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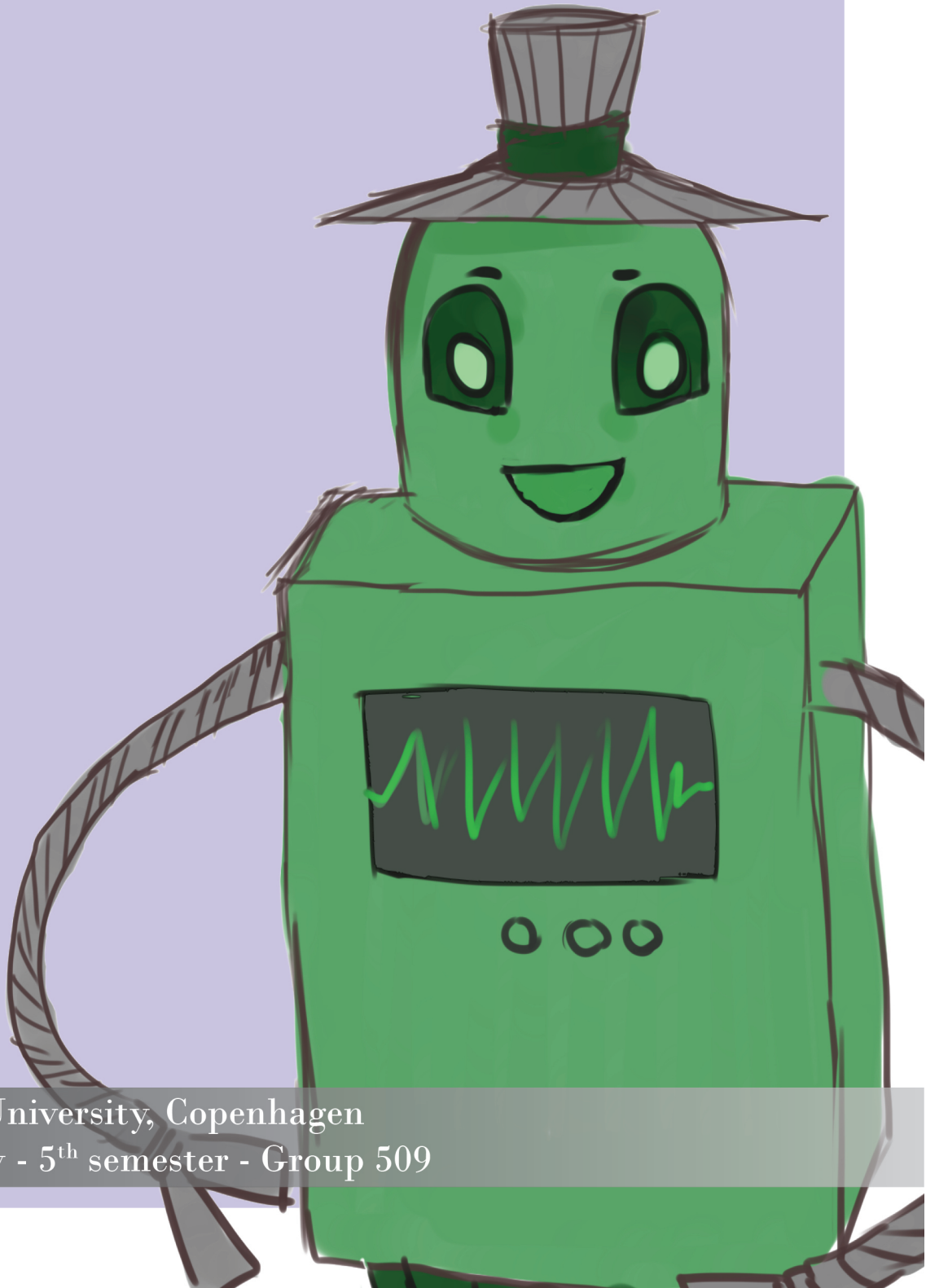
CROSSING THE LINE



Aalborg University, Copenhagen
Medialogy - 5th semester - Group 509

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Audio-Visual Experiments – Pre-Rendered Experiences

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Abstract:

This project revolves around perception of the spatial construction in movies and the changes occurring when a scene uses either continuity editing or discontinuity editing, in regards to keeping or crossing the 180 degree line. This was further investigated in order to be able to design the given scene to fit with both types of editing, while having a simple plot and animations.

The test was conducted as a between-group experiment to which convenience sampling was used, while the participants were assigned to each group randomly. The test suggests that there might not be any significant difference in how the viewer perceives the spatial construction of a scene when this is edited while keeping the 180 degree line (continuous editing) or crossing it (discontinuous editing).

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Contents

Abbreviations

SOTA	**S**tate **O**f **T**he **A**rt
CGI	**C**omputer **G**enerated **I**magery
IPS	**I**nitial **P**roblem **S**tatement
FPS	**F**inal **P**roblem **S**tatement
GPU	**G**raphics **P**rocessing **U**nit
CPU	**C**entral **P**rocessing **U**nit
POV	**P**oint **O**f **V**iew
GHQ	**G**eneral **H**ead**q**uarters

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Chapter 1

Introduction

The semester theme for this semester was *"Audio-Visual Experiments Pre-Rendered Experiences"*, and it was hence with this in mind that the topic for this project was found. Since the majority of the group members had passion for movies, this was the obvious direction to go in. The motivation within this project was greatly influenced by the editing styles and cuts directors have been using in the past years, since it was noticed that directors often do not use certain aspects of the editing, such as discontinuity which caught the attention.

The main questions, which had lead us through the projects progress, were referring to the editing filmmakers used in their movies. Why do directors avoid usage of discontinuity and its techniques? How do viewers perceive the story in a scene, where discontinuity is used, instead of continuity? These questions were investigated (see Chapter 4 Investigation), leading up to Chapter 5 Final Problem Statement, which was further explored with all its methods (see Chapter 6 Methods), before designing (see Chapter 7 Design) and implementing (see Chapter 8 Implementation) two similar pre-rendered animated scenes, only different in the way they were edited. On the basis of the FPS (see Chapter 5 Final Problem Statement) was a hypothesis made and then tested (see Chapter 9 Test). The results (see Chapter 9.4 Test Results) from the test was analyzed and concluded upon, leading up to a discussion (see Chapter 10 Discussion) of the project itself and the conclusion (see Chapter 11 Conclusion) upon the project.

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Chapter 2

Initial Problem Statement

How is it possible to use continuity and discontinuity editing to change the story of a scene?

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Chapter 3

Pre-Analysis

In this section, the thoughts made before starting the project will be put into what topics would be a good idea to look into for Chapter 4 Investigation. The topics will be based on the IPS (see Chapter 2 Initial Problem Statement) and this will work as a frame of what the project will contain and be about and specify what and why it is looked into.

In modern film editing, continuity in the shots is usually what is strived for in order to hide the jump between shots and not confuse the viewer, this is then achieved using different techniques. The opposite of this, discontinuity in the shots, lies simply in breaking the rules of continuity editing [Bordwell and Thompson, 2013a, p. 231-275]. To find out which parts of the continuity and discontinuity editing could be used for this project, will the specific theoretical techniques in the two styles and what differs them from each other be investigated. As continuity editing is more used in general and hence in daily practice, it will further be looked into if there are cases of practical use of discontinuity editing.

How a story is written can be one of the most fundamental things affecting a scene. Therefore it is desired to look into what aspects of the story can be changed and what it will do for the perception of the story. This includes the aspects of telling a story and a look into the case of it being a short film as there will be used a type of shorter scenario due to resources in this project.

As the genre is not an important aspect of the IPS (see Chapter 2 Initial Problem Statement), this subject will not be looked into depth with. Instead of researching different genres, it will naturally come as a story, which will be chosen or created, and the genre will be as seen fit for the scene at a later time. It is needed to be aware of, however, that the audience most likely will have certain expectations depending on which genre the story/scene is.

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Chapter 4

Investigation

In this chapter, different subjects will be presented, in order to get a better understanding of the elements presented in the Chapter 2 Initial Problem Statement. These subjects will include information on the two editing styles, continuity and discontinuity, together with a presentation of famous directors using discontinuity. Leading on is storytelling, with a focus on short films, which will be followed by a discussion.

4.1 Continuity and Discontinuity Editing

The first subject, which will be presented, is continuity and discontinuity editing. It is needed to know what continuity and discontinuity editing is and how it can be applied, before it is possible to use it to *"change the story of a scene"*, as the IPS (see Chapter 2 Initial Problem Statement) says. This will include different parameters needed when using the two editing techniques. The two editing techniques will be separately defined and their sub-techniques will be described.

According to Bordwell and Thompson continuity editing is used to ensure a narrative continuation. Back when filmmakers started using editing, they sought to arrange shots as to tell a story coherently and clearly. The basic purpose of continuity editing is to allow space, time, and action to continue in a smooth flow over a series of shots, which is supported by certain strategies of cinematography (see Appendix B Cinematography) [Bordwell and Thompson, 2013a, p. 231-234]. The opposite of continuity editing is discontinuity editing. This can be said as doing continuity wrong, though there are examples of discontinuity editing being used in a way so it is not confusing and disorienting to the viewers. [Bordwell and Thompson, 2013a, p. 251-260].

There are four different aspects, which are used in both continuous and discontinuous editing; rhythmical, graphical, temporal and spatial editing and it is these four types of editing, which will be presented in the following sections.

4.1.1 Rhythmical Editing

Controlling the rhythm can be used to change the viewers impression on the scene. This can be done through the act of movement in the scene, the cameras position and its

movement, the context of the scene and the pattern of the shots lengths the last one being the one usually referred to when talking about a films rhythm. [Bordwell and Thompson, 2013a, p. 226].

Rhythm usually has a recognizable pattern. Having all the shots around the same length of each other will create a steady rhythm. Increasing the length can slow down the tempo, where decreasing the length can speed the tempo up. Sudden changes in the rhythm can also create an effect, for example can a few shots of suddenly very short length create a very stressed moment and few shots of suddenly long length can create a moment of long pause to e.g. let the audiences respond to what just happened in the movie. [Bordwell and Thompson, 2013a, p. 226].

4.1.2 Graphical Editing

Discontinuity by the graphical relationship between shots can be achieved by using configurations such as light shots followed by dark ones, using lines and shapes, a lot of movement in some scenes followed by static shots and by the volume and depth of each scene and their order. Continuity in the graphical relationship between shots, however, occurs when the graphical elements are repeating from shot to shot. [Bordwell and Thompson, 2013a, p. 221].

Such graphical continuation or discontinuation editing can be achieved by following the four aspects of the mise-en-scène; setting, costumes and makeup, lighting, and staging (see Appendix A Mise-en-scène) and most qualities of cinematography photography; camera mobility, photography and framing (see Appendix B Cinematography). [Bordwell and Thompson, 2013a, p. 221].

A graphic match is mainly used to create continuity in the shots that follow one another. Such a graphic match can be noticed when a shot has the same graphical composition, colors, movement, and shape as the shot before. In order to achieve continuity, the director would usually try to keep the same composition and overall lighting levels and also tries to avoid drastic changes in colors from one shot to another [Bordwell and Thompson, 2013a, p. 221]. An example of this can be seen in Figure 4.1 and Figure 4.2 on Page 9.

Graphical discontinuous editing may appear in wide screen compositions when this is organized around characters facing each other [Bordwell and Thompson, 2013a, p. 221]. A similar example can be seen in *Pulp Fiction* [Tarantino, 1994] where two characters are facing each other and shots move from one character to another. The graphical discontinuity in this can be noticed through the fact that the characters are placed in opposing position of the screen so the viewer has to look from left to right according to which shot is on the screen (see Figure 4.3 on Page 9) [Bordwell and Thompson, 2013a, p. 221].

Another example of a graphical discontinuity can be noticed when moving from a shot with bright lighting to little light or in the difference of the shadow placement. As already mentioned, discontinuity in graphic can be noticed in the movement in one shot,

Figure 4.1: Shot from *True Stories* graphically matched with Figure 4.2 [Bordwell and Thompson, 2013a, p. 221]

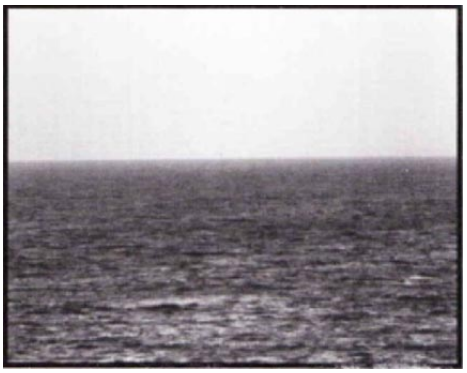

Figure 4.2: Shot from *True Stories* following the shot from Figure 4.1 [Bordwell and Thompson, 2013a, p. 221]

Figure 4.3: Conversation from *Pulp Fiction* [Tarantino, 1994] where the viewer needs to move their eyes back and forth across the screen [Bordwell and Thompson, 2013a, p. 223]

which is followed by a shot with no movement. This technique can be noticed in the movie *The Birds* [Hitchcock, 1963], where a fire has started and is ravaging the city, creating a lot of movement to the objects and the fire itself, followed by a still shot of the main characters face (see Figure 4.4 on Page 10) [Bordwell and Thompson, 2013a, p. 224].

4.1.3 Temporal Editing

Temporal discontinuation is the manipulation of both order and frequency of the shots. Normally, events are ordered 1-2-3, but for discontinuity they can be scrambled and played in different orders. This can also be done in continuity editing, but then it will normally involve flashbacks, future events or similar. With discontinuity, it is usually a scene played in scrambled order, not stretching over a long period of time within the story. Normally a scene is only played once, but playing it extra times will extend the duration of the story without extending the story itself. A scene can be repeated in either its entirety or just part of it to build up tension or suspense. Although a scene is repeated, it does not need to be the exact same shot, as the angle of the camera can

Figure 4.4: Series of shots from *The Birds* [Bordwell and Thompson, 2013a, p. 225]

be changed, and thereby stretching the moment, making screen time greater than the story time (see Appendix D Narratives) [Bordwell and Thompson, 2013a, p. 225-257].

As mentioned earlier is it most common to present shots in the order 1, 2, 3. The order could also be scrambled in any other order, such as to be presented in a 3, 1, 2 order, creating either flashbacks or flash-forwards. Manipulation of the duration of shots can be done using elliptical editing, which presents an action in less time on screen than it does in the story. A shot of a man climbing a flight of stairs, could be cut down to first showing the man at the bottom of the stairs and then cutting to the man at the top of the stairs, possibly in a swipe or fade effect to enhance the feeling of time gone by. [Bordwell and Thompson, 2013a, p. 225-257].

4.1.4 Spatial Editing

When a filmmaker edits a movie, he is capable of having two points in space and imply that the two points are related to each other in some way [Bordwell and Thompson, 2013b, p. 227], thus making spatial continuity in a movie, though, this form of editing, as the other three editing techniques mentioned before, also has ways of creating discontinuity. First, however, the focus will be upon the Kuleshov effect and then how the viewer can be presented to the space in the film.

In the 1920s the director Lev Kuleshov showed that you can in fact take shots of separate dramatic elements and - when showing them in succession to each other - make the viewer believe that the shots were somehow connected and the viewer could therefore create a spatial whole out of the else unrelated shots. This is called the Kuleshov-effect and is shortly defined as being: *"any series of shots that in the absence of an establishing shot prompts the spectator to infer a spatial whole on the basis of seeing only portions of the space."* [Bordwell and Thompson, 2013b, p. 228]. For more on the Kuleshov-effect see Appendix H Kuleshov-effect.

Editing can, however, also underline action taking place in different locations where

multiple spaces are instead constructed. This is called cross cutting. [Bordwell and Thompson, 2013a, p. 227-229]. Another way of presenting space is by making the space ambiguous. This can for example be done by using only close ups of the characters and by having the background in a neutral color. [Bordwell and Thompson, 2013a, p. 227-229].

In general there are different ways to present the space in a movie to the viewer. One is to start the scene by showing the space in a way so the viewer will get the spatial whole of it, then go closer to the subjects and thereby show only components of the space and not give an overall image of it while at it. Another way is by only showing components of the scene, which the viewer will then use to construct the scene, as the whole scene is never shown. In this case it is the editing itself and the mise-en-scène, which makes the space components seem to be out of a whole to the viewer. [Bordwell and Thompson, 2013a, p. 227].

Spatial continuity can be achieved by not crossing the 180° line. When a scene contains two objects that are in some aspect communicating with each other (e.g. people talking, fighting or car chases), it is stated that the angle of the shot should always be kept within the same 180° of the two objects. If a shot crosses that line, it will create a discontinuity as the two objects now switched places in the shot. [Bordwell and Thompson, 2013a, p. 231-234].

Another spatial editing technique is jump cuts. Jump cuts is when two shots of the same subject is cut together and with only a small difference in camera distance and angle. This will create small abrupt gaps, which interrupts the story and are very noticeable. For continuation editing there is a rule called the 30° rule, which avoids these jumps. The rule tells that the camera needs to be moved at least 30° between each shot. [Bordwell and Thompson, 2013a, p. 252-254].

4.1.5 Directors Famous For Using Discontinuity Editing

As some directors are known for their talent for doing a certain thing in a certain way, discontinuity editing also has its famous directors behind it. This is looked into to see if there actually is some validity in using discontinuity, through seeing if famous directors has tried to use it as a prime editing technique to some success. These people have shaped it to what we know of it today, and it is hence some of these directors, who will be presented in this section.

The director Georges Méilès is known to be the *"creator"* of the jump cut, which was an accidental discovery because of his theatrograph[1] jamming. Being a stage illusionist, Méilès used this newfound technique to create trick films, one being *The Vanishing Lady* [Méilès, 1896] from 1896, which is shown in Figure 4.5 on Page 12. The film shows a woman sitting in a chair being covered by a cloth. The chair is empty as the cloth is removed, whereafter a skeleton appears in the place of the woman with a gesture from

[1] An early version of the movie camera [Webster]

Figure 4.5: Image from *"The Vanishing Lady"*. [Méilès, 1896]

the magician [Fairservice, 2001, p. 12-13], hence creating the illusion of continuity by using the discontinuous jump cuts.

Figure 4.6: 4 shots from *"Battleship Potemkin"* [Eisenstein, 1925] showing how Eisenstein uses jump cuts to extend the scene and emotion.

Sergej Eisenstein, however, is known for being one of the pioneers of discontinuity editing. Eisenstein believed that using discontinuity to edit together two or more images, making the whole greater than the sum of its individual parts. One of his most famous demonstrations of discontinuity editing is the *"Odessa Steps"* sequence from his film *"Battleship Potemkin"* [Eisenstein, 1925] from 1925. In this sequence, he extends the time of a crowd running down a set of stairs which would take around a minute, to a whole of seven minutes through quick progression and alternation using jump cuts. An example is by showing an action and then showing a persons reaction to it, such as seen on Figure 4.6 on Page 12.

4.2 Storytelling

Now that it is known what continuity and discontinuity is and how this was used, storytelling will be the next subject to approach. Since the IPS (see Chapter 2 Initial

Problem Statement) revolves around changing the story of a scene, story is therefore a subject needed to know what is, how it is written, and what the different forms of storytelling are, in order to see if it is possible to change the story of a scene simply by the way the scene is edited. Storytelling is a very broad subject. It can be anything related to telling a story. This is too broad a subject to research into if everything should be covered. It will therefore be narrowed down to a few basic elements such as storytelling in film and especially in short film. In this section forms, view, plot and storytelling in short film will be compared to long film.

4.2.1 Forms

A film can have different forms and these different forms can help change the way a story is told. The standard form to use in movies is telling a story chronologically (see Chapter 4.1.3 Temporal Editing). This means that the story starts at the beginning, then works its way to the middle and then goes to the end. Think about a cop movie. First a crime is committed, and then there is a chase and finally an arrest. An example can be seen in Figure 4.7 on Page 13. This is of course a very simplified example, but it shows the point [Bordwell and Thompson, 2013c, p. 74].

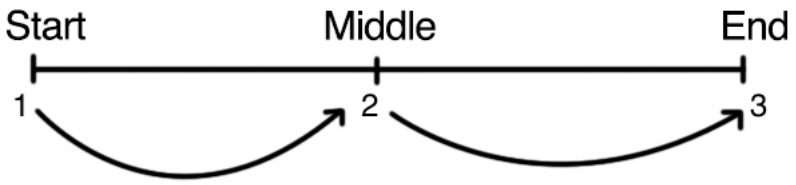

Figure 4.7: Time line of a chronological story.

Besides using a form, which tells a story chronologically, there are also a couple of different forms that uses flashbacks in some way or another. The first of these forms is where a regular flashback is used. Using the example from before, the movie may begin at the arrest instead. The viewer is then intrigued about what had happened before the arrest and this is therefore the place for the flashback. The movie then takes the viewer back to the very beginning of the story and works its way through the middle to the end. This is illustrated in Figure 4.8 on Page 14.

This is a standard way of using a flashback to change the flow of the story. The viewer knows how it is going to end, but it is the road to the end that is intriguing. If we move away from the traditional uses, it is possible to look at a way of having multiple flashbacks. This can be used to tell the end of the story throughout the whole movie; the movie starts at the end of the story and then there is a flashback to the beginning, before the movie jumps back to the end again. Then there is a flashback to the middle of the story and we jump to the end. This can for example be used in movies where

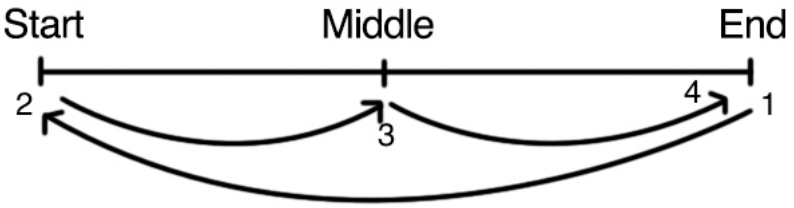

Figure 4.8: Time line of a story starting with a flashback.

a suspect is being interrogated and when the suspect tells something new, a flashback takes the viewer back to when that thing is happening. This is illustrated in Figure 4.9 on Page 14.

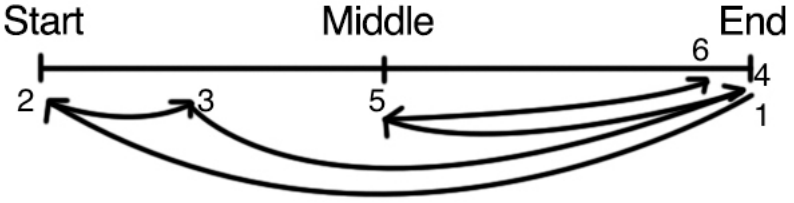

Figure 4.9: Time line of a story with multiple flashbacks.

Even though this might not seem structured, there is still a structure in the story and a red thread to follow. The viewer can be guided with the narrative (see Appendix D Narratives). The last form is where seemingly random flashbacks are used and the movie starts at the middle. Then the story jumps to the beginning, works its way to the middle, and again jumps to the end, as illustrated on Figure 4.10 on Page 14.

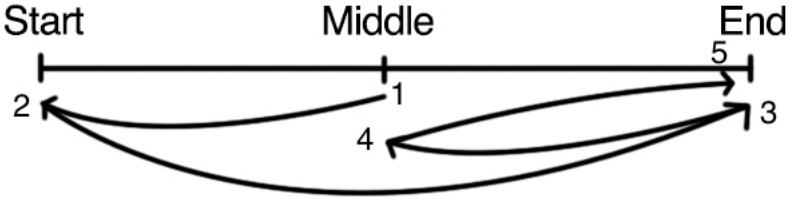

Figure 4.10: Time line of a story with random flashbacks.

Common for the last two forms are their use of titles or audio cues to let the viewer know where we are in the story. This is not a rule, but more a guideline and a help for the viewer. [Bordwell and Thompson, 2013c, p. 75].

4.2.2 Short Film Compared To Long Film

When talking about storytelling it is needed to think about the format in which it is used: Is it a short film, a long film, or a TV show and so on, hence it is needed to know the differences and similarities between these formats; more specifically between a long film and a short film, in order to be able to choose the correct format and make a story fitting for that format. Therefore, this section will look into short films and how they are different from a long film. By getting all the information about how short films are created, it can be used to create two short films and test them.

When making a long film there is lot of guidelines and information for how the story should be written. The long film usually follows a three act format; 1:2:1 [Cooper and Dancyger, 2005, p. 5]. Let us assume that a movie is two hours long; this would mean that the introduction would be one unit long, often 30 minutes. The middle, which is where the action and the main part of the plot of the story take place, will be two units long, usually one hour. The ending is then one unit long and therefore also 30 minutes. By using this setup for a short film, which could for example be three minutes long, it would have a 45 seconds intro, 90 seconds for the middle and 45 seconds for the end. It would be a very long intro and ending and not enough time to tell the actual story [Cooper and Dancyger, 2005, p. 55]. It is therefore a good idea when speaking about short films not to use the three-act formula and instead use a five-act formula, as suggested by Pat Cooper and Ken Dancyger. The five act formula starts with an intro, which shows the protagonist. This should be very short and can often be accomplished in just a single framing [Cooper and Dancyger, 2005, p. 55-56]. After introducing the protagonist, the story needs to quickly introduce a catalyst. The catalyst is often called the inciting incident in writing terms [Cooper and Dancyger, 2005, p. 44]. This is an event that sets the story in motion. In a long film this can be quite long, but in a short film it is often just a glance at the protagonist or a single framing of action. At this point the viewer knows the basic of the story and the development of the action can begin. This part of the short film is the main part and takes up most of the time. In a long film this would be used about half of the time available, but in the short film it is about 80-90% of the time available. The last two things in the short films five-act formula are the resolve of the conflict and the closure of the whole film. The resolve is where it is shown whether or not the protagonist fails or succeeds in his or her quest. This should take up most of the remaining time and the closure should just be a single shot of the protagonist in the end [Cooper and Dancyger, 2005, p. 55-56].

The content of the short film should also be less complex than that in the long film. The long film contains a complex plot and most times also a subplot. The short film usually contains just a single plot and is much simpler. There are often much fewer characters, usually three to four, in the short film compared to the number of characters in most long films. [Cooper and Dancyger, 2005, p. 5].

