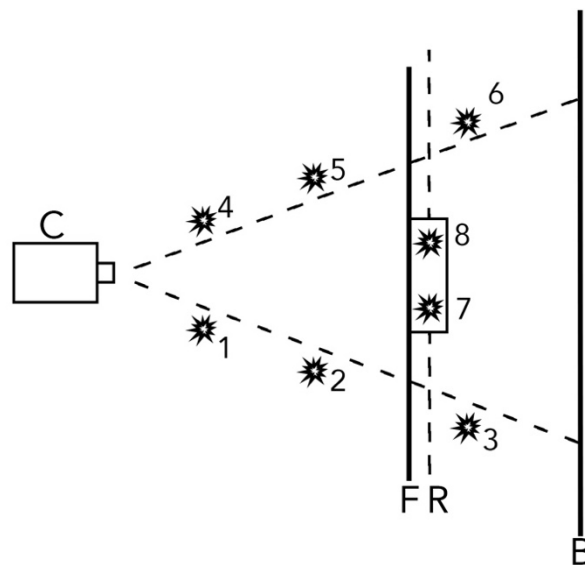


Image by Diana Dahllund

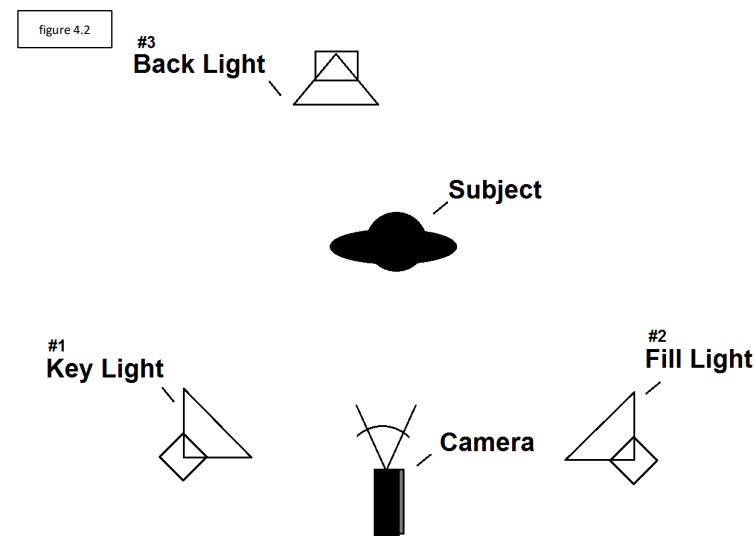
v-pattern lighting set up diagram.

Adapted from "Herr Lubitsch Goes to Hollywood: German and American Film after World War I" by Thompson, K. 2005. Amsterdam University Press (Film Culture in Transition), Amsterdam. Available from: <https://doi.org/10.25969/mediarep/4115>. [21 March 2023].

three-point lighting

The three-point-lighting setup is now considered a fundamental and widely used lighting technique in the film industry. It was developed in Hollywood during the mid-1910s to early 1920s (Thompson, 2005, p. 39). This technique involves the use of three different light sources - key light, fill light, and backlight - to create depth and guide the viewer's attention to the most important part of the frame.

The key light serves as the primary light source, typically directed at the main actors or the action taking place. On the other hand, the fill light is a dimmer light that is cast on the busier or more distracting side of the set to prevent drawing attention away from the actors. It can also be used to soften shadows and create a softer, more attractive look by casting the light from the opposite side of the key light. The backlight, the third element of three-point lighting, projects highlight onto the actor's hair and creates a distinct outline of the object or actor being backlit. This has often been coined as an "edge" light. A diagram of the placement of lights is included below to aid in visual comprehension.



3-point lighting set up diagram

From "8 Film Light Techniques" by Sharma, S. 21 November 2018. Medium. Retrieved 8 May 2023, from <https://medium.com/@thejigsaw.in/8-film-lighting-techniques-d1fe50186552>.

By combining these three light sources, the three-point lighting technique produces a visually striking image that enhances the storytelling when implemented thoughtfully. While there are debates regarding the relevance and applicability of this technique in contemporary cinema, it remains a fundamental and indispensable learning tool. Through its ability to cover all the essential aspects of lighting, the three-point lighting technique provides a reliable and accessible starting point for cinematographers when faced with creative challenges. Ultimately, the effectiveness of this technique

relies on its thoughtful implementation and adaptation to the specific requirements of each film production.

Despite changes in technology and approach, many cinematographers and gaffers still consider three-point lighting as the backbone of lighting. Tuomo Hutri (2023) notes that using more than three lights should prompt an evaluation of its reason, just as using less than three lights should have a good reason. This underscores the point that three-point lighting is an excellent reference point for filmmakers, regardless of the production scale. Even when more lights are available, the filmmaker should still consider the choice of using more lights. On the other hand, a tight budget does not necessarily mean that three-point lighting systems are inaccessible, as such systems may already be available in the location or a natural setting.

Similarly, Ville Penttilä (2023) notes that three-point lighting has not disappeared in any way. While more lighting methods have arisen in contemporary contexts, all the lighting methods that have been used in the past are still usable. The traditional ways of lighting serve as a foundation for contemporary approaches and aesthetics, as they provide a starting point for experimentation and adaptation. Therefore, three-point lighting continues to be a relevant and essential technique for cinematographers and gaffers in creating visually stunning and effective images.

Contrary to the views of most cinematographers who employ three-point lighting in their work and acknowledge its importance, many gaffers interviewed, apart from Penttilä, do not substantially consider the technique. Instead, their lighting technique is rooted in naturalism, with gaffers seeking inspiration from the direction of the key light to determine how the rest of the area is illuminated. This approach focuses on achieving the desired effect through comparison with the primary light source. However, it can be argued that this method strongly resembles the foundational principles of three-point lighting and that the latter may be subconsciously guiding the lighting design, even if the cinematographer or gaffer is not consciously aware of it. On the other hand, one could argue that the naturalistic approach to lighting forms the basis of three-point lighting. Either way, these two approaches can be viewed as interdependent, complementing each other. It is also undeniable that the terminology associated with three-point lighting - including key light, fill light, kicker, edge light, and backlight - serves as a critical communication tool for cinematographers and gaffers to express their ideas clearly and achieve the desired visual aesthetic through lighting.

The three-point lighting setup is a fundamental and widely used lighting technique in the film industry. Despite changes in technology and approach, three-point lighting remains relevant and essential as a learning tool and reference point for filmmakers, providing a reliable starting point for cinematographers at the start of lighting plans or when faced with creative challenges. While some gaffers do not consider it

intentionally, many cinematographers and gaffers still acknowledge its importance, and the terminology associated with three-point lighting serves as a critical communication tool for achieving the desired visual aesthetic through lighting. While v-pattern and three-point lighting have been at the forefront of cinematographers' and gaffers' minds, it's worth noting that they are not the only lighting techniques used throughout the history of cinema. Though it is impossible to cover all lighting techniques, as doing so would exceed the intended scope of this thesis topic, these two techniques serve as a reference to the idea that while many lighting techniques have existed prior, three-point lighting seems to have remained in regular use. In contrast, others have fallen out of circulation in contemporary filmmaking. As previously mentioned, it's crucial to consider the impact of filmmaking practices, along with the principles of lighting, on the modern aesthetic of cinema. These practices determine how lighting influences the overall visual. The continued popularity of three-point lighting in cinematography can be attributed to the versatility it offers in achieving different visual styles and aesthetics. The three-point lighting practice is a foundational element, like a skeleton, in the aesthetic impact of visual storytelling, which may explain its longevity compared to other techniques.

justified vs realism in lighting

The pursuit of realism in cinematography has been an enduring preoccupation since the recognition of cinematographers as artists following the studio era of film. Nestor Almendros states in the book *Masters of Light*:

"I start from realism. My way of lighting and seeing is realistic; I don't use imagination. I use research" (Almendros, 2013, p. 25).

Experienced cinematographers and gaffers are known to rely on the story to guide their lighting decisions, as each film, scene, and shot hinges on the narrative and the use of lighting to maintain the illusion of reality. This connection between realism and narrative coherence lies at the heart of the art and craft of cinematography. In fact, Almendros asserts that his method of working follows this tradition, with the primary goal of creating a realistic portrayal of lighting within the frame. However, he notes that the availability of lighting equipment has significantly evolved over time, enabling cinematographers to achieve a greater degree of accuracy in replicating realism on screen.

That is my method. I haven't invented that, of course. They used to do that before my time, but they used to use hard lights with fresnel lenses. Hard lights only exist in the theatrical world; if you were filming a play or a nightclub, it would be justified. But in normal situations, very

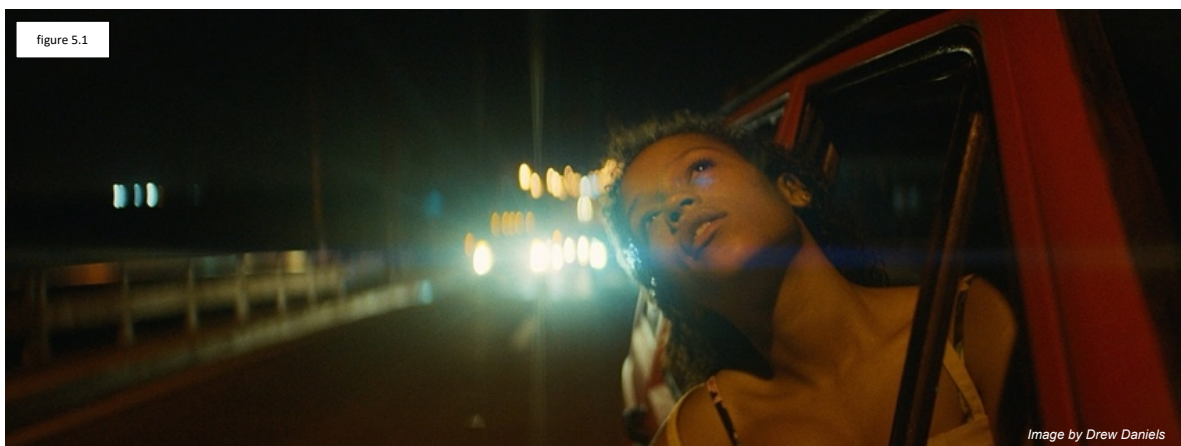
seldom do people have spotlights in their houses (Almendros, 2013, p.25).

