Lighting for video

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Contents

1 Introduction

This handout provides you with the basics of lighting for video. This is a rapidly changing field especially with the arrival of cameras which can work on a much wider contrast range so that lighting techniques today are much more inspired by feature film making (Brown, 2008) than by techniques developed for TV (Millerson, 1999).

The first section follows roughly the so called three point lighting idea. However, this concept comes from still photography and cannot be used for real life scenarios. For that reason we switch rather to four standard lighting scenarios which usually occur in filming:

- INT/DAY
- EXT/DAY
- INT/NIGHT
- EXT/NIGHT

Each situation requires a unique approach and the rest of this handout is structured along these four scenarios.

2 Lighting basics

2.1 Three/four point lighting

This is the classic scenario with three different light sources and we will be extending it to four or even five light sources. Use this with caution because it comes from portrait photography where usually both subject and camera are static. From the moment we have camera / subject movement and different camera angles against the subject the roles of the lights will change.

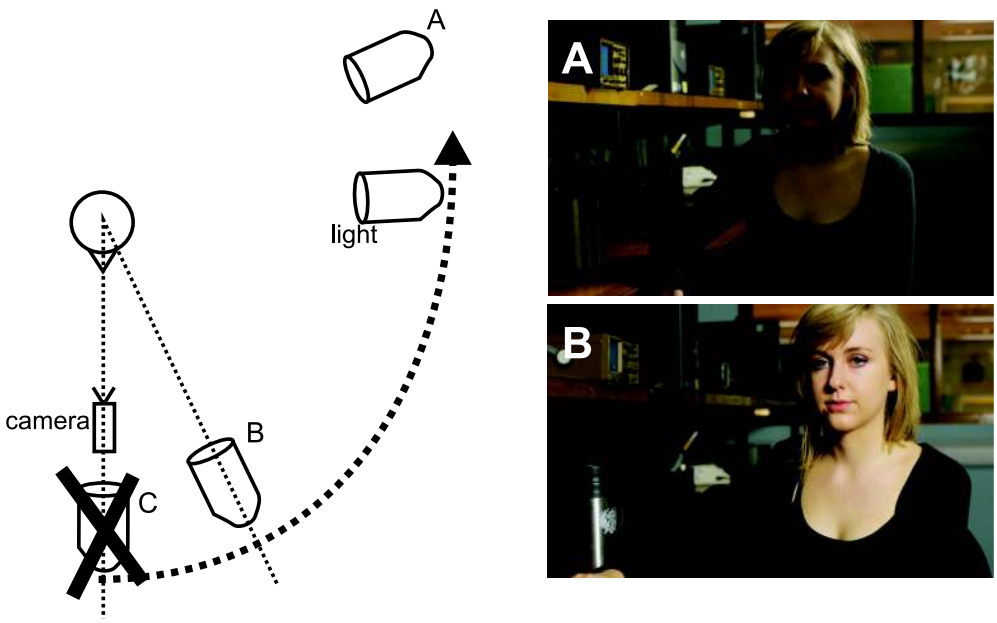

Figure 1: Key light. This position and the brightness of the key light is important to set the tone of the film. Experiment with different angles between camera and key light. B: standard position for documentaries, A: more "cinematic" position of the key. C: key behind or on camera.

2.1.1 Key

The light called the "Key" is the light which is actually *perceived* by the viewer. It is the most essential light in a scene so it's important to think of its position carefully. Fig. 1 shows two different positions of the key in

relation to the camera and the subject which pretty much set the mood of the film.

- The source which subjectively illuminates the scene.
- The source which creates the principle shadows in the scene.
- In a realistic setting the key needs to be justified by the light sources, for example, the sun, a ceiling light, a practical light or even the inside light of a fridge.
- In a studio setting the placement of the key guarantees that the interviewee looks "nice".
- Never place the key on the camera or light the subject from the same direction because this will look very flat[1]. Roughly the key should be at least 10° off from the camera axis.
- Every face should be lit by one key if there is more than one key light in the room.

Now let's explore more systematically how the camera/key angle determines the look of the footage. Fig. 2 shows the subject lit from zero degrees to up to 180 degrees between camera and light. Let's look at the different camera/key angles:

0° At zero degrees (Fig. 2) the subject looks flat and shadow-less. This can be used for effect but generally this angle should be avoided by all means and corresponds to the classical on camera flash (which on top of that creates red eyes). At very low intensities this angle can be used as a so called "eye light" where a small LED light on the camera shines into the eye of the actor/actress and brings the eyes to life and reduces contrast in the face. However, this has to be used with caution.

20° Having the light at a slight angle gives the subject much more structure. This is the preferred position for **documentaries and factual reporting** (see section 3).

90° Having the light sideways we have maximum shadow on the face which can be used for dramatic effect.

[1]This is the reason why on camera flashes produce horrible pictures.

Figure 2: Exploring different camera/key angles in a systematic way from 0 to 180 degrees. The light was a six tube fluorescent strip light "kino flo" style with four tubes switched on at 4×55W (manufacturer: Fotowerkstatt Mainz). Panasonic GH2, f=35mm, f/2.8, OM zoom lens with adapter.

135° At this angle the key is at an angle behind the subject and lights only a small section of the face. This angle is often used in moody situations and in **cinematic lighting**. Don't be fooled by the too dark exposure of the face because we will correct this in the next section with a fill light. It seems to be counterintuitive but this is the most popular configuration for many films. We will use it extensively in section 4 where the keys are usually shine against the camera which sounds pretty counterintuitive.

180° This looks pretty unrealistic having the key right behind the subject however this is the preferred location if the key is very intense, for example **when dealing with sunlight** (see also Fig. 9C). Having the key from behind allows for even illumination of the face with the help of a reflector and at the same time avoiding harsh light falling onto the face.

Figure 3: Overhead lighting with a paper lantern. A) in front of the subject, B) directly above and C) from behind. GH2, f/1.4, 50mm prime lens, Canon FD. Light: 125W fluorescent photo light suspended from a boom arm.

Besides moving the light around the subject in the horizontal plane one can also move the light over the subject so that we have overhead lighting. Fig 3 shows the scenario where we have hung a large paper lantern over the the subject. Inside was a daylight balanced fluorescent photo light at 125W (500W tungsten equivalent). This scenario is used to simulate **interiour nighttime** where the light source is often a ceiling light (see also section 4.2.3). In Fig 3A the light is in front of the subject at 0° but suspended higher above her head. This gives a nice soft light on her face. In contrast to Fig. 2A at 0° this looks much more pleasant because the high angle creates soft shadows on her face. One could imagine a scene at a table where the light is suspended over the centre of the table. Fig 3B and Fig 3C are similar to Fig. 2E-F but will provide interesting contrasts when used with many people in a room having the light either in front of them or behind.

