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# THE RIGHT CHOICE: CAMERA SENSORS AND CREATIVITY

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**Abstract**: This study analyzes the visual output of three specific camera sensors of major manufacturers and examines their significance for the final cinematic look of a production. In the context of a long-term shift of creative decision-making towards post-production, the results suggest that the choice of camera sensors and camera setups is becoming less important.

In a first step, a selection of three high-quality cameras was used to capture identical shots of a person in varying lighting situations using identical lenses and optical filtration. In a second step, the resulting footage of the three different sensors was matched in terms of color and tone in the grading process. The objective was to determine whether the decision for a particular camera sensor retains a creative impact throughout the production process or rather loses its relevance due to color grading. Lastly, visual professionals, such as directors of photography and post-production specialists, were asked to compare the test footage and to identify the originating cameras.

The findings show that the color-graded footage could not be consistently attributed to the particular camera by the participants. Even though the test shootings had been conducted under various lighting conditions that emphasized particular strengths and weaknesses of each sensor type, the average accuracy in correctly identifying the cameras and their sensor was only about 42 percent. This leads to the conclusion that in terms of visual perception, the choice of camera sensor has only limited creative impact and can be largely compensated for by postproduction processes.

**Keywords**: Digital cinematography, comparison test, camera sensor, image processing, visual aesthetics, color grading, postproduction

## 1 INTRODUCTION

Interest in the latest developments in digital camera technology within the professional film world has a long history and includes a specific genre of comparative tests known as «camera shootouts». They have been conducted around the world by manufacturers, cinematographers' associations, production companies, films schools, and many others. Legendary camera shootouts were made, for instance, in the framework of the SMPTE annual meetings, (cf. Meacham et al., 2012) or by the Chicago rental company and accessories manufacturer Zacuto Films, who even won an Emmy Award for their series, «The Great Camera Shootout 2010» (Zacuto Films, 2010). While our study builds on this tradition to a certain degree, it also introduces formalized questionnaires aimed at film professionals to evaluate the role of visual perception.

Our study focuses on the evolution of camera sensor technology in recent years, highlighting the differences between major manufacturers and how these differences impact film production from both a practical and creative standpoint. The question of this research is to what degree the choice of camera sensors is decisive in current production workflows in terms of achieving the final look of a film, or, more specifically, whether trained film industry professionals specialised in the visual area of film are able to reliably attribute color-graded footage to the particular camera or sensor from which the footage originates.

## 2 METHODOLOGICAL APPROACH

Comparison shots were taken using three leading cameras with varying lighting conditions and shot types. The test was conducted in two blocks. After a postproduction phase in which the shots were matched manually in terms of contrast and color, they were presented to 14 test participants in a cinema with 4K DCP projection. The result of this first phase (referred to as block 1) was discussed within the peer-group. Based on a standardized questionnaire, the feedback from the test participants was collected and analyzed to obtain meaningful results for film production and to improve the postproduction process for a second research block. In the second block, we asked 28 test participants to attribute the same shots to the originating sensors. This time, the test shots were processed in a more technically standardized way, using the industry-leading software CineMatch. In block 1, the footage had been matched in a manual grading process, using DaVinci Resolve.

The test participants were directors of photography, editors, and colorists from the Swiss and international film community as well as camera students of the Zurich University of the Arts (ZHdK), all with extensive experience with different cameras and their respective images.

## 3 CONTEXTUALIZATION AND SIMILAR STUDIES

In film theory, digital cinematography was often described as being a «clinically clean medium» (Flaxton, 2008) with an aura of an «essential virtuality» or «immateriality» (Lister et al., 2008). Manovich (1996) described the paradox whereby its arrival could be understood both as a «radical break with older modes of visual representation» and at the same time a reinforcement of those modes through its simulation

of photochemical photography (Belton, 2014). For decades, the discourse about the aesthetic quality of digital cinematography was thus dominated by the characteristics of analog film recording as its standard reference (Wheeler, 2001; Kloock, 2007; Flaxton, 2008; Akser, 2014). This close connection continued, even after the equivalence of resolution, color reproduction as well as dynamic range were not only achieved but also partially exceeded, and even after both digital projections and digital recordings had become the norm in the film industry around the world (Bordwell, 2012; Richardson et al., 2013; Flückiger, 2014; Kriss, 2015; Siegel, 2015; Loertscher et al., 2016).

Discussion of the aesthetic quality of digital images among film professionals revolves around colors, tonal values, sharpness, and contrast ratio, which are decisive parameters when it comes to optimizing and creatively changing the image look in post-production. All current high-quality camera systems offer processing and recording methods, which provide an extended dynamic range, equivalent to analog negative film stock, and thus allow for a vast range of creative postproduction options. During these developments, alongside with the ongoing improvement of color grading tools, the focus shifts towards postproduction and away from specific camera sensors and camera set-ups (Grandinetti et al., 2014; Thorpe, 2016; Prince, 2019; Iseli et al., 2020; Stump, 2021; Oggenfuss 2022; Huellsner 2023).

A recent degree thesis in the field of engineering demonstrates that tone and color reproduction in two well known, high-level camera systems can be altered during the postproduction pipeline «to the point that they are perceptually equalized» (López Salazar, 2020, p. 11). In his study, López Salazar uses a series of raw data acquired by an ARRI Alexa Mini and a RED Weapon Helium under controlled illumination and with the same lens. The shots showed a woman with light skin and contain several objects, including a color checker chart for precise mapping. The process and the results of the mapping are comprehensibly documented with still photographs (López Salazar, 2020, pp. 39–44). However, the assessment of «perceptible equality» is based solely on the author's judgment. This is a major difference from the premise of our study, which also compares footage from high-level cameras matched in post-production but introduces a formalized peer group survey with film professionals to determine whether the differences are perceptible to a larger group of individuals or not.

## 4 TEST DESIGN

### 4.1 Production of Stimulus Videos

Eight static shots were filmed, each featuring a person. These shots were captured under different lighting conditions during the day, twilight, and at night. Both, a wide shot and a closeup were included for each of the lighting conditions. Only existing light sources were used in the production of these shots.

For the shots in direct sunlight, neutral density (ND) filters were used to set an aperture measured and defined beforehand for each scene. External ND filters were used to ensure consistent filtration across all cameras, because internal ND filters from different camera manufacturers may have slight variations in their coloration and strength. The ISO value was set to 800 for daylight scenes. For the darker twilight and night shots, the RED Gemini and the Sony FX6 were set to their higher native ISO values (FX6: 12800 Gemini: 3200), while the ISO of the Arri Alexa Mini was pushed to 1600 and 3200

respectively, leading to more noticeable noise on the Arri Alexa Mini.