Similarly, could we discern that in contemporary cinematography, the aim or desire for realism hasn't changed, but rather the tools of the craft have evolved to enable a more accurate representation of reality? Hence, the technology functions as a means to achieve the desired level of realism in terms of lighting on set, while the driving force behind it remains the story itself. The evolution of technology has allowed cinematographers and gaffers to replicate their visions with greater accuracy than in the past, as seen in contemporary cinematography. Without these advancements, such a high level of realism may not have been achievable.

When it comes to lighting and equipment choices, Ville Penttilä's (2023) approach has changed due to the vast number of tools available. Although there are more brushes in his toolbox, Penttilä's aim remains to serve the story as believably and naturally as possible. The benefit is that there is a wide range of equipment to choose from to achieve the same goal as before.

Furthermore, Penttilä acknowledges that the aesthetics of lighting in cinema has gone through many transformations throughout the years. The introduction of Kinoflo's fluorescent lights had a significant impact on film lighting, leading to the widespread adoption of the light. One notable example is the film *Seven* (1995), which is entirely lit with fluorescent lights. Penttilä observes that this new type of lighting changed the look of many films and later triggered a tendency to tint the visuals towards green. The contemporary aesthetic of cinematography is a branch from the same trend tree with the current trend being soft, pretty, and delicate light. The abundance of new LED equipment in the market has contributed to this trend, resulting in oversaturated use of soft light. Penttilä predicts that this trend will eventually shift as technology or other factors provide new opportunities to explore different aesthetics.

figure 5.1



An example of a mix of soft light on Taylor Russell as Emily and hard light from car headlights in the background in the recent film *Waves* (Shults 2019)

To illustrate this point, Penttilä mentions a film he worked on where the same day repeated over throughout the plot. In the production, for a scene, they blended harsh light with softer light to emulate the beauty of a sunset while still maintaining a smooth look for the actress. This blending of light sources could be one possible direction that the aesthetics of films may increasingly adopt and embrace as a prominent feature in the future. Regardless of the direction aesthetics take, the primary motivation for using new technology in contemporary cinematography is to create more realistic and true-to-story visuals. With technological advancements and evolving aesthetics, cinematographers and gaffers must remain adaptable to achieve their desired effect.



Matleena Kuusela (2023) expressed her disapproval of the growing popularity of LED lights in productions, citing her preference for tungsten and HMI lighting, which are complete light sources since it is a full spectrum source. According to Kuusela, tungsten lighting requires less additional equipment, such as diffusion to disperse the light to achieve a pleasing visual effect. This is a widely held opinion in cinematography and gaffer circles, and it is often the subject of debate. Despite her preference for tungsten, Kuusela acknowledges that the use of LED lights is often necessary for the sake of efficiency in contemporary productions, as they are battery-powered and easily adjustable on the go. This has led to the inclusion of LED lights as an essential tool in her equipment arsenal when necessary. However, she notes that the choice between tungsten and LED lighting ultimately depends on the specific production's budget and time constraints, with LED lights also being a more power-efficient option.

In spite of the increased efficiency that LED lights offer, some argue that their use can negatively impact aesthetic quality. Kuusela shares this sentiment, noting that the combination of LED and tungsten lighting in the same scene can be easily noticeable and unpleasing to the eye. She attributes this to the fact that LED lights do not produce a full spectrum of light. While acknowledging the improvement of LED technology and the reduced gap with full spectrum lighting, Kuusela still considers it a quality compromise for the sake of efficiency. Achieving a naturalistic look with LED lighting requires more effort and can never compare to the full spectrum. Consequently, she avoids mixing LED and tungsten lighting sources. Recently, she experimented with combining LED and HMI lighting, as they have more similar aesthetic qualities. However, Kuusela has yet to see the final product and cannot definitively state whether she is satisfied with the results or would be willing to repeat the experiment in future projects.

Kuusela has been successful in converting some cinematographers to use more tungsten lighting. She has observed that many cinematographers tend to stick with LED lights out of habit and comfort, even if other lights could also achieve the desired, natural effect. Despite this observation, Kuusela emphasises that her lighting choices are always guided by the scene's needs, with the goal of achieving natural-looking lighting that enhances the overall vision. In a recent project, Kuusela worked with a cinematographer who envisioned primarily white light, which led to the decision to use HMI instead of tungsten units. Thus, even though each cinematographer and gaffer may differ in preferences, the overarching objective remains the same: to achieve naturally motivated, appropriate lighting that is also aesthetically pleasing.

Kuusela describes a sense of comfort that persists in the film industry due to several factors, including time constraints, over-saturated marketing, and peer advocacy for certain equipment. However, the most concerning factor is the pressure to be efficient, which leads cinematographers and gaffers to rely on familiar tools recommended by colleagues. From the interviews conducted, it is evident that cinematographers and gaffers share Kuusela's opinion to some degree on the quality difference between full-spectrum lights and LED lights, as they all acknowledge the difference. However, the efficiency of LED lights often outweighs the aesthetic considerations for contemporary productions. This raises the question of what drives equipment decisions in the industry. The cinematographer's dilemma arises as the quality of light is more important than the tools used to achieve it, but the pressure to be efficient means that cinematographers often opt for the comfortable and familiar option, risking repetition, and stagnation in contemporary cinema aesthetics.

In short, the pursuit of realism in cinematography has always been and remains a central objective, but the tools and methods of achieving it have evolved with technological advancements. The primary motivation for using technology in

contemporary filmmaking is to create more realistic and accurate scenes, with the story still guiding lighting decisions. The aesthetics of lighting in cinema have undergone many transformations, and the current trend is soft, pretty, and delicate light, with an oversaturation of LED lighting. While some cinematographers and gaffers prefer tungsten lighting, which produces a full spectrum of light and requires less additional equipment, they acknowledge that LED lights are often necessary for efficiency in modern productions. However, for some, there is a concern that the use of LED lighting can negatively impact aesthetic quality and realism, and it requires more effort to achieve a naturalistic look. Regardless, cinematographers and gaffers must stay flexible and adaptable to achieve their desired lighting aesthetic using the available tools and technology while also working within the constraints of production schedules and available resources.

gender-motivated lighting

In the 1920s and 1930s, a lighting practice known as gender-based logic gained popularity among cinematographers, in addition to the traditional three-point lighting technique. In the *Cinema Journal*, Keating explored the connection between the traditional approaches to portrait photography in the 1910s and how they were integrated into lighting for motion pictures. Although Hollywood close-ups from the 1920s and 1930s did not resemble photographic portraits from the 1910s on a technical level, Keating argued that the influence of traditional portraiture on Hollywood cinematography was deeper, as it was guided by a logic of character that was shaped by a discourse of difference. Specifically, techniques of emphasis and expression were used to differentiate images of men and women, reflecting the societal expectations of femininity and masculinity (Keating, 2006, p. 107).

During the 1910s, portrait photography tended to favour a natural daylight look. With the introduction of artificial lighting, photographers attempted to emulate soft daylight as closely as possible. However, some photographers made distinctions in their approach to lighting men and women. In *The Fine Art of Photography*, Anderson describes the "true portrait" as one that presents a complete and satisfactory representation of the face's contours and gradations, is fully descriptive of the sitter's character, and is artistically pleasing to the unacquainted viewer.

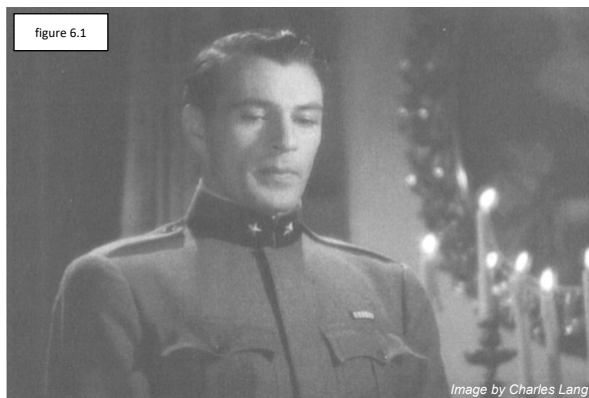
"The true portrait, then, should present a complete and satisfactory representation of the contours and gradations of the face; it should be as fully descriptive as possible of the sitter's character; and it should be a picture of such nature as to be artistically pleasing to one who is unacquainted with the original" (Anderson, 1919, p. 234).

The emphasis for photographers was on portraying the subject's character, which influenced their lighting approach. However, the intersection of the expression of character and sexual differences also played a role in lighting practices. Lighting approaches were guided by appropriate societal expectations of femininity and masculinity for "expressing character." Anderson explains that these traditional approaches reflected the society at the time and not an immutable rule.

According to Anderson's definition, men were traditionally seen as having strongly marked characters, with their lifestyle encouraging the development of mental processes. This was reflected in photographers' use of darker backgrounds and harsher light sources. In contrast, women were viewed as delicate and soft, and photographers used soft lighting and techniques to diminish blemishes and lines (Anderson, 1919, p. 237). However, gender discourse was not merely a binary opposition, and many photographers and cinematographers adapted traditional practices to suit the style of the photograph or motion picture. Factors that determined photographers' approach to lighting included the direction and quality of light, contrast, tonality, lens diffusion, lens focus, retouching, and postproduction contrast.