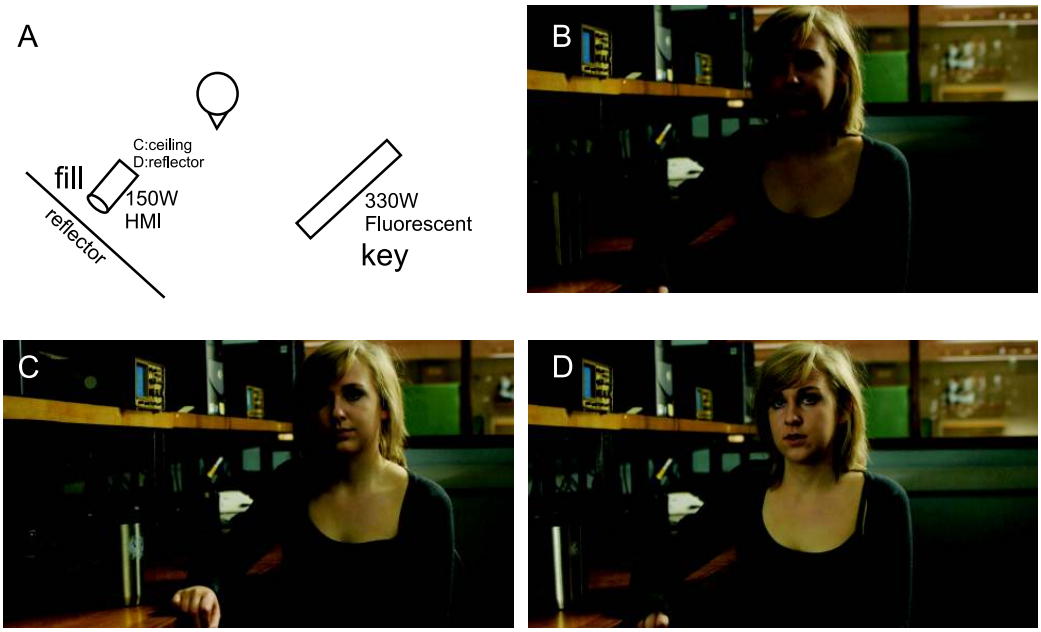

Figure 4: Fill light. B-D show different levels of fill. B) no fill, C) HMI bounced against the ceiling and D) HMI bounced against a large reflector.

2.1.2 Fill

There are two reasons to employ a fill light. The first one is based on the fact that a video camera perceives contrast differently to a human observer. A video camera has a very limited contrast range so that the contrast between the shadows and highlights need to be reduced so that the recorded image appears to be natural to a viewer. Contrast reduction can be achieved by just bouncing light back into the subject or by shining a light against a diffuse surface (ceiling, wall, screen on a stand, ...). Also in terms of visibility of facial expressions it is important to give the actor's face enough fill so that especially the eyes can be seen properly.

The second reason to use fill is to set the mood of the film. Generally a high amount of fill ("high key") is used in upbeat or sitcom situations. A low amount of fill ("low key") is used in drama or moody situations. With too much fill scenes look flat and create the look of a soap opera. Always start a scene without a fill and then add as much fill needed to create the

right tone. Either use barn doors on HMIs when used as a bounce light or use dimmers on tungsten lights.

- Its main is aim to reduce the contrast of the image so that dark areas are never pitch black.
- Usually very soft and shadow-less.
- Bounced off a wall, ceiling, reflector, screens, walls, etc.
- The amount of fill influences strongly the mood of a film. So, use it carefully. For more dramatic moody looks usually no fill is needed. For rather upbeat stories the fill might be stronger ("comedies") or even dominate the lighting ("soaps","sit-coms").
- **never** use a fill without a key light.

Fig. 4 shows different strengths of a fill light in the "cinematic" lighting condition where the key is at 135° (see Fig. 2E). Without fill (Fig. 4B) the contrast is too high to see her facial expressions. In Fig. 4C we used an 150W HMI light and bounced it off the ceiling so that the reflected light illuminated the face. Such light creates a soft shadow-less light. In Fig. 4D we used a large reflector (a simple slide projection screen) which reflected light from the HMI into the face of the subject.

Figure 5: Background lighting. A) no background lighting. B) background lighting with two 150W HMI lights from the right, slightly against the camera. The background light also acts as a back-light for the subject. Camera: GH2, f/2.8, 28mm OM zoom with adapter.

2.1.3 Background light

This is often overseen but is very important to create atmosphere and depth of the scene. In many cinematic scenarios the background is often the brightest area, for example, a window, the sun shining against a wall or a practical light. If you really want to create a good atmosphere spend loads of time on the background lighting.

- Creates depth of the scene by making objects/people visible (often lit at steep angles)
- Creates the overall atmosphere of the room, for example light coming through a window, or a practical light shines on a wall.
- Classical strategy to make "dull" interviews more interesting with the help of coloured gels in the background.
- Often hard light can be used here to great effect because it can be directed properly and lights up only those areas which are interesting.

Fig. 5 shows the effect of background lighting. In Fig. 5A there is no background lighting. The key light at about 20° also lights the background but the light along the benches falls off towards total darkness. To our advantage here is the lit area behind the window which provides natural background lighting without adding any more lighting. Also windows to the outside provide a natural background and require no lighting – often even at night time.

2.1.4 Back-light / Kicker

The term back light is not so well defined as key and fill. The classical back light is right behind the subject and creates the classical rim light usually seen in still photography or television-studio interviews. In normal filming-situations it is rarely used and looks staged. The problem is that it looks unnatural and will directly reveal the intention to create a flattering look. However, if used in a more subtle way by using the key also as a back-light or the background light shining on the subject from behind it can enhance the scene without being suspicious (as shown in Fig. 5B).

- Behind the subject

- Creates depth
- Emphasises the hair, rim, enhances contrast
- Looks artificial, studio like
- Standard lighting for portraits and in studio interview settings

2.1.5 Summary

When you design your lighting *always* start with the key light(s). Make sure that every actor is always lit by a key light wherever he/she is in the room. Then decide upon the background lighting and make sure that the background is not dull. Third decide if you need back-light or if that is already covered by the key lights. At last, decide if you really need fill at all to reduce contrast or if the light spill from the key lights provides already enough fill.

1. Position(s) of the key light(s) so that every person has his/her key at all times.
2. Provide background lighting appropriate to the situation. Make sure it mainly lights objects, furniture, shelves, the floor and if the subject then usually from behind.
3. Check the contrast on camera: is a fill really needed? Are the blacks still visible? If not add a bounce light (ceiling or screen) and keep it intensity as low as possible. Conversely, is there too much fill through light spill from the key and/or backlights? Wrap black foil around key and back-lights to get them more directional.

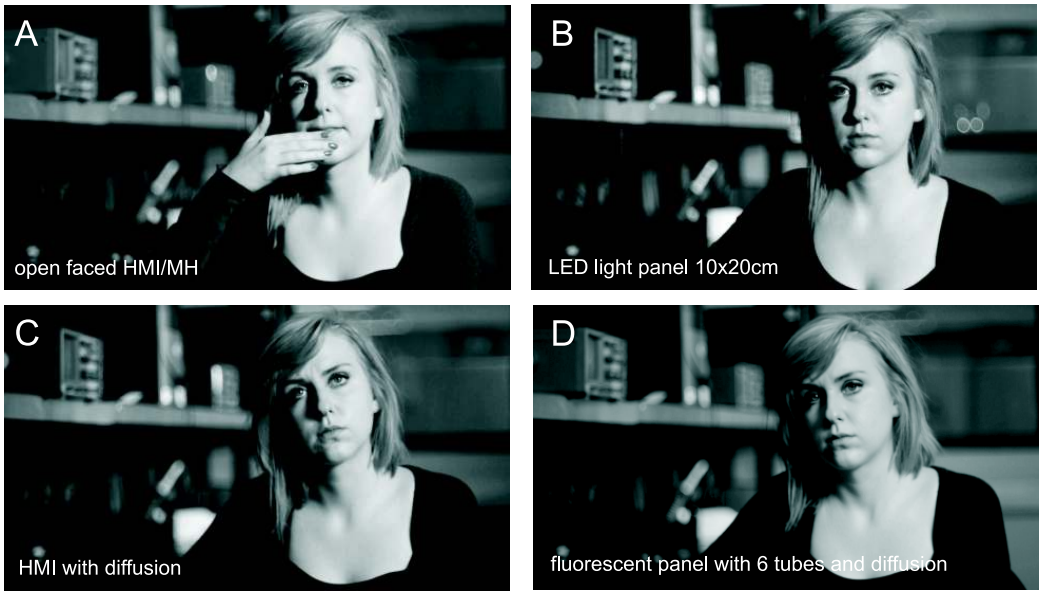

Figure 6: The quality of light. A-D is ordered from hard to soft. A) open faced HMI light, B) LED light panel, C) HMI/MH light with diffusion, D) fluorescent ("kino flo") style light with diffusion. Camera: Panasonic GH2, 50mm f/1.4 prime lens. In particular compare the shadows cast by the nose and how it becomes softer from A) to D).