After consulting with some directors of photography, the Arri Alexa Mini was chosen as a reference for the daytime shots, while the RED Gemini with its higher base ISO was used as a reference for the nighttime and twilight scenes.

The captured images were adjusted and matched to the reference for color and exposure using DaVinci Resolve. Important factors to consider when grading included the Sony FX6 having a smaller dynamic range and therefore higher contrast than the other two cameras that needed to be matched. Another thing is that the RED Gemini has less image noise because it has more pixels, while the Arri Alexa Mini has consistent image noise even in well-exposed situations due to its larger photosites. The higher base ISO of the RED Gemini and the Sony FX6 provide a clear advantage in lower light situations in this regard, leading to less visible noise. Additionally, the internal recording codec (XAVC-I) of the Sony FX6 is limited by stronger compression, which can lead to visible artifacts when making extensive adjustments in postproduction. In contrast, both the RED Gemini and the Arri Alexa Mini offer ProRes or even RAW codecs, providing more flexibility in postproduction especially when making strong adjustments.

Overall, though, the three camera sensors could be adjusted very closely to each other in postproduction. Labelled thumbnails of the different stimuli are listed in Appendix I, p. 10f (cf. Oggenfuss 2022).

The final film of both blocks was projected onto a large screen using a professional Christie projector, using a standard DCP (Digital Cinema Package). The movie was shown in 4K resolution to give the viewers the best possible image quality.

### 4.2 Comparison Test, Block 1

The videos in this section were manually graded to match as closely as possible. This work was part of a bachelor thesis at the Zurich University of the Arts (Oggenfuss, 2022). The audience in the first block consisted of 14 participants. Since it consisted of film professionals, there were preconceived notions about the respective cameras and the images they supposedly produce. The test audience was informed which three cameras were used and that they would see the same shot three times, once from each of these cameras. The purpose of this was to provide the participants with the chance to search for patterns and characteristics to clearly differentiate between the cameras. The images were presented in a blind manner with the participants unaware of the identity and order of the images. The individual shots were first shown one camera after the other and then in a side by side comparison. By having the ability to view each image side-by-side, even the smallest differences between the images could be observed, limiting a neutral assessment.

The audience was then asked to complete a questionnaire indicating which camera they believed corresponded to each of the three shots. Additionally, they were asked to give notes as to what they based their decision on. After the segment where viewers distinguished between the cameras, the same shots were displayed side by side once more, prompting participants to choose their preferred image among the three.

In the discussions it was suggested that the results could be improved by using the software CineMatch to equalize the differences instead of manually

grading the images, simplifying, and streamlining the process of postproduction. Thus, a second block was conducted where the footage was color-matched using the CineMatch software.

### 4.3 Comparison test, block 2

This time the audience consisted of 28 people, once again mostly working in the visual aspects of film production. The same experimental setup and the same shots from the first block were used. The eight shots were shown, first on full screen and then side by side, allowing participants time to answer. However, this time the shots were color-matched using Filmconvert's CineMatch instead of the manually graded shots. CineMatch is a software that boasts the ability to perfectly match the characteristics of different cameras to each other. So, the main difference between the two blocks is eliminating the subjective and creative interpretation a colorist might have brought into the shots.

When asked for their preference, the participants were shown twelve images. Four different shots, each filmed with all three cameras, were shown side by side. Out of these four shots, two were adjusted using CineMatch, while the remaining two were the ones from the first block matched by a colorist. Next, the participants were asked to pick their favorite image in each group of three and asked to point out why they preferred that specific image, as well as any noticeable differences in image quality or color reproduction between the shots filmed with different cameras and color grading methods.

## 5 RESULTS

Following the presentation of the videos and the collection of data and feedback from the participants, we assessed the cameras' recognition performance. Unfortunately, shots 3 and 4, a wide shot and a closeup taken in daylight, had to be excluded from the evaluation. This was due to the aperture being set differently on the cameras, resulting in the Alexa capturing images that were overly sharp compared to the other two cameras. This led to skewed results, as there is a widespread belief that the Sony camera is significantly sharper than the Alexa. Nevertheless, both, wide shots and close-ups were still available for all lighting conditions, with shots one and two for daylight, five and six for twilight, and seven and eight for night, respectively.

### 5.1 Block 1

In this block, the videos graded by hand were compared. Overall, the three tested cameras could not be consistently distinguished by the participants as can be seen in table 1. Although the practical test was conducted under vastly different lighting conditions, clearly highlighting the strengths and weaknesses of each sensor type, on average over all three cameras, the viewers were only able to correctly identify and assign the image to the camera 40.8% of the time, with 33.3% being pure coincidence leading to a difference of 9.5%.

Overall, we can see a tendency in the direction of the viewers not being able to differentiate the cameras consistently in a daylight setting, while clearer differences could be made out in the twilight and night setting (Shots 5-8). Additionally, it seems the cameras were better identified in the wide shots as compared to the closeups.

When participants were asked about their preferred image, the RED Gemini emerged as the favorite, with 39.4% expressing a preference for its image. The Arri Alexa Mini came in a close second, with 36.1%

Table 1 Test Results Block 1

| | Shot 1 D-WS | Shot 2 D-CU | Shot 5 T-WS | Shot 6 T-CU | Shot 7 N-WS | Shot 8 N-CU | Total |
|---|---|---|---|---|---|---|---|
| Sony FX6 | 71.4% | 21.4% | 35.7% | 50.0% | 64.3% | 28.6% | 45.2% |
| RED Gemini | 57.1% | 14.3% | 50% | 21.4% | 35.7% | 35.7% | 35.7% |
| Arri Alexa | 50.0% | 14.3% | 28.6% | 50.0% | 35.7% | 71.4% | 41.7% |

Note: Correct attribution percentage of each camera in block 1 with 14 participants (n = 14)

of participants favoring its image. In a slightly distant third place, the Sony FX6 garnered the preference of 24.5% of individuals compared to the other two cameras.

### 5.2 Block 2

In the second block, the videos were matched with the software CineMatch. As in the first block, the percentage at which the cameras were correctly identified was similar with a total average of 42.1% correctly identified shots. Overall, the findings in this second block align closely with those in the first block, further confirming our assumptions that it's difficult to differentiate the images of the cameras, even for trained professionals.

As seen in Table 2, the reliability with which each camera could be distinguished is very similar to the results in block 1, but the Sony FX6 was a bit less reliably identified. Significant differences between the cameras were only seen in shots 1, 7 and 8 and to a lesser extent in shot 6.

When participants were asked about their preference in this block, the RED Gemini once again emerged as the favorite, with 41.7% expressing a preference for its image. The image of the Arri Alexa Mini was preferred by 32.1%. In third place, the Sony FX6 garnered the preference of 26.2% of individuals compared to the other two cameras.