In Hollywood, a similar approach was taken to figure lighting, but technical differences between still photography and cinematography existed. Exposure time differences required cinematographers to provide more light, often with stronger sources to expose film stock adequately, which made emulating soft natural lighting difficult. Additionally, cinematographers had fewer options at their disposal than photographers, and retouching was almost impossible to experiment with in film productions due to the risk of ruining the film. Moreover, studios in motion pictures made the transition to artificial lighting ahead of photography because of the need for more lighting. However, this does not diminish the influence that photography's approach to portraiture had on motion pictures' approach to figure lighting. Rather, it suggests that there was a change in technical approach in the transition from photography to cinematography.

Nonetheless, both in theory and practice, gender-based lighting strategies served as default norms for lighting in the film industry. These conventions were used as guidelines to govern the way cinematographers thought about figure/portrait lighting. Classic Hollywood films provide evidence that distinct lighting was often adopted in close-up reverse shots between men and women to complement the "character" of each shot. To illustrate this, stills from *A Farewell to Arms* (1932) are provided below.



In A Farewell to Arms (Borzage 1932) Charles Lang uses common 3/4 sidelight for lighting men at the time, which models the 'character' in Gary Cooper's face.



For Helen Hayes, Lang uses an almost frontal key to flatten her features - a technique associated with lighting women in earlier cinema practices.

Cinematographers employed unique techniques to implement the theoretical gender binary into practice. The direction of light played a crucial role in how lines appeared in the image. Frontal lighting, which was preferred for women, smoothed out wrinkles, while sidelight, which was preferred for men, emphasised lines. Both men and women were backlit, but due to the diffused lenses often used for women, the backlight appeared more prominent, resulting in a "halo" effect. The quality of light determined the softness or hardness of the image. Cinematographers used more heavily diffused lighting for women because of the expressive associations of the term "softness" and the tendency for soft lighting to diminish the appearance of facial lines. Moreover, contrast in lighting was used as a tool to accentuate the strong and harsh features of men, while close-ups with women often featured more fill light. Finally, lens diffusion impacted the softness of the overall image. Soft lenses or placing gauze over the lens were traditionally used for shots of women to further soften their appearance.



In a nighttime exterior scene, a similar 3/4 side placement is used for Gary Cooper's key-light, while increasing the contrast.



In the same nighttime exterior, cinematographer Charles Lang darkens the overall tonality while maintaining soft, gentle gradations when lighting Helen Hayes.

In recent years, the gap in how men and women are lit in contemporary cinema has significantly closed. Lighting decisions are typically made based on how best to

represent the character within the script, regardless of gender. While Mika Orasmaa (2022) admits to occasionally using lighting to soften actresses' features depending on the day and actress' expectations, the difference between how men and women are lit is nowhere near as radical as it used to be. Ville Penttilä (2023) also emphasizes that gaffing decisions are not dependent on gender, but rather on what the story requires the actor to look like. In the film *The Mother* (2023), for example, a softening semi frontal light was used to make an actress suit the role because she was older in real life than the character she was playing.

However, a question arises: has the significant change in lighting men and women differently stemmed more from a cultural shift over the years or from advancements in lighting equipment? At first glance, it may seem that the changing perception and categorization of gender in contemporary Western culture has allowed for more expressive lighting that represents women and men more fairly. The expectation of how women should be represented has shifted from narrow parameters to a more inclusive "a woman can be anything." As a result, women can be lit in more diverse ways. However, it could be argued that equipment advancements have also played a significant role in closing the gap between how women and men are lit. With the rise in the use of softer lighting sources, men are now lit with more subtle sources that match how women are lit. Even if there is a slight discrepancy, it is often unnoticeable to the viewer.

Although the gap between how women and men are lit is closing, there are still instances where lighting is used to soften features. For example, actresses are often expected to appear young even at an older age, which may result in attempts to emphasise youthfulness more in women than in men. Unfortunately, society tends to view the ageing of men as more acceptable than the ageing of women. With this in mind, Meri Proud (2023) raises an important point regarding the actor's comfort level while shooting. As there still is a societal expectation that women cannot age while men can, and actresses who have grown up with this may feel uncomfortable without a light softening their features, particularly if the belief has been expressed more prominently throughout their career. This discomfort could even impact their performance, which is why cinematographers and gaffers handle the situation delicately and sometimes even use a light for the actor's peace of mind, even if it doesn't visibly affect the final visual. The rise of new technological advancements in lighting equipment, with smaller units that can emit very little light, has made this type of use more apparent and feasible in contemporary cinematography.

In an ideal world, lighting decisions would be based solely on the character's needs, but we are getting closer to this ideal in contemporary filmmaking than in 1920s Hollywood with some of the interviewees highlighting that the gender binary is not something they consciously consider when making lighting decisions, indicating that we are making progress towards a more inclusive and representative lighting aesthetic in the industry. There is still much to be considered about the influence of

technological advancements in the matter. This aesthetic choice is impacted by societal pressure more than anything else though technological advancements in lighting equipment have provided a greater variety in the quality of light, as society has become more progressive, it has been important for technological advancements to develop alongside society so that society also has the tools to close the gap. Therefore, it would be remiss to argue that technological advancements in lighting technology haven't had any influence on the issue of gender-based lighting.

led directly on subject

A big downfall of LED prior to the emergence of Arri Skypanel, Vortex and other reliable LED lighting was that it could not be used directly on the face of an actor in the early days of LED technology. The LED lights were too harsh, did not replicate colour accurately enough as their CRI was low and left a displeasing luminescence that was more noticeable on skin texture than in the background. For a while, this kept cinematographers from using LED directly on the face of actors. During the interviews, this was questioned – is LED used directly on the face? The answer is yes, the discrepancy between LED light and full spectrum light is so minimal that it is no longer a concern for most cinematographers and gaffers. For example, Mika Orasmaa (2023) mentions that there is a difference, but maybe it's more of a psychogenic difference that LED lights are harsher and more modern than soft full-spectrum lights. However, Orasmaa mentions that this discrepancy can be corrected in the grade because it is so fine. Especially if considering a heavier look for a film, the difference between LED on the face and full spectrum on the face is no longer noticeable to him because the colourist can select the face and fix the skin tones to match the look in post-production.

Although the approach to using LED lights may vary among professionals, most cinematographers and gaffers do not see any problem with lighting a subject with modern LEDs in their preferred ways of working. Orasmaa, for instance, prefers to bounce even a soft LED light rather than shining it directly on the actor, while Ville Penttillä (2023) sees no point in making a soft source of light even softer. Despite these differences in practice, most cinematographers and gaffers are comfortable using modern LED lighting to light the subject. Some even keep an LED light close by the camera, like Rauno Ronkainen (2023), who noted this practice as one of the significant changes in his way of working throughout his career in response to technological developments.

In contrast, Matleena Kuusela (2023) has not used LED lighting directly on the subject without something in between the unit and the subject, much like Orasmaa's preference. She sees LED as a compromise for time and believes that the light

emitted from LED needs to be obstructed substantially to achieve the desired effect and considers that LED requires more work to achieve a naturalistic look. For her, a vortex light will minimally have a softbox or an octabox, but preferably, in addition to these, a 4x4 diffusion frame in front of it to provide the best possible light achieved by LED to light the subject. While others might find the difference between full-spectrum and modern high CRI LED lighting to be subtle, Kuusela finds this mathematical discrepancy between the lights to be highly noticeable. Therefore, when it comes to night scenes, she prefers to use tungsten versions to light the subject, which provide a similar effect to soft diffused LED like a China ball, using a 100-watt bulb, nanolight, or a small chimera.

In summary, the early limitations of LED lighting made it challenging to use directly on the face of actors due to the harshness of the light, inaccurate colour replication, and unpleasant luminescence on skin texture. With the emergence of reliable LED lighting options such as Arri Skypanel and Vortex, cinematographers and gaffers now have the freedom to use LED lighting in their own preferred ways of working. Although professionals in the field may have varying approaches, the majority do not see any issue with using LED lighting to illuminate the subject, and they accept the use of them even if their preference would be to use full spectrum lights specifically to assist with meeting strict time constraints. While some still prefer to use additional diffusion and obstruction to achieve, in their view, a more pleasing look, others find LED lighting to be sufficiently pleasing to the eye without these added measures. Thus, there has been significant aesthetic development in LED lighting, even in recent years, and this trend is likely to continue in the coming years. The limits and capabilities of LED lighting sources have not yet been fully explored, and we are still at the beginning of the LED lighting journey, with a predominant use of soft LED lighting in various ways.

small lights = big lights

During a small workshop at Aalto University, Karri Pöykiö (2023) discussed a feature film, *Stormskerry Maja* (2024), which he is currently working on and the equipment list, highlighting how the definition of a "small light" has evolved over time. Pöykiö gave an example of how, in the past, a 2k tungsten Fresnel was considered a small light on a film set when tungsten lights were primarily used for lighting. However, for this current feature, a 2k tungsten Fresnel is now considered a big light due to its harsher and stronger output compared to the most used LED sources on set, such as the Vortex and Astera tubes.

Moreover, the purpose of practical lights may have evolved. In any form, whether it's a lamp, fire, or massive TV screen, practical lights can now be used as a key light instead of merely an atmospheric light. Traditionally, large lights were necessary to

expose the image correctly, and practicals served a different purpose. However, in contemporary filmmaking, the key light can easily be a lamp on the bedside table, which can be extended by smaller LED units such as Vortex, Kinoflo Select LED, or other reliable sources.

This approach suggests that while the use of practical lights appears to remain the same, some cinematographers may be using more lighting units in contemporary filmmaking. Mika Orasmaa (2022) has observed an increase in the number of individual light sources he uses for a scene. In addition to practical sources within the image for depth, intrigue, and aesthetics, Orasmaa also uses small units such as Astera tubes and Kinoflo Select LED lights to extend the practical source from multiple locations. In a traditional tungsten workflow, the sources of light would have been larger and would have flooded more light into the scene. LED units, however, seem to be easier to control and use to paint the scene with light in a specific nuanced manner. Consequently, at least for some cinematographers who have experienced this development in their careers, there are likely more units in a contemporary lighting setup than in a traditional tungsten lighting setup when practicals also served a different purpose.