2.2 Quality of light

Depending on the light source the subject will look substantially different. The trend in general goes towards soft lights, especially large area fluorescent or LED lights. In the earlier days this was created by bouncing light off reflectors, for example, foam boards or white cardboard on a stand. Lighting technology is changing rapidly. However, the general difference between lights is still if they are "hard" or "soft".

Fig. 6 shows different light sources which have different sizes. In A) the light source is an open faces HMI/MH light which produces hard shadows in the face. In B) the subject is lit with an LED panel which has about the size of 10cm x 20cm. Because of it's size shadows are slightly washed out and the face looks softer. In C) the HMI has been covered with diffusion which provides a 20x20cm surface which is still quite small but also makes

the subject look softer. The softest and most popular look is created by large surfaces which can easily be provided by 6 tube fluorescent lights plus diffusion. The surface here is roughly 50x50cm and shadows are washed out substantially which creates a flattering look.

2.2.1 Hard light

This is light originating from point sources or small sources such as Redheads, clear light bulbs, PAR lights or HMI/MH open face lights or single LEDs. These sources create a **sharp shadow** which is not very flattering on people (see Fig. 6A) but works well as a background light or back light. Also night time outdoor light is usually hard because both moonlight and streetlighting are hard lights without diffusion. The other candidate is sunlight which is also a hard light source.

Use for:

- Back light
- Background lighting
- Night-time shoots
- Sometimes as a key to create special effects (direct sunlight, film noir, crime, basement light, ...)

2.2.2 Soft light

This is light originating from surfaces such as fluorescent lights, bounced light, diffused light or overcast sky. This light the light of choice to light faces. The larger the illuminated surface the better it looks on faces (see Fig. 6D) which can be up to 1m x 1m or more ("beaty shot").

- Soft key light (very fashionable just now) with large LED panels, fluorescent lights or reflectors bouncing off light.
- To soften even more shine the light through a diffusor (for example, attach it to the barn door with pegs).
- Can act as fill light when used in conjunction with hard light.

- As a diffuse base light for interiors, often overhead in paper lanterns or inflatable balloons.
- For "beauty shots" when using very large. illuminated surfaces and shine it at an angle at the subject.

2.3 Colour reproduction

For filming we need to light the scene with light sources which look natural. This means that they must be able to produce the full visible spectrum in a similar shape as the sun does it or how normal tungsten bulbs generate light. Important here is the *colour rendering index* which is explained next.

2.3.1 Colour rendering index

The only light source with a perfect continuous spectrum is tungsten lighting, so basically anything which is heated up and is glowing. This is called black body radiation. Any other light sources, such as fluorescent lights or gas discharge lamps have usually discontinuous spectra and have not the perfect ability to produce all wavelengths of the visible spectrum.

The so called colour rendering index (CRI) has been introduced which compares the light of a tungsten bulb (100% CRI) to the light of other sources. The highest CRI of non tungsten light is that of a xenon lamp of nearly 100% CRI which is used in cinema projectors or electronic flashes. The worst CRI has sodium street lighting because it emits yellow, only. Normal mercury street lighting has about 50%. For filming a CRI of %90 or above is required. This can be achieved by HMI lights (90%), certain MH lights (Osram Powerstar daylight, $> 90\%$) and by special three phosphor fluorescent lights, for example, Osram Daylight 954 with a CRI of $> 90\%$. LED lights are quickly catching up and now there are a few available at over 90% but are still very expensive.

Be warned of normal fluorescent lights in offices. If white balanced against a high-CRI source they might look green! There are special gels which remove the green cast (called minus green) of standard fluorescent lights or you can add a green gel to your other light sources (called plus green) and then remove the green cast by white balancing on the plus green filtered light.

2.3.2 Colour temperature

Every light source has a different spectral distribution which is measured in the colour temperature. This temperature refers to the temperature of the black body mentioned above and is therefore approximately correct for tungsten bulbs. Professional tungsten light bulbs for film have about 3200K (red-ish) colour temperature and daylight has about 5500K (blue-ish) colour temperature. A difference in colour temperature can be just described as how blue-ish or red-ish the light source looks. For the video camera this manifests in different strengths for red and blue.

Because different lights will cause different amounts of red,blue and green you need to tell the camera what is white. This is usually done by filming a white sheet of paper (with no zebra pattern in it!) and pressing the white balance button. Never use automatic white balance because this will cause different tints during the shoot so that shot and reverse shot won't fit together.

Often you will have different light sources with different colour temperatures on set. Therefore, you need to decide before your shoot how to compensate these differences or if you want to use them for your advantage. Sources with a lower colour temperature will look warmer and sources with a higher colour temperature will look colder. For example, you might light a scene with daylight balanced fluorescent lights and the practical lights are tungsten. In this case the tungsten lights will look orange which might add to a "cosy" atmosphere. On the other hand in an office atmosphere you want to have a rather neutral look and you cover all tungsten light bulbs with gels which convert from tungsten to daylight (C.T.B or 1/2 C.T.B).

If you have daylight coming into a room this needs to be matched with the colour temperature of the film lights. These gels are called full "colour temperature orange" (C.T.O., to convert from daylight to tungsten) and "colour temperature blue" (C.T.B., to convert from tungsten to daylight). So, for example you could fit full CTO (LEE 204) onto the window to convert it to tungsten or you could add full CTB (LEE 201) on your tungsten lights to convert it to daylight. Note that you loose about 50% of your light with full C.T.B. so it's probably more economical to reduce the incoming daylight which is usually too bright anyway (see sections about exposure and contrast). Alternatively, you could avoid the hassle completely by just using daylight balanced fluorescent lights for filming purposes which are usually at 5500K which is daylight colour temperature.

The CTO and CTB filters are the most common filters for colour temperature conversion. In many other situations you might want to have conversions between other colour temperatures, for example for matching different lights with slightly different colour temperatures. Or you just want to create a subtle colour temperature contrast between the fill and the key. The colour temperature shift is expressed in "mired" which is the difference between the reciprocal colour temperatures:

$$\frac{10^6}{T_{\text{after}}} - \frac{10^6}{T_{\text{before}}} = \text{mired shift} \tag{1}$$

You can look up these shifts for technical conversion filters. For example to convert daylight of 6000K to tungsten light of 3200K you need a filter with mired shift of 145 where LEE filter 204 matches best.

Every camera reacts differently to different colour temperature shifts so it's important to "know" your camera and how it reacts to these changes.

2.3.3 Choice of lights

There are three major different light sources available which all have their advantages and disadvantages.

- **Tungsten lighting** is the classical lighting source still used by 99% of low budget film makers. For these productions tungsten lights come as so called Red Heads (800W) and Blondes (2000W). They can be dimmed and are lightweight. The problem is their power consumption which will cause problems on location. Red heads draw 5A and blondes 10A of current. In a household the max current from all sockets might be as low as 16A which limits the number of lights which can be used. Another problem is the lifetime of the bulbs which might be in extreme cases just a few days. Finally these lights are getting very hot and cause a constant fire hazard. For daylight scenes the daylight needs to be colour corrected to tungsten with full CTO on windows. An alternative to the Redheads and Blondes are PAR lights (PAR64, PAR56, ...) used mainly on stage but are also an excellent choice because they are very efficient and are much cheaper than Redheads.