4.3 Discussion

Continuity editing techniques guarantee narrative continuation in a film, while discontinuity editing is often more used to create confusion or a bit of chaos. Discontinuity editing can be used to make obvious cuts, which go directly against what is strived for with the continuity editing, or even break the continuity in its other different aspects. There are four of these aspects to the continuity and discontinuity editing, which are: rhythmical, graphical, temporal, and spatial editing (see Chapter 4.1 Continuity and Discontinuity Editing). When looking closer at these four aspects of editing it was discovered that discontinuity editing is seldom used by todays filmmakers and that discontinuity editing is even considered as doing continuity editing in a *"wrong"* way (see Chapter 4.1 Continuity and Discontinuity Editing). It would therefore be interesting to change the direction of this project from using discontinuity to change the perception of the story (see Chapter 2 Initial Problem Statement) to use a specific aspect of the discontinuity editing, in order to see how many details of the scene is being picked up and how many are lost. It is also wanted to see to which degree of how discontinuous the particular aspect of the editing should be, in order for the viewers to be confused about it.

Working with editing techniques, which change the rhythm of the scene (see Chapter 4.1.1 Rhythmical Editing) or the graphical continuation (see Chapter 4.1.2 Graphical Editing) would not give enough options, though, to see if the viewer would actually become confused by it, as the number of different degrees is limited, since it is believed that audiences are rather used to graphical and rhythmical discontinuation in movies. If going for either the graphical or the rhythmical editing it is possible it would be needed to go to extremes, e.g. by inverting all the colors from one shot to the other, in order to see when the viewer is not capable of picking up the details in the scene anymore.

When working with temporal (see Chapter 4.1.3 Temporal Editing) and/or spatial (see Chapter 4.1.4 Spatial Editing) discontinuous relationships between shots, on the other hand, it seems more plausible that it is possible to create different degrees of discontinuity and perhaps disorientation in the audiences mind, which will make it easier to test if the change is going from fully understandable to losing out on details of the scene. It is to be noticed that the viewers have most likely become more used to temporal discontinuity rather than spatial discontinuity, due to the fact that the temporal displacement of shots has been used a numerous amount of times in various movies, examples being Memento [Nolan, 2000] or Sin City [Miller and Rodriguez, 2005]. Spatial discontinuity, on the other hand, is highly avoided by most filmmakers or only used when it is intended to disorient the audience (see Chapter 4.1 Continuity and Discontinuity Editing).

Temporal editing is a difficult subject to approach, because it is already now seen as something that could take a lot of planning of the order of shots, before the editing is done as, if there is something that does not work, changing it can affect the whole story of the scene in an undesired way. On the other hand, shots focusing on creating

spatial discontinuity are less hazardous to work with as the spatial construction of the scene can be easily controlled through details, such as having the scene take place inside a room, knowing the size of the room and its details. Spatial discontinuity editing is also believed to be more forgiving to flaws in the initial plan. The focus will therefore be on the spatial relationship of the shots when edited continuously contra discontinuously.

When working with spatial discontinuity, mainly two things can be done in order to create discontinuity: by breaking the 180° line or by using jump cuts (see Chapter 4.1.4 Spatial Editing). When it comes to using both continuity and discontinuity editing, breaking the 180° line seems to, theoretically, be the easiest to confuse the audience with, hence making it interesting to see if this is actually the case; does the audience become confused when presented to something where the 180° line has been crossed? By figuring out how to cross the 180° line in a way that can be controlled by certain variables, it is possible to systematically break the 180° line throughout a chosen scene, hence it is wanted to use spatial discontinuity editing by crossing the 180° line.

To have two versions of a given scene, which in one case crosses the 180° line and in the other case do not, it is easiest achieved through the use of pre-rendered animations. This will allow for the exact same scene to be filmed for both continuity and discontinuity editing. If it were to be filmed with real actors, the whole scene would have to be filmed twice; one time with continuity editing in mind, having the cameras placed one way, and in another way with discontinuity editing in mind, where the cameras would be placed differently. This means the actors would need to act and move in the exact same way in both versions of the scene, while it is possible to film the scene when all movements of the characters have already been animated in the pre-rendered animation film. This means that all movements and placements for characters, objects and props will be the same in both versions of the scene, even if the two scenes were not filmed (rendered) simultaneously.

There are different ways to write and tell a story (see Chapter 4.2 Storytelling); the development of the story depends on different variables, such as the form (see Chapter 4.2.1 Forms). The scene is going to be kept short in order to focus on the cutting, but long enough for it to have a story on its own. Ideally the short clip needs to work with both the cinematography (see Appendix B Cinematography) and the mise-en-scène (see Appendix A Mise-en-scène) in the viewer's eyes and have a simple, yet interesting plot (see Appendix D Narratives).

Since it is acknowledged that the story is not a main focus in itself anymore and that it is believed that others have already made stories perfectly fit for this purpose, it is wanted to find an already existing scene and re-animate it.

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Chapter 5

Final Problem Statement

What is the difference in perceived spatial construction of a movie scene represented by two versions of an animated pre rendered short story: one created by keeping the 180° line and one by breaking it?

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Chapter 6

Methods

In this chapter, the focus will be on the independent, dependent and constant variables all containing the theory needed, in order to test the FPS (see Chapter 5 Final Problem Statement), and about the test in general. This theory includes spatial relationship between shots, state of the art, perception of space, and when to cut. This will be leading up to the test itself, which includes; what to test, how to test and the sample group. First, however, there will be looked upon the Chapter 5 Final Problem Statement and the different terms in it will be defined.

6.1 Terms

In this section, the terms included in the FPS (see Chapter 5 Final Problem Statement) will be explained and defined, so it is clear what is meant with the terms and how they are going to be used when they are mentioned.

6.1.1 Perceived

How do people understand and see the scene? If the editing style of the scene is changed, will the viewer then identify the spatial construction in the same way as in the original scene? Later in Chapter 6.2.2.1 Perception of Scene will be looked into.

6.1.2 Spatial Construction

Spatial construction refers to the space in which the story is set and how the story evolves throughout the spatial plane. It refers to the setup of the map, of where the characters are interacting and how far these are from each other, may it be in a room or in a city. This is the main topic on which the see Chapter 5 Final Problem Statement will be tested; therefore a certain spatial construction must be specifically set by the story and be kept as a guiding scheme.

6.1.3 Pre-Rendered Scene

Pre-rendered is in this content a clip, which is made with no intention of being changed or affected by variables, such as interaction. This means that pre-rendered as a term is used whenever some imagery is rendered and then played back. It is the same, which is shown every time the imagery is played and everything in it has already been rendered before showing it. This is in opposition to real time rendering, where the rendering goes on as the graphics is being shown and interacted with in one way or the other. For the pre-rendered part, computer generated imagery will be used; which is modeled objects used in an animation.

6.1.4 180 degree line and breaking it

The 180 degree line is an editing technique that is mainly used to give a continuity relationship between the scenes and shots of a movie. However, this technique can be broken and therefore allowing the editors to achieve discontinuity instead. The same idea is used in this case, when these are mentioned in the final problem statement. See Chapter 4.1.4 Spatial Editing.

6.2 The Independent, Dependent and Constant Variable

When experimenting, researchers are interested in the relationship between the changes they make and their effect, i.e. the dependent variable and independent variables. The independent variables are the methods that can be manipulated, where the dependent variables are the measures that show the effect of the cause. The dependent variables change with the participants behavior, the independent variables do not. [Lazer, Feng, and Hochheiser, p. 25].

An example of this could be as following: an advertisement is made, in which the researchers change the wording in one of the sentences displayed in the ad, to measure how the message is perceived. The sentence is only shown for a short moment and the researchers want to measure how much of an effect the change of the wording has made by handing out a questionnaire about the participants understanding of the message.

Imagine now that the participant gets distracted and looks away, the moment the sentence is shown. Because of the participants unawareness in that moment, the sentence with the changed wording was not read.

As that happened, the independent variable will not change, as the sentence still has its changed wording. The dependent variables however, will change as the participants perception of the message will now be different, as he didnt read part of the message.

In this chapter, the main sections will be set up as *Independent Variables* and *Dependent Variables* with subs-sections according to which section they fit into. Other than those variables there are some things that are not changed, but are still required for the project. These will be placed under a section called *Constant Variables*. It is called that

because it contains knowledge, which is needed for implementation and design, but is not directly part of the variable desired to be changed.

In a general sense, things will be placed in their sections because of their use in the project. The section *Independent Variables* will contain information used to create the spatial discontinuity editing. What is put into the *Dependent Variables* will be what helps in; either directly measuring the effect or exposing it and the constant will have things that are needed for creating a scene in general.

6.2.1 Independent Variable

The independent variable will in this section be presented. This includes the spatial relationship between shots, which covers both keeping and breaking the 180° line and will be followed by a state of the art-section, which looks upon two examples of movies where the axis of action has been broken.

6.2.1.1 Spatial Relationship Between Shots

This section will include a thorough description of the 180° line, how this can be used to create understandable spatial construction, how to break this line and what happens when this line is crossed. This is looked into, in order to help designing the discontinuity; hence it is an independent variable.

6.2.1.1.1 Keeping The 180° Line One of the strategies in continuity editing is the 180 degree line. The 180° line is also called the axis of action, and is a straight line through the main thing happening within the scene. For continuity should the cameras only be placed on one side of that line, in order to always know where characters and objects are in relation to each other (see Chapter 4.1.4 Spatial Continuity). This ensures that relative positions in the frame remain consistent.

An example of how this works can be seen in Figure 6.1 on Page 24. Camera 1, 2, and 3 shows a conversation between a boy and a girl from three different angles. Having the cameras on the same side of the axis of action makes the characters stay in their position; the girl is always to the left and the boy is always to the right. By adding a camera on the opposite side of the axis, such as camera X will make it seem as though the characters have switched position, which would in theory confuse the viewer and break the continuity. [Bordwell and Thompson, 2013a, p. 231-234].

The 180° line also ensures consistent eye lines and screen direction. Camera 1, 2, and 3 all shows the girl looking to the right, while camera X will make her look to the left. Imagining the girl walking from left to right, as long as she is only being filmed by cameras 1, 2, and 3, she will appear as so. Switching to camera X she will now appear as moving right to left, which in a scene would be considered very disorienting for the viewers. [Bordwell and Thompson, 2013a, p. 231-234].

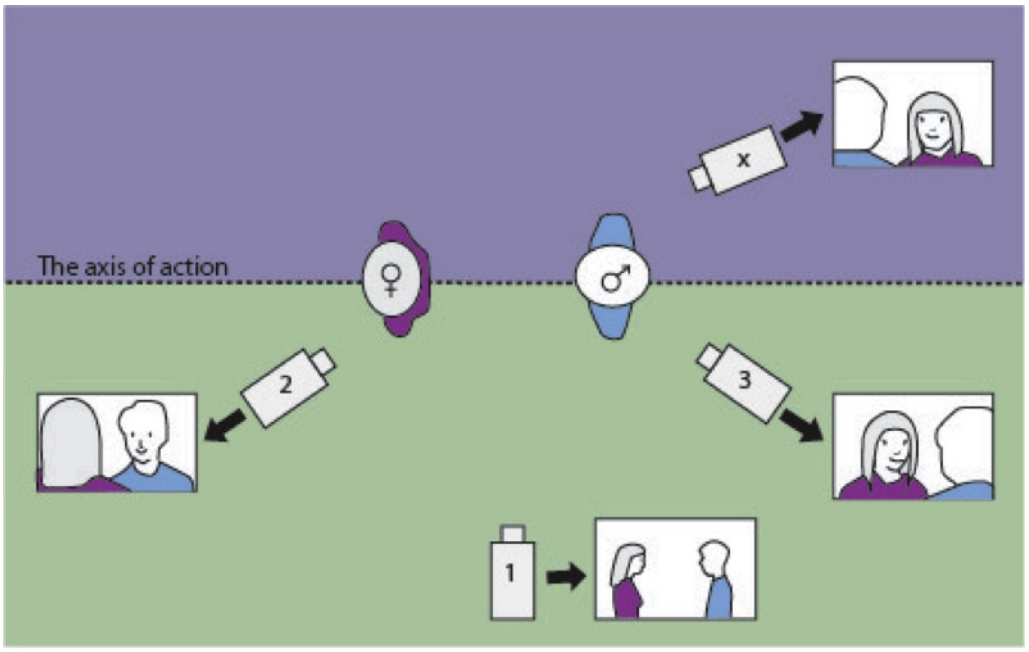

Figure 6.1: Shows the 180° line used in continuity editing and how the cameras are used on only one side of the line.

6.2.1.1.2 Breaking The 180° Line On the other hand, the 180° line can be used to create spatial discontinuity in a movie. One of the reasons a filmmaker would want to use discontinuity is to give a feeling of chaos and therefore portray how the characters are feeling in the current situation, like e.g. lost or confused. One way to achieve such effect is by breaking the 180° line. As mentioned before the invisible line, the axis of action, will need to be the crossed in order to create discontinuity. Therefore, by keeping an alternation from moving from one side to the other of the line, the filmmaker can create confusion in the audiences perception of the spatial construction. [Bordwell and Thompson, 2013a, p. 231-234+252-254].

In order to get an idea how this works, an example where the axis of action is kept and an example where this is broken, will be given.

Figure 6.2 and Figure 6.3 on Page 25 shows two shots from Source Code [Jones, 2011] where the axis of action has not been crossed. Looking at Figure 6.1 from Chapter 6.2.1.1.1 Keeping The 180° Line, it is possible to see that the characters in Figure 6.2 and Figure 6.3 on Page 25 have not moved side. Even though they are filmed from the front and the back they are still on the left side of the frame (the female character) and the right side of the frame (the male character).

Breaking the 180° line crossing the axis of action - will need to be done in the right way, though, in order to not disorient the viewers. A 180° shot switching around a character would normally make it seem as though the character turned around. With the character doing some gesture or motion, such as drinking see Figure 6.4 on Page 25 - then there will be no narrative confusion, as you will then know that you are watching

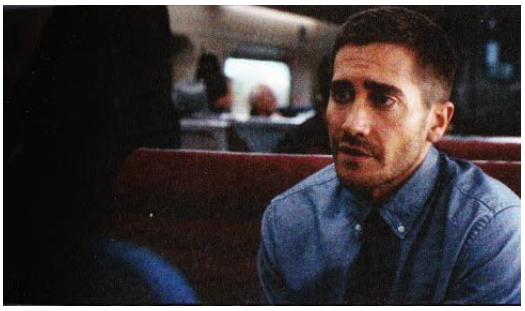

Figure 6.2: A shot from Source Code [Jones, 2011] which followed by Figure 6.3 shows a cut keeping continuity.

Figure 6.3: A shot following Figure 6.2 keeping continuity.

the character from the other side and it is not the character who have been switching side between shots [Bordwell and Thompson, 2013a, p. 251-260].

Figure 6.4: The drinking scene from the movie *Early Summer* [Ozu, 1951], which breaks the 180° line.

6.2.1.2 State of the Art

Analyzing scenes with use of discontinuity through the 180° line from the blockbusters by professional directors gives an idea of what can be done and maybe what to avoid. This helps in creating the discontinuity, thus it is a part of the independent variables.

It is also necessary to look at what the best directors in the business have done, to see if there is anything that can be learned from them in terms of discontinuity editing. In this section a car chase scene from the James Bond movie Quantum of Solace [Forster, 2008] will be presented as to show how crossing the 180° line can create discontinuity.

6.2.1.2.1 Quantum Of Solace Quantum of Solace begins with a car chase, where the director is breaking the 180° line multiple times. In general it is a film that uses an expressionistic approach where the action within the movie is happening quickly and rather chaotic, letting disorientation to some degree get into the movie. According

to John Rosenberg *"Quantum of Solace rely on an extremely fast, selectively nonlinear structure that overrides the viewers ability to digest all that occurs in front of him. It becomes difficult to decipher time and locale."* [Rosenberg, 2010, p. 73]. There are of course both benefits and disadvantages of having these fast and rather chaotic shots, as you could make the audience get an adrenaline kick, raising of the pulse and more focused attention, *but* you might also lose some of the audience and they might lose interest in not only the scene, but the whole movie. The opening sequence, which we will get to in a moment, is cut so fast that *"the audience perceives little more than the pure adrenaline rush of the car chase"* [Rosenberg, 2010, p. 73-74]. According to the editor of Quantum of Solace, Richard Pearson, was the goal of the fast editing and having a grey car being chased by three black cars to be *"more like an art film"* [Rosenberg, 2010, p. 74] and being *"much more impressionistic."* [Rosenberg, 2010, p. 74].

The first example of breaking the 180° line can be seen in Figure 6.5, where the camera shoots a car from the front and in the next take (Figure 6.6) the camera shoots the car from behind.

Figure 6.5: Shot from *Quantum of Solace* where the 180° line is broken between two shots.

Figure 6.6: Shot from *Quantum of Solace* where the 180° line is broken between Figure 6.5 and Figure 6.6.

It is assumed that the viewer is not even sure which car is which in Figure 6.6 on Page 26. The spatial contraction of the scene in Figure 6.5 and Figure 6.6 on Page 26 can be seen in Figure 6.7. The 180° line lies between the two cards and from one shot to the next the camera crosses the line to film the cars from a different angle.

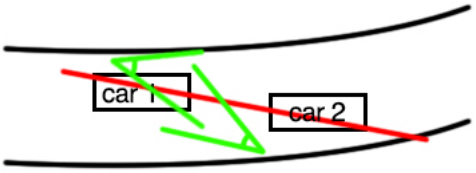

Figure 6.7: Spatial construction of Figure 6.5 and Figure 6.6 on Page 26.

The camera moves away from the car chase and when the camera comes back to the chase again, it goes back to shoot a car from behind in Figure 6.8. In the heat of action,

the viewer will probably not notice the license plate or the overall design of the car and it is assumed that they will be confused about which car they are now looking at.

Figure 6.8: A shot from Quantum of Solace breaking the 180° line with Figure 6.9

Figure 6.9: A shot from Quantum of Solace which together with Figure 6.8 breaks the 180° line

In Figure 6.9 is the viewer now seeing a car from the front, hence has the director again broken the 180° line between Figure 6.8 and Figure 6.9. The very observant viewer will notice the Aston Martin logo in Figure 6.8 and the classic Aston Martin grille in Figure 6.9 and make the connection that it is the same car. Some viewers might also notice the change in the grille from Figure 6.5 to Figure 6.9.

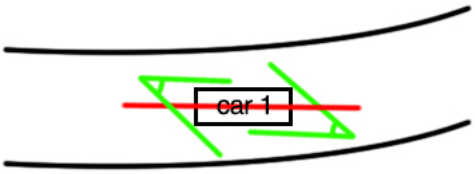

Figure 6.10: Spatial construction of Figure 6.8 and Figure 6.9.

In Figure 6.10 the spatial construction of the scene from Figure 6.8 and Figure 6.9 the 180° line lies through the car and the cut from Figure 6.8 and Figure 6.9 crosses the line to show the car from a slightly different angle.

Figure 6.11: A shot from Quantum of Solace breaking the 180° line with Figure 6.12

Figure 6.12: A shot from Quantum of Solace which together with Figure 6.11 breaks the 180° line

In Figure 6.11 and Figure 6.12 the camera cuts from showing the cars from one side to showing them on the opposite side. The cut from Figure 6.11 and Figure 6.12 breaks the 180° line. Figure 6.12 shows an overview of the two cars and it is assumed that it makes the cut less confusing

Figure 6.13: A shot from Quantum of Solace breaking the 180° line with Figure 6.14

Figure 6.14: A shot from Quantum of Solace which together with Figure 6.13 breaks the 180° line

In Figure 6.13 and Figure 6.14 the viewer first see the car from outside and then there is a cut to a view from inside the car. The same thing can be seen in Figure 6.15 and Figure 6.16 where the camera cut back and is positioned outside the car again.

Figure 6.15: A shot from Quantum of Solace breaking the 180° line with Figure 6.16

Figure 6.16: A shot from Quantum of Solace which together with Figure 6.15 breaks the 180° line

The examples from Quantum of Solace shows how breaking the 180° line in an action scene can cause confusion and at the same time help making the scene more action packed.

6.2.2 Dependent Variables

In this section the dependent variables will be presented. This includes perception of space, which includes both how humans perceive space in real life and how space on the screen is perceived, editing about when to cut (the rule of six) and the test itself.

6.2.2.1 Perception of Space

There is a reason why humans perceive space on the screen as they do. On the screen there are many of the same methods used to present space and depth that humans

use, in order to piece space together. Therefore will these methods be presented in this section. First, however, there will be a short look upon realism, the humans two eyes and the human visual field.

6.2.2.1.1 Living In An Euclidean World Humans live in a world, called an Euclidean world - Euclidean is the geometry of this external world: the real world. The authors of the book Sensation and Perception state very clearly what is meant with Euclidean; *"This means that parallel lines remain parallel as they are extended in space, that objects maintain the same size and shape as they move around in the space, that the internal angles of a triangle always add to 180° , and so forth."*[Wolfe et al., 2012, p. 149]. This is, however, not where the story ends. Humans do not see the world as being Euclidean. Instead is the geometry, when projected into human eyes, shown as being non-Euclidean, simply because the retina is not only curved, but it is in fact also a two-dimensional surface. This means that parallel lines are not always seen as being parallel in the retinal projected image, and that objects do not keep the same size as the object is moved further away from the viewer. All in all, this means that it is needed to reconstruct an Euclidean world from a non-Euclidean input, or rather; actual two non-Euclidean inputs, as we have two eyes. [Wolfe et al., 2012, p. 149-151].

6.2.2.1.2 Cues To A Three-Dimensional Space; Depth Cues Since humans need to reconstruct an Euclidean world from non-Euclidean input, specific cues that makes it possible to do so are needed. It is, however, stated in the book Sensation and Perception that *"Even when no one is trying to fool us, it is geometrically impossible (not to mention computationally infeasible) for the visual system to create a perfectly faithful reconstruction of Euclidean space, given the non-Euclidean input we receive through our eyes."*[Wolfe et al., 2012, p. 152]. This is here that the depth cues come into play, as they make it possible to reconstruct the Euclidean world to at least a certain degree. In the rest of this section, the focus will be on these depth cues, what they are, how they work and how they relate to making depth present space in movies.

6.2.2.1.2.1 Occlusion Occlusion shows how objects position is in relation to one another and is present whenever any object overlaps another object. It is - according to Wolfe et al. - seen as being the most reliable depth cue by most researchers. Occlusion does, however, not tell anything about how far the different objects are from each other this is also called a nonmetrical depth cue as it is only the order of the objects, which is shown. Occlusion is represented on the screen by overlapping objects in the exact same way as it is in real life, and present a depth cue for the same reasons as well; *"The overlap creates depth because one object must be closer than the other object for the overlap to occur."* [Block, 2008, p. 41] as it is simply explained by Bruce Block. [Wolfe et al., 2012, p. 152-153] [Block, 2008, p. 41-42]. An example of occlusion can be seen in Figure 6.17.

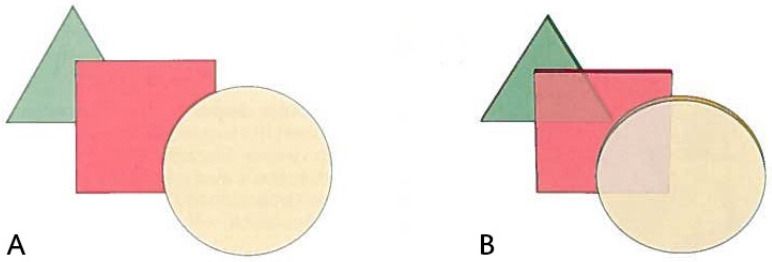

Figure 6.17: Shows how occluded (overlapped) objects are perceived as being further away than the object overlapping it. [Wolfe et al., 2012, p. 152-153]

6.2.2.1.2.2 Size and Position When an object gets farther away from the viewer, the object seems to get smaller. This is called *relative size* and the visual system knows this fact of projective geometry implicitly. This depth cue is most effective when the size change happens systematically and is shown according to relative height. Relative height is that the smallest objects are in the upper part of the visual field, while the biggest objects are in the lower part of the visual field. This is because, when looking at objects at a ground plane, the more distant they are, the higher they are set in the visual field and the smaller they are. [Wolfe et al., 2012, p. 153-155]. An example of this can be seen in Figure 6.18.

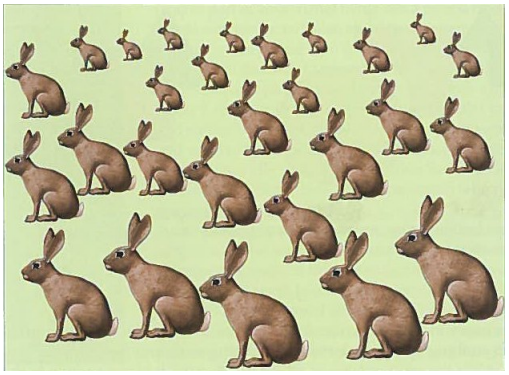

Figure 6.18: Shows that all the rabbits are being perceived as being the same size, the rabbits in the top of the image are just perceived as being further away from the viewer than the rabbits in the bottom of the image [Wolfe et al., 2012, p. 154].

Another depth cue is objects of *familiar size*. When an objects size is already known, it is possible to infer the position of said object according to how large the object looks like. Both relative and familiar size as depth cues gives some metrical information about where they are, also called relative metrical depth cues, although familiar size could in fact be an absolute metrical depth cue. [Wolfe et al., 2012, p. 156]. An example of this can be seen in Figure 6.19.

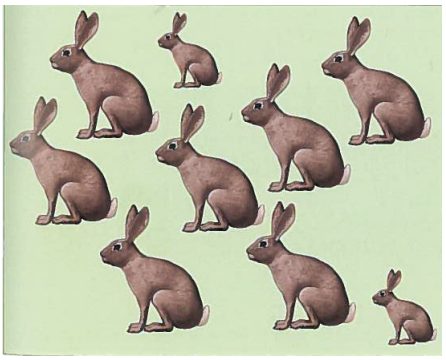

Figure 6.19: Shows how two of the rabbits in this image is perceived as being smaller than the other rabbits, since the size change does not happen gradually [Wolfe et al., 2012, p. 155]

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In the same way is these depth cues used in movies to create deep space. Block explains it very clearly for familiar size and size difference: *"As an object of known size gets smaller, it appears farther away. As an object of known size gets larger, it appears closer."* [Block, 2008, p. 27]. And the depth can easily be made even more deep by separating the shown objects in different planes (foreground, middle ground and background), as this makes the size difference between the objects larger. Size difference is also a very important method to create depth on a two-dimensional screen and is in movies sometimes called *staging in depth* instead of size change. [Block, 2008, p. 27-28].