When it comes to aesthetics, the number and type of lighting units used can significantly impact the shape, quality, and intensity of the lighting. The use of a greater number of smaller units can alter the dynamics of the key, fill, and backlight and affect how they shape the subject. While this change may not significantly impact the final product's aesthetic, it can greatly affect the cinematographer's working practices. Ultimately, it depends on how the cinematographer uses these smaller units, regardless of their number. However, it's worth noting that factors such as surface area and intensity of a unit still affect the overall aesthetic quality of the light, even if their impact is mitigated by the cinematographer's chosen practices.

collaboration with production designer

Despite the consensus among cinematographers that collaboration with production designers has been crucial since the inception of cinema, there remains a question as to whether the evolution of light technology has altered the nature of this partnership or introduced novel elements that were previously not as extensively considered. The distinction between lighting and the art department is becoming increasingly blurred as technological advancements allow for more integration of colour, texture, reflections, practical lighting, built-in lighting, and other elements into both lighting and set design. Consequently, the proliferation of lighting techniques, as noted by Ville Penttilä (2023), has a direct impact on the creative expression of the art department in collaboration with lighting.

Given the interconnectedness of the art department and lighting, it is important to obtain a comprehensive analysis of the effects of lighting technology on collaboration. To this end, it was deemed necessary to interview a production designer for this thesis. According to Kaisa Mäkinen (2023), her starting point for collaboration remains unchanged, as she aims to design and construct a set that can be lit. For Mäkinen, the ability to create a set that is amenable to lighting is the most critical skill when designing a set. This requires the inclusion of light sources, such as practicals, windows, or other elements, that provide motivation in the required locations within a set, allowing the cinematographer and gaffer to extend the film's aesthetic work into the realm of lighting. Such collaboration is vital for the success of both the production designer and the cinematographer in realising their respective visions that serves the overall direction of the film's aesthetic. Despite the influence of technological advancements on lighting, this fundamental aspect of collaboration between the art department and lighting has remained unchanged, although the interaction between the two has expanded due to the increased possibilities for artistic expression that are available to both departments.

Firstly, Mäkinen reflects on how lighting technology has impacted her own work, noting that the absence of a cluttered and tangled array of light units and cables has substantially increased the comfort and space available in her work environment. This advantage extends beyond the art department, benefitting everyone involved in the film set. Specifically, the lighting crew can work more efficiently, with all equipment connected to a DMX board or a gaffer's control, enabling easy and swift adjustments, and reducing the clutter and obstructions inside and around the set. Such a work environment is particularly ideal for film sets where space is typically limited, and the presence of cables, large lighting units, and accessories can create significant challenges.

In addition to discussing the impact of lighting technology on her own work environment, Mäkinen also reflects on the progression of the aesthetics of film and practical lights. She observes that there is now a wide variety of lighting units available, ranging from futuristic to retro in her own work as well as the lighting department's work. As a result, lights can be seamlessly integrated into a film set in various set designs. While practical lights have been a part of film sets for many years, their role has evolved. In the past, practicals were mainly used to provide ambience since they didn't emit enough light, whereas now they can serve even as the key light, illuminating the set.



figure 7.1
In this still from *The Handmaiden* (Park 2016) the practical is the key light for the subject, lighting the frame.



figure 7.2
This wide from *Everything Everywhere All at Once* (Kwan 2022), there is a multitude of practical sources including lamps and screens that add ambience, but also significantly impact the lighting of the shot.

Furthermore, practical lights can play a key role in advancing the plot. Since almost all technological devices emit light to some degree, anything with a screen within the set can provide motivation for light or be the actual light source providing the key light in the scene. Mäkinen also emphasises the importance of having more lighting motivations rather than less. Consequently, Mäkinen's work has undergone a change with an increase in the number of production design elements such as props, background screens, and practical lighting that emit light, which require screening and testing by the cinematographer to ensure that the desired visual effect is achieved without any aberrations or loss in quality.

In his interview, Rauno Ronkainen (2023) echoes the idea that with such a vast range of light-emitting props available in contemporary times, it is necessary to conduct tests to maintain control over a film's aesthetic. This, in turn, leads to increased collaboration, not only in terms of creative input but also in the technical aspects of the filmmaking process. Furthermore, the use of lighting as a set design element has become more prevalent in addition to prop sources. Ronkainen cites an example of a scene set in an aeroplane design where LED lights were integrated into the set, and each unit's colour and intensity were selected individually. He notes that the responsibility for such decisions lies not only with cinematography but also with production design. The boundary between these departments is blurred, making it difficult to attribute the aesthetic to any one person or department later on. As all departments contribute ideas, the gaffer may also have practical comments that impact artistic choices. As a result, he suggests that the ideas of the production designer, cinematographer and gaffer should be considered to achieve a combination of technical execution and artistic vision. Effective collaboration within the departments naturally fosters these ideas, leading to an ever more interconnected and cohesive final product.



figure 7.3
This still from *Squid Game* (Red Light, Green Light 2021) season 1, episode 1, the subject's face is lit by the cellphone screen that he is holding.
Image by Lee Hyeong-deok



figure 7.4
In this still from *I'm No Longer Here* (Frias de la Parra 2019), the subject is lit with LED strip lighting from the shop window.
Image by Damian Garcia

During her interview, Meri Proud (2023) acknowledges that the collaboration between the lighting and art departments has undergone significant changes over time. While she recognizes that there has always been some level of cooperation between the two departments, she notes that it has become more intricate and refined with the advancements in the industry. Proud points out that technical decisions are typically made before the gaffer becomes involved in the process. Therefore, she emphasises that the most successful production designers are those who incorporate the technical and aesthetic aspects of lighting into the design process from the outset. For instance, Proud cites the example of LED technology which, while offering new possibilities, also creates new challenges that require close collaboration between the two departments. Proud uses curtains in front of windows as an example whereas gaffers often want to create an illusion behind the window. In such cases, rather than tearing down black curtains, which have an opacity soft LED light cannot compete with, Proud believes that it is essential to discuss potential complications in advance to avoid any misunderstandings and collaborate to full ability taking into account both the art and technical implementations.

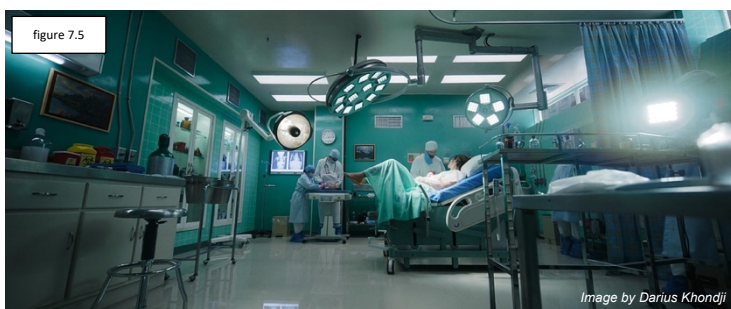


figure 7.5
This still from *Bardo, False Chronicle of a Handful of Truths* (Iñárritu 2022) is a clear example of set elements with built in lighting.
Image by Darius Khondji



figure 7.6
Tár (Field 2022) showcases built in lighting into the production design in this still from an airplane interior.
Image by Florian Hoffmeister

Proud contends that the increasing availability of lighting tools has led to a greater need for communication and collaboration between the two departments, given the possibilities of creation that have also increased. Furthermore, Proud highlights the impact of technological advancements, such as cellular phones, which have

revolutionised communication in film productions. Proud remembers that when she first started working in the industry, there was only one cellular phone available on set, which was exclusively used by the producer and cinematographer. However, in modern film productions, everyone can use their phones to call or message other department heads to discuss artistic choices, resulting in more opportunities for effective collaboration. As a result, the evolution of lighting and phone technologies has broadened the possibilities for communication and collaboration, thereby enhancing the partnership between the lighting and art departments.

As film technologies continue to evolve, the collaboration between the art department and lighting is crucial in bringing to life the unique visions of the production designer and cinematographer, all of which contribute to the film's aesthetic. With advancements in technology, the possibilities for lighting have expanded, providing filmmakers with a wider range of tools and more efficient work environments. As a result, effective communication and collaboration between the art and lighting departments have become increasingly essential to fully realise the creative potential of these new technologies.

lighting and actors

In the interviews with professionals, LED-based technology was mentioned as a practical solution for several reasons. One of the key reasons is its low power consumption, which makes it possible to operate using batteries. As a result, it provides a cable-free way of working on top of the already smaller and more compact units, which makes them easy to move around. Mika Orasmaa (2022) noted that he aims to have a cable-free set wherever possible. Although it is not yet possible, this is the direction in which the industry could be heading.

The benefits of a cable-free working environment are numerous. It not only frees up time from the lighting unit but also provides space for other departments to operate as previously also noted by Kaisa Mäkinen (2023). Moreover, it eliminates potential hazards and, possibly most importantly, offers actors the freedom to move and work within the set to perform at their best. Within the cinematography industry, there has been a longstanding debate on how much equipment can be placed around actors without interfering with their work or that of the director. Ultimately, a film set aims to mimic real life, and too many lights and equipment can detract from that goal.

An important factor that emerged during interviews with professionals is that the downsizing of lighting has had a significant impact on creating a more realistic lighting environment for actors, allowing them to better emulate realism within their performances. Gone are the days of harsh spotlights and stage lighting that actors must ignore in order to perform and be seen.