- **Fluorescent film lights** are special fluorescent tubes which have a CRI of over 95%. These are tubes manufactured mainly by Osram

which were initially designed for fashion shops or still photography (as the MH bulbs). Now they are gaining rapid popularity for filming often referred to "Kino Flos" (like Hoover). They have the colour temperature of daylight and can therefore be mixed with daylight to create the illusion of light coming through a window or they can be used as ceiling lights to create a diffuse office like atmosphere. They are also excellent for night time interior shots simulating practical lights. Usually 2–6 tubes are combined in one light which produces a very soft light which can be even more diffused by adding a diffuser to the barn doors. They can be mixed with MH and HMI lights because of their similar colour temperature. The power consumption is about 4 times smaller compared to tungsten lighting. The only disadvantage is that they are not dimmable so that ND filters should be at hand.

- **HMI or MH lights** are lights which produce the light with the help of a cocktail of different metals which evaporate once switched on. They are more than four (!) times more efficient than tungsten lights. So, a 150W MH/HMI light gives about the same output as an 800W Redhead. Since a couple of years ago only HMI lights had a CRI of 90% or better and these are very expensive. However, now also the much cheaper MH bulbs available offering a CRI of over 90% making them an excellent choice for filming. For night/daytime outdoor shoots the HMI/MH are the only lights with enough light output. The other advantage is that they are daylight balanced so that there is no loss of light through the application of gels as it would happen with tungsten lighting. Their disadvantage is their weight because they have an in-built transformer. For lights up to 150W (Red Head replacement) the weight of the transformer is negligible but for higher wattages the transformer is often kept on the ground because they easily reach 5 to 10 kilos. These lights are not dimmable and therefore require ND filters to control their light intensity.

- **LED lights** gaining rapidly in popularity in filming. They are lightweight and have a very efficiency compared to the fluorescent lights. LED lights are panels consisting of many LEDs of to 10,000. They are very lightweight and can be fitted without hassle in confined spaces. They are dimmable and do not change their colour temperature as tungsten do. They are available as mains powered lights or battery operated

lights which are especially useful for documentary work. The main problem just now is the colour rendering index which is usually at around 80% which is not enough for reproducing skin tone perfectly. However, the LED lights catching up quickly in quality and 90% versions are already available. Another advantage is that the single LEDs are available as wide angle and narrow angle versions so that it is possible to make LED lights which are soft (large surface) and at the same time directional. This opens up new exciting lighting opportunities for INT/NIGHT shoots where spill light needs to be minimised and at the same time soft lights are required.

Figure 7: Lighting for documentary. Undramatic lighting with the key just off the camera ($10 - 20°$) and background/back-lighting.

3 Lighting for documentary

In contrast to fiction lighting for a documentary is always a bit improvised. Especially the setup times are shorter and the amount of equipment is usually pretty limited. Fig. 7 shows a standard setup which we now discuss.

3.1 Keylight

The key light is the light which casts the principle shadows on the face of the subject (see Fig. 7C). The most important consideration is the camera/key angle (see section 2.1.1). This determines the main look of the footage. In general the key should be at an angle with the camera as already outlined in the three point lighting section. In other words any light which is mounted *on* the camera is a definite no-no! This obviously becomes more tricky when the subject is moving and the angle between the subject and key is changing.

In terms of hard and soft lights a soft key looks excellent on faces while a hard key looks very good on objects or hands because it creates precise edges. For example when a person is doing a manual task it looks best to light the face with a soft key and the hands / tools with a hard key, often at a steep angle.

- Never have the key on or behind the camera.
- Use soft keys for faces, use hard keys for objects, tools and hands.

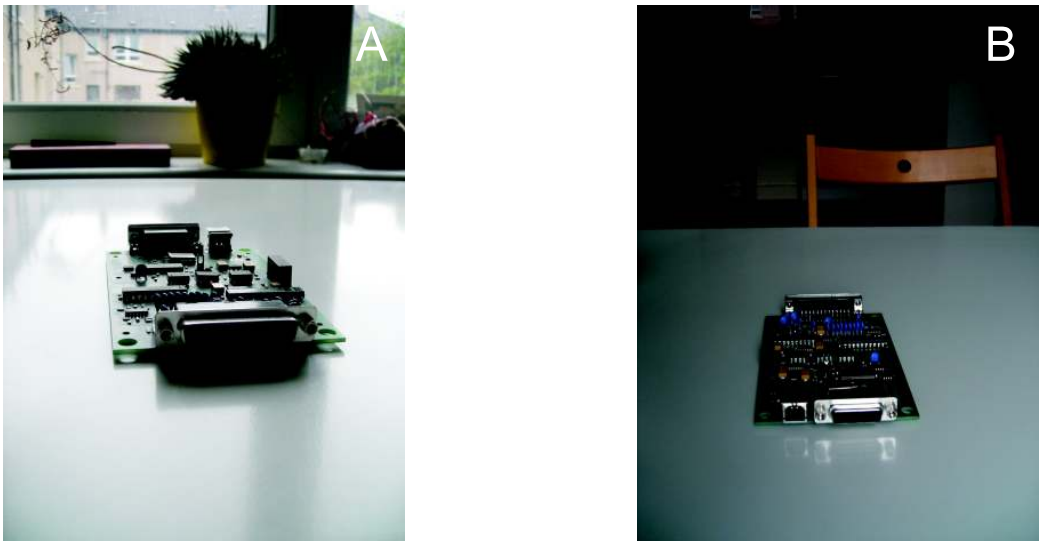

Figure 8: Use of daylight as background lighting in INT/DAY. A) filming against a window, B) filming with the window light

3.2 Background lighting

Background lighting makes films interesting. For example, shining a hard light sideways against a bookshelf looks more interesting than something drowning in the dark. In Fig 7 there are two areas with background lighting. The benches with the oscilloscopes (Fig 7A) have been lit with the help of two HMI lights at a steep angle. The area in Fig 7B behind the windows was lit by the available light in that room and acts also as a background light which comes for free. This shows that positioning of the subject can make a huge difference without adding more lights. Fig. 8 demonstrates the use of windows as background. While Fig. 8A looks interesting and provides an openness of the situation, Fig. 8B looks depressing because the background is drowned in black. As a general recommendation one should always shoot against windows and never with the window behind the camera.

Having the window behind a camera is the worst case scenario because this corresponds to having the key at 0° (see Fig. 2A) and having a black hole as the background.

Often science programs use coloured gels to create an interesting look. While a blue light looks awful on a face it might turn a boring lab into something more interesting.

- Use hard directional lights for background at steep angles (hard lights with barn doors).
- Integrate practical lights or naturally lit areas available on location.
- Shoot against windows to create depth and use the daylight as back(ground) light.
- Use coloured gels to make the background more interesting.

3.3 Fill light

As said before a fill light is used to reduce the contrast of a scene. This is usually a bounce light or anything which is not creating shadows. Outside it's a reflector bounced back into the subject's face or an HMI bounced against a screen. Use it to control the contrast of the scene. For example, in Fig. 8A a fill could have been used to reduce the contrast. The more fill the more upbeat it will look but at the same time less exciting. Modern cameras can work often without fill and the blacks can easily be corrected in post.

- For upbeat atmosphere use strong fill (bounce), for dramatic atmosphere use less or no fill.
- Try to avoid the use of fill lights by experimenting with the back-lights and creating enough light spill from key and/or back-lights.

Figure 9: A) INT/DAY, B)INT/NIGHT, C)EXT/DAY, D)EXT/NIGHT

3.4 INT/EXT – DAY/NIGHT

These are expressions used in fiction but are also useful here. In general you will encounter four situations: interior/exterior and day/night. This gives us a matrix with examples shown in Fig. 9.