Table 2 Test Results Block 2

| | Shot 1 D-WS | Shot 2 D-CU | Shot 5 T-WS | Shot 6 T-CU | Shot 7 N-WS | Shot 8 N-CU | Total |
|---|---|---|---|---|---|---|---|
| Sony FX6 | 42.9% | 39.3% | 35.7% | 14.3% | 82.1% | 21.4% | 39.3% |
| RED Gemini | 64.3% | 39.3% | 50.0% | 14.3% | 46.4% | 35.7% | 41.7% |
| Arri Alexa | 57.1% | 32.1% | 50.0% | 35.7% | 53.6% | 42.9% | 45.2% |
| $\chi^2$ *p*-value | $<.001^{***}$ | 0.594 | 0.093 | $0.011^{*}$ | $<.001^{***}$ | $<.001^{***}$ | |

*Note:* Correct attribution percentage of each camera in block 2 with 28 participants (n = 28).

When looking at the comments and words the participants used to describe the differences between the images, why they preferred certain pictures or their certainty regarding the camera source, the three most mentioned factors were colors (32 mentions), skin tones (18) and contrast (13), followed by image noise (11), details and blacks (both 8 mentions). There definitely seems to be a slight difference in perceived color between the images. But, as director of photography and image designer Patrick Lindenmaier mentions in his interview, color is one of the easy to understand and quantifiable aspects, while a certain dimensionality (5 mentions), texture or film-feel (both 3 mentions) is very difficult to describe or quantify in a meaningful and measurable way (cf. Appendix II, p.12 ff).

## 6 CONCLUSION & DISCUSSION

Experts struggled to consistently distinguish between different shots captured with Arri Alexa Mini, RED Gemini, and Sony FX6 in various lighting conditions. The cameras' identification varied depending on the situations they were used in, as the distinctions between them were accentuated during twilight and night scenes, and the differences were also more noticeable in wide shots compared to close-ups. While the human face and its skin tones are crucial to the aesthetic appreciation of an image, the overall impact the image has is influenced by the texture and colors of the entire composition, as addressed by Patrick Lindenmaier in his interview (cf. Appendix II, p.12ff). Overall, the Sony FX6 was most easily identified by the audience and was perceived as having a less appealing image compared to the other two cameras. In general, though, the cameras and their sensors were not as recognizable as expected, especially in well-lit scenarios. Postproduction can minimize most of the existing differences between the cameras, making it difficult even for experts to distinguish between them. This has been demonstrated through both the use of CineMatch's matching of the shots and to an even greater degree by hand-grading the shots to match.

There were some limitations, however, such as the small number of participants, especially in the first block. Additionally, there were not enough shots per lighting condition to make reliable statements about the general lighting situation and not be limited to the specific situation in the shots. The cast also lacked diversity, which partly undermines the argument that accurate skin tones can be used as a differentiation feature between cameras. Future studies should thus include black and Asian subjects, as some cameras or sensors may favor certain skin tones over others (Sung, 2022). It is also important to note that in the CineMatch block, the comparison and evaluation is clearly based on the quality of CineMatch's color profiles and not so much on the differences between the cameras, due to the limited information available on how precisely their system matches the cameras.

In conclusion, it can be said that the images produced by today's cameras have reached a level of uniformity that allows a seamless and consistent visual experience after postproduction, almost independent of the sensor technology. It is thus possible to seamlessly combine footage from various camera models on a single shoot. Consequently, the practical advantages of camera equipment can now come to the fore when choosing the technology. These include ease of use, data size, workflow efficiency, weight, battery consumption, durability, price and error-proneness. None of these factors were considered in this test; however, they are extremely

important in professional production environments and for students who want to familiarize themselves with the pros and cons of different technologies.

The results of this study can also contribute to a more sober discussion. With the current state of technology, choosing a camera is not so much a creative decision, which is the argument often used to enhance camera sales, but rather a practical and of course a financial one.

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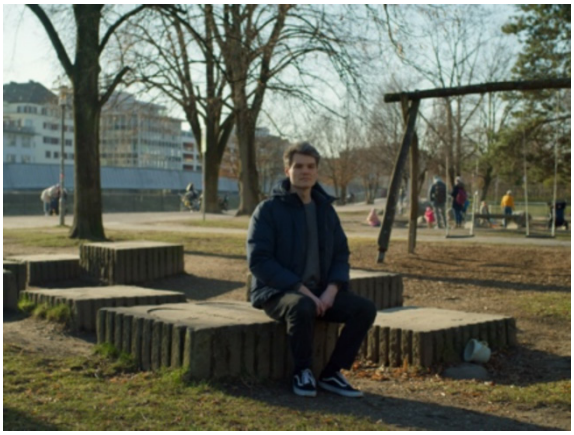
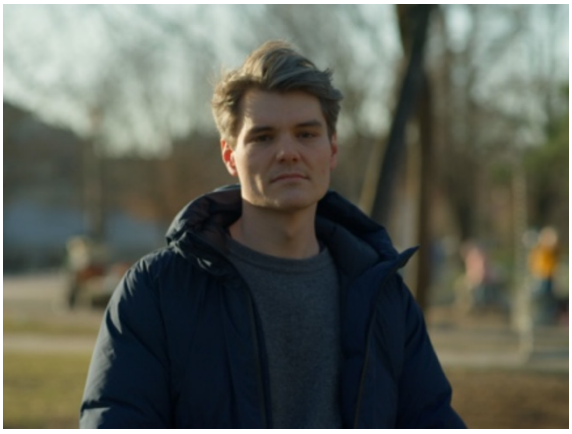
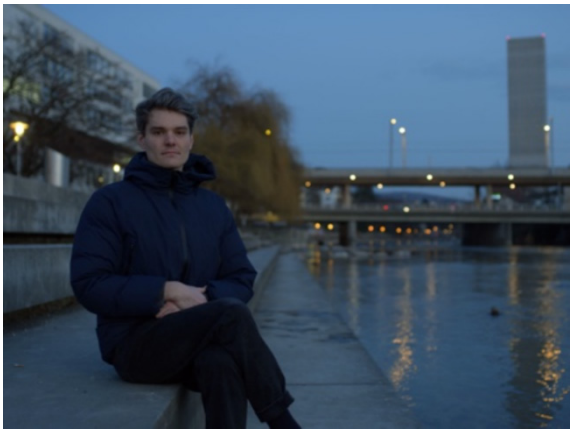
## APPENDIX I
## OVERVIEW OF TEST STIMULI