It is the same for the up/down position of objects on the screen, as it is also known that the vertical position of any object affects how far away the object is perceived to be from the viewer; objects placed high in the frame seems to be further away than objects placed lower in the frame. There is, however, a twist to this, as this changes, if there is a horizontal line in the frame; the closer the objects are to this horizontal line, the more distant they seem and the further away they are from the line, the closer they seem to be to the viewer. [Block, 2008, p. 40-41].

6.2.2.1.2.3 Aerial Perspective, Aerial Diffusion And Textual Diffusion Objects farther away seem fainter and less distinct than objects close to the viewer. This is due to that light is scattered through the atmosphere, so the further away the objects are, the more atmosphere and therefore the more scattered does the light from the objects become. The cue for aerial perspective is also called haze. The reason why objects far away usually get a more bluish-color is simply because that the short wavelengths, which make the blue color, are scattered more than the other wavelengths. [Wolfe et al., 2012, p. 157].

As before is this knowledge widely used in movies, though, here it is mostly known as aerial diffusion. Block states that this diffusion is dependent upon the particles in the air and these particles can be everything from fog or rain to smoke. In general it

can be said that aerial diffusion does three things to the illusion of depth on screen; *"aerial diffusion causes a loss in detail and texture, it lowers the pictures tonal contrast, and it changes the color of objects to the color of the aerial diffusion itself."* [Block, 2008, p. 35]. We will go into these topics in the following sections. Most importantly, however, there need to be at least one object, which is not being affected by the aerial diffusion, in order for the aerial diffusion to create depth in the frame. This is because it is actually the contrast between two objects, which creates the depth, not the aerial diffusion itself. [Block, 2008, p. 35-36]. An example of this can be seen in Figure 6.20 and Figure 6.21.

Figure 6.20: Shows an image with no aerial diffusion [Block, 2008, p. 35].

Figure 6.21: Shows an image with aerial diffusion in the form of fog. In the image it can be seen that the objects closest to the viewer is not affected by the fog. [Block, 2008, p. 36]

Another depth cue, related to aerial diffusion, which is being used in movies, is textual diffusion. Texture diffusion is the gradient loss of texture and detail dependent on how far away the given object is (the further away the object is, the less texture it got within the frame). Block comes with an example of what is meant with texture; if you for example have a plain wall it has just a smooth texture and not much detail, while a wool sweater has a more nubbley texture, as Block puts it. [Block, 2008, p. 34-35]. An example of this can be seen in Figure 6.22.

6.2.2.1.2.4 Linear Perspective Even though parallel lines in the Euclidean world never converge, they still appear to do so in the two dimensional surface that is projected into our eyes, as long as the parallel lines are long enough, that is. The point that the lines seem to converge at is called the vanishing point. This depth cue also work with that of relative size and height, as assuming that the vanishing point lies at the horizon we automatically think of the lines as being parallel, but the further away (the further up) they go, the closer each line appear to be at each other and thereby does the gap between them seem to be smaller. [Wolfe et al., 2012, p. 158].

Movies do also have linear perspective in a similar way, though Block talks about different kinds of perspective; one-point perspective with one vanishing point, two point perspective with two vanishing points, and three-point perspective with three vanishing

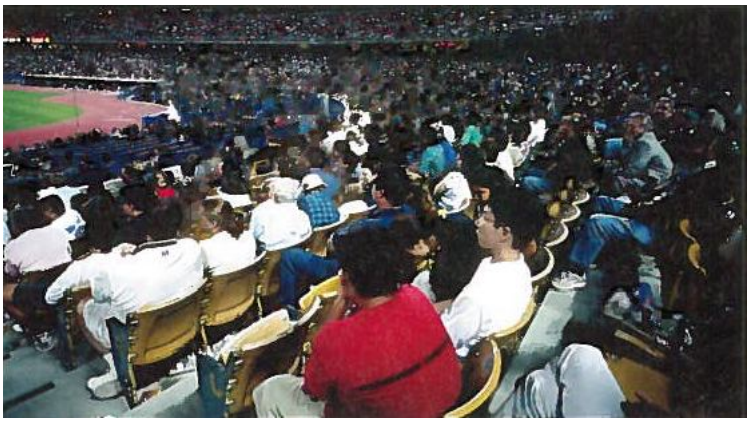

Figure 6.22: Shows how the objects closest to the viewer have more texture than the objects further away from the viewer. This image does also use other depth cues than textual diffusion, such as gradual size change and the position of the objects [Block, 2008, p. 35].

points. But it is not only planes, buildings or simple parallel lines, which can make a vanishing point on screen; all objects can. Block also states that the viewer will naturally draw his attention to any vanishing points within the frame, and if there are both a vanishing point and a human present; the attention will be drawn to both. This means that the viewers attention can be guided through the frame and any actor or important object can be supported by adding a vanishing point where the object or actor is positioned. [Block, 2008, p. 14-27].

6.2.2.1.2.5 Pictorial Depth Cues And Pictures; Why We Perceive Depth In Pictures All the depth cues discussed so far are also called pictorial depth cues. As Wolfe et al. explains it; *"These are the cues produced by projection of the three-dimensional world onto the two-dimensional surface of the retina. A realistic picture or photograph is the result of projecting the three-dimensional world onto the two-dimensional surface of film or canvas. When that image is viewed from the correct position, the retinal image (in one eye, at least) formed by the two-dimensional picture will be the same as the retinal image that would have been formed by the three-dimensional world, and hence we see depth in the picture."*[Wolfe et al., 2012, p. 158]. This does, however, not mean that an image only looks correct when viewed from a certain position, even though you might be inclined to think so. In fact, most pictures look correct from multiple positions, as long as the viewer can take the orientation of the image into account when viewing it. The ability to mentally correct the distortion, which can take place, is however limited. [Wolfe et al., 2012, p. 158-159].

6.2.2.1.2.6 Motion Cues, Camera And Object Movement Now that the pictorial depth cues have been made clear, there are, however, also some depth cues that cannot be used in any stationary two-dimensional surface, one of which is motion. More

precisely is one of these depth cues called motion parallax. This is when you look at some objects while you are moving e.g. in a train and some of the objects seem to move a lot, while the other objects seem to move just a bit or maybe not at all. Wolfe et al. explains it: *"The term* parallax *refers to the geometric relationship revealed here: when you change your viewpoint, rolling down the tracks, objects closer to you shift position more than objects farther away"* [Wolfe et al., 2012, p. 161]. As discussed before there are metrical and non-metrical depth cues, where motion parallax does give information about how far away or how close objects are, hence it is a metrical depth cue. Motion parallax can in fact give information about depth, when all other depth cues fail to do so. Motion parallax does, however, only work when the viewers head is moving in some way or the other [Wolfe et al., 2012, p. 160-161].

Remember stating that motion cues do not work on a static two-dimensional surface? Well, luckily, movies are not entirely static, as they do simulate motion by the changing of frames. This means that both objects and the camera (simulating the viewers eyes) can in fact move, creating motion cues as well.

There are two basic ways that any object can move in the frame; parallel or perpendicular to the picture plane. Parallel movement to the picture plane can come in four different types; left-right, up-down, diagonal and circular movement. When it is only one object, which moves parallel to the picture plane, no depth is created, but as soon as two objects move parallel to the picture plane in two different planes deep space is created. In the same way as motion parallax functions, this means that any object in the background seem to not move as much as any object in the foreground does, even though they in real life (when the scene is filmed) actually move the exact same distance. In terms of movies is this difference in the speed (the object in the background plane seems to move more slowly) and the distance traveled called relative movement. When an object on the other hand moves perpendicular to the image plane, the object can move both directly to/from the camera and diagonal in relation to the camera. Even though the object moves at a constant speed towards the camera, the speed seems to increase, the closer the object comes to the camera, while the opposite happens when it moves away from the camera, which creates a depth cue. [Block, 2008, p. 28-30].

When talking about camera movement is depth created using three different moves; dolly in/out, the track left/right and the boom up/down. A dolly in/out is when the camera is moved farther away from or closer to the object, and this creates relative movement between the different planes; when moving towards a given object will this object - in the foreground - get larger faster than the objects in the background will. Talking about the track left/right it is illusory depth which is created and again this depends on object movement; when moving from left to right or the opposite does the object(s) in the foreground move faster than the object(s) in the background, which means that this depth cue is also dependent on relative movement. The last camera movement is the boom up/down, where the camera is either lowered or raised, as with the others will the objects in the foreground move faster (maybe even out of the frame)

than the object(s) in the background, creating relative movement. As Block explains, it is the relative movement created by the camera movement, which creates the illusion of depth in the flat two-dimensional surface that is the screen [Block, 2008, p. 30-34].

6.2.2.1.2.7 Shape Change Shape change can appear with both moving and stationary objects, and occurs whenever the object are turning in the real world or the camera moves around it, as any object that rotates or are rotated around needs a third dimension. This is perceived as being a cue to illusory depth. There can also be shape change in objects without movement; here it is when the same objects within the scene appear to have different shapes, which is dependent on the camera angle. This is also called apparent shape change and is interpreted as being depth [Block, 2008, p. 37-38].

6.2.2.1.2.8 Tonal And Color Separation Tonal separation refers to the black-grey-white scale in a series of tonal steps and no colors at all. The depth within the frame is dependent of this tonal separation as light objects appear to be closer to the viewer than dark objects does, this can even be independent from size. [Block, 2008, p. 39].

In the same way as tonal separation can be used as a depth cue, so can color separation. Here it is necessary to divide the colors into warm colors (red, orange and yellow) and cool colors (blue and green). The warm colors is most often seen as being close to the viewer, while cool colors seem to be farther away from the viewer. [Block, 2008, p. 39-40].

6.2.2.1.2.9 Accommodation, Convergence And Focus The eyes need to be focused in order to see an object properly. To do so, the eyes focus using a process called accommodation. This is where the lens get fatter/thinner dependent upon if the objects are close or farther away. The eyes do also rotate inward, the nearer the object gets to the viewer, and this is called convergence. This information about accommodation and convergence tell the viewer how far away he is from the object and it thereby functions as a depth cue. Convergence is used more than accommodation is and these two depth cues are the only ones - except from familiar size which give information about the precise distance to the given object. [Wolfe et al., 2012, p. 162].

6.2.2.2 Editing; When To Cut - The Rule of Six

When talking about editing, it is needed to know when it is most suited to make the cut. The editor Walter Murch has made the Rule of Six, which are six criteria that establishes *"what makes a good cut"* [Murch, 2001, p. 17-18].

According to Murch the ideal cut is one that cover these six criteria: *"1) it is true to the emotion of the moment; 2) it advances the story; 3) it occurs at a moment that is rhythmically interesting and* right*; 4) it acknowledges what you might call* eye-trace*-the concern with the location and movement of the audience's focus of interest*

within the frame; 5) it respects planarity*-the grammar of three dimensions transposed by photography to two (the questions of stage-line, etc.); 6) and it respects the three-dimensional continuity of the actual space (where people are in the room and in relation to one another).”* [Murch, 2001, p. 18]

This gives us the six criteria, which Murch has put into a list, where the more important he finds the criteria to be, the higher it is on the list. He has also given each criteria percent for how important he believes the criteria to be in relation to the other six criteria. The six criteria of the rule of six are:

1. Emotion 51%
2. Story 23%
3. Rhythm 10%
4. Eye-trace 7%
5. Two dimensional plane of screen 5%
6. Three-dimensional space of action 4%

[Murch, 2001, p. 18]

With the first criteria, emotion, it is meant that you, as the filmmaker, should ask the question *“How do you want the audience to feel?”* [Murch, 2001, p. 18], and if you then make the viewers feel that emotion you wanted them to feel, you have been successful. As Murch says it is after all not the editing or the camera work that will be remembered by the audience, it is instead how they felt when watching the movie [Murch, 2001, p. 18]. This also indicates that this criterion is by far the most important criteria to fulfill or satisfy, as Murch calls it and if the filmmaker needs to *“sacrifice”* any of the criteria, he should start by sacrificing from the bottom up of the list, and *always* keep emotion. As Murch very clearly states it: *“when you come right down to it, under most circumstances, the top of the list-emotion-is worth more than all five of the things underneath it.”* [Murch, 2001, p. 19]. If the emotion is right, the story is interesting and the rhythm right, the audience has a tendency to not notice or be troubled by editorial problems with any of the last three subjects in the list (eye-trace, two dimensional plane of screen and three-dimensional space of action). [Murch, 2001, p. 18-19].

This also indicates that the list can be divided into two sections; the important ones, which are the first three subjects on the list, and the less important ones, which are the last three subjects on the list [Imaginox, 2010]. As Murch puts it, the important ones on the list emotion, story and rhythm are tied very closely together and he comes with the example of them as being connected by forces similar to the bonds of protons and neutrons inside an atom, while the bonds between the last three things on the list eye-trace, two dimensional plane of screen and three-dimensional space of action is much less tied together. Walter Murch states, though, that you will in most cases be able to satisfy all six criteria, and this is of course what should be aimed for; if it is

possible to satisfy all six criteria then you should always make the cut at that particular place. [Murch, 2001, p. 20].

6.2.3 Constant Variables: Dinner table Conundrum

In this section, the dinner table conundrum will be explained. This includes what the dinner table conundrum is and the four schemas, which is used for dinner table scenes.

The dinner table conundrum is present not only when a filmmaker is shooting a dinner table conversation, but also *"if you're shooting a poker game, or a gang planning a heist, or officers in GHQ poring over a map of enemy territory, or mourners gathered around a grave."* [Bordwell, 2005, p. 4]. It is all about the problems and obstacles, which are with the staging, shooting and the editing when three, or more characters are surrounding any common site. There are two principal schemas, which is normally used for dealing with those problems - though Bordwell also suggests a third and even a fourth one all used for the classical continuity filming. The two schemas are: the silent-era approach and the mixed sound-cinema strategy. The third one that Bordwell suggests is where circular tracking shots are used and the fourth one is where a stationary camera is used. It is these four schemas that will be focused upon in the rest of this section. [Bordwell, 2005, p. 4].

Let us start with the fourth one that Bordwell suggests where the solution is to simply have the camera showing the table from a distance and use only one continuous shot. This is useful when the actors know their lines very well and the filmmaker do therefore not need to change the setup for the lights. There are, however, some problems with this schema too; one problem is that there will be at least one person with their back to the camera at least it will be so in most cases and the filmmaker might want to let the viewer see that persons face too. Another problem is that you would need to cut, in order to make the pace faster, but you cannot do that since it is only in one take. [Bordwell, 2005, p. 1+5].

The silent era schema has one solution to the problems encountered when having a dinner table scene; to use several shots, where each character is given a separate shot (also called a *"single"*) whenever that character speaks or reacts to something. But having a lot of singles definitely also have its down sides, as it might *"create a choppy feel and it doesnt cover every eventuality."* [Bordwell, 2005, p. 1]. This solution was common in the 1920s and worked very well for silent films. [Bordwell, 2005, p. 1].

The mixed sound-cinema strategy uses a different approach, though it also has more solutions to the dinner table conundrum. One solution it uses is to have multiple cuts. Having both some shots where two characters are seated side by side chatting and singles, where the singles *"can be reserved for underscoring a key line of facial expression"* [Bordwell, 2005, p. 1]. The other solution is to use singles, where it is still possible to see something of one of the other characters, that being a shoulder, an elbow or something similar. The solution developed in the *"classical"* age of sound filmmaking in most countries uses different shots, where some shows several characters, while others are showing

one or two characters. [Bordwell, 2005, p. 1-2].

All of these different solutions do, however, still have their problems; *"For the sake of speed and economy it's best to film shots taken from a single camera setup all at once, regardless of where they'll eventually cut into the scene. If we are going to use several two-shots of Anna and Bart in the course of the scene, we should shoot all of those in a batch. Then we shift the camera angle to film all of our shots of Anna alone before shifting again to shoot all our singles of Bart. In sum, we will shoot each actor's lines, gesture, and glances* "out of continuity" *"* [Bordwell, 2005, p. 2].

This means that the production time is very high and as Kevin Bacon (actor, then later director) says - *"its a real pain in the ass to shoot"* [Bordwell, 2005, p. 3], since the filmmaker needs to cover the whole room when filming and the actors need to break their performance into pieces, as the filming does not take place in chronological order. There is also the problem that when you have a dinner table conversation the people around the table are eating and drinking so there need to be continuity in all the movements and so on. So that if someone raises a half full glass and then there is a cut, the glass needs to be raised in the exact same way *and* still be only half full, even though the separate shots might have been filmed with several days in between them. On a film-set this is what the script supervisor is there for; to keep track of the shot-to-shot continuity. [Bordwell, 2005, p. 2].

At last there is the third schema, which Bordwell suggests; the one where circular tracking shots are used. This schema goes around the problems with continuity in movements and objects, as here is the conversation or meal filmed using a camera, which circles around the table, where it passes each character at the proper moment. Bordwell also tells *"One contemporary directing manual recommends the circling camera as the best way to dodge the numerous matching problems raised by* "the dinner-table conundrum"*."* [Bordwell, 2005, p. 2]. The problem with this schema, however, is that the filmmaker cannot make the pace faster or slow it down, as this will again create difficulties with maintaining the continuity of the shots. [Bordwell, 2005, p. 4].

6.3 Test

The goal of the test is to see whether crossing the 180 degree line in a movie scene makes a change in the perception of the spatial construction or not: Will the spatial construction be greatly influenced by the use of the 180 degree line or by breaking it? This will be tested using questionnaires and by asking participants to draw the spatial construction of the scene in the two versions of the animation. These drawings of the spatial construction of the scene will in the end be compared to each other, and it is all the preparations made for the test, which will be presented in this section.

In order to test something a hypothesis is needed. This hypothesis can then be proven or disproved. The point is to make a hypothesis; an idea of what is expected. [Lazer, Feng, and Hochheiser, p. 161-162].). The focus of the test is to show whether or not

that breaking the 180° line will make a change in the participants perceived spatial construction of the pre rendered scene. Since filmmakers usually avoid crossing the 180° line (see Chapter 4.1 Continuity and Discontinuity Editing), it is assumed that the discontinuous edited scene will have a negative effect on the perceived spatial construction of the scene, and a null hypothesis and an alternative hypothesis were therefore written accordingly:

Null hypothesis

Breaking the 180° line in a movie scene will have the same results in perceived spatial construction of the pre-rendered animated scene, which kept the 180° line.

Alternative hypothesis

By breaking the 180° line, the spatial construction of a pre-rendered animated scene will be perceived different in a negative manner from the pre-rendered animated scene, which is not breaking the rule.

6.3.1 True Experiment

When working with an experiment there are some points needed to be taken into considerations, in order for it to be a true experiment, these points will quickly be presented in this section together with a discussion of whether or not this test can be called a true experiment.

1. In order to make a true experiment, the experiment should be based on minimum one research hypothesis, which can be tested and with the goal on validating it.
2. There should be a minimum of two conditions. This could for example be a treatment condition or group, and a control condition or group.
3. Quantitative methods are normally used when measuring the dependent variables.
4. The results are analyzed using various statistical significance tests.
5. The test is designed and conducted with the aim of avoiding biases, which might occur.
6. The experiment should have the possibility of being conducted multiple times using different participants and under different circumstances, here referring to the time and location and by other test conductors.

[Lazer, Feng, and Hochheiser, p. 42]

6.3.2 Methodological Triangulation

When having a test it should be considered to use methodological triangulation, in order to get more valid results, hence will it be described what methodological triangulation involves in this section.

Triangulation is the process of using more than one independent measurement process to acquire concrete results on a matter. The idea of triangulation is associated with measurements in social and behavioral research. Methodological triangulation refers mainly to the usage of different research methods, both quantitative and qualitative. This method is used to complete the responses and results from tests and tries to fill in most of the gaps created by biases occurring when using certain research methods. Methodological triangulation is also useful because it creates validity by giving multiple, independent data sources, which might point in the same direction, therefore increasing the confidence in the conclusion. [Lazer, Feng, and Hochheiser, p. 295].

Research methods, which can be used in a methodological triangulation are both qualitative and quantitative, and can be questionnaires, interviews, focus groups, observations or surveys. A questionnaire will therefore be handed out right after the participant has finished watching the animated scene presented to them, in order to gather significant data from both scenes. The questionnaire will first be used to gain general knowledge about the participants and their perception and understanding of the scene (see the full questionnaire as it was handed out to participants on the CD). The questionnaire will then take advantage of both open-ended questions and closed-ended questions. The open-ended questions will give the participants the chance to give a longer and more qualitative answer, while the closed-ended questions, such as yes/no, single, and multiple choice answers will be used for quantitative data.

Other ways to test and gather quantitative data is methods such as measuring the physical reactions of the body, such as heart rate, breath, or blood flow. When testing a product, questionnaires and interviews can be used, however, in some cases it can be difficult for the participants to e.g. remember what was felt at a specific time during the test. The reason this will not be used, compared to the questionnaires and the drawing task is because, heart rates, blood flow and breath measurements would not help get better results on the participants perceived spatial construction of the scene. If it is for example wanted to measure how scared a person will be while playing a game, measuring the heart rate might give more specific results, than questionnaires would. Analyzing the heart rate at multiple test participants can make it clear whether or not their heart rate changed, which could indicate that the participants was scared. Physiological tools can be chosen based on for example scientific papers, so if testing the element of fear (being scared) it might be possible to find how a body reacts to indicate said feeling and thereby choose the most useful physiological tool, if any is needed. When working with physiological tools there are multiple ways of doing so. Each way requires different levels and types of sensors. There are two different classes of sensors: the transducers, which convert mechanical or physical measurements into an electrical form and electrodes; which directly record electrical signals. [Lazer, Feng, and Hochheiser, p. 350-351].

6.3.2.1 Eye Tracking

The best methodological method to use for the data gathering seemed to be the eye tracking, as it is the most direct interaction with the screen itself. For this reason it is investigated what possibilities there is if working with eye tracking.

A possibility to further understand why the participants of the test do or do not notice the things they do, would be to gather data about where they are looking at the screen. This information could potentially be used for feedback on the editing, to see if it works as intended or how else the viewer look at screen.

To track the viewers eyes, the hardware Eyelink 1000 plus from SR Research could be used, as it tracks the viewers pupil fixation by the use of an infrared camera [Smith, 2011]. This data can explain where the viewer looked at a certain time and for how long the viewer gazes at it [Smith, 2011], which could show if there were any specific cues, which seemed to attract the viewers attention in the scene. Interpreting this data, however, can in general be very challenging [Lazer, Feng, and Hochheiser, p. 349], as seen in Tim Smiths research working with eye tracking, where he says:

"However, when the scene is moving, it is much more difficult to relate the gaze of a viewer on the screen to objects in the scene. To overcome this difficulty, my colleagues and I developed new visualisation techniques and analysis tools. These efforts were part of a large project investigating eye movement behaviour during film and TV viewing (Dynamic Images and Eye Movements, what we call the DIEM project)." [Smith, 2011]

Because of the time and resources required to put into it, it is deemed as something there was not space for as a methodological technique for data sampling, there will instead be focused on other techniques, to make those of a higher quality.

6.3.3 Data Analysis

When trying to gather data there are multiple sampling methods to use. One of these methods is called convenience sampling. Convenience sampling means that the test participants are chosen when they are available and where it is convenient at the given time and place where the test is conducted [Lazer, Feng, and Hochheiser, p. 226]. Convenience sampling is used simply because as the name implies it is convenient. Even though the sampling method is based on convenience, some requirements are still going to be made, which will be stated later in the process.

For this project a between group experiment will be conducted. The participants are split into two groups using convenience sampling. The two groups will each test a different version of the pre-rendered animated scene. The test conductor randomly determines the choice of scene by taking a card from a shuffled deck of playing cards. If the card is red the participant will watch the discontinuity edited scene. If the card is black the participant will watch the continuity edited scene. When doing a between group experiment there are three different statistical tests, which can be in used order to see if the null-hypothesis can be rejected or not: Independent-samples t test, one-way ANOVA and a factorial ANOVA. The independent-samples t test is optimal when having

one independent variable and two conditions for the independent variable. A one-way ANOVA is optimal when having one independent variable and three or more conditions for the independent variable. The factorial ANOVA is optimal when having two or more independent variables and 2 or more conditions for each independent variable. In the case the between group experiment have one independent variable, the editing technique used, and there are two conditions for that variable; discontinuity and continuity. Therefore it is optimal to the independent-samples t test. [Lazer, Feng, and Hochheiser, p. 74-75].

The independent-samples t test can both be one-tailed and two-tailed. The amount of tails used is based on the alternative hypothesis. As described in Chapter 6.3 Test, the alternative hypothesis looks for a negative effect. This means that the tail can only go one way, meaning the t test will be one-tailed. For a two-tailed t test to be used, the hypothesis needed to look for a change, but not in a specific direction (positive or negative). The one-tailed t test is a way of comparing two means and testing if the given null-hypothesis can be rejected. If the null-hypothesis can be rejected, the alternative hypothesis then needs to be accepted.

In order to figure out if the null-hypothesis can be rejected or not, the performed t test returns a number, which needs to be compared to a t table [Gerstman, 2007]. The t value is used in the t table to find the p value (the probability of the difference in the gathered data being a sampling error).

To figure out if the difference in the data is due to a sampling error, a significance level is chosen. The significance level is normally chosen to be 0.05 (5%) or 0.10 (10%) [Lazer, Feng, and Hochheiser, p. 75]. For this project a significance level of 0.05 will be used.

6.3.4 Participants

Participants are chosen randomly meaning that no specific criteria exist. If there are two or more variables, which need to be tested, and the participants are only testing one variable each, it is important to maintain the randomizing when distributing them between the variables. This is done by e.g. flip a coin and depending on if it is heads or tails, the participant will be distributed as such. This also means that the conductors do not even know how the participants will be distributed between the variables, until the coin is flipped. [Lazer, Feng, and Hochheiser, p. 28].

According to Lazer et al. 20-30 participants are needed when conducting a test [Lazer, Feng, and Hochheiser, p. 401]. For this test a minimum of 32 participants are wanted, which gives at least 16 participants for each variable (discontinuously and continuously edited scene). The participants will be gathered randomly, meaning that things such as age, gender, and similar will not have an impact on who is chosen. The participants will be distributed between the two variables by drawing a card from a normal deck of cards. If the card is black, the participant will watch the continuously edited scene, and if the cars are red, he will watch the discontinuously edited scene.