Two key technological advancements have made this possible: sensitive sensors and soft lighting technology. During the workshop at Aalto University mentioned earlier, Karri Pöykiö (2023) discussed his current feature film production, *Stormskerry Maja* (2024), which is being shot using the new Arri Alexa 35 camera. This camera can handle low-light situations better than the human eye. Pöykiö mentioned that the Astera tubes they are using are set at only 20%, and the difference between having them on or off is barely noticeable to the human eye. However, when viewed through the camera's viewfinder loop, the difference is significant, as the fill light appears to be completely missing when the Astera tube is turned off.

One of the significant benefits of this technological development is that it has made it easier for the cinematographer to discuss the visual elements of a scene without needing to resort to mentioning how the image needs to be adjusted in post-production, as the amount of light necessary to capture a clean, correctly exposed image is now available on set. This advancement also ensures that the final image and the lighting on set are closer to one another than ever before, thereby reducing the potential for misinterpretation of the vision by other departments involved in set design, props, special effects, camera operation, and more.



This still from The Worst Person in the World (Trier 2021) is primarily lit with the practical light above the actors, resulting in a very realistic lighting that could be seen in real life rather than just in a film.

However, the most significant advantage, according to Pöykiö (2023), is for actors who can now perform in an environment that is simulated to be as close to the script's atmosphere as accurately as possible. With low light-sensitive cameras and lighting equipment capable of producing clean, aesthetically pleasing, soft, and dim

light, actors no longer must imagine a dimly lit room in a studio but can now perform in a room that is actually dimly lit. This level of realism allows actors to blend story and reality, creating more relatable art. Pöykiö asserts that this new collaboration between cinematography/lighting and actors is made possible by the advent of low light-sensitive cameras and lighting equipment capable of radiating soft, dim light. Thus, the creative potential flowing from advancements in lighting technology extends beyond cinematography to impact other artistic aspects of production and has a ripple effect on acting, production design, directing, and other departments.

night lighting

The aesthetic of night lighting in films has evolved over time, and the approach of cinematographers plays a crucial role in determining the extent of this development. Different lighting methods and technologies have been embraced by various filmmakers, such as the flying moon lighting method favoured by Mika Orasmaa (2022), which has become significantly faster to implement and command with the advent of LED technology. Similarly, Karri Pöykiö (2023) emphasises the ability to create illusions in night scenes using lightweight and battery-powered equipment. For instance, in a tight timeframe, LED lights can be used to create the illusion of a city or village in the background of a scene, even if there is none.

Meri Proud (2023) affirms that the development of lighting technology has expanded the possibilities of night lighting in film. However, she argues that the starting point for achieving effective night lighting remains a challenge. Despite the diverse range of tools available to gaffers and cinematographers, the film industry tends to rely on established formulas for implementing night lighting. These practices typically feature lighting that is either inspired by the cool, soft tones of moonlight or the warm, orange hues of sodium vapour streetlights. Moreover, Proud's insight highlights that a film's aesthetic and genre have always played a crucial role in determining how night lighting should be executed. For instance, children's movies may require brighter lighting than horror films, given their respective styles. The good news is that both low and high-budget films now have access to a wide range of lighting options to enact the desired style, which wasn't always the case in the past. This has led to a greater degree of experimentation with night lighting, facilitated by the availability of a large variety of equipment.

Considering the importance of lighting for contrast, it is worth exploring how the role of exercising levels of stylistic choices in night lighting has evolved with advancements in light technology. Jani Lehtinen (2023) explains how the role of exercising levels of stylistic choices in night lighting has evolved with advancements in light technology. In classic films, night lighting perhaps had a more abstract style. When a light was directed at something within the frame, it caused that part of the

frame to be 3 or 4 stops over-exposed, radiating while everything else in the frame was underlit, this contrast creating a distinctive stylistic feeling of the night. This stylistic choice may have been swayed by the limited format in low light conditions and equipment available during earlier cinema. Conversely, contemporary night lighting seems dimmer, with less contrast, altering viewers' and filmmakers' perception of night within contemporary films. The newer way of imitating light at night takes advantage of low light-sensitive cameras and lighting technology like LEDs, which is a testament to the interdependence of artistic style and technology. Lehtinen sees these artistic styles as a gift of riches in artistic expression. Filmmakers' fight against engrained perceptions of night aesthetics and having more reference material to base extreme artistic choices upon broadens the creator's mind to the possibilities within night lighting aesthetics. This highlights the progression and expansion of the artistic style of lighting, with an increased range of lighting tools in the toolbox to assist.

As the role of exercising levels of stylistic choices in night lighting has evolved with advancements in light technology, finding the right balance between too much contrast and just enough has become a delicate art. With the progression of highly sensitive low-light contemporary cameras, some cinematographers have fallen into the trap of not lighting with enough contrast. According to Rauno Ronkainen (2023), lighting for contrast is still significant even with the use of these advanced highly sensitive cameras in low-light scenarios. The appropriate lighting facilitates the keying of certain colours in post-production, making the process easier and more attainable. In cases where the image lacks contrast or lighting is insufficient, with levels that are very similar, the manipulation of the image in post-production becomes challenging. However, lighting for contrast allows for balancing out the image in post-production by bringing each element to a desired level. Cinematographers with experience are better positioned to determine what can be easily altered in post-production without being overly complicated or necessitating rotoscoping to achieve the desired visual. Given a choice, Ronkainen prefers to err on the side of over-lighting to achieve greater control with a digital negative that has good density rather than leaving the scene lowly lit with similar levels across the board. In considering lighting, the aim is to have a healthy negative that captures all the necessary details and information in both film and digital formats. For instance, if a night scene appears too bright, it may require tweaking the contrast, light shape or boundary, or colour contrast to create an illusion of night, much like in the time of shooting with film stock. Simply dimming the levels will not result in a change in the image but rather compresses the same information. When lighting, it is vital to consider the three-dimensionality of an image through contrast, regardless of the sensitivity of the camera. Although contemporary cameras require less light to create contrast, it remains crucial to take into account for achieving the desired image rather than a mess of dim, pastel tones.

Overall, night lighting in films has come a long way, with the advent of new technologies and equipment providing filmmakers with a wider range of options to achieve their desired aesthetic, especially when visually expressing night. While established formulas for implementing night lighting still persist, the availability of a diverse range of lighting tools has allowed for more experimentation and creativity in stylistic endeavours. Nevertheless, finding the right balance between too much contrast and just enough remains a delicate art with the ever-growing capabilities of cameras in low-light scenarios. As technology and art expression continue to evolve, we can anticipate further developments and artistic explorations in the realm of night lighting aesthetics.

lighting accessories

In evaluating the developments in lighting over the years, it is important to note that the equipment requiring technology and electricity to function is only one aspect of lighting. Another important component of lighting is the accessories used to shape light quality, texture, and form. With the introduction of LED lighting, the use of diffusion, gels, and other light-shaping tools has become significantly easier, as the heat emitted by LED lighting units is considerably less. This has resulted in more efficient and cost-effective lighting solutions, as many light-shaping tools can be attached directly to the lighting unit which Karri Pöykiö (2023) emphasised in his interview.

Jani Lehtinen (2023) has highlighted the development of light-shaping tools as one of the most significant changes in lighting. Stefan Karie, the founder of DOP Choice, has built a career out of creating lighting accessories such as snap grids, soft boxes, and egg crates for LED light sources. These accessories have contributed to the soft and directed use of LED lights. However, the prominence and over-creation of these types of tools may have also contributed to the way that LED light is marketed and used. LED lighting is often marketed to provide quickly produced soft and beautiful light that gives skin tones and textures a beautiful glow. Therefore, it is important to consider how much the way LED light is used is determined by how it is marketed.

Furthermore, the fact that all new LED technology until now is predominantly marketed as soft lighting raises questions about how much this trend has increased the use of soft light in productions. An argument could be made that the heavy marketing of LED lights, along with the accessories used for LED lights, has contributed to the prominence of soft lighting in films. It is important to consider how much of this trend is driven by marketing and how much is based on the technical capabilities of LED lights. As technology continues to advance, it will be interesting to see how LED lighting techniques and trends continue to evolve in response to both technical capabilities and marketing strategies.

environmental benefits of LED

Given the current climate crisis, it's essential to consider the environmental impact of the film industry, particularly the effects of lighting. The extended use of halogen and HMI bulbs during film production consumes significant amounts of electricity and contributes to waste and environmental degradation. In his interview, Jani Lehtinen acknowledged the industry's responsibility to reduce its environmental impact. Just as the world has embraced LED lights due to their low energy consumption, the film industry should also strive to adopt more sustainable practices.

However, Lehtinen also acknowledges that the artistic vision ultimately drives the decision-making process. While there's a need to adopt a more environmentally conscious approach, lighting choices still depend on the shooting location and aesthetic goals of the film. Although advancements in camera sensitivity have made it easier to use less powerful emitting lights, these factors continue to be critical in choosing the right lighting for a scene. In his own work, Lehtinen still brings HMI lights as a backup when predominantly lighting LEDs in a place with varying lighting conditions. By adopting a more sustainable approach to lighting, the film industry can contribute to a healthier environment though the goal is to not compromise artistic vision. As more energy-conscious lighting sources enter the market, future endeavours in lighting technology could further reduce the industry's impact on the environment.

3.3 control of colour lighting

From the inception of colour film, cinematographers have been able to manipulate another element of contrast in addition to light - that is, contrast in colour. According to Rauno Ronkainen (2023), he has frequently employed this technique throughout his career, starting from his student days when he would question and examine how films separated the foreground and background for depth. This drove him to strive for a similar approach in his cinematography. In an ideal world, these are also facets that production and costume design teams consider. In the case of predominantly tungsten lighting sources in a scene, Ronkainen emphasises the importance of potentially using a whiter light source to create colour contrast in the subject's skin tone for example, which helps to distinguish between different tonal values within the image and facilitates easier colour manipulation in post-production. This ensures that the overall colour tone of the image does not become excessively warm. This is a practice that can be applied to any lighting setup and should be considered.