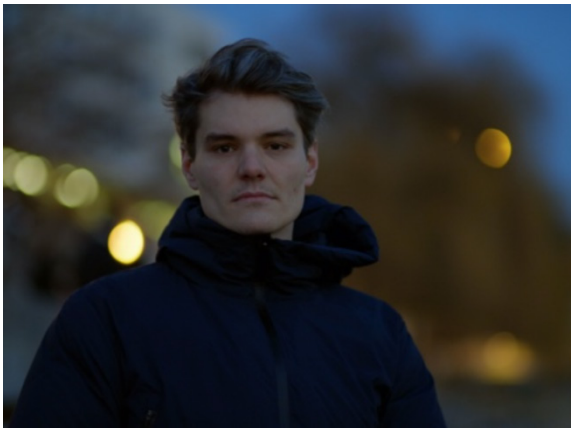
Shot 1 Wide-shot, daylight



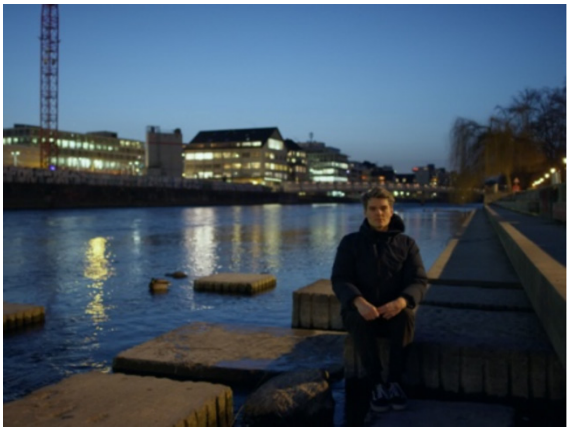
Shot 2 Close-up, daylight



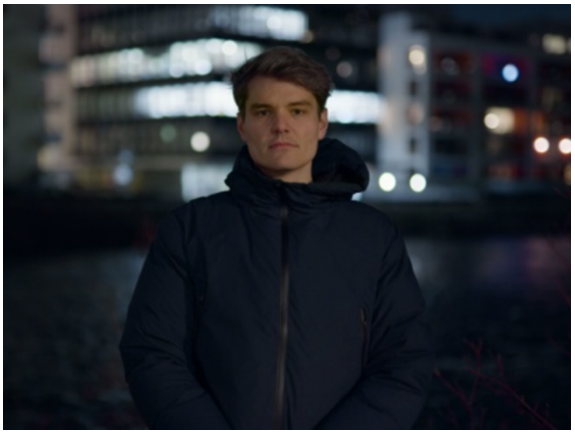
Shot 5 Wide-shot, twilight



Shot 6 Close-up, twilight

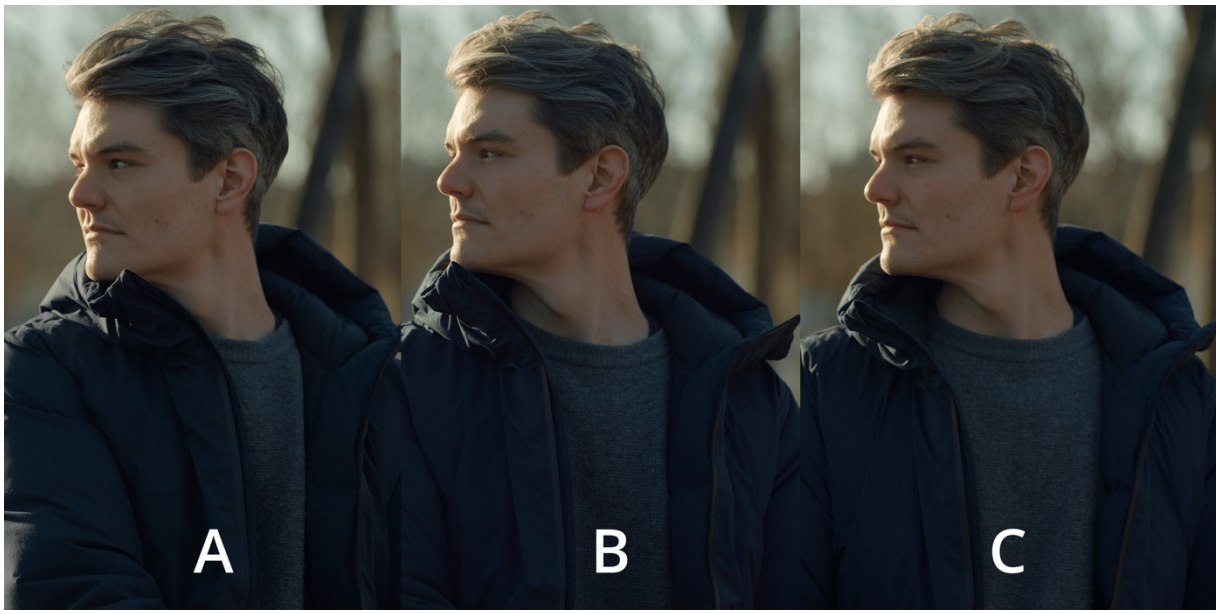


Shot 7 Wide-shot, night

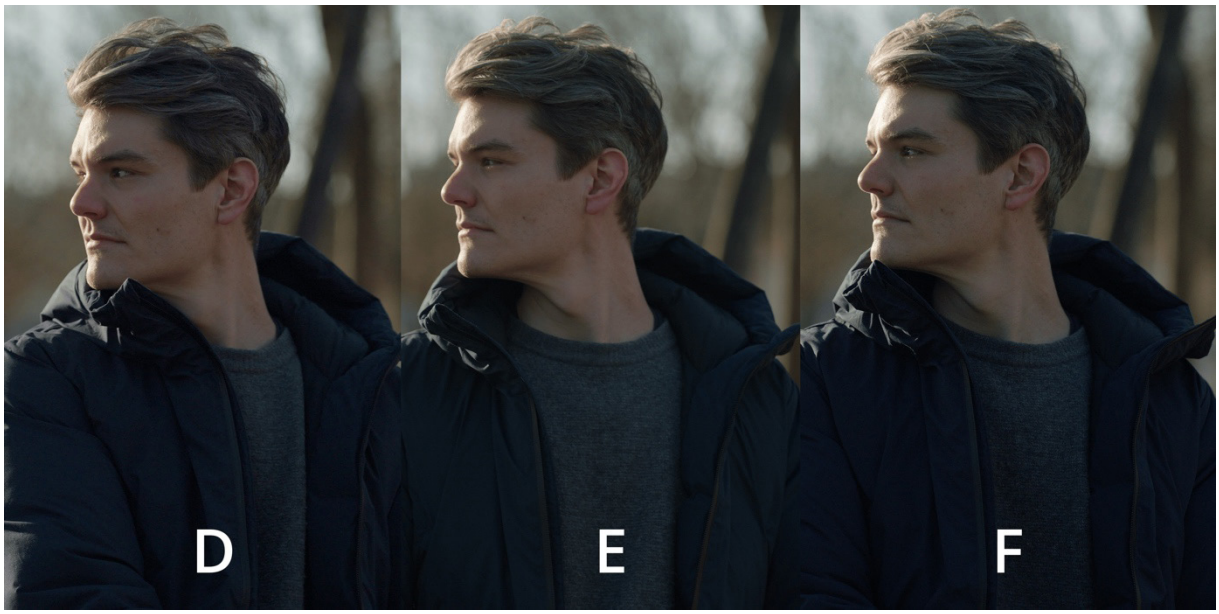