6.3.5 Environment

The test can take place in multiple different environments, such as in a closed environment or in a more open one, where the test is taken to the participants. If the test was to be set in a closed environment the participant could come and be seated similar to a movie theatre and there could be anything from a single to multiple participants at a time. If the test instead was to be taken to the participants it would take place anywhere the test participants would be situated when they are asked to participate in the test. This is also believed to make it easier to convince possible test participants to actually participate in the test.

One of the two versions of the scene could be shown on a screen for multiple participants at once, if the test was to take place at a closed environment. This would save time when testing, especially when compared to bringing the test to the participants, it would, however, mean that there should be found certain times where a lot of participants could spare time simultaneously to watch the scene. This means that even though it might take less time to test for the conductors, it might be more difficult to get all participants together at the same time, since their schedules might vary a lot.

When bringing the test to the participants it would be needed to show the test on a portable device, such as a computer. This would mean that it would most likely only be possible to test one participant at a time per computer, hence having multiple computers for the testing would spare time. The main reason for choosing this method is because the participants will not need to meet at a specific time, but instead will the test be where the participants are and it is therefore believed that there is a higher chance of the participants wanting to take a couple of minutes off from their work to participate in the short test.

6.3.6 Midterm

For the Midterm, the goal was to test whether or not the questionnaire and testing method was containing some mistakes or lacks, hence this will be used as a pilot test. For the test, it was possible to test on 37 participants and the results of the test will be analyzed in this section.

In order to prevent bias - if some of the same participants, should be used for the actual test - another scene would be chosen for the actual test and therefore not be the same as the Friends scene, which was chosen for the midterm test. For the midterm test, the scene focused on Phoebes birthday party where the Friends characters are gathered around a table in a restaurant with other people eating at other tables in the room and Monica and Ross mother at the bar with Emma, Ross and Rachels child.

The participants were asked to see the scene and then afterwards answer a questionnaire (see the full questionnaire on the CD), which was originally made for the actual test for the final prototype. By observing and analyzing the results it became clear that some changes were necessary.

The question, asking the participants to give a short summery, should also be changed since some participants gave too long replies; one of the participants used around 1400 characters. Having a limit on 500 characters in the questionnaire and making the participants aware of this limit in the question formulation might solve this.

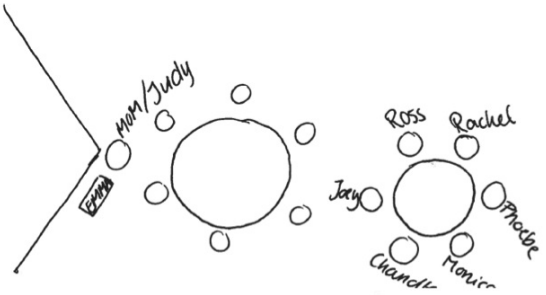

Figure 6.23: The correct drawing, made by the conductors, focusing on the placement of the relevant characters in the scene.

By looking at Figure 6.23 it is possible to see what the wanted result for the question *"Draw the scene from a top down view perspective as detailed as possible"* was. Here the focus is upon the relevant characters, however, by looking at Figure 6.24 it can be seen that the results of the drawings were very different from each other, and the majority of them also differed from Figure 6.23. This indicates that there was not given enough information to the participants, when only asking them to draw the spatial construction of the scene from a top down view.

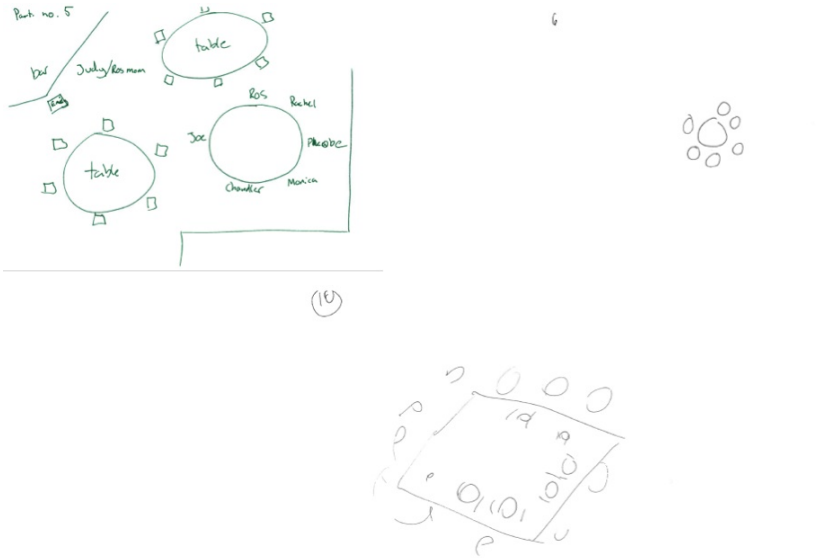

Figure 6.24: Three examples of drawings from three participants showing the difference in detail.

A solution to this is to change the question-formulation, so it is more specific; *"when drawing the scene please add names to the characters and make it as specific as possible*

in regards to the placement of the characters according to each other and the objects in the room. Please draw it from a top down view.". Adding a picture example of how to draw some characters in a scene space could maybe also help the participants to understand what to do.

The test showed that it took in average about 5-10 minutes for the participants to complete the whole test. This made it possible to test multiple people fairly quick and it was therefore relatively easy to get full 37 test participants, especially because of the fact that three computers were used for testing purposes only, meaning that there could be three test participants doing the test simultaneously. Since the setup was working well in an otherwise noisy environment, where the participants could easily be disturbed, it shows that the actual test can in fact be conducted with flexibility in regards to the setup and the location.

6.4 Sub Conclusion

This chapter provided an insight of the theoretical parts, which should be taken into consideration when designing and editing the pre-rendered animated scene. The dependent and independent variables presented prepared the ground for the testing and highlighted the methods, which will be manipulated, and the variables, which will be used to measure the effects, such as spatial construction. The constant variable, the dinner table conundrum theory, is used to prepare the scene and the number of characters required, in order to test the FPS (see Chapter 5) with an improved testing approach gathered from the midterm.

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Chapter 7

Design

The design of the pre-rendered animated scene will be presented in this chapter. This includes the relevant theory needed in order to create and understand the design of the scene, and the actual design of the scene - its characters, props and objects will be shown and explained. The chapter also includes the camera positions and all the cuts for both the continuity edited and the discontinuity edited versions of the scene. Later in this chapter lighting and sound will be explained.

7.1 Movie Scene

In order to test the FPS (see Chapter 5 Final Problem Statement) it was required to choose a movie scene (see Chapter 4.3 Discussion). This scene was chosen according to certain requirements such as the size of the spatial construction in a scene, amount of characters and the plot happening in the certain scene.

Dinner table scenes are ones that could fulfill these requirements and this kind of scene was chosen in order to avoid too much action happening on a wide area of space. Another requirement was to have more than two characters talking and seated around the table in the scene, this way it would give a wide range of choices when it comes to editing the scene in a discontinuous way and looking at the dinner table conundrum it is desirable to have three or more characters (see Chapter 6.2.3 Dinner Table Conundrum). Besides, dinner table scenes are known for their difficulty in filming them due to various problems in both the editing and in continuity difficulties regarding movements and the props. These problems related to dinner table scenes are known as the *"dinner table conundrum"*, and are present whenever three or more people are situated around something such as a table that being for dinner, a card/board game or someone plotting a coup. Many of these problems can be countered since this specific scene is made as a pre-rendered animation instead of filming it in real life. See Chapter 6.2.3 Dinner Table Conundrum for more about the dinner table conundrum and how filmmakers normally go around the problem. [Bordwell, 2005, p. 1-4]

After doing research of available dinner table scenes was a scene found in the television series called Friends. This scene is present in first season, episode 18, and starts

around 4 minutes and 50 seconds in the episode and last for 3 minutes. The scene revolves around a poker game, where all the six main characters (three females and three males) are present. This specific scene was chosen, since it keeps the 180° line, thus keeping the camera on only one side of the axis of action. The number of characters in the scene six is seen as being not too many and not too few, and in this way it is believed that it is easier to avoid the bias of the user being able to too easily see where each character is seated, but not making it too difficult either. A 3 minutes scene should also give the viewer enough time to actually get an idea of where each character is situated without needing to solely keeping focus on that (see Figure 7.1, in order to see a frame from the scene).

Figure 7.1: Friends scene minute 5, episode 18 (season 1)

Another reason for choosing this particular scene is because it has a small, understandable story: six people meet up to play poker. At the same time have the story small props like cards, cookies, a conversation about the poker game and small activities in between chatting. Therefore it should not be difficult for the viewer to understand the plot and thus allow him or her to pay attention to other details of the scene, than only the spatial construction.

7.2 Storyboard

7.2.1 Continuity Edited Scene Construction

This storyboard is mainly focused on showing where the camera is positioned in the original scene; therefore it is clear that the camera will never be put on the other side of the axis of action (see Chapter 6.2.1.1.1 Keeping The 180° Line). In Figure 7.2 there is a representation of where the camera is placed in some of the shots between 2 and 29 and it is noticed that the camera has the same position for all the shots which can be seen below; the two figures show how the camera is placed when Chandler is talking and it is always the same camera position throughout the animation, hence so many shots

have the same representation as the ones below. The full storyboard representation can be seen in on the CD.

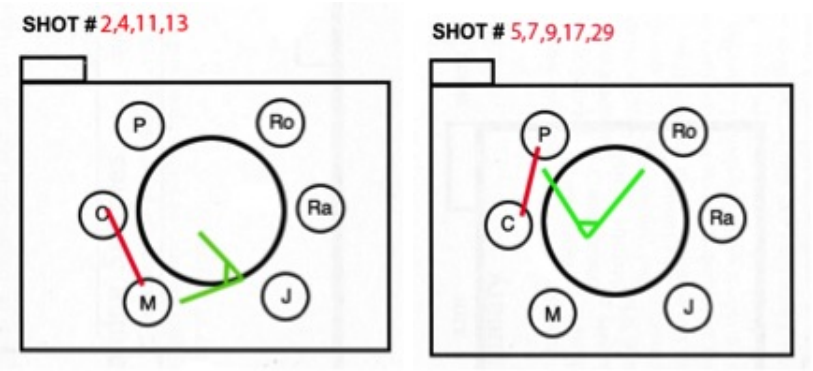


Figure 7.2: Shows where the camera (green) is positioned during the conversation between Monica (M) and Chandler(C) and shows conversation between Pheobe(P) and Chandler(C).

7.2.2 Discontinuity Edited Scene Construction

A discontinuous edited storyboard was also created, in order to give an overview of how the 180° line should be crossed. As known from Methods (see Chapter 6.2.1.1.2 Breaking The 180° Line), discontinuity in the spatial editing happens as the axis of action is crossed. There are different degrees of how much or how often the line could be crossed and it would be possible to have multiple scenes with the difference in the degree of crossing it to perhaps get a deeper meaning of when it affects for the viewers understanding of the spatial construction, under the assumption that it would do so in the end. However, because of the projects time restraints, only a single degree of breaking the line is chosen. With that being said, it is wanted to achieve the degree of crossing the 180° line extremely often within the scene. To give the feeling that the line is crossed extremely often, a requirement for the editing is that; at every cut the line must be crossed, see Table 7.1 for possible degrees, which could be used.

The degrees to which the 180° line can be crossed				
Never ← – → Extremely often				
The 180° line is never crossed	The 180° line is crossed at every 4^{th} cut	The 180° line is crossed at every second cut	The 180° line is crossed at 3 out of 4 cuts.	The 180° line is crossed at every cut

Table 7.1: Shows the various degrees to which the 180° line can possibly be crossed

In the continuously edited scene, there were shots where it is possible to see the whole table. These shots are removed, because it was learned that giving a full shot of the scene does a lot for understanding the space (see Chapter 4.1.4 Spatial Editing). A

shot like that was not wanted in the discontinuity scene because of how much it gave to the perception of the spatial construction (see Chapter 4.1.4 Spatial Editing), and only having the full shot in the continuity edited scene was too big of a change to a variable that is measured.

An example of the discontinuously edited shots can be seen in the Figure 7.3 and Figure 7.4 while the full storyboard can be seen on the CD. The first example, Figure 7.3, takes place when the conversation between Phoebe and Ross - where the camera placed on the lower side of the axis of action is followed by a conversation between Chandler and Joey, where the camera is changed to be on the upper side, meaning the opposite side of the axis of action.

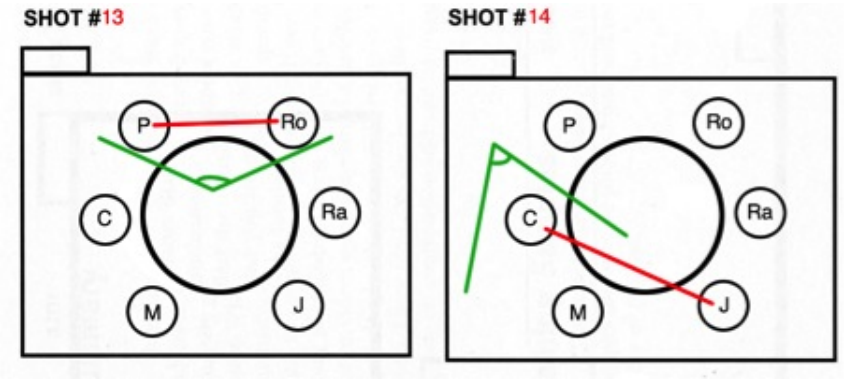


Figure 7.3: Shows where the camera (green) is positioned during the conversation between Phoebe (P) and Ross (Ro) and then Chandler (C) and Joey (J). It also shows where the axis of action (red line) is positioned.

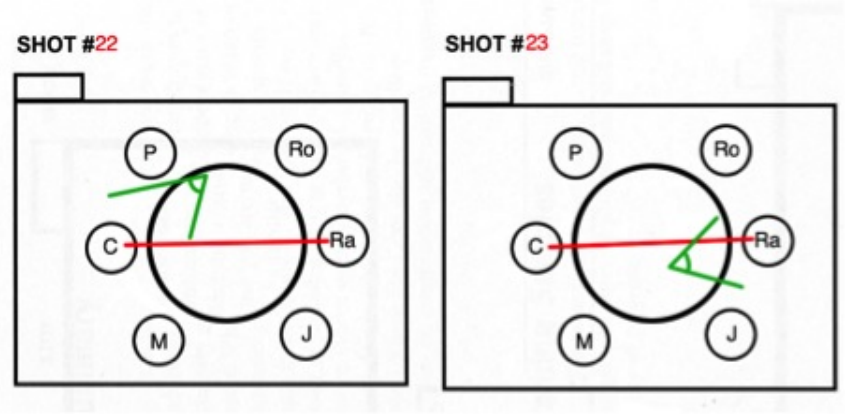


Figure 7.4: Shows where the camera (green) is positioned during the conversation between Chandler (C) and Rachel (R). It also shows where the axis of action (red line) is positioned.

Another example of how discontinuity is achieved can be seen in Figure 7.4, where the camera is moved on opposite side of the 180° line during two following shots. In the conversation between Chandler and Rachel, the camera moves numerous times according

to who is talking at that certain moment; when Chandler talks is the camera on the upper side of the axis of action and when Rachel replies is the camera instead on the lower side of the axis.

7.3 The Robots

This section contains the design of the robots. This includes the decisions and considerations made during the design process.

It is possible to rather easily not encounter the uncanny valley when robots are used instead of human characters. The uncanny valley is seen when human figures has an almost-but-not-exactly human appearance, thus being found unappealing by the participants. See Appendix E for more about the uncanny valley.

Costumes can affect the mood of the viewer and actor, along with their graphical qualities (see Appendix A Mise-en-Scène, Section A.1.2 Costumes and Makeup). Even though robots obviously do not have costumes per se, they can still have different body-appearances, thus acting as their costumes.

The robots are therefore given different colors and body appearances to fit the characteristic of the robots counterpart in the show Friends, in order for the viewer to easily distinguish between the robots. It is, however, strived to not make them so recognizable that the original Friends characters shine too much through the design of the robots. This means that the robots each have a different color and features, such as one having a screen with an image on it, and another having a screen with some text. To see the design of each robot see Figure 7.7, Figure 7.5, Figure 7.6, Figure 7.8, Figure 7.9 and Figure 7.10.

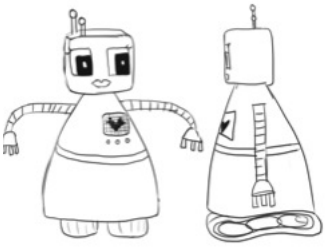


Figure 7.5: Design of the robot Rachel

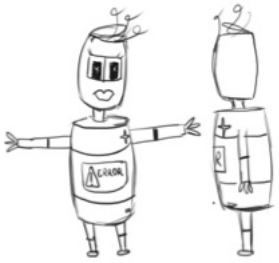


Figure 7.6: Design of the robot Phoebe

Since the robots are based on the Friends-characters there are three male and three female characters. This was indicated by using eyelashes, lipstick and female mouths on the girls and a simple, straight black mouth on the boys. The robots were given small, noticeable quirks, not only to distinguish them individually, but also to indicate some of the Friends characters personalities; e.g. Rachel is the pink robot, showing that she is the most girly one; loving shopping and fashion. Phoebe was made as the destroyed one with a broken head and showing error on her screen, since she is the more odd character in the show. Ross was given a top hat, since he sometimes tries new styles, which do

not always work very well, just like a robot with a top hat might look out of place. With Joey being the more childish character in the show, he was also made as the most childish of the robots, looking most like a childrens toy.

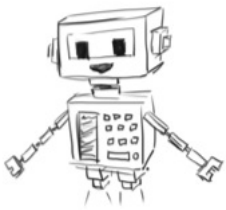
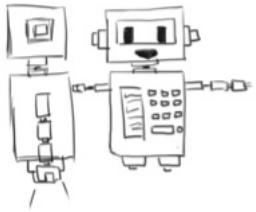


Figure 7.7: Design of the robot Joey



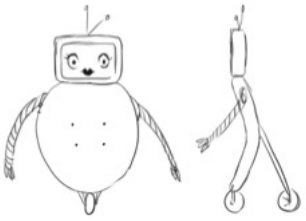


Figure 7.8: Design of the robot Monica

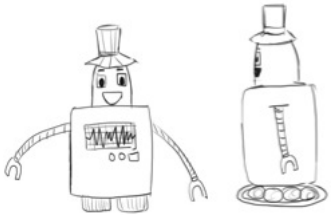


Figure 7.9: Design of the robot Ross

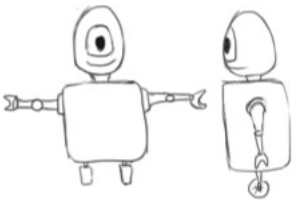


Figure 7.10: Design of the robot Chandler

The art style is the same for all the robots; so there are rarely used smooth edges, but mostly going with sharp edges and corners, all resembling childrens robot toys to some degree. Three different kinds of legs and feet were used, in order to create diversity, while still keeping them simplistic. The chosen kinds of feet and legs were wheels, tracks, and some feet making it possible to hover above ground. It was also taken into consideration that these kinds of legs and feet would be rather easy to animate, if needed.

7.4 Objects and Props

In order to replicate the chosen movie scene, certain props and objects needs to be added. Objects and props are not the same thing and it is needed to distinguish the two things: props are important objects used in the plot, while the objects are all the other things in the scene. The main props are basically the cards, which the characters use to play with, the snacks, which one character brings onto the table from the kitchen, and the table. The props were slightly altered to fit with the characters in the scene being robots. The snacks, which one of the characters brings to the table, are changed into being small metal wheels, also known as gears. These gears have different shapes and sizes, which can be used to represent the diversity in food in the scene. This diversity can also be sustained by the different colors of the metal that the gears are made of. A sketch representation of the snacks design can be seen in Figure 7.11.

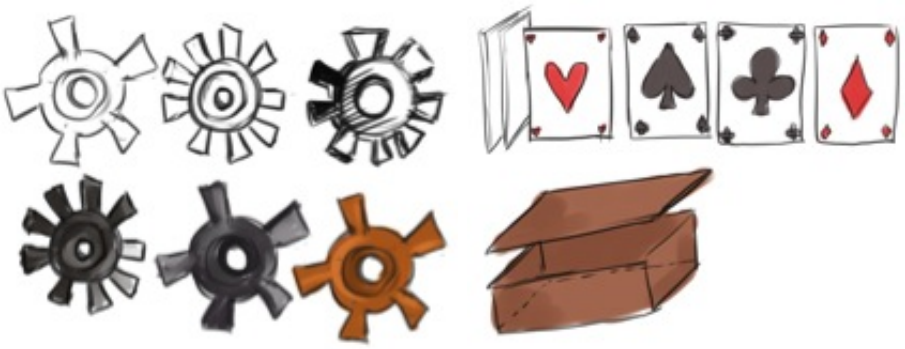


Figure 7.11: Props used in the movie scene, gears to the left and the cards and their box to the right.

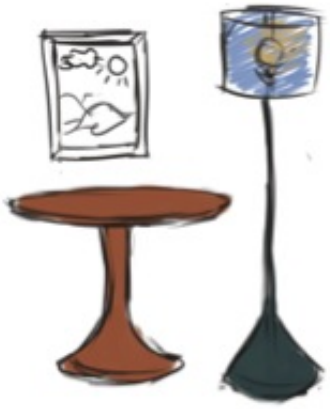


Figure 7.12: Shows the design of the table (prop) and the two objects; the lamp and a painting.

The other important prop - the cards, which the characters use to play poker with are not changed into being something else, and they can be stored in a wood box on the table. The wooden box was added, in order to have more objects on table and thereby not leave it empty; therefore will there be a welcoming feeling to it. A sketch of the cards and the box can be seen in Figure 7.11 to the right; the cards are simply represented by the four marks and can then easily be duplicated. To get a more realistic feeling, each card, which can be found in a deck could be turned into a texture and applied as a material to the modeled cards, however, that would be extra work, since the viewers will not have a close up of the cards nor is it believed that they will get the chance to pay much attention to the cards.

The table is also to be considered a prop and it might even be thought of as the main prop, since it is what brings the characters together, having them seated around the table all next to each other, and it is also where the rest of the props are placed. (see Figure 7.12).

Another important aspect about recreating the TV-show scene is adding objects to

fill the room as well, such as a painting on a wall or a lamp (see Figure 7.12). These objects can then make the room more soothing to look at and less empty.

7.5 The Scene Itself

After sketching the design of the objects and props can the overall design of the scene setup be made. In Figure 7.13 the objects have been placed in their proper positions and a colored representation of the walls and floor can be seen in the figure to the left. Here are the walls shown having a sky-pattern with a blue background and clouds, while the floor is kept orange, in order to give a pleasant feeling to the room. A window is also added to let light come from left, while the lamp is placed to the right, meaning that light comes from both sides of the characters, giving a well-lit room. The figure to the right shows a top down view of the scene setup, where the table is placed in the left corner and the red dots represents the characters around it, while a small kitchenette can be seen in the right corner. This kitchenette can be used by the character, which gets up to bring chips or rather; gears - to the table.

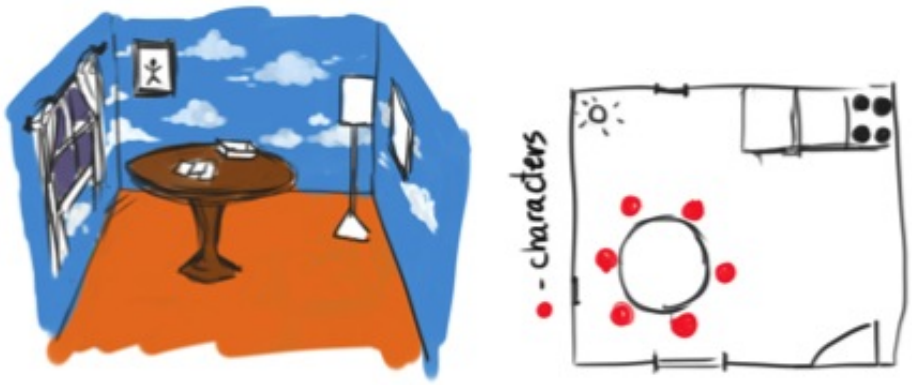


Figure 7.13: Overview of the scene

7.6 Lighting

The scene will also need to be lit. Hence, there will be looked into how to do this effectively. The light sources of a film are; all the lights visible within the scene, such as streetlights and extra lights added behind the camera. If a light in the scene is not bright enough, extra lights can be added to fake its light. Normally the light design is created to seem consistent with the scene, avoiding fake, unrealistic lights. For more on light see Appendix F Lighting. [Bordwell and Thompson, 2013a, p. 124-131].

7.6.1 Qualities Of Light

Quality is the intensity of the illumination, which can be hard lighting and soft lighting. Hard lights create clearly defined shadows where you can easily see when the shadow starts and stops. With soft light, on the other hand, it is basically impossible to tell where the shadow and light split, as they fade into each other. Light has five main noticeable qualities when looking at a scene or a picture: color, brightness, softness, throw pattern, and angle of the light. These qualities can determine the mood or the feeling the scene gives the viewer and it can also be used as hints of information. See Appendix F Lighting for more on the qualities of light. [Birn, 2006, Chapter 1, Section Motivation].

7.6.2 Three Point Lighting

This light setup is mainly used to light up a characters face. As the name implies, there are three important light sources used in the scene. These light sources have certain names according to their functions; key light, fill light and rim light. The key light focuses on the characters main illumination and is therefore bright and casts dark shadows. The fill light extends the key light and softens it, while the rim light is used as an outlining light, set behind the character, and it therefore defines the characters contours, see an example of such in Figure 7.14.

Figure 7.14: The figure shows a setup of the three point lighting illumination process with the three lights. [Birn, 2006, Chapter 5].

The three point lighting, however, is not always set up as in Figure 7.14.There are various ways to place the ligts, which are used in order to hide or bring out certain characteristics of the subject in the scene. One variation would be to set the rim and key light to the same direction, for example the front of a character, which would light the characters front profile clearly, while giving an outline on the back. [Birn, 2006, Chapter 5].

The brightness ratio between the key and fill light is 1:2. This is also called the key-to-fill ratio and this ratio can give an even lighting of the two lights, which has an acceptable contrast and shadows. In movies and scenes not all characters are lit with

the same type of ratio. Some popular ratios for movies are 5 key for 1 fill, or 10 key for 1 fill, which will give a stronger contrasts. [Birn, 2006, Chapter 5].

The three point lighting is overall just a guide to illuminate certain characters or objects. However, it is not good practice to overuse this. The three types of light sources used for illuminating characters can also be considered tools and therefore be able to create personal designs of ways to use the light. [Birn, 2006, Chapter 5].