In this still from The Deer Hunter (Cimino 1978), the subject is lit with colour contrast in mind. Despite the tungsten key light, the subject appears three-dimensional due to the interplay of tonal and colour contrast. The use of colour contrast enhances the overall depth and dimensionality of the still.



This still from Everything Everywhere All at Once (Kwan 2022) features a more subtle colour contrast, which can be observed on the subject's neck. While a warm key light dominates the scene, the cooler fill light emits from the right side of the frame.

The use of colour contrast in image-making is a vital aspect of cinematography that can significantly impact the final product. To achieve the desired results, cinematographers and gaffers require precise control over their lighting fixtures, which is where the DMX protocol comes into play. According to Karri Pöykiö (2023), one of the most significant developments in light technology is DMX (Digital Multiplex). DMX is a communication protocol used in lighting, mainly in stage and event production, to control the dimming and colour mixing of lighting fixtures. It allows for multiple lighting fixtures to be controlled by a single controller or console, making it more efficient and versatile than traditional analogue control systems. The DMX protocol sends a digital signal through a DMX cable to each fixture, which interprets the signal to adjust its light output based on the instructions received. This system has become a staple in stage productions, but it has also revolutionised the way that gaffers work on film sets.

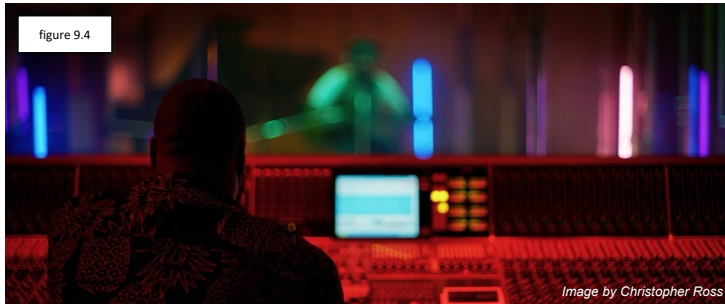
With the use of wireless DMX controllers, gaffers can work alongside cinematographers to make quick changes to lighting without the need for a technician to make physical adjustments to the lights. This system significantly speeds up the work efficiency of the lighting crew on set during shoot days. This newfound ability also allows for more creativity to be brought to the scene, as gaffers and cinematographers can experiment with colour contrast, light contrast, and special effects without having to rely on a large crew or a significant budget.



In this wide shot from Empire of Light (Mendes 2022), there is a subtle colour contrast between the warm lighting in the dining room and the more neutral lighting in the kitchen.

It could be argued that DMX technology has helped with the further popularisation of LED as all the benefit of the lights is accessible with the touch of a button or the push of a slider. In this way, DMX technology has made it easier to manipulate colour in a scene shot by shot. According to Pöykiö, the use of a DMX board allows gaffers to achieve more precise and creative approaches to lighting. This is especially important when it comes to lighting skin tones, which can vary significantly from person to person. With the ability to wirelessly adjust the colour or intensity of the light, gaffers can fine-tune the lighting to bring out the best in each subject's complexion. Moreover, DMX technology allows for subtle adjustments to lighting levels as the camera or subject moves within a scene, providing greater control and precision in the final product. By leveraging the versatility of DMX, gaffers can achieve more nuanced and effective lighting, resulting in a more visually compelling and engaging final product. Moreover, the ability to change the colour of the light on set helps promote creativity, as was the case with a bar scene that Pöykiö worked on. Without LED technology and multi-colour lights available, Pöykiö and the cinematographer might not have thought to gel tungsten or HMI lights, which would have led to a different lighting scenario altogether. However, since there was a possibility of changing light colour, it helped promote creativity to create a mixed lighting scenario that felt appropriate and heightened the mood within the aesthetic parameters they had set. With the ability to change the colour of the light at their fingertips, gaffers and cinematographers have the freedom to experiment and create

unique and colourful lighting scenarios that can heighten the mood and aesthetic of the scene.



In these two shots from Yesterday (Boyle 2019), a drastic colour contrast in lighting is evident, which appears to be solely lit by LED sources.

The aesthetics of cinema, particularly regarding colour, have been significantly influenced by technological advancements, which have played a crucial role in driving innovation and creativity. In the early days of cinema, elaborate programmed lighting was restricted to high-budget films, but now, independent filmmakers can also achieve the same effects. What matters most is the shape and quality of light, not the tool that creates it. In the past, achieving colour lighting was time-consuming and required a lot of crew members to execute it effectively. However, innovations such as DMX have made it possible to manipulate lighting shape and quality more efficiently and across a broader range of equipment and budgets. What was once impossible to create 50 years ago is now easily achievable in contemporary production. This allows all types of productions to achieve higher quality results with the equipment and time they have. Although many versions of lighting technology are no longer in use, it is important to acknowledge that they played a crucial role in the progression of contemporary equipment.

3.4 democratisation of cinema

The democratisation of the film industry through digitalisation has made filmmaking more accessible, allowing almost anyone with the determination to produce a feature film. However, the traditional path of working one's way up the ladder from assistant to operator and finally cinematographer is no longer the only way to acquire the skills and experience necessary to become a cinematographer.

"Learning the characteristics of emulsions is ground-level knowledge in the era of 35 mm film" (Bailey, 2012, p. 10)

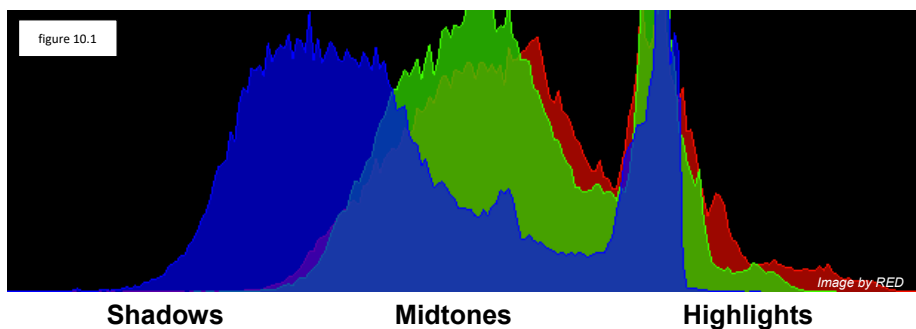
As Bailey notes in the foreword of the book *Masters of Light* (2012), learning about emulsions was fundamental knowledge for cinematographers in the era of 35mm film. Even veteran cinematographers required tests when experimenting with new film stock. This thorough and calculated process meant that the cinematographer could only see the fruits of their labour the next day when viewing dailies. There was no guarantee during the shoot that the image was successfully exposed, so the cinematographer had to rely on their previous experience and knowledge of lighting to capture the scene.

"The conundrum of digital video filmmaking lies partly in the simultaneous complexity of the cameras themselves and the apparent ease of actually creating images" (Bailey, 2012, p. 9)

With the rise of digital video, creating images has become significantly easier, influencing lighting practices in contemporary filmmaking. Digital cameras often have a monitor, providing an image for the cinematographer and director to view. This has given many amateur cinematographers the confidence to shoot without measuring light adequately for the desired effect. While digital cameras have built-in tools to measure light, such as histograms and vectorscopes, some amateur cinematographers may rely solely on their visual judgement, neglecting the use of lighting measurement tools. This approach represents a departure from the traditional methods of cinematography, where the cinematographer relied on their experience and expertise to create the desired aesthetic. While the ability to see the effects of lighting choices in real time can be liberating, it also challenges the notion of lighting as an art form. Without careful consideration of lighting and its impact on the final product, the resulting work may fall short of its artistic potential.

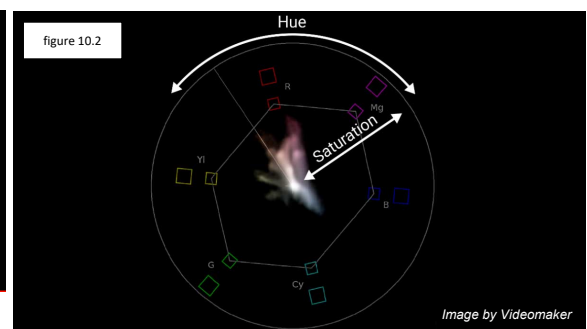
"But the aesthetic consequences of exposure decisions based on lighting are inherent in the choices that any cinematographer makes" (Bailey, 2012 p. 12)

As Bailey (2012) further notes, the aesthetic consequences of exposure decisions based on lighting are inherent in the choices that any cinematographer makes. Although cameras have changed over the years, the aesthetic choices still heavily lie in lighting and how it cooperates with the chosen medium. In her interview, Kaisa Mäkinen (2023) emphasised that although there have been significant technological advancements with cameras, realising the full aesthetic potential of production design in the final image captured ultimately depends on the skill of the cinematographer and gaffer in lighting the scene accordingly. Thus, an image that is captured without thought or consideration regarding lighting lacks a vital storytelling element. While the film market is saturated with feature films that deviate from the lighting practices of professional storytellers, exceptional feature films and professional cinematographers hold lighting in high regard.



An illustration of a histogram exposure tool, which provides a visual representation of the distribution of brightness levels in an image.

From "Exposure with Red Cameras: In-Camera Histogram Tools" by RED. N.d. RED. Retrieved 8 May 2023, from <https://www.red.com/red-101/red-camera-exposure-tools>.



A vectorscope exposure tool, which provides a visual representation of how saturation and hue are distributed.