	DAY	NIGHT
INT	Use natural light as a key or use a soft fluorescent as a key, shoot against windows and reduce the contrast with bounce lights or direct fluorescent lights, avoid hard sunlight falling on somebody's face. If this is the case shoot against it or move to another place in the room. Fig. 9A has been created by a 110W fluorescent on the right and with some additional light coming from a large window.	Use a soft or overhead light to create the key. Have it fairly high to simulate an interior light. Use practical lights in the background or other available light sources to create pools of light. Fig. 9B has been created by having a 110W fluorescent lights to the right and using the overhead lights in the background to a great effect.
EXT	Shoot against the sun and use a reflector to bounce light into the face. Fig. 9C shows an example where the sun is roughly behind the subject. The larger the reflector the nicer it looks.	Use a soft light as a key light (LED or fluorescent) and then use available lights in the background such as street lights or the city lights in the background on a hill or rooftop.

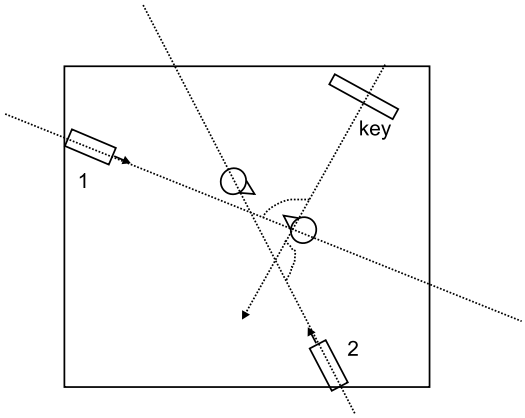

Figure 10: Angle between key and camera positions. In this example both angles are above 90 degrees.

4 Cinematic lighting

This section gives some example for more "cinematic" lighting. This is obviously very subjective but I hope to reflect the general trend here in film making.

4.1 General rules

There are rules which need to be obeyed:

1. Maximise all angles between the key and all camera positions.
2. Decide your key / fill ratio.
3. Don't overexpose!

4.1.1 Maximise the camera vs. key angles

A useful rule is to **maximise the angles between the key light and every camera position**. Fig. 10 shows a typical setting. The key light is *behind* the actors which seems to be counterintuitive. The two camera positions are in classical shot/reverse shot setting. From position one we

see that the angle is about 90 degrees and from position two the angle is at about 100 degrees. Obviously, it is not always possible to have key/camera angles of more than 90 degrees for all positions but make a decision which angle needs to look more dramatic or cinematic (high camera/key angle) and which allows a more flat lighting from the front. This positioning of the light is the most economical and produces a good night time lighting with just one light or illuminated white carboard.

Figure 11: Neutral density filters on the windows. Section A has no ND filters, section B has one layer of LEE 210 (ND2) and section C has two layers of LEE 210. Note that it was a sunny day. In overcast weather one layer would have been enough. From the set of CAF-FIED. The daylight was faked by the large fluorescent light (6×55W) on the kitchen sink.

4.1.2 Key / fill ratio

Not only the position of the key but also the intensity ratios between key and fill determine the atmosphere.

- **High key** means that the fill is as bright as the key which is often used in sitcoms or in situations where an upbeat mood is required. The can be achieved by using many bounce lights to overpower the key(s).
- **Low key** has a low fill intensity or none where the key light is the dominant light source and clearly identifiable. This is often used to create the "cinematic look".

4.1.3 Don't overexpose

A typical giveaway that you are shooting on video are overexposed areas, especially in windows or the sky. Use techniques to reduce contrast (see also Brown 2008):

- Use fill lights. Bounce light against the ceiling or another surface to reduce the contrast. In EXT daytime situations use a large reflector[2].
- Use ND filters to reduce the light coming through windows (Fig. 11). Balance then the light with internal lights (for example with fluorescent lights) which fake the light through the window or use bounce lights.
- For outdoor shoots prefer days with overcast sky or shoot against the sun (but not into the sun!) and bounce it back. The diffuse bounce light from sunlight looks very flattering. So, bring your large reflector.

Always check in the viewfinder if there is 100% zebra somewhere in the image and adjust the aperture accordingly. The only allowed areas for overexposure are reflections or sometimes rim light (especially when shot against the sun). Always use manual aperture. Automatic aperture won't solve your problem because the most cinematic shots are shot very often against bright backgrounds (windows, ...) or are strongly back-lit which will make your subject look very dark. So, always use manual aperture (and keep the gain at 0dB).

[2]With large I mean really large. Not one of these small hand-held reflectors but if possible a slide projection screen or something similar.

Figure 12: Depth of field. A-C compares the depth of field between different cameras: Sony HVR-V1, Panasonic GH2 and Canon 5D MkII. D-F depth of field of the Canon 5D at different aperture settings (f/1.4, f/2.8 and f/11). All shots except of A) are shot with the same 50mm prime lens (B-F). The box around B) and E) shows the difference between the GH2 and 5D with the *same* lens (50mm) attached. This is due to different image sensor sizes of both cameras.

4.1.4 Depth of field

The depth of field (DOF) is defined by distance range where the subject is in focus. In film making a large DOF is often not desirable because one wants to have the face of the actor in focus while keeping the background blurred. The soft DOF draws attention to a certain aspect in the scene. There are simple rules which determine the depth of field:

- The more you zoom in the more shallow the depth of field. This generally works for your advantage because closeups are the most important shots and they will look always softer.

- The larger the sensor size (the surface where the light is projected on by the lens) the more shallow is the depth of field. Video cameras traditionally have smaller sensors than film-film cameras (35mm) so that the DOF is much deeper. This causes a "journalistic" or a cheap sitcom look where everything is in focus. Fig. 12 compares different cameras with different image sensor sizes. The Sony HVR-V1 (and most camcorders) has a small image sensor which creates a large depth of field (see Fig. 12A). The only chance to achieve a softer image is

by zooming into the subject (and of course do proper lighting). The Panasonic GH2 has a micro four third (M4/3) image sensor which is substantially larger than that of a classical camcorder sensor and the depth of field becomes shallow at f/2.8 and below which is demonstrated in Fig. 12B. The camera with the largest image sensor is the Canon 5D which has an image sensor which has the same size as a 35mm film or a still camera which is called full frame sensor. This camera creates a similar filming look to a proper film-film camera. The GH2 (M4/3) in contrast has an image sensor which is half the size of that of the 5D. This also means that a 50mm lens on the 5D requires a 25mm lens on the GH2. In turn this means that the same lens cuts out a different section of the same scene which is clearly visible in Figs. 12B,E which both were filmed with a 50mm lens. In contrast to the full frame 5D (Fig. 12E) the image of the M4/3 GH2 appears to be cropped by half (Fig. 12B). For that reason people talk about the so called "crop factor": the M4/3 has a crop factor of two because it crops the image of a full frame camera by factor two.

- The smaller the f-stop number (the wider the aperture) the more shallow the depth of field. In practise keep the f-stop number low, for example at $f/2.8$ or $f/1.4$ with the help of on/in camera ND filters. Conversely, if you want to increase the depth of field you can remove the ND filters and work at high f-stop numbers such as $f/11$. This is shown in Fig. 12D-F where we have changed the aperture from f/1.4 to f/11 and adjusting the ISO number to obtain a similar exposure. It can be clearly seen the depth of field is increasing from left to right. However, this also shows that it is difficult to obtain a deep depth of field when using cameras such as the 5D because the images becomes very grainy. In such a situation one probably needs to resort to wide angle lenses which naturally have a large depth of field (basically not zooming in).