Shot 8 Close-up, night

## APPENDIX I
## COMPARISON OF COLOR GRADES

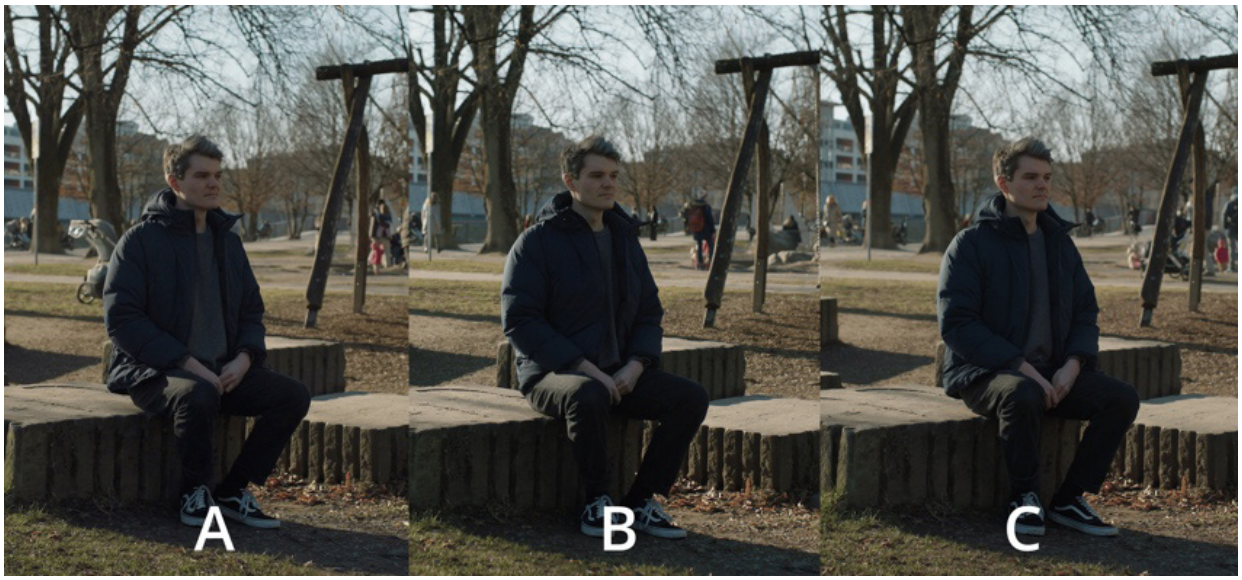



A: Sony FX6, B: Arri Alexa, C: RED Gemini, Example of shot 2, graded manually

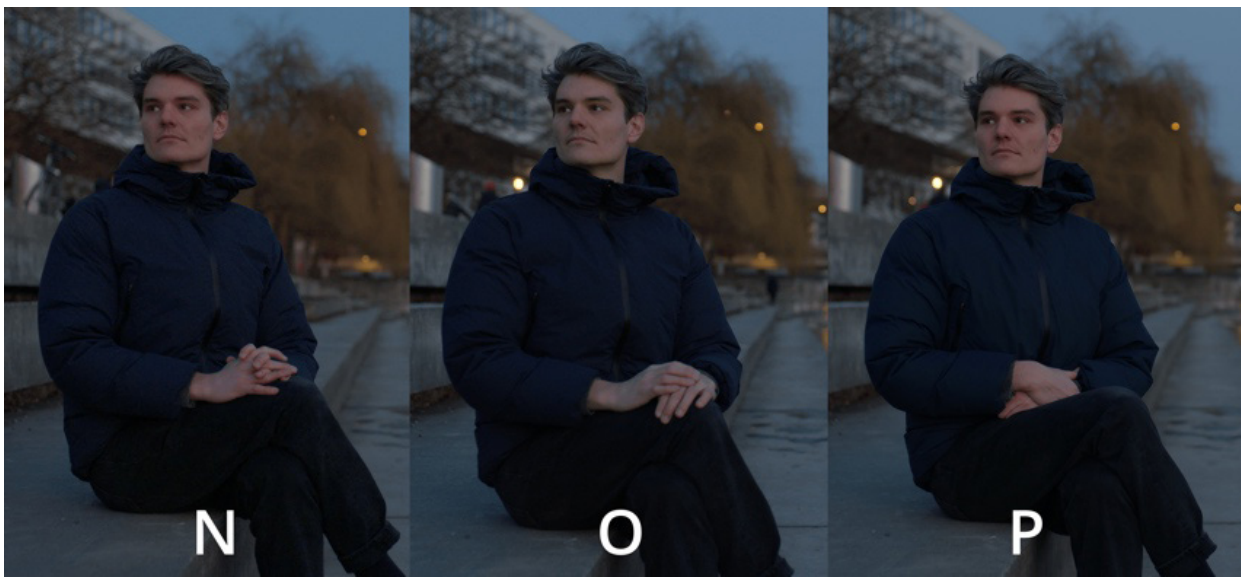



D: Sony FX6, E: RED Gemini, F: Arri Alexa, Example of shot 2, graded with CineMatch