From "What are Vectorscopes and Why are They Important?" by Collins, G. 20 January 2023. Videomaker. Retrieved 8 May 2023, from <https://www.videomaker.com/how-to/editing/color-correction/what-are-vectorscopes-and-why-are-they-important/>.

lightmeter

The emergence of monitoring and super-sensitive sensors has rendered exposure tools obsolete for some veteran cinematographers. In the case of Mika Orasmaa (2022), the need for a lightmeter has diminished due to the camera's heightened sensitivity to light in comparison to the human eye. Consequently, a calibrated monitor has become an indispensable tool in his arsenal for lighting. Given the camera's sensitivity to light, proper calibration of the monitor is critical for obtaining a faithful image of what is being captured. Analogous to the era of film, where an overabundance of light rendered the human eye unreliable for gauging exposure balance made the light meter indispensable, the monitor now serves a similar purpose in contemporary filmmaking, as it can reveal low-light values beyond the capability of the human eye.

Tuomo Hutri (2023) has also observed a shift in his use of a lightmeter. Previously, Hutri relied heavily on the lightmeter as a means of measuring and gauging the lighting of a scene which was necessary, along with prior experience, to achieve the desired aesthetic and maintain a healthy negative film stock. Nowadays, he tends to

use the light meter before the shoot for pre-lighting and communication purposes to determine the required levels and further discuss the matter with the gaffer. Additionally, Hutri occasionally uses a lightmeter throughout the shoot day to maintain continuity, ensuring that the aesthetic of the film is consistent. In this sense, the lightmeter serves as a basic tool to prevent aesthetic inconsistencies brought on by fatigue or his eyes adjusting to various lighting scenarios. Hutri notes that this shift may be influenced by his personal journey as a cinematographer and his skill level at the time when film was prominent. Notably, Hutri mentions hearing that renowned cinematographer Vittorio Storaro would only measure the key light possibly due to his familiarity with the format and with using the same equipment repeatedly, even in the era of film.



A relatively contemporary sekonic light meter with labels.

Adapted From "Film 101 - 3 Reasons You Should Use a Light Meter?" by Bryan, S. N.d. *Stephanie Bryan Photography*. Retrieved 8 May 2023, from <https://stephaniebryanphoto.com/myblog/film-101-3-reasons-you-should-use-a-light-meter>.

In the interviews, it was commonly observed by cinematographers and gaffers that the role of the light meter has shifted. These insights into the use of the light meter raise questions about its continued relevance in the era of digital cinematography. While everyone's shift in use may be influenced by personal experience and skill level, it is important to consider whether technological advancements have made the light meter less pivotal without sacrificing image quality or whether it remains a fundamental aspect of cinematography. As such, it is important to explore the continued relevance of the light meter in the evolving landscape of cinematography.

As a student of cinematography, I was taught that a light meter is essential. However, I had not considered that this idea may be challenged by technological advancements. As tools of the trade evolve with technology, even the most commonly used and favoured tools are subject to obsolescence. While the light

meter is still widely used, is it primarily out of habit from the days of film, or is it a fundamental aspect of cinematography as a whole? In the age of digital cinematography, could the light meter become less pivotal without sacrificing the quality of the images produced, or will it lead to uninspired lighting? These are important questions that merit further exploration.

diversity within the industry

Although technological advancements in equipment, including cameras and lighting, have not entirely eradicated the barrier to entry in the film industry, they have certainly had an impact. While films can now be produced outside of the traditional studio zone, financing and distribution remain significant hurdles that must be overcome before the film industry can truly become accessible to all aspiring filmmakers (Steele, 2011). Though these restrictive factors exist, there has been a significant reduction in the barrier to entry, enabling greater diversity within the industry.

One important factor that is often overlooked when discussing diversity in the film industry is the diversity within the below-the-line crew. While it is notable that there is now a greater representation of people of colour and women-identifying persons as directors in contemporary cinema, it is equally important to acknowledge the increasing number of women who are working as electricians, camera assistants, and grips. Meri Proud (2023) has recognised the significant impact of technological advancements on this growing diversity. Historically, technical roles in the film industry have been dominated by men. Proud recalls that, earlier in her career, it was unusual to see women on the lighting crew, though they were typically embraced in positions such as makeup designer or script supervisor. However, today's Finnish film industry shows a consistent representation of women in lighting, camera, and grip crews. Proud states that technological advancements have contributed to this shift, as many aspects of these departments no longer rely largely on physical strength, weight, or external appearance but also require intelligence and skill. For example, lighting technology, though not all, has become smaller or easier to manage, and the control of lighting now depends less on physical ability and more on technological tools like DMX systems. As a result, women are excelling in these departments and providing invaluable insight into film productions.

Proud notes that these changes have also led to more realistic working conditions, which she attributes to the increased diversity of the crew rather than technological advancements alone. For example, in the past, lighting crew members were expected to be able to lift six sandbags at a time, which was an unspoken expectation formed in an environment traditionally dominated by men. Proud emphasises that this and many other demanding expectations that were present

before are not healthy. When working as a gaffer, she insists her crew carry a maximum of two sandbags at a time. These changes, combined with technological advancements, have improved gender equality in Proud's opinion. Although there is still a predominantly masculine environment, there have been significant changes in thinking within technical departments of the industry.

Proud concludes by stating that technological advancements have contributed to the normalisation of diversity within the film industry by decreasing dangerous and strenuous expectations that have previously prevented women from entering technical crews. New technology has led to more intelligent work practices that allow individuals with varying physical abilities to contribute to the industry in meaningful ways. While there is still progress to be made, it is clear that the industry has made great strides in creating more equal opportunities for all those who wish to work in it. In turn, the inclusion of previously excluded filmmakers, has broadened the creative expression of society, leading to greater opportunities for aesthetic exploration in contemporary cinema than ever before.

3.5 impact of lighting technology in the aesthetic of films

At this point, it is fair to conclude that to at least some degree advancements in lighting technology have influenced the way in which lighting is practiced, and conversely, the evolution of lighting practices has had an impact on the development of new technologies. As Alexander Nevill highlights in his thesis *In Light of Moving Images*, Patrick Keating's rationale suggests that *"the casual relationship between technology and style can go both ways. Just as a new technology might spark cinematographers to explore a new style, the stylistic preoccupations of cinematographers might push the industry to invest in certain technological research likely to have market potential"* (2018, p. 123). Therefore, the interplay between technology and artistic expression within the realm of cinematography is a complex and dynamic process.

In contemporary cinema, lighting aesthetics go through different phases. Soft, pretty light is currently one of the most prominent trends. The market is currently saturated with soft LED lights, and many films have incorporated this lighting technique into their aesthetics. As technology has developed and become more compact, it has allowed for more intricate and natural lighting techniques, with lighting sources often hidden within practical sources. This shift towards natural lighting techniques can be seen as a reaction to the traditional studio lighting known in the early days of cinema. These observations inspired the writing of this thesis, as I have frequently encountered similar lighting practices on the sets I have worked on as a camera assistant. Due to its efficiency, LED lighting is now more common than not. This prevalence of LED lighting raises questions about how time constraints influence the implementation of aesthetic choices, which in turn creates an ongoing struggle between time and art in film production.

Moreover, as cameras have become more sensitive, less characterised lighting has become possible, allowing for naturalism and soft lighting to take over. The amount of light required to achieve contrast has also been affected by more sensitive cameras. The stylistic preoccupations of cinematographers have pushed the industry to invest in certain technological research that has market potential and vice versa. In addition, the rapid development of LED technology has revolutionised not just cinema lighting equipment but all light-emitting technology, including appliances, screens, and even everyday objects, as they have been integrated into the film industry. This technological evolution, coupled with improvements in camera sensitivity, has transformed how cinematographers and gaffers use ordinary assets to their advantage when lighting.

While advancements in lighting technology have been significant, it is equally important to acknowledge the role that light-shaping tools and marketing play in the way LED lights are used. The heavy marketing of LED lights as soft lighting solutions

has contributed to their popularity in productions. With the emergence of new energy-efficient technologies, the common aesthetic of LED lights might undergo a weighty shift, especially if they can devise an approach to compete with harsh and spotted sources such as tungsten or HMI fresnels. As technology continues to advance, it will be interesting to witness how lighting techniques and trends continue to evolve in response to both technical capabilities and marketing strategies of the future.

The role of technology in lighting and camera advancements cannot be overlooked, as it has allowed for many unexpected benefits. Realism for actors within the lighting environment has improved, and good visual communication for directors has increased. Night lighting is more intricate than ever before, and technology has allowed for more precise control of lighting and the ability to manipulate colour in a scene shot by shot, resulting in a more visually compelling final product. Moreover, the way cinematographers and gaffers view light has shifted as formats have progressed beyond the scope of the eye's visual perception. Wireless DMX controllers allow for quick changes to lighting increasing work efficiency and in turn, promoting creativity. DMX technology also allows for more precise control of lighting and the ability to manipulate colour in a scene shot by shot, resulting in a more visually compelling final product.

The more abstract influences of technology, which do not necessarily affect the aesthetic of cinema but rather the working environments and in turn also have aesthetic implications are also important to factor into the discussion. Technological advancements have reduced the barrier to entry in the film industry, allowing for greater diversity in a crew. Lighting technology, in particular, has become smaller and easier to manage, relying less on physical strength and more on skill and intelligence. This has resulted in an increase in women working in lighting, camera, and grip departments. These changes have led to more realistic working conditions and improved gender equality within the industry. While progress is ongoing, it's clear that technology has contributed to the normalisation of diversity within the film industry. This, in turn, has had a profound impact on aesthetics, as more diverse voices can now visually express their stories through film, resulting in a more multifaceted industry with regard to aesthetics.

With technology impacting the speed and crew sizes that productions can function at, it is important to note that efficiency and consumerism may have taken over the art of cinematography to some extent. In general, the people behind the funding, want to mass produce products resulting in a desire to manufacture the desired effect in the least amount of time, even if the vision is unclear. As a result, artists, including cinematographers and gaffers, are under pressure to consistently deliver in order to secure future opportunities within the industry. Filmmakers face the challenge of striking a balance between efficiency and artistic expression while

exploring the potential of lighting technology without sacrificing the essence of their artistic storytelling.