7.6.3 Difference Of Light In Animation Films

A difference between working with lights in real movies and light in rendered movies is that, when rendering scenes, time and quality of the rendered images play an important role. Rendering a high quality scene with proper lights and shadows will take a large amount of time, so - in order to solve the issues caused by rendering scenes - it is encouraged not to focus a lot of time into perfecting parts of the scene that will not be shown to the viewer. There are however some techniques usually used to simplify the designers task when creating CGI scenes, known as motivation and cheating.

Motivation is the process before adding lights, including which lights need to be added and what their characteristics are. Cheating, on the other hand, is a way around the planned lights. Cheating is basically adding extra lights hiding errors of other lights or to make it look more realistic. It is possible to shape objects properly if other lights do cannot. For more on motivation and cheating see Appendix F Lighting.

When working with light in a pre-rendered scene; area Light, direction light, spotlight, point light and ambient light are all types of light that can be added and manipulated into giving realistic lights and shadows. However, when adding lights to scenes one must properly choose which kinds to use for certain types of light sources, in order to portray them realistically and make sure they are placed at the correct distance to create realistic shadows and beams. See Figure 7.15 for an example.

Figure 7.15: Illustrating how placements of light in a scene affects its reality. Placing the light too close will create an unnatural perspective for the sunbeams (left), but placing them farther away will create more parallel and natural sunbeams (right). [Birn, 2006, Chapter 3]

Modeling with light is another specific subject when it comes to light and CGI rendered scenes. The main idea is to use light to give a realistic full representation of the CGI models, therefore can it make the characters look flat and therefore give a

2D feeling to it or give it a three dimensional depth feel to it with curves and edges, depending on how the lights are used. If there e.g. is a curved object, it should not have a flat light, but each key component should be modeled with light properly, in order to indicate the curvature of the object as seen in Figure 7.16. [Birn, 2006, Chapter 5].

Figure 7.16: Figure depicting a CGI model with a flat look (left) and a curvy look (right) [Birn, 2006, Chapter 5].

7.6.4 Light In The Scene

Based on the theory about light some thoughts were made about the design wanted for the scene of the animations. These will be explained in this section. For the scene it was decided to use soft light in order to avoid hard shadows and to make the light seem more as indoor lighting. The light sources will be added as lights coming from the lamps, which will be positioned in the room. It is at this point already known that a lamp will be placed in the ceiling over the table, since that lamp is used to light up the events taking place around the table. Sunlight or moonlight should also be lighting through the big window in the scene, creating additional shadows. These decisions are made with the idea of making the light in the scene as realistic as possible. For the scene it is also important that the characters are in focus therefore three point lighting should be used, in order to do so and still have the lights positioned in the same location as the lamps, it may be needed to use the theory about cheating when implementing it.

7.7 Sound

It still remains a question what sound there should be in the scene. Therefore, this section will first cover the theory behind sound, and thereafter this theory will be applied to both the design of the sounds and in the choice of which sounds to include in the pre-rendered continuity and discontinuity edited scenes.

7.7.1 Sound Theory

In this section there will be looked into sound in movies, short films and scenes. This includes the role sound has in movies, the types of sound in movies, and how important

the absence of sound in movies also can be. In movies, the soundtrack is made separately from the images, which means that there are just as many ways that the sounds in the movie can be manipulated as all the other film techniques can be manipulated. Sound has a key function in movies, and according to Bordwell and Thompson sound engages *"a distinct sense mode."* [Bordwell and Thompson, 2013b, p. 270].

Sound can also have an even more important role in movies, as sounds can make the viewer understand the movie in a specific way, which can change when the sounds are altered. Sounds can even cheat the viewer or change his expectations to what happens next. An example of this alteration of sounds can be found in the movie *Letter from Siberia*, where Chris Marker shows a small sequence three times, but with different sounds and voiceover, which changes the understanding of the sequence, see Table 7.2 on Page 62 [Bordwell and Thompson, 2013b, p. 269-270].

There are three types of sounds present in films. These three types are;

1. Speech
2. Music
3. Noise, which are also referred to as sound effects.

[Bordwell and Thompson, 2013b, p. 274]

A sound in the movie can be a mixture of the three types and an example of this can be heard in the movie Psycho [Hitchcock, 1960], where the viewer expects to hear a woman scream, but instead is presented with high-pitched violins. That is a sound effect, which has been altered to be speech; so forth you do categorize a scream as being speech and not a sound effect. This leads us to the fact that some sounds can be very difficult to categorize into just one of the three types of sounds. [Bordwell and Thompson, 2013b, p. 274].

With cartoons, the sounds are often recorded before the actual cartoons frames have been created. This makes it possible to more easily make the mouth-movements in the cartoon to be synchronized with the spoken sound. [Bordwell and Thompson, 2013b, p. 274-275].

Soundtracks to a film are often made simple in order to make the important parts of the film stand out and thereby guide the viewers attention. For example dialogue should not have to compete with music, background music or noise. This means that all sounds in the film should fulfill a specific function, thus a much simpler sound world is created than the sound world outside of the film usually is. Sound effects are usually compared to speech and music as less important. *"They supply an overall sense of a realistic environment and are seldom noticed; if they were missing, however, the silence would be distracting."* [Bordwell and Thompson, 2013b, p. 275]. This also leads to the next topic; silence [Bordwell and Thompson, 2013b, p. 275].

Because it is after all not only the presence of sound, which should be considered when making a movie; the absence of sound in a movie is just as important to master. Silence in a film can increase the attention of the viewer and as Bordwell and Thompson

say: *"Sound gives an almost new value to silence. A quiet passage in a film can create almost unbearable tension, forcing the viewer to concentrate on the screen."* [Bordwell and Thompson, 2013b, p. 270-272].

7.7.2 Sound In The Scene

In the scene used in this project, there wont be any kind of music playing. The scenes does not have a certain point of its story to stand out, but more the overall scene and music would not add anything of importance to the scenes purpose.

For sound effects in the scene, they should be added for natural noise in the room. That means that the plate that is put on the table should be making a noise equivalent to metal against wood at that force. The effects should be kept subtle to not distract the viewer from the conversation though, as it is more important to be able to hear what is said. Because the robots are mechanical beings, sounds of machinery working should be added to the robots movements, to enhance the impression of them actually being robots. These effects would be something in the lines of a humming (such as when you turn on a computer), gears turning etc.

To replace the voices of the actors from Friends, options laid between paying for voice actors or doing them unprofessionally for free. Although paying for voice actors would be the best solution especially based on the higher professionalism, it was steered away from, based on resources, time in the current place of the project and that the voice acting itself should not affect the spatial awareness of the test participants. To make up for obviously sub-par voice acting, and to make them fit to the characters design, the voices would be edited such that they had an electronically generated, mechanic sound effect ergo a robotic voice. No additional music or sounds effects should be added to the scene in order to keep more focus on the dialog and in general the plot and spatial construction of the scene.

7.8 Sub Conclusion

The design chapter led to the decision of using a specific movie scene, which is taken from the series Friends, which therefore includes six main characters for the scene. However, in order to avoid the uncanny valley and personalize the animation, the characters were replaced by robots whose looks were decided to differentiate from one to the other. It was also specifically chosen which cuts to make and where the camera should be placed and all represented in a storyboard, in order to ease the process of implementation. The lights should give a realistic feel to the scene, done so by using soft lights that imitate in door light sources. Sounds in the scene will all come from natural sources and add to the overall ambience of the scene, while the speech will be manipulated so that it sounds as generated by a robot. Based on this knowledge it was possible to set up some requirements.

7.9 Implementation Requirements

- Six characters must be present in the scene
- Each character must have a different color representation
- Characters must be represented by robots to avoid the uncanny valley
- Camera must cross the axis of action each cut
- Full shots should be avoided in order to remove what is considered bias for the spatial construction
- Three point lighting should be used for the scene, since the focus is on lighting up characters
- Soft light because it illustrates indoor light sources, such as lamps, precisely, which gives a realistic look to the scene.
- The robots speech should have an electronic and mechanical effect that would sound robotic.
- Sound effects should be added if any objects interact with each other, replicating the equivalent of the sound it would make in real life.
- Characters should have sound effects linked to their movement to embrace them being robots.

7.10 Design Limitations

Not all things went as desired in the design. It should therefore be noticed that the following design options were changed, because of their independent reasons stated with the topic.

In the design, the choice of voices for the robots was voice acting, where wanted robotic effects could then be applied later on in post-production (see Chapter 7.7.2 Sound In The Scene). This was tried to be achieved, but it proved to be more time consuming than originally planned if an acceptable quality of voice was to be found. For the voices to be acceptable in the sense that they satisfy the viewers expectations of a robot voice, the voices should have an electronic vibe to them. Besides that, it should still show the emotion and rhythm that good voice acting gains from. This could not be achieved with the available level of skill and involvement.

OS Xs build-in Text to Speech software [Apple] was used instead and thereby getting the computer generated voices to re-enact the voice acting. This would remove some of the viewer expectation and be less time consuming. As the project does not focus on the voice acting, it was qualified as an acceptable compromise.

Sound effects were left out of the scene. This was done as the addition of the sound effects would not make up for the time required to make them fit, in regards to the projects goal of spatial awareness of the scene. It is aware that the silence as well has an effect (see Chapter 7.7 Sound), but it is not seen as an effect that will impact the project negatively.

For the lighting of the scene the plan was to create a three-point lighting for the shots (see Chapter 7.6). This was, however, not done, and it comes down to two reasons; the time to set up the lighting for each shot would add too much time to the implementation, and the rendering time added because of the lights would be abnormal. Two lamps are instead placed in the scene, in order to light the whole scene up from the natural occurring sources, such as lamps.

Images	First Commentary	Second Commentary	Third Commentary
	Yakutsk, capital of the Yakutsk Autonomous Soviet Socialist Republic, is a modern city in which comfortable buses made available to the population share the streets with powerful Zyms, the pride of the Soviet automobile industry. In the	Yakutsk is a dark city with an evil reputation. The population is crammed into blood-colored buses while the members of the privileged caste brazenly display the luxury of their Zyms - costly and uncomfortable cards at best. Bending	In Yakutsk, where modern houses are gradually replacing the dark older sections, a bus, less crowded than its London or New York equivalent at rush hour, passes a Zym, an excellent car reserved for public utilities department on account of its scarcity.
	joyful spirit of socialist emulation, happy Soviet workers, among them this picturesque denizen	to the task like slaves, the miserable Soviet workers, among them this sinisterlooking Asiatic,	With courage and tenacity under extremely difficult conditions, Soviet workers, among them this Yakut
	of the Arctic reaches, apply themselves	apply themselves to the premitive labor	afflicted with an eye disorder, apply themselves to
	to making Yakutsk an even better place to live.	of grading with a drag beam.	improving the appearance of their city, which could certainly use it.

Table 7.2: Shows the images and the voiceover in the clip from Letter from Siberia, [Bordwell and Thompson, 2013b, p. 271]

Chapter 8

Implementation

This chapter contains the implementation of the pre-rendered animated scene. This includes modeling the robots in Autodesk Maya, rigging them, making the scene, objects and props and animating the scene itself. These explanations will be followed by different ways of how to render the animated scene and how the scene was rendered. In the end it is explained how the voices were created and added to the clip. During the design phase were the robots called by their names from the TV show Friends, as it was easiest to use those names, since the models were not yet made. During the implementation, the robots changed names to their color. This means that instead of calling the blue robot for Chandler, it is now called Blue. The change in names was also applied to the script. This was done as to not hint to the test participants where the scene came from. The new names of the robots are as follows: Yellow (Phoebe), Red (Joey), Blue (Chandler), Green (Ross), Pink (Rachel) and Purple (Monica).

8.1 The Robots

The creation of the robots will be presented in this section. This covers both the modeling of the robots in Autodesk Maya and rigging them.

8.1.1 Modeling The Robots

The implementation of the robots was made in the modeling software Autodesk Maya, making it possible to create CGI objects. Each robot was made individually based on the concept drawings presented in the design (see Chapter 7.3 The Robots in Chapter 7 Design). The modeling of the robots was at first distributed between four people, but it soon became clear it was easily seen that all of the robots had been modeled by more than one person, each having their own style. It was therefore decided that only one person should model all the robots and thereby gain the same style for all of them. This also meant that the techniques used for modeling just one of the robots are the same for all the robots.

The robots were modeled using different polygons combined together and by extruding them. In Figure 8.1 is the robot Red illustrated showing how he is modeled using only squares added together and extruded from each other. Some of the extruded things are Reds hands, legs/feet, and the neck.

Figure 8.1: Red, illustrating how the robots are made using simple polygons.

The coloring of the robots was also done in Maya using built-in shaders. The robots head and screens were made using a technique where one specific face[1] of an object is chosen and then colored. This means that first a face was chosen, divided into many sub-faces, and coloring those individually, as seen in Figure 8.2, where the red square indicates which face is currently being changed.

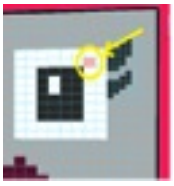


Figure 8.2: Pink's eye, used as an example of how to work with faces in Maya.

8.1.2 Rigging The Robots

The rigging was done using a combination of the Joint Tool and the IK Handle Tool[2]. The IK Handle Tool, as explained by the Maya documentation *"resembles a wire running through a joint chain, and enables you to pose the entire joint chain in one action. As you pose and animate the joint chain, its IK handle automatically figures out how to rotate all the joints in the joint chain..."* [Autodesk, b]. The arms are rigged using three joints; one at the shoulder, one at the elbow and one at the hand (see Figure 8.3).

After the three joints in each arm had been placed, the skin was bound to the rig using Smooth Bind. To make the arms function and bend like a normal arm, the IK Handle Tool was used to create a line between the hand and the shoulder. When the hand is moved, the elbow joint automatically moves and bends in the right direction.

[1] The area formed between connected vertices and/or their edges [Autodesk, a].
[2] Inverse Kinematics Handle Tool [Autodesk, b]

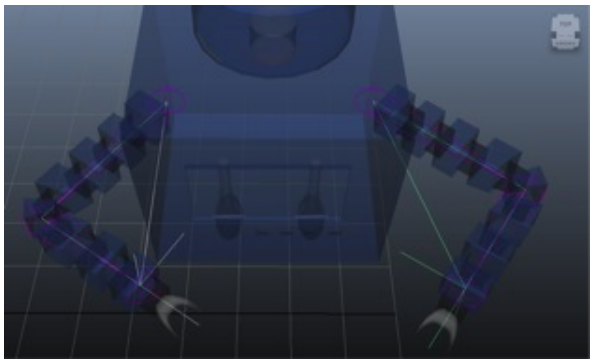


Figure 8.3: Example of rigging Blue with the IK Handle Tool.

This is done for both arms on all the robots. It was not necessary to rig the whole body, since the characters are not going to move or bend.

In Figure 8.4 the finished models of all the characters can be seen.

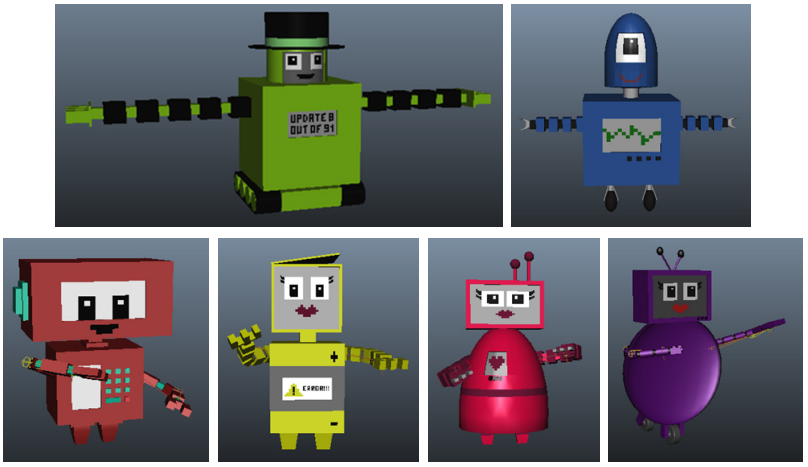


Figure 8.4: These figures show the final models of the six robots, representing characters from the TV-show Friends. Each robot is named according to its color, and from the left is seen: Green (Ross), Blue (Chandler), Red (Joey), Yellow (Phoebe), Pink (Rachel), and Purple (Monica).

8.1.3 Making The Scene

The whole scene was created with simple polygon planes for the walls and ceiling. When the initial structure of the scene had been made, the door, window and rug was added. It was again simple polygon planes and cubes, which was used. The concept drawings Chapter 7.5 The Scene Itself were followed closely and the overall design of the scene is pretty simple and can be seen in Figure 8.5. Instead of using shaders with imported graphics, which would not fit the picture with the size of the objects, the walls were textured using Planar UV Mapping [Autodesk, c], which fit the picture to the surface size.

Figure 8.5: Overview of the finished scene with probs and objects but without robots.

The concept drawing of the objects (see Chapter 7.5 The Scene Itself) were used when making the objects. All of the objects are made out of simple polygons using the standard Maya shapes such as Cube, Cylinder and Sphere. The objects and props were textured using shaders. The props can be seen in Figure 8.5. Two point lights were created, placed into the scene to simulate two lights, one over the table and one in the corner (see Chapter 7.10 Design Limitations). The point lights intensity was put on 1.000, and they both use ray tracing for the shadows. The shadows for the kitchenette was removed as it seemed unnecessary to use time on rendering shadow that did not add much to the scene.

8.1.4 Animating The Scene

The animations of the scene is inspired and loosely based on the characters movements in the chosen scene of the TV-show Friends. As it was with the creation of the robots and the objects, the animation itself was also done using the software Autodesk Maya.

The robots movements were made with only the move tool and rotate tool (see Figure 8.6).

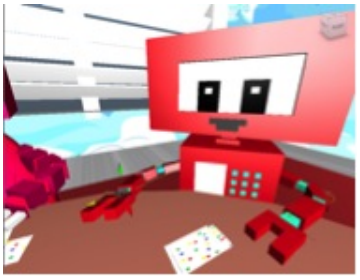


Figure 8.6: Illustrating the move tool on the red robots right hand.

The rigging (see Chapter 8.1.2 Rigging The Robots) made it easier to move the arms of the robots, as the whole arm would follow just one point without extending or minimizing itself.

Figure 8.7: A part of the timeline illustrating the red lines as key frames, with a waveform in the back as the sounds of the scene.

To lock the positions of the movements a key is added on the current frame to the timeline, also known as a key frame. Key frames appear as red lines on the timeline (see Figure 8.7). From one key frame to the next will the attached objects move from their position in the first key frame to their position in the next key frame in a seemingly smooth motion. The sounds of the scene was added later (seen as a waveform on the timeline), with the character movements refitted to follow those later.

With most of the models, one of their arms could not rotate or move up and down without it moving in an unnatural 360 degrees rotation. The reason for this is assumed to be a problem with the rigging, though no permanent fix was found. Each time it happened it was fixed using the graph editor by dragging the rotational key frames up or down until the arm fit the desired location (see Figure 8.8).

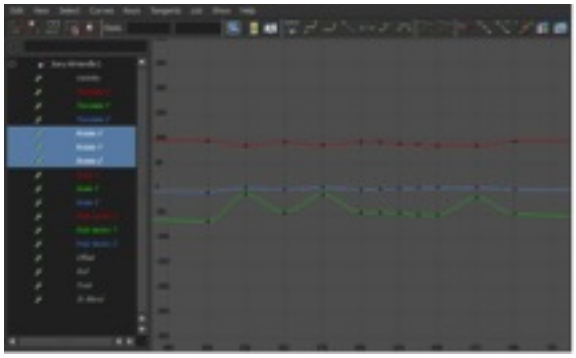


Figure 8.8: The graph editor showing the rotational axis of one of the robots arms. Each black spot on the curves is a key frame. Curved lines between key frames indicate rotation, while straight lines indicate no rotation.

Another problem was that whenever a character moved the rigging fell off it. This meant that two models of the same character had to be created; one with the rigging, for the arm movements, and one without any rigging to be moved around. As the character is to start moving, one of the models is to disappear and the other without rigging is to appear on the exact same position as the other. This was done with the visibility option under the display tab, together with adding key frames when one of the models are to replace the other (see Figure 8.9).

It was decided to create blinking glow instead of actual mouth movements when the robots speak. This was due to both animation skills and the fact that robots not necessarily need mouth movements to talk in order to seem real. The glow was made using the materials of the faces of the mouths. Each mouth on each robot needed to have a different material assigned, as they needed to blink individually. Within the material

Figure 8.9: Screenshot showing two models of the same character. The red box shows the display tab with the visibility option to show or hide the models.

properties, glow intensity was used to create the glow (see Figure 8.10). The darker the color of the mouth, the higher the glow intensity needed to be, as a dark glow would not be seen otherwise.

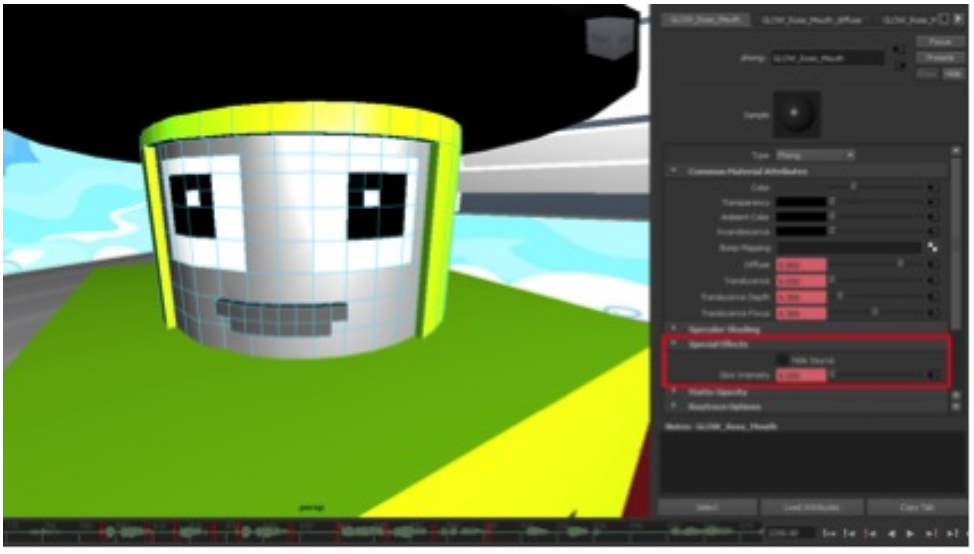


Figure 8.10: Screenshot depicting the special effects tab under the green robots mouth material (red box) and also showing a small part of the key frames of the material (bottom).

Once the proper glow intensity was chosen, the key frames, as it was with the other movements, would be put on the timeline. The first key frame was added on frame 1 with the glow intensity put to 0, so there would be no glow from that frame and onwards. The frame where the robot starts to talk would have a key as well, but for this key the intensity of the glow would be the chosen glow intensity of the robot e.g. 205 (see Figure 8.11). The frame before that though, would also need to have a key frame,

but with intensity of 0, so the glow would appear from one frame to the next and not a graduating glow, is it would have been otherwise.

Figure 8.11: An audio waveform with key frames that changes the glow intensity from 0 to 205 and vice versa.

Two cameras were used for filming the two scenes: one for the continuous version and another for the discontinuous. This seemed easier than having one camera for each new angle, as this meant that only two cameras needed to be rendered instead of multiple. The placements and movements of the two cameras were made following the two storyboards (see the storyboards on the CD).

The sounds were not put into the scene until late in the process, which meant some movements would have to be refitted to follow the voices of the characters. In hindsight sounds should be added very early in the process, so the animations can be made to fit those, as it is usually done with cartoons. The same goes for camera placements and movements; the sooner those are in place, the less extra work for the characters animations are needed, as there is no reason to animate characters, which are not on screen.

8.1.5 Rendering The Scene

Rendering a CGI animation is all about optimization. The rendering can be done with very high settings to get the absolute perfect and most realistic look, but that would also make the render time very long. By doing a non-photo-realistic rendering everything comes down to using the lowest, yet still acceptable, settings.

8.1.5.1 Techniques: Ray Tracing Vs Rasterization

Ray tracing and rasterization are two different rendering techniques, which can be used to render an animation, hence there will in this section be a description of each technique containing what it is good for and where it falls short. This will lead up to a discussion on which technique will be the most beneficial to use for this project. Both ray tracing and rasterization are rendering techniques, which tries to simulate the natural reflection, refraction and shadows of light on an object [Birn, 2006, Chapter 9, Section 3].

8.1.5.1.1 Ray Tracing Ray tracing tries to reproduce the natural reflection, refraction and shadows as photorealistic as possible. This uses the GPU to calculate the state of each pixel based on the light, objects and shadows. To calculate the reflection, the GPU uses the formula $R = L - 2 * perpN * L$ where N is the normal vector, L is

the direction towards the incoming light, R is the direction of the reflected light and $perpN * L$ is the component of L that is perpendicular to N, see Figure 8.12.

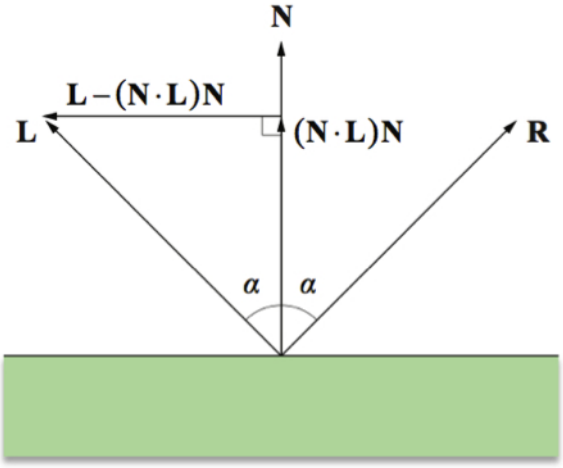


Figure 8.12: Example showing a graphical representation of the reflection formula [Lengyel, 2012, p. 150]

Refraction is more complicated. The input ray does not have the same angle as the output ray. To see a more detailed explanation of the refraction formula and how it is derived look at Appendix C.

Ray tracing has both advantages and disadvantages. The advantages of ray tracing is that it can create highly detailed and photorealistic renders, it is very good for rendering reflections and shadows and even at low settings is the final render highly detailed. The main disadvantage of ray tracing is that it takes a long time to render even just a single frame; this is because every pixel has to have its light, shadow, refraction and reflection calculated. This is also why it is difficult to do real-time ray tracing in games. [GameStar, 2004].