The tips for achieving shallow depth of field are:

- Use a high distance ratio between foreground and background. Shoot in larger rooms where the background is further away so that it has a better chance to be out of focus. Shoot from corner to corner in a room. Alternatively shoot against windows so that the outside is properly blurred.

- Zoom into the subject. For camcorders stay away from the subject as far as possible.
- Keep the aperture as wide open as possible or in other words keep the f-stop numbers low. Use f/2.8 50-70mm for M4/3 and f/5.6mm 100-140mm for 5D. Use ND filters or fader filters to reduce the light entering the lens and do not change the shutter speed (which should be at 1/50 in Europe).
- Use cameras with larger image sensors, for example, digital DSLRs (full frame 5D, M4/3 GH1/GH2, APS 60D, 550D, ...) or camcorders with larger image sensors such as the AF100/101/102.

Be aware that shallow depth of field is often expensive to achieve because there is a tradeoff: Cheaper cameras such as the GH2, 60D, 550D will have smaller image sensors and therefore will require faster lenses with smaller f-stop numbers (f/2.8 or less) while cameras with full frame image sensors are more expensive but require slower less expensive lenses. Choose carefully the camera because some allow the use of many lenses (M4/3, GH2 and with limitations the 60D) while other allow only the use of very expensive lenses (full frame, 5D).

4.2 Practical scenarios

Here I show some examples from films which have been made at the School of Engineering at the University of Glasgow and from my own films.

4.2.1 INT, DAY

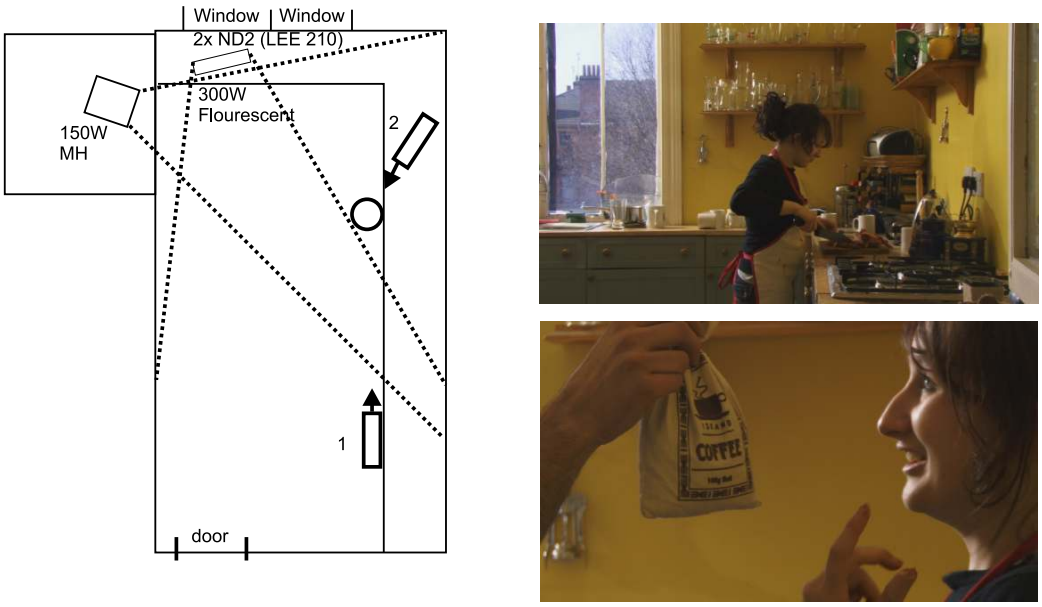

Figure 13: The daylight situation is created by having one large fluorescent light on the kitchen sink and a hard light (MH,150W) in the small back room. The light from the windows is reduced by two layers of LEE 210 (ND2) filters. Note that no reflector was used in this shoot because the reflectance from the walls was enough and gave a nice warm feel. Still taken from CAF-FIEND.

Fig. 13 shows a typical setting for a daylight scene shot against a window:

- Key1: 330W fluorescent light next to the window for daylight effect
- Key2/background: 150W hard HMI on the worktop/shelves
- Fill: none(!), just light-spill from the fluorescent light
- Windows show point ideally towards north to avoid direct sunlight. If not consider covering the windows with black foil when not in shot.

Note the steep angle of the key against the camera especially for setup number 1 which corresponds to the "cinematic" angle in Fig. 2E. This looks pretty different to the demo shots because of a rather high level of fill which comes naturally through the 330W fluorescent light which spills light on the walls and creates a natural bounce light. To give the glasses on the shelves more structure a hard light from the store room was shining just on the shelves and the work-top.

In order to reduce the contrast against the window two layers of neutral density filters (LEE 210) have been applied to the windows. Note that the daylight from the outside does *not* illuminate the interior but this is done by the fluorescent light. This means that light changes from outside (through clouds, daytime etc) won't change the exposure inside so that there are less continuity issues.

Take care that no direct sunlight enters the room because this will be 100 times brighter than any light source in the room and will cause overexposure where it shines against. Consider using black foil or binbags to cover the windows when not in shot and/or plan your shot-list according to the position of the sun.

Figure 14: The daylight comes from top left and the camera is nearly at 150 degrees to the daylight. A reflector was used to bounce light back into the face. Still from CHANGE.

4.2.2 EXT, DAY

- Key: Direction of sunlight / daylight
- Fill: Reflector / bounce light

For exterior shoots it is important to determine the direction of the sun and then plan the shoot accordingly (see Fig. 14). It is crucial to choose the camera / actor positions so that the camera films against the sun (not into the sun!). In order to reduce contrast a reflector should be used to bounce light back into the actor's face. The larger the reflector the more flattering the resulting picture.

In case there is no direct sunlight and we have a pretty overcast sky the filming direction is less of an issue and any direction can be used. A reflector might still be useful to create a "key" effect so that faces are looking a bit more interesting.

4.2.3 INT, NIGHT

Night time atmosphere can be quite different depending if there are lights around on or if it is just moonlight.

Important for night time shoots is that the key is not lighting the walls but ideally just lighting areas which are of interest to keep the room as dark as possible. For that reason directional lights are often used which is easiest with hard lights but also soft lights can be "customised" ranging from simple black bin bags wrapped around to honeycombs. Another trick is to put have the lights close to the walls of the room and shine away from the walls so that they stay dark. This is especially advisable when using soft lights with quite a lot of light spill.