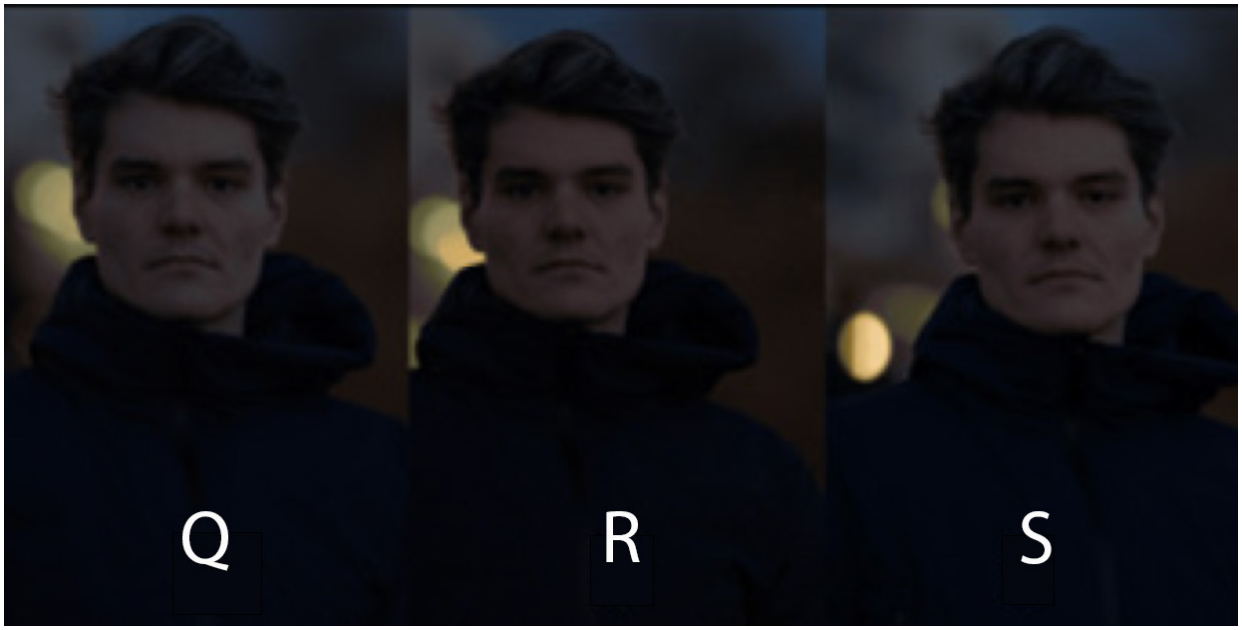
## APPENDIX I
## COMPARISON OF THE SHOTS GRADED WITH CINEMATCH (EXPERIMENTAL BLOCK 2)



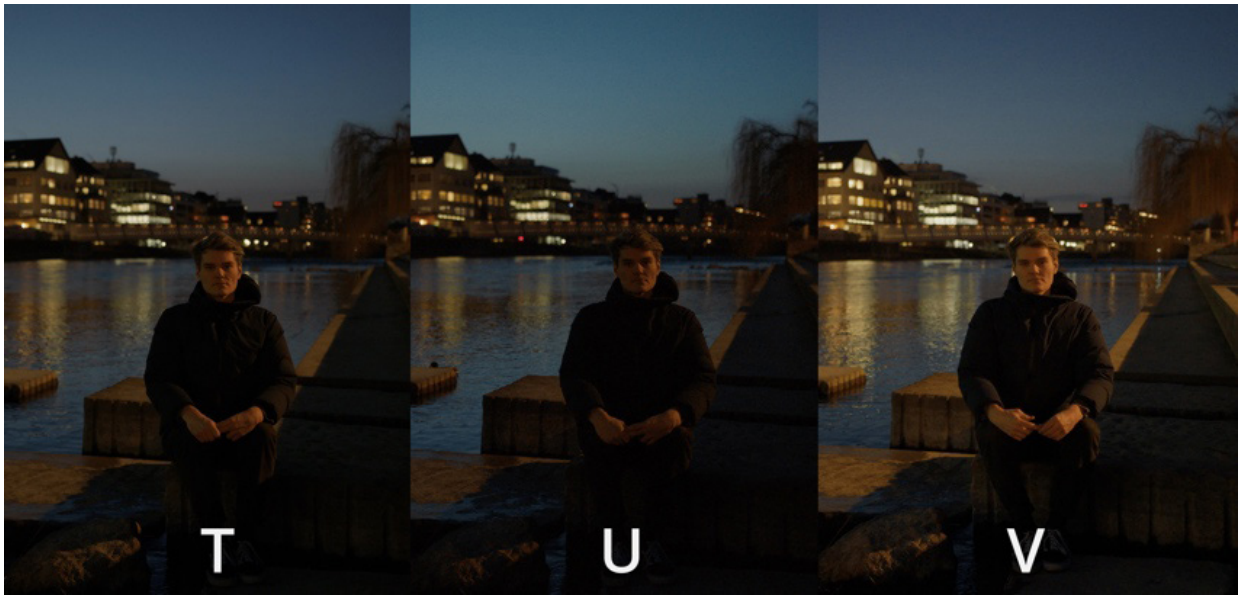

A: Sony FX6, B: Arri Alexa, C: RED Gemini



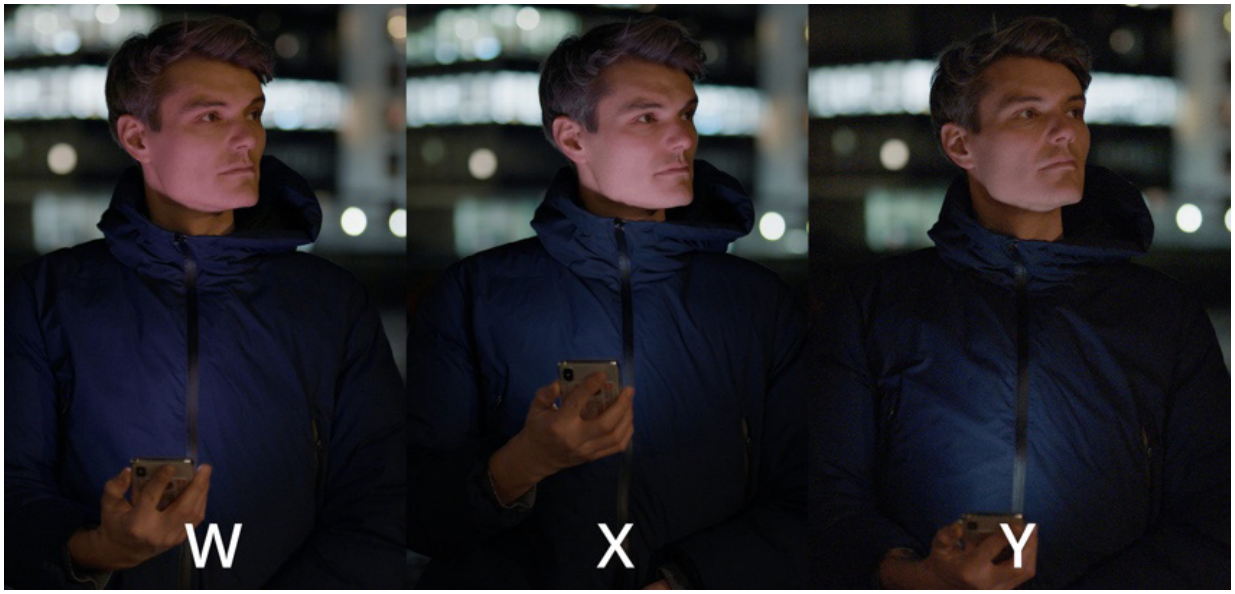

N: Sony FX6, O: Arri Alexa, P: RED Gemini




Q: Arri Alexa, R: Sony FX6, S: RED Gemini




T: RED Gemini, U: Arri Alexa, V: Sony FX6




W: RED Gemini, X: Sony FX6, Y: Arri Alexa

## FULL VIDEO

The full comparison video of the different Stimuli that was used in Block 2 can be seen here:
https://zhdk.medienarchiv.ch/entries/c8323468-ceb3-4838-989d-d7046eee2258