8.1.5.1.2 Rasterization The rasterization rendering technique needs to process every polygon[3] in an image to find out how it is going to look. The rasterization technique can only process one polygon at a time, but the GPU can have multiple single polygon calculations running simultaneously. The render engine cannot look at multiple polygons to try and accurately calculate shadows and reflections between them. Each shadow and reflection is based on a single polygon in rasterization, whereas in ray tracing it is based on a lot of polygons.

The main advantage of rasterization is that it is fast and can therefore be done in real-time. This is efficient when working with games or other live applications and not something pre-rendered.

[3] A polygon is a flat object with a finite number of line segments chained together in a closed loop [Verth and Bishop, 2008, p. 82-83]

The disadvantage of rasterization is that it cannot render shadows, reflections and refractions properly. To render these, the engine needs to cheat and try to approximate the effects. This can for example be done using reflection maps. It is, however, not possible to render realistic looking images. [GameStar, 2004].

8.1.5.1.3 Decision Ray tracing and rasterization both have their strong and weak points. Ray tracing is a very good technique for pre-rendered animation where the render time does not need to be quick or live. On the other hand, rasterization is very good for games and can make some good shadows without them being perfect.

For this project ray tracing will be used. This is because of the main advantages of ray tracing; it is possible to get realistic shadows and reflections (see Chapter 8.1.5.1.1 Ray Tracing), as opposed to rasterization, and since this project uses pre-rendered animations having a short render time (see Chapter 8.1.5.1.2 Rasterization) is neither necessary nor relevant. Instead is it more important to have a good-looking image with realistic shadows and reflections.

Even though a low render time is not important for this project, there is a big difference in having a render time of 2 hours per frame, using suggested settings from Advanced Maya Texturing and Lighting [Lanier, 2008, p. 402], or trying to optimize the render options so it is possible to get a render time of just 1 minute per frame. With an animation consisting of 4150 frames, even a render time of 1 minute per frame results in 69 hours and 10 minutes of render time. Switching to rasterization would not shorten the render time considerably, when compared to the negative effect it would have on the quality.

8.1.5.2 Image Size

The first thing to be decided is the image size of the rendered image. In a time where Blu-ray is one of the common media and everything is full HD, using 1080p seemed like the obvious choice. This is just not the best choice regarding the render time. After trying different image sizes it was decided to use Autodesk Mayas preset for HD 540[4].

8.1.5.3 Ray Tracing

It was decided to use Ray Tracing for the shadows, reflections and refractions (see Chapter 8.1.5.1 Techniques: Ray Tracing Vs Rasterization). Ray Tracing has a lot of different settings in the Maya render window, as it is possible to control both the Reflections, Refractions, Max Trace Depth, Shadows, Reflection Blur Limit and Refraction Blur Limit. These things can be set to default values using Maya's different presets, such as Preview and Production. When creating the first test renders of single frames was the production preset used. After trying different setting combinations it was decided to use the default Ray Tracing values. These values are:

[4]HD 540 has a width of 960px and a height of 540px.

- Reflections: 4
- Refractions: 6
- Max Trace Depth: 10
- Shadows: 5
- Reflection Blur Limit: 1
- Refraction Blur Limit: 1

Figure 8.13, Figure 8.14, Figure 8.15 and Figure 8.16 shows different settings used. The important settings, which were tested, were the Reflections and Refractions. Looking at Figure 8.13, the glasses are completely black. This is because the refraction is set to 1. The render time Figure 8.13 having the above mentioned settings all at 1 results in a render time of 26 seconds per frame. This is quicker than Figure 8.16, which uses the final render settings and has a render time of 38 seconds. The render time presented here is for one specific computer and the render time is based on the computers hardware.

Figure 8.13: Test render with all settings at 1.

Figure 8.14: Test render with reflection, refraction, max trace depth and shadows set to 2.

Figure 8.14 shows a render with reflection, refraction, max trace depth and shadows all set to 2. The render time is also 26 seconds as in Figure 8.13, but the glasses are beginning to look better now. The glasses are not completely black and the part of the glass where it is possible to see Greens (Ross) hand behind is lighter than in Figure 8.13. This is what is strived to make it look like, since the refractions should distort the image behind the glass to some degree.

In Figure 8.15 are the settings half of those used in for the final settings. Reflection is at 2, refraction at 3, max trace depth at 5 and shadows at 2. The liquid in the glass is starting to shine more, compared to Figure 8.14 and the bottom of the glasses is getting the right reflections from the surrounding objects. The glass is not perfect, though, and there are still black parts and the liquid is not looking as good as one could had hoped for. The render time is starting to rise and is at 30 seconds for Figure 8.15.

Figure 8.16 uses the final render settings. Here it is possible to see the refractions through the glass. Both Greens (Ross) hand and part of the table is visible through the top part of the glass and the liquid inside the glass has a good shine to it. The render

Figure 8.15: Test render with reflection at 2, refraction at 3, max trace depth at 5 and shadows at 2.

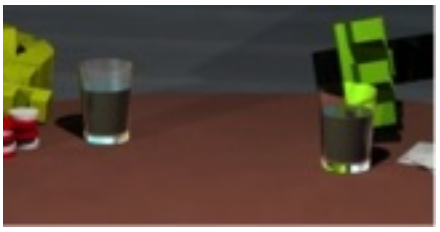


Figure 8.16: Test render using the final render settings.

time has again increased and is now at 38 seconds. This is 12 seconds[5] more than when rendering Figure 8.13. Even though 12 seconds per frame adds around 11 hours of extra render time, it is necessary to have the higher render settings used in Figure 8.16, when compared to the other figures.

8.1.5.4 Sample Mode

Sampling mode refers to method, which will be used to avoid anti-aliasing [Lanier, 2008, p. 350]. Anti-aliasing occurs when a computer monitor tries to display a smooth edge or line. The monitor will display the edge or line as jagged, rough and not smooth. This is due to the physical limitations of the monitor and the amount of pixels available to display the line or edge [Lanier, 2008, p. 313]. In this section the chosen sampling mode will be discussed and the theory behind the sampling mode will be explained. It was chosen to use the Adaptive Sampling Mode in Maya based on test renders. The Adaptive Sampling Mode had an acceptable render time and still looked good. The Adaptive Sampling Mode allows the user to change the Max Sample Level, but not the Min Sample Level. Instead are there always 2 between the min and max level, e.g. -2 and 0 or 0 and 2. To change the Min Sampling Mode it is necessary to use Custom Sampling. Using Custom Sampling it is possible to change both the Min and Max Sampling Modes, whereas Adaptive Sampling can only change the Max Sampling Mode. Since changing the Min Sampling Mode was not needed, Adaptive Sampling was chosen instead. This sampling mode helps avoid jagged edges by using anti-aliasing. A straight line is often represented as a jagged line when rendered on a computer monitor, which happens because there is a finite amount of pixels on the monitor. By using anti-aliasing is it possible to compute multiple sampling points within the same pixel [Lanier, 2008, p. 313].

The color of the pixel, which is being rendered, is determined by the subpixels. The Min and Max values determine how many times the pixel is recursively divided into subpixels, which are then sampled. The pixels and subpixels are sampled based on the Anti-aliasing Contrast or Color Contrast. To get a pixel value, the sampling process looks at the border between two pixels. If the difference in color value is greater than

[5] Render times for each frame varies from render to render

the contrast value, the pixel with the lowest color value is divided into subpixels. The process repeats for the subpixels and the subpixels can be divided into sub-subpixels. The number of times a pixel can be divided is based on the Min and Max Sample Level. With a Max Sample Level of 2 there can be four subpixels with each four sub-subpixels, but if the Max Sample Level is 4 there can be four subpixels with four sub-subpixels with four sub-sub-subpixels with four sub-sub-sub-subpixels. The calculations for a Max of 2 can be written as 4 subpixels * 4 sub-subpixels = 16 samples. With a Max of 4 it can be written as 4 subpixels * 4 sub-subpixels * 4 sub-sub-subpixels * 4 sub-sub-sub-subpixels = 256 samples. [Lanier, 2008, p. 350-351].

The difference in the Max Sampling Level can be seen in Figure 8.17, Figure 8.18 and Figure 8.19. Figure 8.17 shows Adaptive Sampling with a Max of 0 and a Min of -2. This means that there is at least 1 sample per 16 pixels and at most 1 sample per pixel.

Figure 8.17: Adaptive Sampling with Min -2 and Max 0

As seen in Figure 8.17, the straight edges are jagged and do not look very good. This render took 1 second to render. This is very fast, but the result is mediocre.

Figure 8.18 shows a better render. This time the Max is 2 and the Min is 0. This means that there is at least 1 sample per pixel and at most 16 samples per pixel.

Figure 8.18: Adaptive Sampling with Min 0 and Max 2

The render time has increased to 4 seconds this time. While this might not seem like a long render time it is still an increase of 300%.

The samples per pixel have increased dramatically with the larger Max and Min sampling. There are now at least 16 samples per pixel and at most 256 samples per pixel. This gives us a render time of 1 minute and 53 seconds, which is an increase

Figure 8.19: Adaptive Sampling with Max 4 and Min 2

of 11200%. The increase from 1 second to 4 seconds suddenly does not seem that big. Even looking at Figure 8.18 and Figure 8.19 it is difficult to see the difference and the increased render time is not justified by the better quality.

Having a Max at 2 and a Min at 0 was in the end chosen, because of the render time and because the outcome is not notably different from having Max at 4 and Min at 2.

8.1.5.5 Sampling Options; Filter

There are five different sampling filters in Maya; Gauss, Box, Triangle, Mitchell and Lanczos. These filters are there to blend neighborhood pixels together, in order to create a smoother mass and to avoid the jagged boundaries between pixels. Gauss is the most thorough filter and it also produces the best result, but again there is a cost in the render time, which is increased accordingly. Box, on the other hand, has a lower render time, but the result is not of the same quality as Gauss. Triangle is a variance of Box but it gives a more accurate result. Mitchell and Lanczos are both variances of Gauss but they give a higher contrast. [Lanier, 2008, p. 352]. In this section the Gauss and Box filter will be compared.

Figure 8.20: Test render using the Box filter.

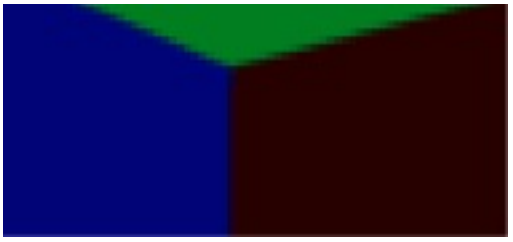


Figure 8.21: Test render using the Gauss filter.

Figure 8.20 and Figure 8.21 shows the difference between the Gauss and Box filter. With a primitive figure like this was the render time for the Gauss and Box filters identical; 2 seconds. The quality difference is highly noticeable and with an identical render time (in this case), it is not difficult to choose the Gauss filter.

Figure 8.22 and Figure 8.23 shows the difference between using a gauss and a box filter in the scene. Figure 8.22 uses the box filter and by looking at the top of Reds

Figure 8.22: Test render using the Box filter in the final scene

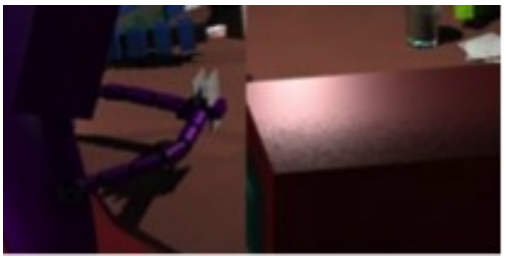


Figure 8.23: Test render using the Gauss filter in the final scene

(Joeys) head it can be seen that the shadows are a bit rough and the edge of his head does not seem sharp. Purples (Monicas) arms have rough edges and the overall image seems grainy. Looking at Figure 8.23, which uses the gauss filter, the before mentioned problems are only fixed to some degree. The rough edges on Reds head and Purples arms are now smoother and the image is overall less grainy. This adds around 1 second of render time, which is about an hour of extra rendering. Only having a single frame to compare to can be difficult, but when adding multiple frames together to an animation the smaller things such as rough edges and grainy pictures are very notable. The added render time is worth it in this case for a smoother finished render.

Higher render settings were tested but after observing the very slow render time, the renders were cancelled and the lowest acceptable render settings were chosen.

For the complete render settings see Appendix G.

8.1.6 Sounds

The voices were created using OS X built-in text-to-speech software. The different character voices were chosen from a list of included voices and their lines were recorded. For recording the sounds Leawo's MusicRecorder on OS X [Leawo] were used and Audacity [Audacity] was used to cut the sounds.

8.2 Putting It All Together

After the animation was rendered (see Chapter 8.1.5 Rendering The Scene) and the sounds had been recorded the image sequence of rendered frames and the audio was imported into Adobe Premier Pro CC. Since the cameras in Maya were already setup to follow the storyboard and the cuts, no extra editing was needed. The sounds were added where the characters mouth starts to glow and did not need to be edited further. The finished animation short film was exported using the built-in preset for HD 720. Even though the frames had been rendered in HD 540, the up scaling to 720 did not noticeably change the quality in a negative way.

Chapter 9

Test

The different aspects of the test will be covered in this chapter, using the theory learned in Chapter 6 Methods. The test scenario will be introduced together with the questionnaires used for the test with specifications about the drawing task. It will then be followed by the pilot test and the information learned while conducting said test. The last thing covered is the test results, including the results presentation and the discussion of said results.

9.1 Test Scenario

This section is a continuation of Chapter 6.3 Test. The test scenario will be introduced, where it will be explained how the test will be conducted together with a list of things needed, in order to conduct it. The things needed in order to test are the following:

- Headphones
- Computers
- The two scenes (the two variables: continuous- and discontinuous edited pre-rendered animation scene)
- The questionnaire
- Pen and paper (size equal to the size of room)
- Drawing guide
- Consent forms

The test will be conducted by two groups with two conductors in each walking around with all the required things for the test, making it possible for the participants to test without going far. The procedure of the test looks like this:

1. Introduce the test for the participant

2. Ask them to sign a consent form allowing the use of test results in this report
3. Guide them to one of the computers used for testing. Starting out with showing them Scene C or D depending on which group they belong to, where C is the continuous edited scene and D the discontinuous edited scene. Explain them where to press after watching the scene, in order for them to answer the questionnaire. Making them aware that if they have any questions regarding the test or questionnaire they can just ask one of the test conductors
4. Thanking them for their help
5. Add matching numbers on the questionnaire and the drawing.

9.2 Questionnaire

First, in order to get general knowledge on the participants, questions about age, gender and study are added to the questionnaire. The data from these questions can then be used to conclude upon and also used to assign the results concluded to a general age group of people, which will test the animation. After getting a general idea on this information, the participant would have to answer information regarding the shown scene and whether they recognized it or not. (See below for the full questions asked) The participants are asked whether they recognize the scene from anywhere, in order to avoid bias in the results. If they feel that they recognize the scene it might mean that they remember some of the spatial construction and the overall plot which would then give biased data and would not be useful for the results analysis. However, in order to see whether the participant is actually recognizing the correct scene and is not misled by the fact that it is a similar scene to many table scenes in series or movies, they are asked where they recognize it from. The questions that were asked can be seen below. If the answer seems to be wrong, the results might still be considered valid and unbiased.

- Do you watch movies or series or anything alike? If so how often?
- Did you recognize the scene from anywhere?
- If yes; where did you recognize the scene from?

Moving on with the questionnaire, the significant questions to the product and result analysis will be asked. Firstly, it is important to know if they remember how many characters they noticed in the scene. This is important because it might have different results than what they perceived when actually getting to draw the scene.

- How many characters were in the scene?

Afterwards, the participants are asked to write a short summary of the event taking place, however, they are asked not to include any details of dialogue or motions that

take place in the scene. With this, it is hoped that they will avoid writing too much unnecessary information and will only focus on the main points in the plot.

- Write a small summary of the story in this scene. (500 characters maximum, Write the story of the scene without including any details of the dialogue and motions that occur.)

In order to have a reference point to how much of the summary can be considered correct when looking at the results, the right amount of points in the summary is written beforehand and can be seen below.

"Robots are gathered around a table playing poker. While some of the robots do not know how to properly play poker they are guided throughout the scene. When one of the robots wants to leave, it is stopped because some of them want to have a rematch."

If the participant gets most of the points in the summary as the one presented, they will be regarded as understanding story of the scene. A summary is asked to be written, in order to see if the participant understands the story, but mixes up the spatial construction or vice versa. After they write a short summary of the scene, they are asked whether they find the dialogue, plot or scene construction confusing. To reason the fact that they had troubles understanding the summary of the scene, they are asked whether they find the dialogue confusing. When asking about the plot, a short explanation by what is meant by plot is given, so the participants know what is referred by plot in this context. The same is done when the term *"spatial construction"* is used. This is asked to see their point of view on how confusing they perceive it and how they represent it on paper.

- Did you find the dialogue confusing?
- Did you find the plot confusing? (Plot refers to the event that is taking place in the current scene.)
- Did you find the spatial construction of scene confusing? (Spatial construction refers to the setup of the scene, mainly where the characters, objects and props are situated.)

The full questionnaire can be see on the CD.

9.3 Drawing Task

The last point on the questionnaire is actually more of a task, which requires the test participants to draw the scene from a top down view according to how they remember and perceived it from the scene. The participants get a detailed instruction on what they are supposed to draw and how, which can be seen in the bullet points.

- Draw the scene from a top down view perspective as detailed as possible;

  - Try to position everything inside the given frame (size of the paper) which represents the room walls
  - Position the characters while they are sitting at the table
  - Add props and objects that you have noticed during the scene where you remember they are placed
  - Add names on characters (eg. Blue according to their color of metal they wear)

- An example can be seen:

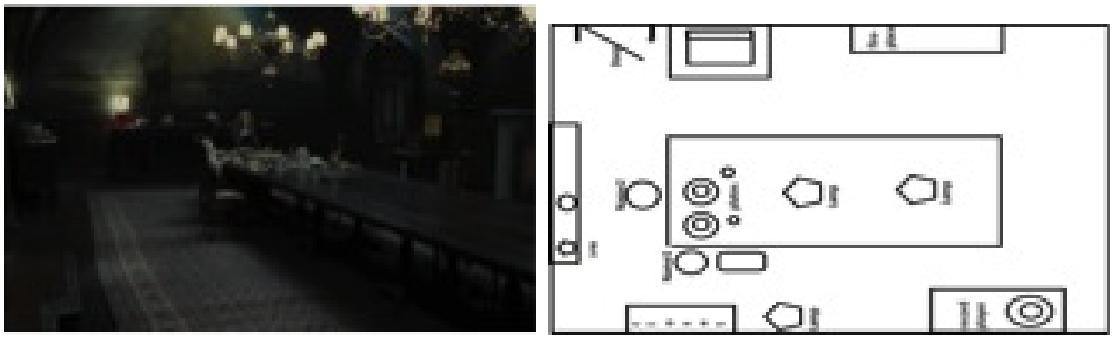


Figure 9.1: Example of a correct drawing

See the CD for reference on guidelines for drawing and and size of picture example handed out to participants

They are told that the paper size represents the walls of the room, so therefore it would not be as difficult to grade the occurring errors. In order to avoid the participants being confused when drawing the characters, they are asked to draw them when they are positioned at the table and not when they move around. The last point, adding names on characters, was considered necessary in order for the results to be clear and also easier to follow when grading. In case the participant thinks the instructions are not clear enough, an example of how it would be done is also added to the guidelines for the drawing.

9.3.1 Grading The Drawings

When going through the images that the test participants have drawn, it is needed to have a grading system. This grading system is created, in order to help make it possible to do a t test on the results afterwards. The grading system gives points based on the placement of the characters and the objects, it also give grades if things are missing, meaning that it is desired to get as low a grade as possible. Table 9.1 shows how many points each error gets.

It was agreed that the characters were the most important objects in the scene, therefore it they give the most amount of points. Objects such as the glass and box

Object	Missing	Wrong place	Too many	Other
Characters	3	0-3 / 5	3	No name: 3
Window	2	2 / 4	2	
Painting	2	2 / 4	2	
Door	2	2 / 4	2	
Table	2	2 / 4	2	
Stove	2	2 / 4	2	
Glass	0.5	0.5	0.5	
Box	0.25	0.25	0.25	
Walls	Square: 2	Other: 3		
Scale	Too big: 1	Too small: 1		

Table 9.1: Grades for each mistake

were not very important and therefore give a lot less points. The two lamps are not showed in both animation and therefore doesnt give any points since one animation would then be able to give more points and the other.

Each drawing starts at 0 points and the less points a drawing gets, the more correct it is. To measure how many points a given drawing should get, a picture of the Maya CGI scene from a top-down-view, the same perspective as the participants should draw it, was created which had an inner and outer areas around each object, matching their shape. The areas is because that the participants will most likely not be able to place the objects in the exact location of the object as they are drawing it off memory, and punishing them off that seemed like an extreme. To create the areas for each object, everything beside the characters and glass was made by making an outline of the shape, and for the inner circle it was scaled by 150%, and the outer 200%. These values seemed to be a good value for the point system, after testing a variation of sizes. It seemed to be a fair way to judge it, as the scale of the object would follow the original object so if the participant place the object in another angle it is more easily off than say if the inner and outer areas were e.g. circles or the shape of the room, which was other considered measurements.

If we use the table as an example, which can be seen in Figure 9.2, its areas are created by rings, similar to its shape. If the majority of the table were inside the inner ring, it would grant them no points, which would be seen as *"precisely placed"*. If the majority was between the inner and outer ring of the object, they would be granted the small amount of points, which for the table would be 2 points. Lastly, if the table is outside the outer ring they would grant the maximum amount of points of 4. For the rest of the objects circles, they can be seen on the CD.

The characters where graded based on how many seats off they were from their correct position. Looking at Figure 9.3, it is possible to see a grading for the yellow character.

Placing yellow correctly will give 0 points, placing her on green's or blue's spot will result in 1 point, placing her on purple's or pink's spot will result in 2 points and finally

Figure 9.2: Example of grading the table

placing her on red's spot, the opposite side of the table, will result in 3 points. If the character is not places around the table it will give 5 points.

9.3.2 Pilot Test

The pilot test was conducted as described in Chapter 6.3 Test, with the changes described in Chapter 6.3.6 Midterm. During the pilot test, certain flaws regarding the test approach and questionnaire have been noticed. The pilot test was conducted on 10 participants in total, 5 tested the continuous- and 5 the discontinuous edited scene. They were also divided into two groups; three tested the first approach of the experiment while the rest tested the improved approach of the test. After having tested on three participants it became clear that changes needed to be made before continuing with the test and thus also allowing testing the improvements added to the test conduction.

9.3.2.1 Pilot Test Results

The test was conducted from 14:00 -16:00 on the same day. The participants were asked to watch an animation and told they would answer a questionnaire afterwards; they were also informed that the characters names are the colors of their metal. Clear flaws in the questionnaire was noticed already after the first three test participants drawings was received and a discussion of how this could possibly be changed was therefore held. Figure 9.4 show examples of the first participants drawings, the drawing and questionnaire results can fully be seen on the CD. Figure 9.4 show how the participant misunderstood or did not pay fully attention to the guidelines offered to them in the beginning. The first issue with the drawing is the fact that the names or any reference to the robots are missing from the drawing and this would make it difficult to analyze the data.

Figure 9.3: Example of grading the yellow character

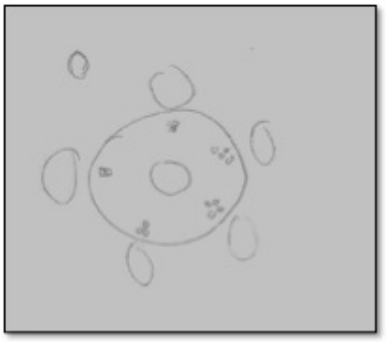


Figure 9.4: Example of drawing

Figure 9.5 shows another two examples of how the participants missed reading the guidelines properly and therefore ended up drawing extra walls, even though they were asked to use the paper size as walls. This can, however, be overlooked since it can be seen as their interpretation of how they perceived the spatial construction in the scene.

Overall for the pilot test, the first thing noticed was that participants did not read through the drawing guide given to them with rules needed to be followed and an example of how it should be done. This resulted in poorly drawn and useless pictures. The guide was therefore also tasked to highlight the fact that the test participants have to read the drawing guidelines and more explanatory text was added to the guidelines, thus making it more clear what is desired. It was also agreed by the conductors that, if the participants did not read the guidelines on their own, the conductors would be allowed to ask them to do so.

The drawing assignment was also moved to the top of the questionnaire so this becomes the first thing the participants need to do, while having the information fresh in mind, therefore removing at least some of the bias caused by the fact that the participants are using memory skills more than constructing a space.

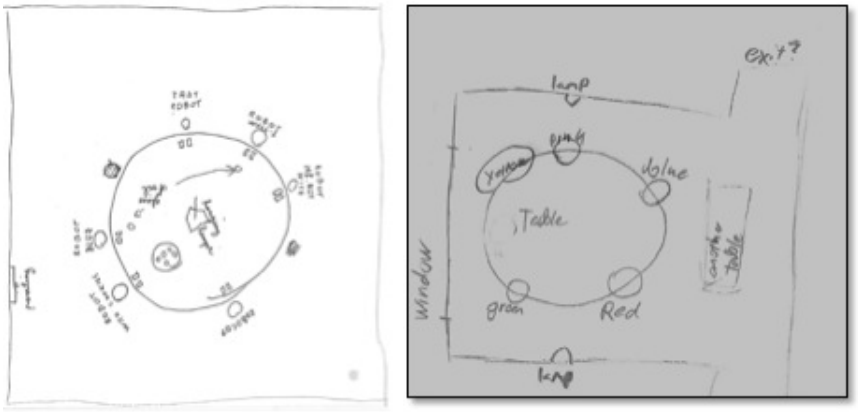


Figure 9.5: Examples of drawings

It was also discovered that in the beginning of the video the title of the video was shown, which in this case was *"continuity"* and *"discontinuity"*, indicating for the participants what the test was about. The names were therefore changed keeping in mind that the name should not indicate anything about the test or the fact that it was one out of two.

After these changes were made the pilot test was continued. When the pilot test was done no further changes was made, since it was decided that the first changes made had been efficient enough, making it possible to move on with the actual testing.

9.4 Test Results

The results from the final test will be presented in this section. They are divided into the results from the continuous edited scene and the discontinuous edited scene before going into depth with the drawings from the two edited scenes. The test was conducted as Chapter 6.3 Test. Some of the test participants noted to the test conductors that they had a hard time remembering the objects and characters within the scene.