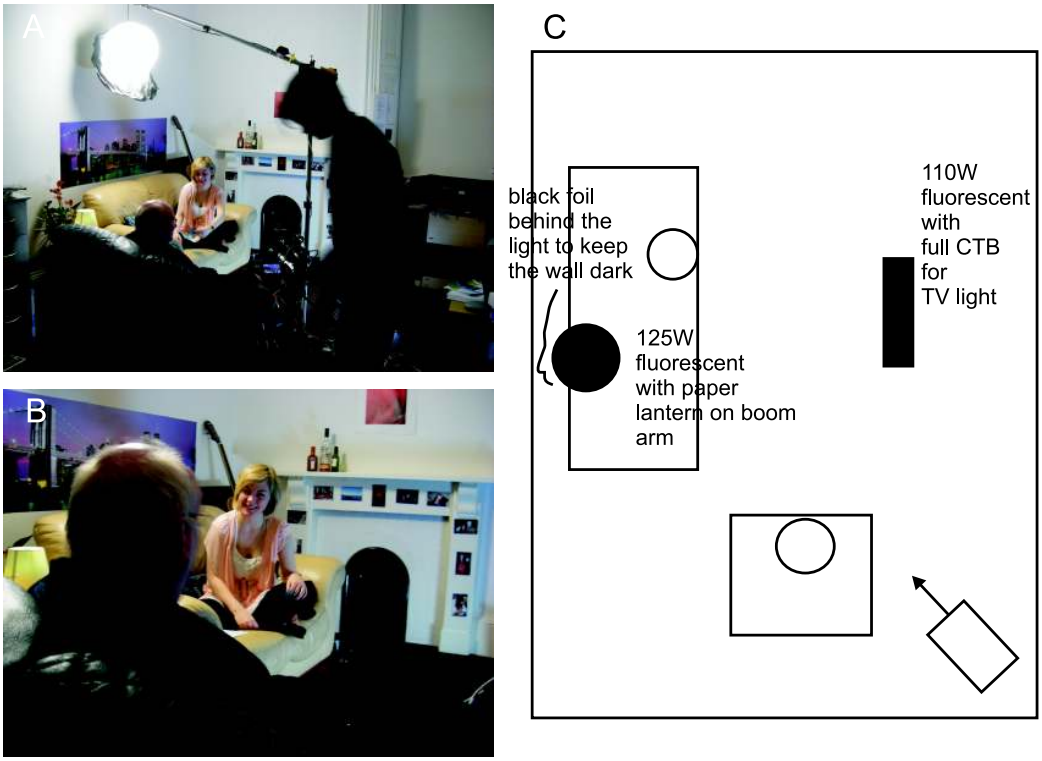

Figure 15: Night time atmosphere with an overhead light. A second light provides a blue-ish shine to fake a TV.

Example 1 The first example of night time lighting demonstrates the use of an overhead light (Fig. 15).

- Key: Soft overhead light with black foil at the back avoiding light spill on walls.
- Background: practical lights with gels for colour correction.
- Fill: none (plus faint light with CTB for TV effect).
- Practical lights on dimmer with 1/2 CTB to balance against the daytime fluorescent.

The overhead light source is a daylight balanced 125W fluorescent light (500W conventional) which has been placed behind the subject to give a rather dark-ish feel. To avoid light spillage on the wall a black foil (here: a simple binbag) has been placed between the light and the wall. On the table is a practical lamp which has half C.T. blue wrapped around a conventional lightbulb connected to a dimmer which is adjusted to avoid overexposure. If no dimmer is available use ND filters on top of the 1/2 CTB. The TV effect is created by a 110W fluorescent light on the floor with full CTB where its barn doors were moved during the shoot. The stand of the boom arm is placed at a location where it won't be visible for any of the camera setups. The approach with the boom has the advantage that no tripods are in shot for all camera setups which allows very flexible shooting.

Example 2 For those who think that the overhead light on a boom is too much work and can also resort to lights on normal stands risking that they will be in shot. Fig. 16 shows the problem. While for the closeups there is no problem the wide shot causes trouble because the tripod is in shot. To avoid this problem one could not shoot a WS at all (which is actually an option) or just moves the key light a bit to the side. The viewer won't notice as long as it is not done too extremely. Here, the WS is not filmed frontally but also at an angle so that the light needs to be moved only a small amount to the left. Note that through the light spill from the fluorescent light we get also a nice background light on the wall behind the male actor. The blinds behind the female actress give here a natural background which is just the remaining light from the outside. Filming took place after sunset with some remaining daylight visible between the blinds.

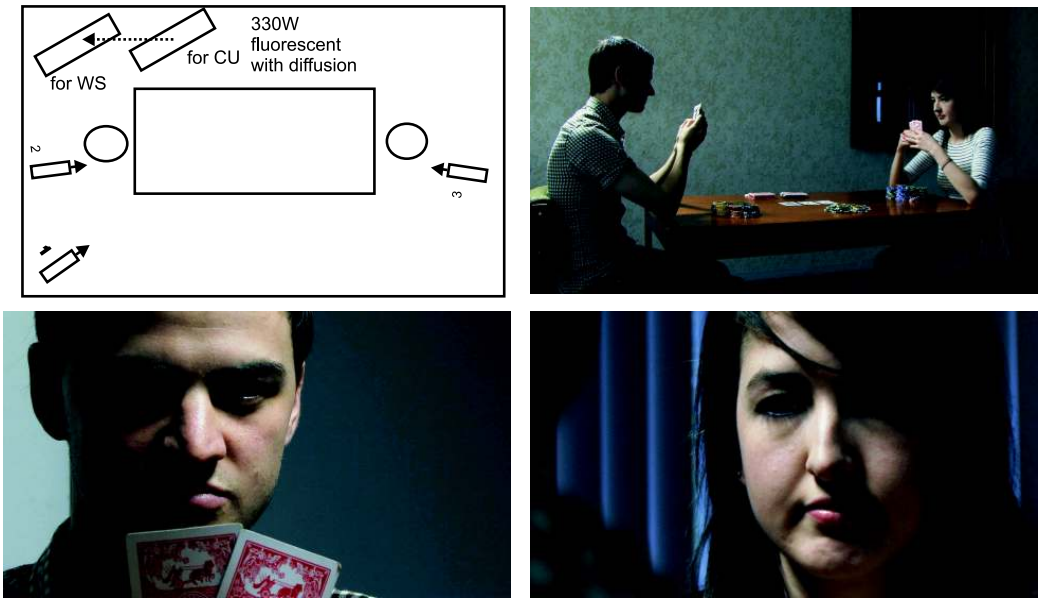

Figure 16: Night time poker scene. Lit with only one fluorescent light placed between the actors.

- Key: 330W Fluorescent light with diffusion
- Fill: none. Just light spill from the room.
- Background: natural night time light from the outside.

Example 3 In the last example we had the problem that the tripod is visible in the wide shot. One solution is to use two key lights in the corner of the room and light the actors from there. Fig. 17 shows a dinner scene which is lit with two fluorescent lights from behind left and right placed as high as possible to give the illusion of ceiling lights. This is also referred as "crossed key" lighting which is a classical lighting for scenes in a room (with strong fill opposed to here often used in sitcoms).

- Key1: left corner
- Key2: right corner
- Fill: none

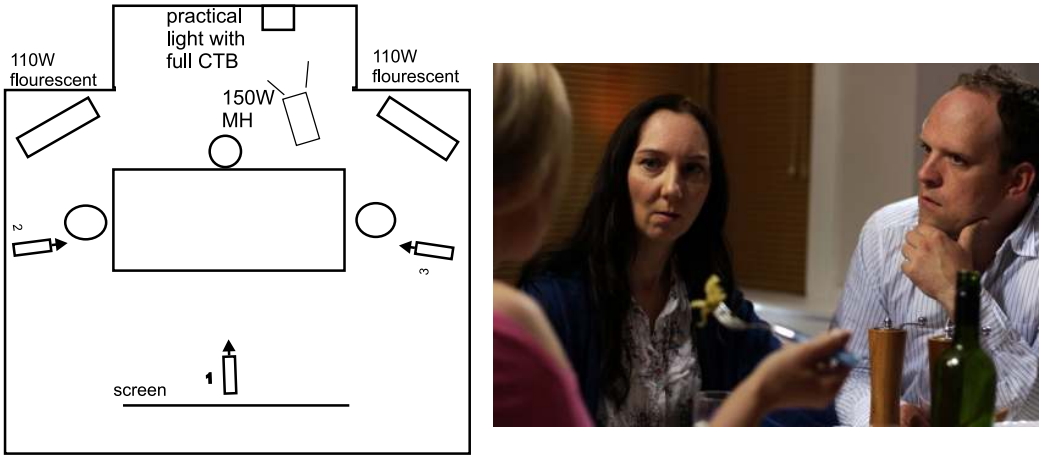

Figure 17: Night time dinner scene. There are two fluorescent lights behind the actors to the left and right. They act as both rim light and key for the opposite actor. The screen reduces the contrast and creates a soft fill. Scene from FRIED.