Just the Side by Side comparison is available here:
https://zhdk.medienarchiv.ch/entries/5979ef89-d295-49eb-b14f-7125168217c7

APPENDIX II

# Color, Texture and Look

An interview with Director of Photography and Image Designer Patrick Lindenmaier (Andromeda Film, Zurich)

Interview:
Pierre Mennel, Zurich University of the Arts, Zurich, September 2023

*P.M.: Patrick, you have seen the tests about the importance of image sensors in terms of the final look of a film, that we conducted at the Zurich University of the Arts. Were you surprised by the results?*

P.L.: No. I wasn't surprised by the result. My assumption was that the looks of the individual cameras would be there, but that they would be hardly visible when matched to each other.

*P.M.: Why are there so many discussions about which camera is suitable for which film if, to put it casually, the visible result is hardly recognizable even by experts?*

P.L.: Yes, there are various reasons for that: For example, that the default settings of individual cameras are very different. These settings are imprinted in people's minds.

*P.M.: Ok, but we usually shoot with flat profiles. And Sony S-Log 3 is very close to an Arri Log-C.*

P.L.: It is. But you also know the other settings from Sony. If you shoot on a Sony without S-log, it behaves very differently. This character that we see is man-made. It's not a natural phenomenon like a beautiful flower that always blooms the same way. The camera engineers influence this look with very complex manufacturing processes.

*P.M.: But with a little effort, as we saw in the test, you can get the three cameras to look almost the same, hardly distinguishable even for people from the industry.*

P.L.: In this test, the colors were mainly matched and no "texture" was used.
The "texture" gives us information about the luminance ranges in which the coarse and fine details are reproduced. This is one of the most important things about how a look is constructed and is very difficult to judge. The "texture" includes, among other things, the reproduction of details that can be seen in the hair or the pores of the skin. Next to color, it is the most important aspect of an image. As we can't use terms such as cooler or warmer as we can with color, "texture" is often treated somewhat neglected. We don't have the vocabulary and it's more of a gut feeling: when they say the image looks aggressive, it helps me as a colorist to realize that they mean the detail drawing and therefore the "texture".

*P.M.: The new Alexa 35 offers different textures. Couldn't these be reproduced more conveniently in post-production?*

P.L.: In 80% of the cases, yes. However, there are certain textures that are difficult to manipulate afterwards. For example, if a detail is emphasized too much by the "texture", it cannot be reduced afterwards as it would have been if it had been shot without "texture".

P.L.: The detail can be lifted separately. If there is another object next to one that is similar in color or luminance, both objects are lifted by the "texture" in the camera. They can therefore no longer be edited separately afterwards. In this respect, certain "textures" of the Alexa reduce the subsequent manipulation of the details.
It is easier to explain using colors:
If I make everything that is red purple and then drag everything that is purple back to red, then what was once purple is also red; in other words, I can no longer distinguish between red and purple. It is the same with the "textures" of a camera. The "textures" are also much more computationally intensive than the colors to manipulate.

*P.M.: Does that mean I have to think of it as a digital filter that is irreversible like analog filters?*

P.L.: Yes, both digital and analog filters always reduce the differentiation of individual elements. This makes it difficult or even impossible to edit individual elements. Almost all the looks we see are a reduction in differentiation. It's the same with the various "textures".

*P.M.: Unless you really know and have tested very carefully how a "texture" reacts, you are better advised to omit the "textures" altogether? Since the "textures" reduce the possibilities to intervene in postproduction.*

P.L.: Yes, that's true, but the reality is different: A director of photography wants a certain look. However, this is not burned in, but only simulated, even though it could also be set on the camera. The production and director really like the picture style until the DOP comes and says during grading that the "texture" has not yet been added. This often leads to a lot of unnecessary discussions. If the DOP determines the "textures" right from the start, these discussions become obsolete. This is also the reason why DOPs want to shoot on film again. The film negative determines a look that cannot be undone.

*P.M.: Speaking of film. In the analog age, a certain look was predetermined by the artifacts of the recording medium. In other words, the image was given a character and that is no longer the case. Is Arri trying to bring that back with the "textures"?*

P.L.: Yes. Still, the question remains: Why are the proposed looks of the cameras so "uncharming" and before in the movie it was more charming? Charming is a bit of a strange term, but it comes closest to what I mean.
P.L.: Film was incredibly limited in its basic possibilities with these Layers. The accuracy of the colors was limited because the three primary colors overlapped very imprecisely. The film engineers therefore had to develop an idea of how this imprecision could be implemented as charmingly as possible. And they succeeded brilliantly. Imprecision is what makes celluloid so charming.

*P.M.: How did these cultural differences manifest themselves? Is it down to skin tone? Or a general sense of whether warmer or cooler images are better received?*

P.L.: Well, I think that people in, say, Japan or China have a fundamentally different understanding of what is defined as beautiful. They have different values than we do and different materials that are culturally important. In Asia, for example, alabaster has a very high status. There is also another aspect: If you make a film that is very successful, then suddenly the colors, textures and materials that appear in this film also become "valuable". We don't know whether the color and texture of the film are good! But the mere fact that the audience likes the movie

has a repercussion on its design. People remember: This is success. That's good, that's love, that's sexy, but it's all retroactive. People get used to the colors and shapes. Suddenly it becomes a trend, a fashion, but we never know whether it's good or bad, it's just successful. But this remembering surely accounts for 50% of our judgment.

*P.M.: The most important thing is always the actors. Doesn't that mean that the development of emulsions, what you like and what you don't like, is based on a skin tone that is recognized in the respective culture?*

P.L.: Beautiful is relative, I prefer to use the word pleasing. The definition of what is pleasing has always been very much linked to women and to a lesser extent to men. A certain type of skin tone was important or was noble. These tones should be optimally reproduced. Cultures are very different in this respect. If you look at Asian faces and what is valued there, it's not the same as in Paris. However, the image itself, the individual image points of film were much less precise and differentiated than today. That was an advantage. Certain imperfections in clothing or make-up were charmingly covered up by technical inadequacy. Today, the images are brutal. They are focused on sharpness and create looks that are too close to reality, and who really wants to have reality depicted?