There were 40 participants in the final test. 20 of these participants tested the continuously edited scene and the last 20 participants tested the discontinuously edited scene. The test took place over the course of two days from 10 in the morning to 15 in the afternoon; it was also made sure that the participants were tested the same time of the day on both days, in order to avoid biases.

9.4.1 Presentation Of Answers From The Continuous Edited Scene

All participants used in this experiment were students at Aalborg University, Copenhagen, which study Medialogy, Sustainable Design or Humanistic Informatics. The age of the participants varies from 20 to 32 and how many of each age of the participants and a normal distribution of the age variation can be seen in Figure 9.6.

After asking the participants to complete the drawing task, the participants had

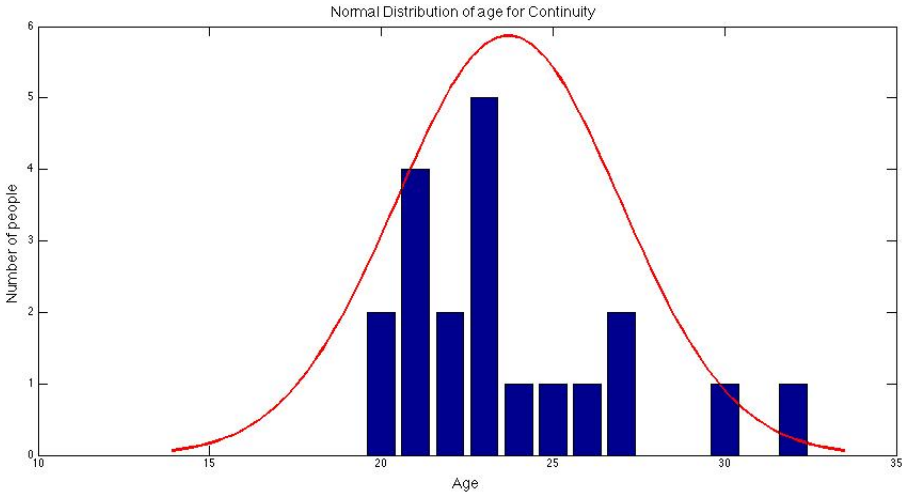
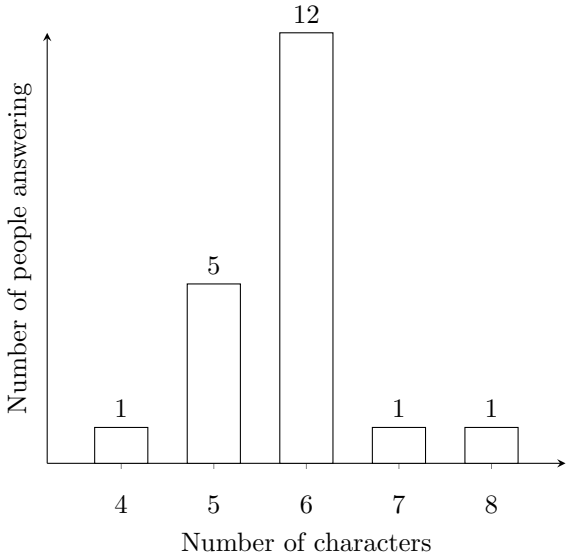


Figure 9.6: Normal Distribution of Age

to answer a questionnaire, and the results of this will be presented below. The full questionnaire can be seen on the CD.

The first question asked was regarding to how many characters they have noticed in the scene. The answers vary from 4 to 8, where 5 participants answered they saw 5 characters, 12 answered that they saw 6 characters, and 1 participant each answered 4, 7 and 8.



Of the 20 participants, who tested the continuous animation, 19 of them answered that they watch movies and series and anything alike, while only one did not.

If yes, how often?	No. of answers
Less than once	2 participants
1-2 Days	3 participants
3-4 Days	6 participants
5-6 Days	3 participants
Every day	5 participants

When participants were asked whether they recognized the scene, the majority answered they did not (11 participants), however, 7 participants agreed to recognizing the scene, while 2 were not sure if the scene seemed familiar or not. The participants, who said they recognized the scene from somewhere, had very different answers to where they believed to recognize the scene from. Overall there were three different answers given; *"Friends"*, the *"Dogs playing poker"* painting, and *"Woody's room in Toy Story"*. A representation of this can be seen in Figure 9.7.

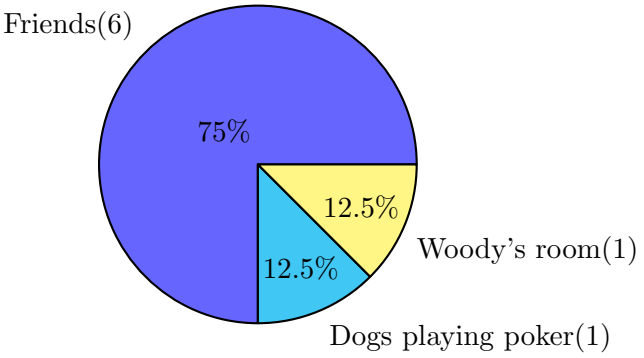


Figure 9.7: A pie chart of the distribution for the question: If yes, then where?

The dialogue was considered confusing by 11 participants, while 6 disagreed. There were also 3 participants who had a different answer and comments to that; *"sometimes it didn't make much sense"*, *"not confusing but hard to follow"*, *"maybe just the computer translation"*. A representation of this can be seen in Figure 9.8.

The plot was found confusing by less than half of the participants, as 8 agreed to it being confusing, while 12 disagreed. A representation of this can be seen in Figure 9.9.

7 participants found that the spatial construction of the scene was not confusing while 9 believe it is confusing, other 4 participants have said; *"yes and no, mainly because I tried to focus on the dialog and colors of the robots."*, *"A bit"*, *"The characters might swap positions at times"*, *"did not pay much attention to the scene"*.

The summaries were graded from wrong to partially correct and correct. Since the summaries are very subjective, they were graded by three group members, however, but only one who chose the decisive grading on both the continuous and discontinuous scene related drawings. For the continuously edited scene, the summaries were rated as this; 9 having gotten partially correct summary, 7 correct summaries and 4 wrong summaries. A representation of this can be seen in Figure 9.10.

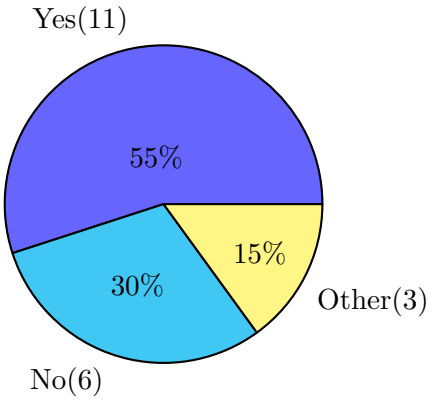


Figure 9.8: A pie chart of the distribution for the question: Did you find the dialogue confusing?

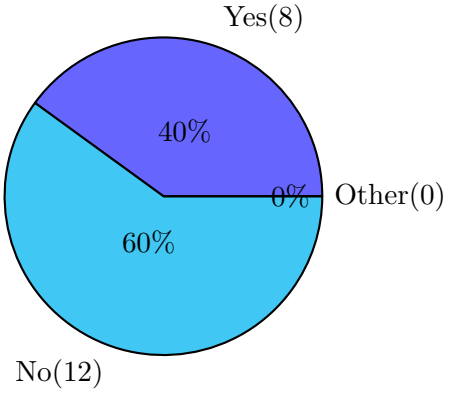


Figure 9.9: A pie chart of the distribution for the question: Did you find the plot confusing?

An example of a summary rated with correct, partially correct and wrong can be read, in that order, in the following:

"Six friends are playing a game of poker. Some for the first time and there was some confusion about the rules."

"6 robots were playing cards,3 boys and 3 girls, the girls did not know proper rules of poker, one robot boy fancies one girl and did not want to win against her."

"Robots there playing poker. They started to disagree on something, argue. Some robots wanted to have a nice game while others wanted to win in any way. (bluffing,lieing)"

Some participants had general comments for the test and the animation they had tested on, examples of such can be seen below;

"The voices were also confusing."

"The robotic voices were quite distracting from the content, in that I had to pay attention to understand what they were saying. Also, I felt the scene suddenly jumped to some other subject or something I wasn't properly introduced to, then suddenly back

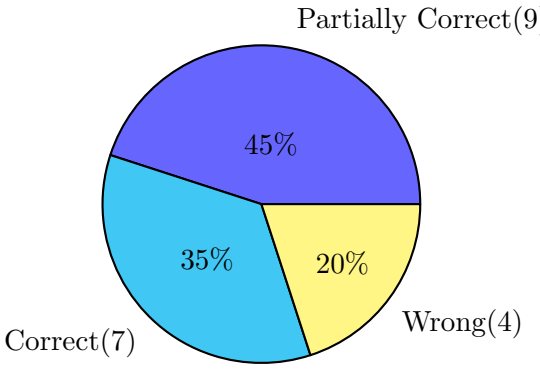


Figure 9.10: A pie chart of the distribution for answer of the summaries

to the poker game."

"At the beginning of the test I saw something about having to position the characters so I was aware of the character's positions and colors. I was not trying to be aware of the scene though. It was a little hard to follow the robotic voices, and at one point they became weird and a little funny."

9.4.2 Presentation of Answers From The Discontinuous Edited Scene

20 participants saw the discontinuous edited scene and answered the questionnaire. The full answers can be seen on the CD.

The participants were divided between being 14 males and 6 females and the age range was between 20 years old and 34 years old, and the distribution can be seen in Figure 9.11.

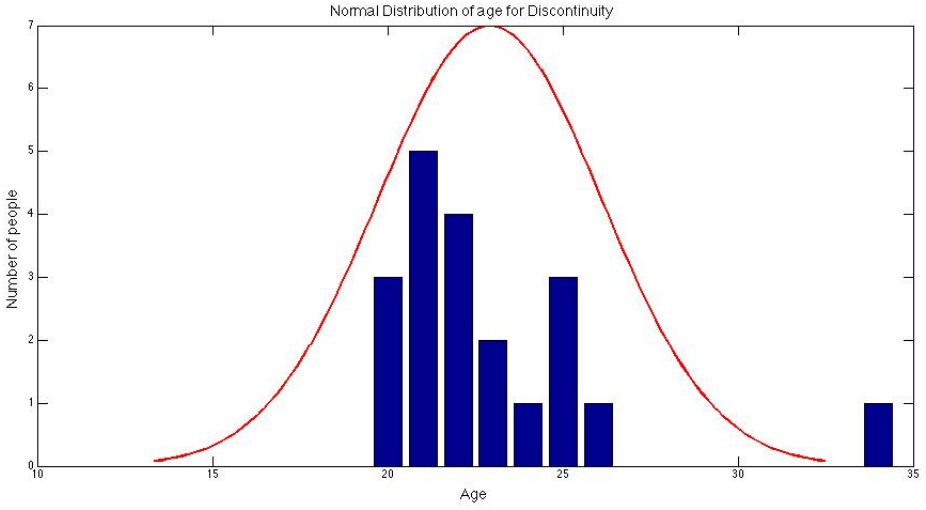


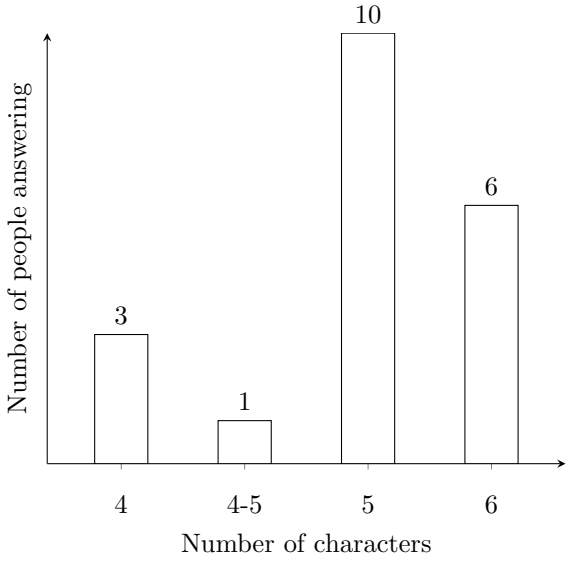
Figure 9.11: Normal Distribution of Age

4 of the 20 participants studied Humanistic Informatics from first semester, 11 par-

If yes, how often?	No. of answers
Less than once	4 participants
1-2 Days	5 participants
3-4 Days	4 participants
5-6 Days	2 participants
Every day	5 participants

Table 9.2: Shows the distribution of how often the participants watch movies, series or anything alike each week.

ticipants was studying Medialogy on third semester, 3 from fifth semester and 1 from ninth semester, and there was also 1 participant who studied Service System Design on first semester. To the question *"How many characters were in the scene?"* 3 participants answered 4, 1 answered 4-5, 10 answered 5 and 6 answered the correct answer, which was 6.



17 of the participants answered that they did sometimes watch movies, series and/or anything alike, while 3 answered that they did not. The distribution of how often each week they watch anything can be seen in Table 9.2. 3 of the answers to *"Less than once"* are the ones who did not watch movies, series or anything alike.

To the question *"Did you recognize the scene"* 11 of the participants answered no, 5 answered yes and 4 did not know. Only six of the test participants answered the question *"If yes, then where?"*. 1 of the participants who had answered No to the previous question answered *"I do not remember"* (translated from Danish *"det kan jeg ikke huske"*), while the other's all had answered Yes to the previous question. 4 of these answered *"Friends"*, which was the correct answer, while 1 simply answered *"a poker scene"*.

12 of the participants answered that they thought the dialogue was confusing, while 5 did not and 3 answered *"Other"*, with shorter explanations, which were:

- *"A little because of the robot voices"*
- *"sometimes yes"*
- *"Only in the sense that the robotic voice acting made the dialogue hard to interperate"*

4 of the participants thought that the plot was confusing, while 16 thought that it was not. A representation can be seen in Figure 9.12.

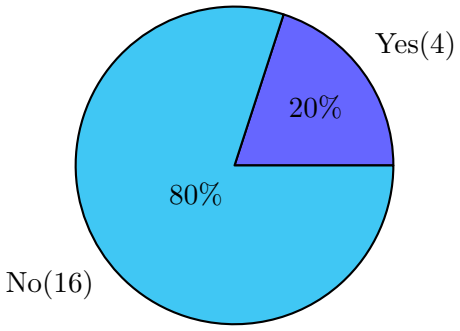


Figure 9.12: A pie chart of the distribution for the question: Was the plot confusing?

About the spatial construction 6 participants answered that it was confusing, while 12 thought it was not. 2 of the participants answered Other and gave short explanations, which were *"it is ok but maybe to much details in the background"* and the other said *"It took some time to adjust to the surroundings but it was not continuously confusing"*. 6 of the participants also had general comments to the test itself, and these were as following:

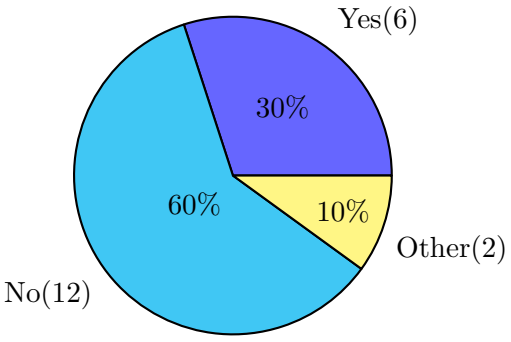


Figure 9.13: A pie chart of the distribution for the question: Was the spatial construction confusing?

"I was focusing way more on the colors and movements rather than the dialogue"

"A lot of attention took the plot itself and form of robots, not the surroundings. For example I did not remembered any of the furniture except for table."

"Had a really hard time understanding what the robots were saying some times."

"i suck at drawing."
"i suck at remembering."
"I remembered where i seen the scene while i was describing it."
A representation can be seen in Figure 9.13.

9.4.2.1 Results of Drawings

Two examples of how the points of the drawings can be calculated can be seen in Figure 9.14 and Figure 9.15.

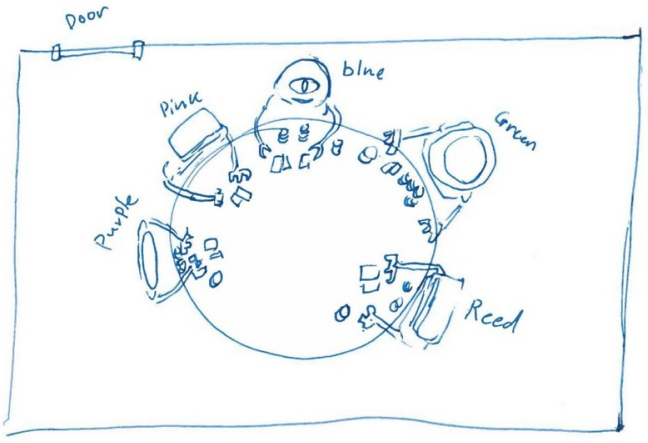


Figure 9.14: Example drawing

Figure 9.14 shows a discontinuity drawn scene. The scene got a grade of 21,75. This score reached by the following calculation: 3 points for a missing character. Blue needs to be moved 3 spots, red 1 spot, green 2 spots, pink 1 spot and purple 2 spots. The windows, stove and painting is missing, this gives 2 points each. The table is placed within the two circles and therefore gives 2 points, the glasses are placed wrong and give 1.5 points and the box is missing, which is 0.25 points. This sums up to 21,75 in total.

Figure 9.15 shows a continuity scene. It got the grade 16,75. The grade was given with the following calculation: 3 points for a missing character, pink needs to be moved 2 spots, yellow 2 spots and blue 2 spots. The window, door and stove are missing, which is 2 points each. The glasses are placed wrong and the box is missing. This sums up to a total of 16,75.

As explained in Chapter 6.3 Test a t test will be made on some of the results from the final test. After going through the drawings and grading them it was possible to get a specific grading for each drawing. In Table 9.3 the summary of the results can be seen.

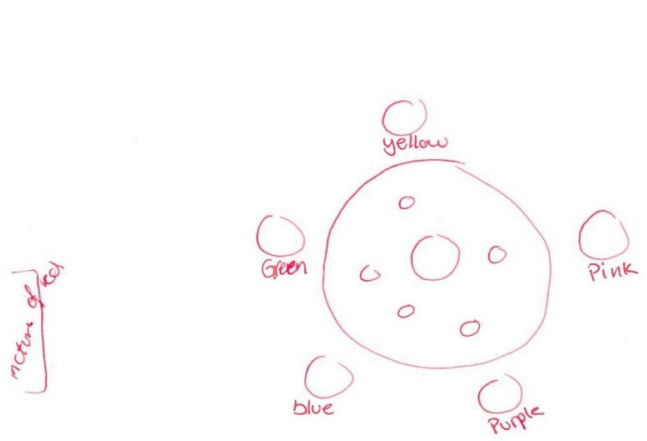


Figure 9.15: Example drawing

	Discontinuity	Continuity
Median	23.25	22.25
Average	23.575	21.2
Min	14.75	8.75
Max	29.25	32.75

Table 9.3: Overview of the discontinuity and continuity grades

Taking the grade for the drawings from the discontinuity edited scene (later referred to as the discontinuity grade) and the continuity edited scene (continuity grade) and plotting them into Matlab using the ttest2 [Mathworks] command[1], it returns the following results:

$$h = 0$$

$$df = 38$$

h will always return to be either 0 or 1. This number indicates whether it is possible to reject the null hypothesis or not (see Chapter 6.3 Test for the null hypothesis for this project). With an h value of 0, it means that the null hypothesis at the 0.05 (5%) significance level needs to be accepted. df is the Degree of Freedom, which means the number of samples in each group (n) minus 1. Since there are 20 samples in each group ($n = 20$) the degree of freedom for each group is $df = 20 - 1 = 19$. Since there are two groups that means the degree of freedom is $19 * 2 = 38$. The result then leads to the fact that the null hypothesis failed to be rejected, hence there is no statistical significant

[1]The ttest2 does a two-sample t test on two vectors.

difference between the perception of the spatial construction of the two pre-rendered scenes, according to the grading of the drawings.

9.5 Results Discussion

The results gathered during the test conduction have led to conclusions and assumptions, which will be presented below. Since the test participants all belong to a small sample group, consisting of students within Aalborg University, can the conclusions not be used to generalize upon them. The results do therefore not reflect the opinions and reactions to continuously- and discontinuously-edited scenes of people in general. When looking at the participants ages, which can be seen in Figure 9.16 and the normal distribution of the ages, it can be noticed that the ages are not very different and can be considered that both groups of participants had similar age groups. All the data will therefore be generalized on both male and female students from Aalborg University with ages varying from 20 to 34.

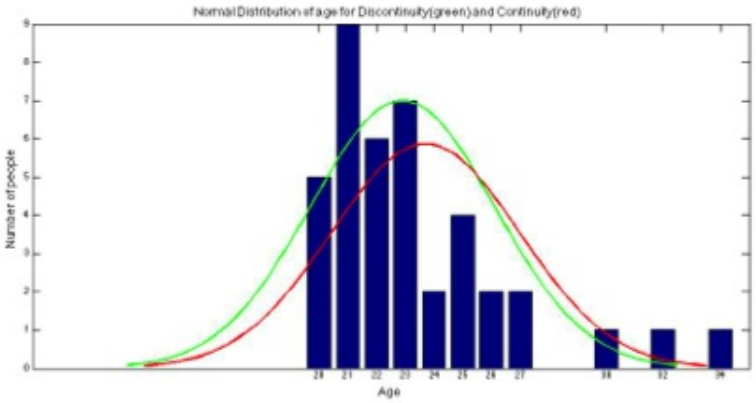


Figure 9.16: Illustrating the distribution of participant ages. The blue bars are both for the continuous and discontinuous, with the green line being the normal distribution of the discontinuous participants and the red line for the continuous.

The first question, asked right after the participant had finished drawing the construction of the scene, was how many characters they remembered seeing in the scene. When looking at the results from the questionnaire and comparing them with the participants drawings, there are numerous participants who said they saw x amount of characters, but drew y amount in the drawing. In the continuously edited scene, there were three participants who said a different number than the one they drew, while in the discontinuously edited scene triple the amount of participants that did so in the previous one. All these 9 participants either said one number lower than what they drew or a number higher. When looking at these numbers, however, no consistency can be noticed. There are at least 3 people who said there are 4 characters, but when looking at their drawings they drew 5. On the other hand there are three other participants who said they saw 5 characters, but drew 4. This inconsistent pattern cannot be used to conclude

upon these results, however, certain assumptions can be made. One of the assumptions is that some of the participants might have misunderstood the question, which was asking them how many characters there were in the scene, however, they might have also thought that they were being asked this again, in order to see the difference between what they drew and what they actually remember from the scene, therefore some of them might not have looked at the drawings to count the characters they drew. It can also be that they thought the scene over again and 12 of the participants realized that there were actually a character less or more, than what they originally thought.

There are a few participants, who believed they saw 7 or 8 characters when watching the continuously edited scene, while the maximum amount of characters the participants believed to see in the discontinuous edited scene were 6. The majority of the participants (12 participants), who watched the continuous edited scene, answered the correct answer of 6 characters being in the scene, while in the discontinuous edited scene the majority (10 participants) answered that they saw 5. From this, it can be assumed that the constant cutting and change of camera position influenced the participants perception on the amount of characters. It might also occur because of the amount of characters distributed in each shot, when comparing the two edited scenes. When looking at the results from the two questionnaires, however, it can also be noticed that at least 5 participants from the discontinuous edited scene and 7 in the continuous edited scene said they recognized the scene from Friends. This can cause a bias when thinking they might have remembered the spatial construction and the amount of characters in the scene, therefore it enforces the invalidity of the characters numbers responses of the participants.

When looking at the results from both the discontinuous and continuous edited scenes, it can be seen that the majority of the participants in both tests believe that the dialogue was confusing. This means that the robot voices were difficult to follow or maybe the dialogue was confusing because it was quite foreign, since it was making rather American jokes and references. That they found the dialogue confusing could have interfered with the results of the summary and the spatial construction, as they could have been focusing too much on the dialogue and could not pay attention to much else, such as where the characters are being. On the other hand, when looking at the question asking whether they had found the plot confusing, over half of the participants in both experiments said that they did not find the plot confusing, which could mean that the voices of the robots might have had a higher impact on the dialogue being confusing rather than the Americanized jokes. For example when Blue (Chandler) jokes about settling the *"Jamestown colony of Virginia"*.

A peculiar thing happens when looking at the results from the continuous edited scene and the question, which referred to the spatial construction being confusing, since 9 participants believed it was confusing, while only 6 participant from the discontinuously edited scene believed it was confusing. Therefore, 7 believed it was not confusing in the continuous while 12 from the discontinuous believe it was not, this opposite change,

Participant no.	Score for drawings	Summary answer
8c	8.75	Correct
1c	9.75	Wrong
2c	32.25	Correct
4c	32.75	Partial correct
3d	14.75	Correct
4d	17.75	Partial correct
50d	29.25	Correct
14d	28.75	Partial correct

Table 9.4: This table show the two highest and the two lowest scores for the two variables based on drawings and summaries

small, but still a change, could mean that participants had an easier time following the spatial construction in the discontinuous edited scene. However, a t test was made to see whether the change was statistically significant and it was discovered that the difference cannot be considered statistically significant, therefore the change cannot be used to conclude upon (see Chapter 9.4.2.1 Results of Drawings).

9.5.1 Drawings vs. Summaries

When looking at the drawings and given grades (see Chapter 9.4.2.1 Results of Drawings) it is clear that no one understood the spatial construction completely. The lowest score was given to participant 8c which had a score on 8.75; it should be reminded that a low score is in this case a positive thing and that the letter after the participant number represents the variable they tested, so in this case 8c watched the continuous edited scene, while any number with the letter d is related to the discontinuous edited scene. For this section eight examples will be used, four for each variable; the two highest and the two lowest for each variable.

Looking at Table 9.4 it can be seen that the lowest and the highest scores both belongs to the continuous variable. It can be assumed that the participants might have focused on different things in the scene; some have focused on the plot while others the room. This assumption could also explain why 1c would have a very low score, but a wrong summary. If said participant has focused on the room and the characters compared to the dialog and action in the room, it is assumed that the spatial construction is easier to understand compared to the plot. The same goes for 2c having a very high score for the drawing, meaning that this participant did not remember or simply could not understand the spatial construction. 2c did, however, get the summary correct, which could have been the focus point for this participant.