- Background: HMI against the blinds

The lighting from behind has two advantages: it increases the angle between the camera positions and the key and it keeps the walls dark. At the same time it creates light spill behind the camera so that it also acts as a fill by bouncing light back from the walls behind the camera. It's a very economical approach. The difficulty is to hide the tripods which in this case was easy because of shelves to the left and right so that the lights could be clamped on them. A practical light in the background needed to be colour corrected with full CTB to the daylight balanced fluorescent lights. To emphasise the light from the practical light a 150W MH was on the floor shining on the blinds.

Example 4

- Key1: 110W fluorescent light
- Key2: 150W HMI
- Fill: none

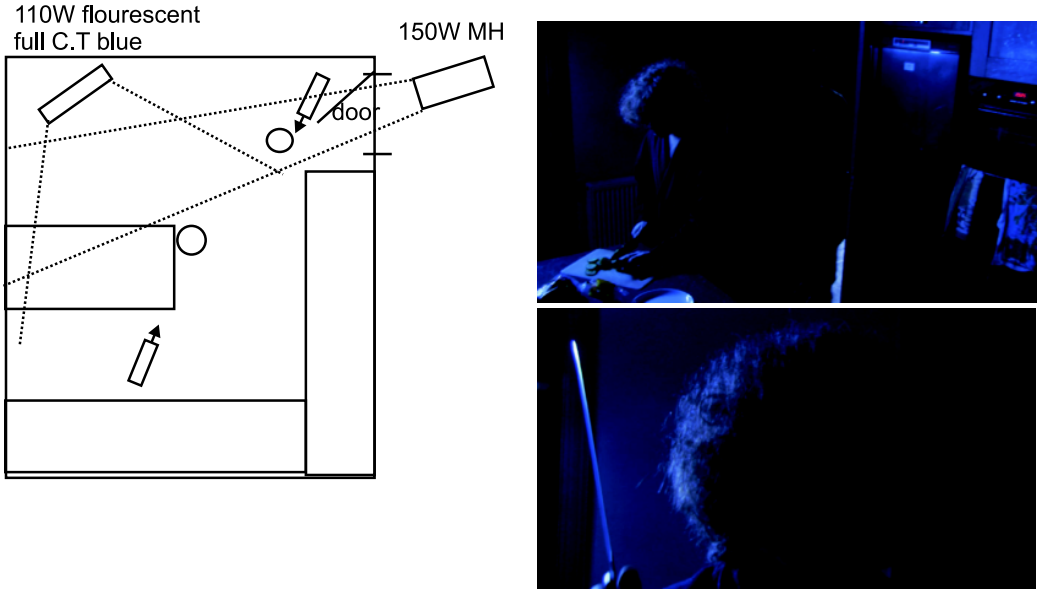

Figure 18: Night time scene where some moonlight exterior is suggested from the left and some light from the hallway. Still from COLD CUT.

Fig. 18 shows a scenario where the actual room is lit by a light with full C.T blue filter to give it a night-like cast and a light from the hallway with no filter to suggest some warmer light source in the hallway, for example a ceiling light. The white balance was on the hall light. This light acts here as a key light for the second actor who is entering the room at a steep angle.

Figure 19: Outdoor night time shoot. Two 250W metal halide lights light the scene. The light to the right is on the floor and acts as the key. The light to the left acts as a general fill. Note that the key also acts as a background light. Still from CHANGE.

4.2.4 EXT, NIGHT

Example 1

- Key: 250W HMI on floor from the right at 90°.
- Background: 250W HMI on stand

Outside night time lighting is usually done with hard lights where one of them acts as a key at a steep angle. In Fig. 19 this was to the right at an angle of about 90 degrees. Another light from the left acted as a back-light. The same rules as for internal lighting apply here: avoid lighting surfaces from the front because this would look like daylight.

In many night time shoots background lighting is needed not to have a black hole behind the actors. Luckily, in this example this was not required because of the air conditioning units lit by both the key and the background light. Note that this is also a variation of the "cross key" setup where they keys shine into the camera. The light on the left would act as a key for the

second actor lying on the floor in a sleeping bag – however in this scene he never gets up.

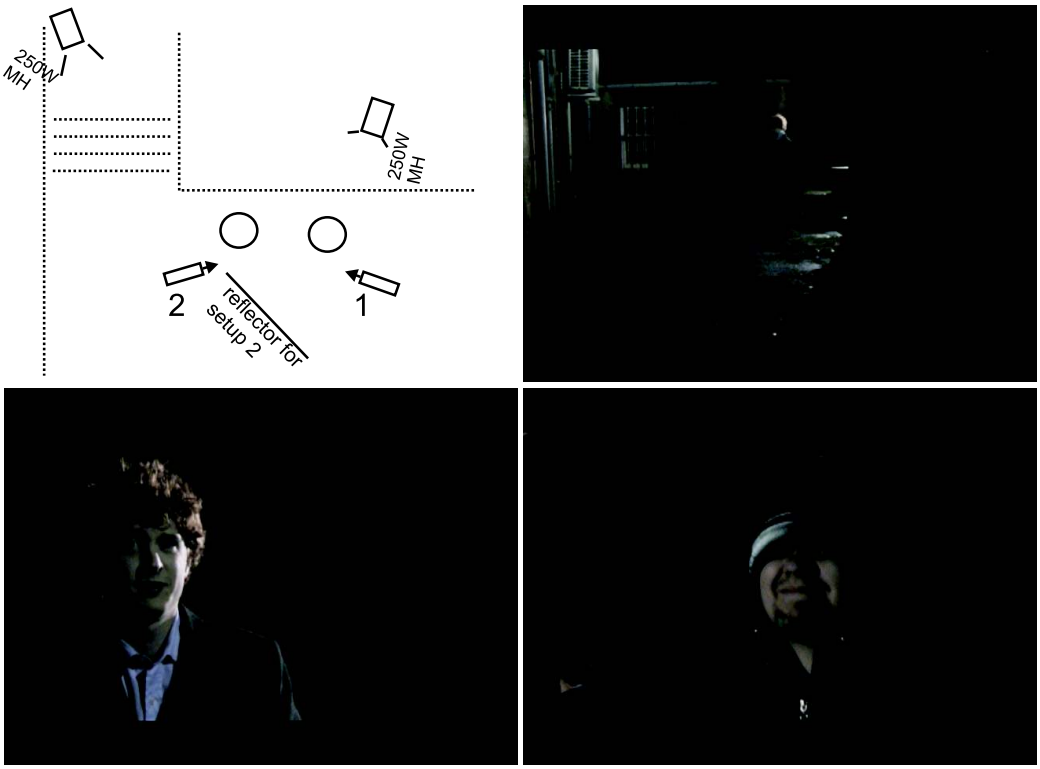

Figure 20: Outdoor night time shoot. Still from the practise shoot THE DEALER.

Example 2

- Key 1 for person on the left
- Key 2 for person on the right
- Fill via reflector for the person on the right

Fig. 20 shows another example of a night time scenario. The light on the left is right around the corner acts as a key for the person coming down the steps and at the same time as a background light for the walls. The light on

the right is on top of the wall and shines at a steep angle down on the scene giving the “dealer” a rimlight and the other person a fill. For the closeup of the dealer a reflector has been used to bounce light back into his face.

Figure 21: Setup for the test shoot. Two HMI lights with Osram Powerstar for background lighting. One 6 tube fluorescent light as the key. The bounce light is not shown in the photo but is right behind the photographer's position. Cameras: HVR-V1, 5D and GH2.

5 Acknowledgement

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