*P.M.: With 8K, will this trend become even stronger?*

P.L.: Yes, you have to justify the 8K. If you don't see a difference, you don't have to shoot in 8K. So, you look for images that "prove" 8K. People want to see something tangible in order to be able to evaluate it. But images are nothing solid, good images are usually rather volatile. It's similar to the discussion about texture. It is very difficult to describe and is not really in our vocabulary. Feelings and sensations are always more difficult to verbalize than concrete things. What 8K or 4K is, on the other hand, is clear and therefore sells well.*P.M.: Japanese art is known for its love of detail, so it's not surprising that Sony emphasizes high-resolution cameras. Arri seems to follow a different philosophy.*P.L.: You mean the question of why this "texture generator" is so important to Arri? The complexity of such a generator is very high and all good engineers know that the more complex they design and build a system, the more difficult it is to maintain consistency. If, on the other hand, the structure is made simple, the images attain a standardized and perfect quality, which in turn has a negative effect on the organic perception of an image.

*P.M.: What is the most important aspect of image composition?*

P.L.: Abstraction. Full frame is currently very popular because of the abstraction induced by the shallow depth of field. The human eye doesn't see anything out of focus in normal life, unless I've forgotten my glasses... The beauty of this blur is something that only photography and film can do. This kind of composition of sharpness and blurriness is an abstract experience. That's why black and white is still so popular even after the invention of color film: it's the greatest abstraction.

*P.M.: Looks like a movie...*

P.L.: Yes, and you start to look at other things.

*P.M.: That's right, even color-blind people don't see in black and white. Black and white always refers to an art product.*

P.L.: Yes, with black and white, nobody thinks about reality anymore, but we allow our perception and our thinking to become fully involved in the fiction.

*P.M.: Maybe our head is trying to convert the shades of gray into colors?*

P.L.: I doubt that. I think the brain is relieved and can concentrate on something else. A reduction in information changes the focus. I focus better on the movement or the facial expressions of an actor. It is remarkable that the silent films in which pantomime was used are more interesting and don't seem as silly as the later sound films. Pantomime is also a form of abstraction. Viewers are immediately interested and try to interpret. It's the same with abstraction as a design element. If something deviates from the norm, it piques the viewers curiosity. Black and white is an easy way to abstract. Filmmakers like Jean Luc Godard, who suddenly shot entire scenes in red in "le Mépris", also used this extreme form of abstraction.

*P.M.: In the evaluation of Analog/Digital, a ZHdK research project, we found that the memorability of unimportant details increases in the digital production process. Things that are completely unimportant for a narrative story were significantly better memorized in digital. Questions such as: "What color is the sofa in the background?" or "What brand was the baseball cap" were answered better in digital images than in analog ones. Unfortunately, this is exactly the opposite of what good camera work is all about. The camera should be able to emphasize and direct the eye. However, the brand of the baseball cap is not important for the story of the short film.*

P.L.: Yes, but I think that primarily has to do with the image steadiness of analog film. Analogue is shaky, so it takes us longer to recognize everything, which means we only have time for the essentials.

*P.M.: Does that mean we should include an artificial shakiness in the digital?*

P.L.: (Laughs). No, of course not. It's just a phenomenon that you have to deal with: The absolutely still picture contributed enormously to the fact that handheld cameras suddenly became fashionable in digital cinema. Handheld cameras were suddenly a "must", precisely in order to incorporate this kind of abstraction and this kind of imprecision that the imperfect image registration and grain used to provide. Digital images from a tripod suddenly seemed flat and boring. I would put it like this again: The defects of the celluloid help us to concentrate on the essentials. An abstraction is always a "defect" compared to the "truth"!

## CV

**Pierre Mennel** is a swiss cinematographer and professor of cinematography with an extensive career in feature films, documentaries, and commercial productions. A founding member of Videowerkstatt Zürich in 1986, Mennel worked as a freelance camera and lighting assistant before studying film and video at the Zurich University of the Arts (ZHdK), earning his master's degree in filmmaking in 1995. Since then, he has collaborated on numerous art video projects and has served as the director of photography (D.O.P.) for over 45 feature films and cinema documentaries. Mennel has been a lecturer in cinematography at ZHdK since 2005 and was appointed professor in 2015. He is a member of IMAGO and the Swiss Cinematographer Society (S.C.S.) and has received several accolades for his work, including a nomination for Best Cinematography at the Swiss Film Award (2015) and the City of Zurich's Lifetime Achievement Award (2009).

**Christian Iseli** studied history as well as German and English literature at the University of Bern. After graduating, he was a journalist and documentary film director and worked in editing and cinematography on both fiction and documentary films. As professor at the Zurich University of the Arts (ZHdK) he focused his research primarily on the effect of digital technology on film aesthetics. Between 2018 and his retirement in 2022, Iseli was the director of ZHdK's Immersive Arts Space.

Dr. **Miriam Laura Loertscher** is a film researcher and media psychologist, currently leading the Research Focus Film at the Zurich University of the Arts (ZHdK). She earned her PhD in 2020 from the University of Bern, where her dissertation explored the effects of digital cinema technology on film perception. Her academic journey includes studies in psychology at the University of Bern and cinema studies at the University of Zurich. Her professional experience spans various roles in Swiss art institutions and film festivals. Since 2014, she has been involved in multiple research projects at the Institute of the Performing Arts and Film at ZHdK. Her research focuses on film perception and the impact of emerging digital technologies, such as higher frame rate (HFR), VR/XR and virtual production. She employs a practice-based, empirical methodology that integrates artistic research.

**Ian Oggenfuss** is a Swiss-French cinematographer and director. He began his filmmaking journey with The Lonely Way, a short film awarded by the Canton of Zurich upon his high school graduation. From 2017 to 2022, Oggenfuus studied film at the Zurich University of the Arts (ZHdK), specializing in cinematography. During his studies, he gained experience as a director, director of photography, and camera operator on various projects. Since 2018, he has worked as a freelance director for commercials and as a cinematographer on feature films, including Der Unsichtbare Zoo (Romuald Karmakar), Wider Than the Sky (Valerio Jalongo), and Hirschfeld (Stina Werenfels). In recognition of his contributions to the field, he became a member of the European Film Academy in 2024.

**Marius Mahler** began working in the film industry after completing his compulsory education, establishing himself as a camera assistant for both national and international commercials and feature films. This experience sparked a strong interest in the cognitive processes that ultimately draw us in through the perception of moving images, leading him to research film perception. After graduating with a Bachelor's degree in Psychology and Neuroinformatics from the University of Zurich (UZH) in 2017, he transitioned to Zurich University of Applied Sciences (ZHAW) to write his Master's thesis in film research in collaboration with the Zurich University of the Arts (ZHdK) in 2020. During this period, he served as a Research Assistant at the UZH Plasticity Research Lab from 2017 to 2018. Following this role, he became an Assistant Researcher at the Zurich University of the Arts (ZHdK), where he focuses on film perception.