The drive for efficiency and profitability in the film industry may stifle artistic experimentation and result in repetitive, imitative works. This is due to a surge in contributors because of the democratisation of cinema, as well as pressure to churn out content for profit. It is crucial to explore the interplay between technology and style and to examine the constraints imposed on artists by the industry. As new technologies emerge, older practices become outdated and forgotten. It is worth questioning whether these older practices still hold value in filmmaking and whether they have been discarded prematurely. What ways of working are being pushed under the rug as new technologies appear?

Overall, the impact of technological advancements on lighting technology in cinema cannot be overstated. These advancements have allowed for more intricate lighting practices, which undoubtedly has led to visually stunning and believable films. The dark side to this though, is the balance between efficiency and artistic expression. We must be mindful of the limitations that the industry's demands place upon artists and consider the implications of new technologies. We make technology, and in turn, technology makes us. As we continue to push forward with innovation, it is essential to maintain a critical eye towards the potential consequences of our choices. Without this awareness, the industry risks falling into a loop of repetition, stifling creativity, and only prioritising mass production. Ultimately, it is up to filmmakers to use technology in a responsible and thoughtful way so that the art of cinema and the artists creating cinema can continue to evolve and thrive.

4 final thoughts

Before I present my final thoughts, I would like to remind you that this study does not provide a complete answer to how the development of lighting technology has impacted the contemporary aesthetic of cinema but rather serves as a starting point for discussion. My perspective on the matter is limited, and I acknowledge my potential biases and shortcomings regarding this research. The purpose of this study is to explore the technological advancements made so far and their impact on aesthetics. It is crucial to consider how common practices are also shaped by these technological advancements and their influence on aesthetics.

As a young cinematographer, the focus of this thesis has been primarily on new and wireless lighting technology, as this is the development I have grown up in the midst of. While this approach has resulted in a significant gap in the coverage of the history of lighting technology, the implications of new technology have a far greater impact on the aesthetics of contemporary cinema than outdated technology. As such, this specification is justified. It is my belief that the form and shape of light are more interesting than its composition, and while some tools for shaping light have fallen out of use, they have paved the way for the tools currently available in contemporary productions. Therefore, even though these tools are not covered in this thesis, their value should be highly regarded and remembered rather than completely forgotten.

The examination of lighting as an artistic process is not only pertinent to the experience of being a cinematographer but also relates to Eric Fromm's perspective on how individuals who dedicate themselves to an art form perceive the world differently. For example, an illustrator sees a flower bush differently than someone walking their dog in the park. A musician hears the noise of a subway differently from someone just on their way to work. Much like, a cinematographer sees the dappled sunlight in a café differently to someone who picking up their morning coffee. To become a true master of art always requires complete immersion, not just when one feels like it. Art is so much with you, that it is irrispirable from you. For Fromm, to call yourself an artist it must come deeper from in you, down to the very way you live your life (West, 2021b).

The immersive nature of art, as described by Fromm, is exemplified in the art of cinematography where the dedication to mastering an art form and perceiving the world through a unique lens is apparent. Through this research, I have gained an understanding that the impact of technology on lighting aesthetics is an ongoing process. My initial bias was towards the belief that natural lighting is equal to soft lighting which has been the preferred choice due to its simplicity, efficiency, and automatic believability, leading to the phasing out of elaborate or genre lighting styles. While I still hold this belief to a certain extent, I have discovered that naturalism has always been a fundamental element of lighting preparation. Cinematographers typically begin with the question of where the light naturally falls and build upon this to create the desired aesthetic for the film. This holds true regardless of the film's genre or style, whether it is a science fiction, period piece,

documentary, or horror film. The starting point of lighting is to enhance the world that is already familiar to us. In essence, this approach forms the crux of lighting: to enhance the world that is already familiar to us. Since technology and lighting aesthetics are constantly evolving, I must continuously adapt my perception of these aesthetics throughout my career to produce authentic and engaging lighting experiences for the viewer.

Philosopher Walter Benjamin draws a parallel between film and storytelling. Both are received collectively, but unlike storytelling, film is now mass producible. Benjamin warns against the dangers of mass distribution in art, which changes the definition of art itself. Benjamin reminds us that if you choose to mass-reproduce anything, you must consider profitability and production costs to some extent. The primary focus is no longer making art just for the sake of art, as Benjamin defines it. This leads to prioritising what is most profitable, distributable, and sellable. When making art into a commodity, creators and observers face real consequences. By prioritising profit and low-cost production, art, and the process of making art becomes diluted (West, 2021c).

Now, to bring this to lighting technology. Lighting has progressed tremendously in technological advancements in merely the last five years. There is no denying that these technological developments have impacted aesthetics in some capacity, bringing on trend after trend throughout the years. While these advancements offer great potential for variety, opportunity, and inspiration for cinematographers, their true impact depends on how closely they are examined and how broadly the interconnectedness of aesthetics and factors such as diversity, working conditions, funding, and technology are considered. In general, technological advancements in lighting offer numerous benefits, including increased potential for creative variety and greater diversity within the film industry. While these benefits cannot be solely attributed to lighting technology, they have undoubtedly played a crucial role in bringing the industry to where it stands today.

Furthermore, the pressure on the entire film industry which then trickles down to lighting, is the pressure of mass production. So many streaming services want new, innovative content for their channels, but they want it to be made with low risk. This further pushes the use of LED technology as the first choice because it is quick. Every cinematographer and gaffer confirms that there are different aesthetic qualities between LED, HMI, and tungsten sources. That's why they also want to have the opportunity to use them *all* artistically. Of course, not all decisions when using LED are made because of efficiency, and the efficiency itself has benefits like battery operation, less space, and less cable, but isn't it enough if even in some cases LED is purely picked out of the necessity of efficiency rather than as an artistic expression? All of this comes down to merely the question, how much efficiency is too much efficiency?

The heavy focus on LED technology in recent years has saturated the market with these tools, leading to films that may unintentionally imitate each other aesthetically. While the artist is still in control of the art, the tools they use can shape the final product. There is a risk that the trends no longer are merely trends but could grow to be an all-encompassing aesthetic essence. While past trends, such as the excessive use of fluorescent lighting when it was introduced, have eventually faded, the current trend of using soft and visually pleasing lighting marketed through LED technology has persisted and continues to dominate many artistic endeavours for its many benefits. It is important to consider when it is necessary to move away from a trend before it becomes ingrained into the aesthetics of cinema.

The development of LED technology has not only influenced the film industry but also inspired everyday objects to incorporate light in their designs. Every set that I have been on in my life, apart from period films, has had some form of screen as a part of the lighting in at least one scene. Although I appreciate the merging of cinema equipment with everyday equipment, it exacerbates the creative dilemma. The mass availability of equipment that is not designed for capturing images confuses filmmakers and muddles the market and in turn, has aesthetic implications.

The decision on what lighting equipment to use is predominantly determined by three parties: cinematographers/gaffers, rental houses/manufacturers, and producers/production companies. Streaming services demand new and innovative content with low risk, which has led to the predominance of LED technology due to its speed, reliability, and ease of use. Cinematographers are enticed by these benefits and often trade other more expensive and elaborate equipment for LED lighting to have more time to create and to see production value on the screen. However, manufacturers and rental houses struggle to keep up with the needs of cinematographers, as talking about light is difficult to express in words. The manufacturer's compulsion to make more and evolve the technology overall is fueled by the cheap production cost of LED technology. The vast market for LED technology has drowned out many good options with the abundance of equipment available.

Production companies and producers aim to distribute money well within production and therefore opt for cheaper alternatives. Of course, the ability to create a film using advanced technology is far preferable to the previous situation where such a possibility did not exist, as at least the film is produced. This can create an unnecessary dialogue for cinematographers to convince producers to opt for better options rather than less expensive ones. In the end, it is always a balancing act, as the equipment also needs to work as designed in order to save time and money for production value. Otherwise, the benefits of cheaper technology are redundant. The oversaturation of the LED market is, therefore, a hindrance rather than a benefit.

Moreover, as the image can now be seen on monitors immediately while shooting, everyone has opinions on lighting in contemporary productions, which forces cinematographers to justify their artistic choices at a level they have never had to before and further complicates the cinematographer's dilemma. While this is certainly part of the cinematographer's role, I would contend that it has become increasingly challenging to maintain an internal vision amidst the abundance of opinions and an influx of LED technology within the market over the years.

Despite the potential challenge posed by the oversaturation of the LED market, the vast array of tools available remains a valuable resource for both novice and seasoned cinematographers. However, as I mentioned earlier, it is essential to acknowledge that the quality, shape, and form of light are of utmost importance, surpassing the significance of the equipment that produces it. Although various tools can replicate comparable lighting qualities, a clear vision of the intended form and shape of light is essential to achieve the desired outcome. The examples from interviews are a testament to this as each gaffer and cinematographer had their own preferences and ways of replicating lighting scenarios. Inspiration for envisioned lighting can be drawn from everyday lighting scenarios, emphasizing the importance of focusing on the world around us over trending technology. As a cinematographer, I have always been inclined to observe lighting in my day-to-day life and this research has affirmed the significance of this habit.

It is also crucial to recognise the value of older practices and techniques that may no longer be favoured. As lighting evolves over time, it is important to understand that this evolution does not always entail progression or forgetting, but rather change in some way or another. This change can be influenced by external factors such as technology and production company requirements, as well as internal factors such as the way a cinematographer perceives the world and practices lighting. The most prevalent directing factor in contemporary cinema at present is LED technology. As cinematographers, gaffers, and manufacturers search for new ways to emulate light, change remains the only constant. However, change need not always involve new technology, as occasionally, it can also involve a return to something that was previously familiar. As an emerging cinematographer, I strive to continuously prioritise this ideology in my decision-making process when it comes to lighting, with the aim of influencing the evolution of aesthetics in lighting towards a direction in which I hope to participate.

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