Moving on to the discontinuous variable; once again looking at Table 9.4 none of the four participants answered wrong in the summary. Participant 50d is one of the participants who got the summary completely correct, and it could be assumed that it was due to the same as in the case of 2c. 3d on the other hand had the lowest score for

the drawings for the discontinuously edited scene and the summary correct, however, even with the lowest score for the discontinuous variable with a score of 14.75 is not as low as the lowest score for the continuous variable with a score of 8.75. Nothing can, however, be assumed about this, since it is also the continuous variable, which has the highest score. 14d has the second highest score and the summary partial correct, so here the memory might have troubled the participants when answering the questionnaire, as it could have for many of the other participants as well. The last one is 4d with the second lowest score, which is still a high score on 17.25 compared to the lowest one on 8.75. 4d has the summary partial correct so it can be assumed that this participant had the same troubles as participant 14d.

9.5.2 Biases

When performing a test, you are almost bound to also have to deal with some biases. In this section the biases for the test will therefore be presented, this includes biases from the animation itself and biases from the test itself.

9.5.2.1 Biases From The Animation Itself

There are a number of biases, which might have influenced the test, when talking about the animation itself. It is these biases that will be presented and discussed in this section, and it includes the number of cuts in the two scenes and shadows.

9.5.2.1.1 Number Of Cuts In The Two Scenes As it can be seen by the storyboards for the continuous edited scene and the discontinuous scene (see the storyboards on the CD) the number of cuts differ. This also means that it is possible that the different characters are not shown in the same amount of times and is not shown on the screen in the same amount of time in each of the scenes. This can create a bias as the test participants then might not be able to see where one or multiple of the characters are placed according to the other characters, the objects and the room itself. This is also supported by the fact that the framing of each cut also differs, meaning that some of the characters are not shown in the same amount of times together with one of the characters sitting next to that specific character in each scene, which was discovered to be an important way of framing (see Chapter 6.2.3 Dinner table Conundrum). An example of this is the case of Red (Joey), which is shown together with one of the other characters in the continuously edited scene, but is always shown as the only character in the frame in the discontinuously edited scene. This makes it more difficult for the test participants to construct the space and see where the characters are placed according to each other, which were one of the ways the test participants could avoid getting a high grade in the drawings of the spatial construction of the scene.

This leads us to another bias, as it was discovered that the two different edited animations not only show the different props and objects in a different amount of times similar to with the characters two objects are only shown in each their scene. Both times

it is the lamps. In the continuously edited scene is the lamp above the table shown, but it is never shown in the discontinuously edited scene, while in the discontinuously edited scene the lamp near one of the walls is shown, but it is never shown in the continuously edited scene. This made it rather difficult to grade the drawings, as with the lamp over the table it is only showed once, but it is shown as the main object hence it should be in the point of attention at the viewer it is much more visible than when the other lamp is shown in the discontinuously edited scene. Besides from the two lamps then there is also an object, which were in the scene, but it was never shown; the carpet. This was simply not counted in as a thing, which could give points, when the test participants had to make the drawings of the spatial construction.

9.5.2.1.2 Shadows Even though shadows as such is not mentioned to be one of the important aspects when it comes to the perception of space in either the human perception or on screen (see Chapter 6.2.2.1 Perception of Space), except for the tonal range, it is still believed that the shadows in the animations might have had an impact on the results. In the scenes, the kitchen counters did not cast any shadows, meaning that the light sources in the scene did not *"see"* the kitchen, which might have changed the test participants perception of where the kitchen was placed in the room, as it might have made it difficult for them to see that the counters were in fact placed a bit away from the end wall, see Figure 9.17.

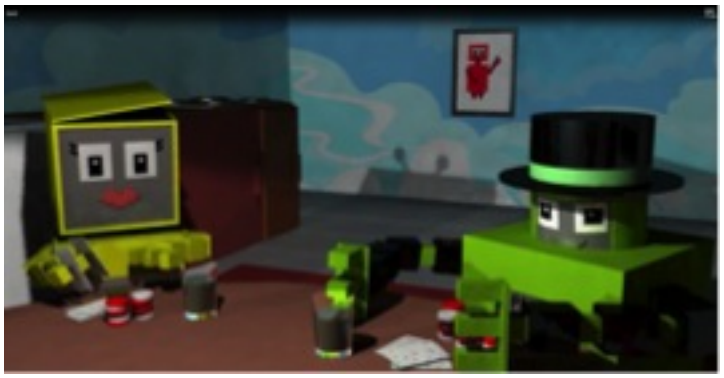


Figure 9.17: shows a frame from the continuously edited scene, where it can be seen that the kitchen counters does not cast any shadows at all.

In the same way it is possible that the shadow from the plate, which is the only cast shadow from that area, might have changed the test participants perception of the spatial construction of the room, see Figure 9.18.

9.5.3 Biases From The Test Itself

This section will contain a discussion of the possible biases from the test itself, which includes biases related to the drawing guidelines and to telling the participants the character names.

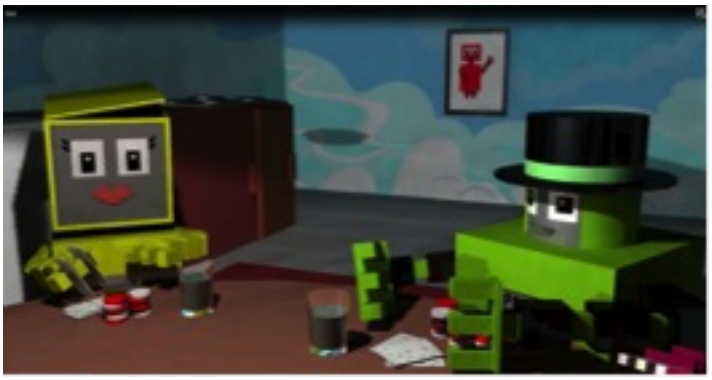


Figure 9.18: shows a frame of the continuously edited scene, where the shadow of the plate is the only thing casting a shadow in the wall.

9.5.3.1 Character Names

When the test was conducted, only some of the test participants were told that the characters' names were equivalent to their color. This could have possibly impacted the results, as the participants who were not aware of this could have been potentially more confused about the story as the scene started.

9.5.3.2 The Drawing Guidelines

Because of restrictions with the used program for the questionnaire (Google Docs), it was necessary to include the specific guidelines for how it was desired that the test participants made the drawings of the spatial construction of the room (the guidelines can be found on the CD). Not only is it possible that this paper, together with the blank paper there were present for them to draw upon could have influenced the participants, as they then might have had an idea of that they needed to draw something later, the guidelines could have not always been read properly. This mean that some participants understood and made the drawing exactly as they were supposed to, while others might not have read them properly or understood them correct, meaning that they did not make the drawing entirely as they were supposed to do. It is however, not known how to make sure that everyone read the guidelines properly, as the test conductors already made the test participants aware of the guidelines when they were presented to the questionnaire in the conducted test.

9.5.3.3 The Grading Of The Drawings

There were only one person on the grading of the drawings because of the resource management goal at that point was trying to work with as many tasks as possible, and the person believed it could be done alone, which the group agreed upon. We believe the reason of the error in the grading lies as a human mistake, possibly that they had been gone through too fast. Our reason behind this is that when the person who graded

the drawings tried to grade one of them again, the result was different than the original grading.

9.6 Sub Conclusion

From the conducted test it can be concluded that the participants perception of the spatial construction of the pre-rendered animated dinner table scene did not differ significantly depending on whether the participants watched the continuously edited version or the discontinuously edited (see Chapter 9.4.2.1 Results of Drawings). It should be noted, however, that this is only the case of discontinuity by crossing the 180° line and when there are no full shots, which would give an overview of the space, in either version of the scene. It is also only for this particular sample group students at Aalborg University, Copenhagen, in the age range from 20 to 34 (see Chapter 9.4 Test Results) that it can be concluded that they see the spatial construction of the different scenes as being the same. It should, however, be taken into consideration that there are some biases related to the test (see Chapter 9.5.2 Biases) which means that this information might only point in the direction of crossing the 180 degree line do not influence the viewers perception of the spatial construction. Especially because it would be needed to test on more people in different age ranges from different places, so the test participants are not only coming from a single location, as it was in this test (see Chapter 9.4 Test Results).

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Chapter 10

Discussion

This chapter will touch upon the encountered flaws and the solutions, which should have been taken into consideration, in order to avoid a majority of the biases (see Chapter 9.5.2 Biases). General comments on the test approach, research made and their usage and implementation will also be in focus and discussed thoroughly.

Has the research been sufficient?

An overall point for the research made throughout the report is to have a better focus on using the researched theory and information. By focusing more on the theory, it would have been possible to create a better animation with better cuts and a steadier crossing of the 180° system.

One of the theory sections, which could have used a lot more focus, is the *"Dinner table conundrum"* (see Chapter 6.2.3 Dinner Table Conundrum). Focusing on this section would have given a better input on how to film the characters sitting at the table and therefore create smoother cuts and a less confusing editing. The topics *"Narratives"* (see Appendix D Narratives) and *"Storytelling"* (see Chapter 4.2 Storytelling)provided us with certain rules and guidelines to create stories, which could have improved the animations considerably. It probably would have been a better approach to create or find a story, which follows the narrative and storytelling rules and therefore avoid confusing the participants about the plot happening on screen. Another approach to make the animations better with a less confusing plot and story could have been by improving the chosen table scene e.g. by adding a more understandable beginning and end to the plot and use a certain storytelling form and create flow in the story. Thereby it would be possible to have a beginning and end, which led the viewer know why the characters met up, why they are playing poker and clearly state what is happening in the end. For example; Introduce each characters and plot in the beginning and end the scene clearly, so the viewers know that the scene is in fact done. This way it might avoid some confusion and shift some of the participants focus onto what is happening in the scene.

Ideally it would have been beneficial to have used the theoretical points gathered in the *"Three point lighting"* (see Chapter 7.6.2 Three Point Lighting) and *"Light in animation film"* (see Chapter 7.6.3 Difference Of Light In Animation Films) sections more than it was the case. The knowledge gathered in these sections would help improving

the setup of the light inside the animations. Characters in movie scenes are often lit by three point lighting, however, when doing animations, achieving such settings requires a lot more time, both when creating the scene and when rendering it. It was therefore an active choice not to add all the theoretical points about lights into the scene, in order to remove some of the rendering time.

The rule of six should have been used more, when editing the scene, instead of just copying where the cuts were in the original Friends scene; could the editing in the original, continuously edited scene have been improved? Using the rule of six more would had made sure that all cuts would keep be true to at least the emotion of the moment in each shot and it would also have followed the story better, making the editing more smooth and hopefully less noticeable. This might then lead to a better understanding of the plot and less participants being confused. Another bias related to the cuts in the animations could have been caused by the uneven cuts within the two edited scenes (see Chapter 9.5.2 Biases). This could have been fixed by focusing a lot more on trying to create an equal amount of cuts in the two scenes and perhaps try to cut at the same time within both animations.

Were the design and implementation phases optimal?

When designing and implementing the two pre-rendered animated scenes it would have been a better approach to focus more on when the cuts should be made and how the camera should be set in each shot of the animation by keeping the emotion, story and rhythm of the shots (see Chapter 6.2.2.2 Editing; When To Cut - The Rule of Six) in mind. The same could be applied to the light effects and the story of the scene. Certain decisions in the design could, however, have been different and thus lead to a different result when creating the animation. Such decisions should have been the length of the scene, which could have influenced the perception of the spatial construction. If the animation had been longer, the participants might not have needed to rely as much on their memory when they were asked to draw the spatial construction of the scene, all done from their memory of the scene. An average length of the animation and a captivating story would then allow them to mentally create the space around the characters in the story. This is, however, not something we know for sure. It would therefore ideally have been best to create multiple animations with multiple different lengths, which could then be tested and see whether the length of the scene had any effect on the participants perception of the spatial construction. Would they remember more of the space in the scene after seeing it for a longer time? Or would they remember more after seeing it for an even shorter amount of time, than it was shown in the conducted test?

Even though the length of the animation could have been chosen differently, we believe that the spatial construction of the scene was optimal, however, not just having characters, but also small props, objects and colorful patterns, makes the room seem welcoming and less uncanny. The design and implementation is considered to have mostly fulfilled our expectations, we believe this design did not affect the participants

perception of the spatial construction and the use of different colors for robot should have helped the participants see major differences between the characters on screen. Another flaw, which could have been fixed by doing a better design and implementation, are the characters voices. The fact that the voices and the dialogue itself required a lot of focus, in order to be understood properly (see Chapter 9.5.2 Biases) could have created a rather big bias when testing the spatial construction, as the participants had too much attention on the dialogue. Many of the test participants also stated that they found the dialogue confusing or difficult to follow due to the voices used (see Chapter 9.4 Test Results). An ideal approach would therefore have been to use professional voice actors instead of robotic computer voices. In order to use professional actors it would require more resources and more time would have been necessary.

Besides the dialogue and the plot of the created scene, the animations seem to be aesthetically-wise optimal when it comes to the models, animating them and the spatial construction of the scene. Considering the time and effort put into creating these animations, we feel that we managed to make solid animations, which fulfilled the expectations set by ourselves in the beginning. Even though the lowest acceptable rendering settings were used for the animations, we consider the animations to have acceptable quality and resolution. We could have focused on getting the animations done earlier, for example we could have ended the preparations two weeks before, which means more time for rendering would have been available. Therefore, slightly better rendering would have been available as well, however not the highest, since such settings would require a lot more rendering time to make the lights, effects, resolution and quality of the scene considerably better. Throughout the implementation, certain solutions were used to create the robots. For example when coloring the robots, each face was selected and assigned a certain color to it, instead could an UV map of the robots have been created and add textures to them. We did not see it necessary to create UV maps or focus on better textures when it did not play an important role thinking of the spatial construction of the scene. The time, which would have been used on the better coloring techniques, was instead spent on creating the animations, which caused quite some troubles and we were glad, we had the time to fix the issues and finish the animations. The animation of the mouths could have used more attention, so the mouths could have more expressiveness when the characters are talking. Right now the only thing, which indicates that the characters are talking, is the mouth lighting up (flashing) to indicate that they are speaking. When considering the time we had to create these animations, and the fact that the expressiveness of the mouth does not influence the spatial construction of the scene, we consider this effect fairly suitable for the animation.

Was the testing approach optimal?

In order to get better results to conclude upon in the test and the overall report, a better testing approach should have been adopted. A higher amount of participants might have helped to increase or decrease the difference in the results gathered between the two edited animations, however, in order to increase the validity and remove most of

the biases presented in the test discussion (see Chapter 9.5 Results Discussion), changes to the test should have been considered. Such changes could have been to use more ways to measure the results, such as eye tracking (see Chapter 6.3.2.1 Eye Tracking) and therefore also focus more on improving the animations in a way that we would guide the viewers eyes to the objects, characters and props.

Another approach could have been to improve the drawing task guidance and information the participants would be given. It was noticed that many of the participants seemed to not have paid attention to the guidelines of what to include in the drawing of the spatial construction presented to them on paper, or that they maybe did not understand them correctly or simply could not remember the spatial construction of the scene, and therefore ended up giving incomplete drawings or drawings that were not possible to grade as intended (see Chapter 9.5.2 Biases). A fix could have been to having the test conductors to guide the users by giving them a verbal explanation of how they should approach the drawing and also let them have the drawing guidelines written on paper, which would then increase their attention to the details, and give the participants more opportunity to ask, if there was something they did not understand, as it might be easier for some participants to ask when the conductor is already talking with them.

In order to remove some of the reliance on memory, a list of objects to be placed in the drawing could have been given to each participant. They would thereby only have to place the objects in the drawing and not focus on remembering what they have seen, only where they have seen them. This, however, would mean that they would be told what the construction of the scene included and might mean we would force them to place objects they did not notice in the scene and end up putting them randomly around the scene.

The grading system of the summaries was divided into three degrees: wrong, partially correct, and correct. A system with more details and guidelines could have been made as it was for the drawings, instead of it being subjectively graded by us. Having a more detailed grading system for drawings could have resulted in different results and possibly more specific.

As stated in the test chapter under bias (see Chapter 9.5.2 Biases), it is not believed that the grading system itself were the fault, but a human error. We created the grading system of the drawings to turn the answers into a numerical form, which we could make statistical use of. The instructions for the grading should in our opinion be clear enough to follow and let multiple people grade, instead of only one person, and still not be affected by the factor of unclear instructions.

Another approach to the drawing task could have been by creating a sort of paper where the participants would have to place objects on a paper which represented the scene, where they believe they have seen them.

Going with the original approach or the *"place the object"* approach, either could have been done by letting a computer grade the drawings at the end by calculating how

many objects were placed properly and how many were off by how much, as this would minimize the possibility of human error.

We created the grading system of the drawings to turn the answers into a numerical form, which we could make statistical use of. The instructions for the grading should in our opinion be clear enough to follow and let multiple people grade, instead of only one person, and still not be affected by the factor of unclear instructions.

There were only one person on the grading of the drawings because of the resource management goal at that point was trying to work with as many tasks as possible, and the person believed it could be done alone, which the group agreed upon. We believe the reason of the error in the grading lies as a human mistake, possibly that they had been gone through too fast. Our reason behind this is that when the person who graded the drawings tried to grade one of them again, the result was different than the original grading.

The goal for this project is to make a true experiment, but the conduction of said experiment often ends up not being able to fulfill the requirements. The same happened in this case, since multiple biases were detected (see Chapter 6.3.1 True Experiment).

It can be concluded that this experiment was not a true experiment, since not all of the requirements were met. The first point was achieved, since a hypothesis was tested and we have reached the conclusion that we failed to reject our null hypothesis. The data was analyzed using a statistical significance test, as a t test was used (see Chapter 9.4.2.1 Results of Drawings), hence the fourth requirement was also met. The test was also designed and conducted in the hope of avoiding biases, which the fifth requirement is all about, but multiple biases was still encountered, meaning that this requirement was not fulfilled to a satisfactory degree. Since the test took place on a single location and only during two days in the same hours, it is not possible to know for sure if the test fulfill the sixth requirement, and the test is therefore not considered a true experiment.

Did we fulfill our final problem statement?

What is the difference in perceived spatial construction of a movie scene represented by two versions of an animated pre-rendered short story: one created by keeping the 180° line and one by breaking it?

Overall, the way the animations were tested is considered to not have been a proper enough approach and therefore we encountered numerous biases, which were discussed in the the test results (see Chapter 9.4 Test Results), we therefore believe that we did not fulfill our Final Problem Statement and cannot be concluded upon. If we, however, assume that the results and test approach were valid, we can generalize a conclusion based on the results, which says there is no significant statistical difference between the two edited animations. This would mean that by keeping the 180 degree line or by crossing it each cut will not show signs of differences in students, aged between 20 and 36, perception of the spatial construction.

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Chapter 11

Conclusion

This chapter contains a sum up of the overall progress of the report. Firstly, what the different chapters added to this particular project will be concluded. Afterwards, the results gathered in the test will be concluded upon. The methods chapter gave a deeper understanding of the theoretical parts relating to the final problem statement, which was to design the pre-rendered animation scene. It was also the methods chapter, which gave the requirements for which type of scene was to be chosen. The methods and approach for testing was also decided and improved in this chapter through a midterm test.

In the design, the scene was chosen to be a poker scene from the TV-show *"Friends"*. The characters in the scene were chosen to be made as robots, in order to avoid the uncanny valley, and they were designed with inspiration from the original characters from *"Friends"* giving them individual features. Every cut was also planned in the design and documented in the form of two storyboards; one for each variable. The design included theory about sound and light in movies, and this theory was considered relevant knowledge when implementing the scene and animating it. The decisions made for sound and light in the design were, however, changed as it states in the design limitations due to limited time and with the belief that it would not have a negative effect on the spatial construction of the scene.

During the implementation most time was used on the animation itself and the editing, since that was the focus point of the FPS. The modeling of the room and the characters were rather simple, in order to make it easy to distinguish the objects, characters and props from each other, and thus trying to make it easier to understand the spatial construction. The animation was edited both using discontinuous spatial editing and using spatial continuous editing, in order to test the two variables. The test was a between group experiment. The participants were selected using convenience sampling and each of the participants was assigned randomly to each variable (either the continuously edited scene or the discontinuous edited scene).

The data was gathered using both quantitative and qualitative methods. The single qualitative question was the drawing question, and it was made into quantitative data, because of the grades, the drawings were given. The test showed that it was not possible to reject the null hypothesis, since there was no significant change between the two

variables, hence there was no significant difference between the spatial construction perceived by the test participants when watching either the discontinuously edited scene or the continuously edited scene. It was argued that this result might be due to the test conditions not being sufficient enough. This could possibly be because of the many biases, which was encountered. Many of the biases are related to the conduction of the test and especially to one question from the questionnaire asking the participants to draw the spatial construction of the animated scene. Even though guidelines with specific points to follow was given to the participants, they did not manage to fulfill these requirements in all cases, resulting in poorly made drawings with a high score meaning that there were many mistakes in the drawings.

It was also discussed if the gathered theory could have been used more efficiently, and hence make the final result more pleasing. The fact that the participants were from Aalborg University, Copenhagen, was a part of making the results less valid/reliable, however, this was a conscious choice, since it was due to convenience. This means, though, that the results can only *suggest* that there is no difference in the perceived spatial construction when it comes to editing movies by either keeping the 180 degree line (continuous spatial editing) or by crossing it (discontinuous spatial editing), and that this suggestion only applies to students at Aalborg University, Copenhagen, in the age range 20-34. It would be needed to change the test and test on more people, in order to come with more than a suggestion.

Appendix A

Mise-en-Scène

Mise-en-scène is needed to know how to set up the scene and the frame of the scene, in order to be able to design the scene and every frame. This is what mise-en-scène is about; what is in the shot. This is regardless of the spatial editing techniques and is therefore under the constant variables. The term mise-en-scène derives from French, where it means *"putting into the scene"* [Bordwell and Thompson, 2013b, p. 118] but just as opposed to how simply it sounds there are a lot more to mise-en-scène than that.

A.1 What Is Mise-En-Scène?

Mise-en-scène is present in every frame of every movie ever made and is simply put everything that is present in the frame. It is categorized into four aspects, which the following subsections will cover; the four aspects are setting, costumes and makeup, lighting, and staging.

When a movie is created, the filmmaker wants to guide where the viewers attention is within the frame, in order for the audience to see the important parts of the frame, so that the viewer will see what is important for what is going on in the scene. It is also wanted to make the viewer interested through curiosity and suspense. Filmmakers usually try to create an emotional affection to go with what is happening in the scene, and mise-en-scène helps in doing this. [Bordwell and Thompson, 2013b, p. 147].

A.1.1 Setting

Setting is where the action in the frame takes place, but it can do more than that: it can be a part of the narrative action, and the design of the setting can help shape how the viewer understands the action of the story [Bordwell and Thompson, 2013b, p. 121-123]. The setting can also *"overwhelm the actors [...] or it can be reduced to almost nothing"* [Bordwell and Thompson, 2013c, p. 115].

A.1.2 Costumes and Makeup

There is a huge range of possibilities when it comes to costumes and makeup and it can similar to the setting have a specific function in the film. Costumes are often used to create the desired mood for both the viewer and the actor, when they perform on the screen. The given costumes can also be used for their graphical qualities; e.g. for their color or look. Costumes *"can play important motivic and casual roles in narratives."* [Bordwell and Thompson, 2013b, p. 125].

Makeup has from the beginning been a part of the filmmaking; in the beginning it was because the actors faces else would not have been shown properly in the early films, and up until present days it is still widely used to enhance or even change the actors appearance. [Bordwell and Thompson, 2013b, p. 128].

A.1.3 Lighting

Light helps the filmmaker to guide the viewers attention within the frame. When there is a place in the scene, which is brightly lit it draws the viewers eyes, while shadows instead can hide details or help to build up suspense. In fact, shadows is a very important aspect of lighting and they *"help create our sense of a scenes space"* [Bordwell and Thompson, 2013b, p. 131]. Joseph von Sternberg, said to be one of the masters of lighting, do according to Bordwell and Thompson say that *"The proper use of light can embellish and dramatize every object."* [Bordwell and Thompson, 2013b, p. 131]. [Bordwell and Thompson, 2013b, p. 131].

When talking about lighting, one is bound to also talk about the shadows created by the lack of lighting. There are two kinds of shadows, when talking about movies:

1. Attached shadows also called shading is when there is a part of an object, prop, actor or setting, which is not illuminated by the light, simply because the lighting cannot reach that part.

2. Cast shadows is when an object, prop or actor casts or projects a shadow on another surface, for example a wall.

[Bordwell and Thompson, 2013b, p. 131]

Now that the shadows have been covered, let us move to the actual subject; the lighting. When talking about light, there are four different features, which is used to describe the light:

1. **Quality**: is the intensity of the light itself and indicates whether a light is soft or hard.[1]

2. **Direction**: is the track of the lightsource to the objects that it illuminates.

[1] A soft light creates soft shadows with undefined edges, while a hard light as e.g. the sun creates hard shadows with defined edges. Often is a light somewhere in between. [Bordwell and Thompson, 2013b, p. 132]

3. **Source**: is where the light emits from.

4. **Color**: is the color of the light. Often is there distinguished between warm (red, orange, yellow) and cool (blue, pink, green) colors.

[Bordwell and Thompson, 2013b, p. 132]

Light can be set in various places in order to lit the objects, props, setting and actors in the desired way. The most common ways of lighting is by having either frontal light, backlighting, top lighting or a side light. But in order to achieve the desired look is there often multiple lights, consisting of one or multiple key lights and fill lights. As the names suggest is a key light the main light, which illuminates the subject, while the fill light fills in where needed and is less intense than the keylight. These lights are often combined In various ways, though one of the most widely used ways of illuminating the subject in Hollywood is by using the three-point lighting, which uses a key light, fill light and a backlight. Often in Hollywood is a light setup such as the three point lighting set up for every camera position. This is to create the desired lighting in all shots, so all composition are clear, even though that is not particularly realistic. [Bordwell and Thompson, 2013b, p. 132-135].

When creating mise-en-scène lighting can be used to create both high-key lighting and low key lighting. High key lighting is when there is a low contrast between the bight and darker areas of the frame and most often it is soft light, which has been used. High key lighting can be used in order to give the viewer an idea about the time of day. Low key lighting on the other hand is when there is a much higher contrast between the light and dark areas in the frame and in this case is the shadows often both sharper and darker, since hard light is normally used. Low key lighting can also create an effect called chiaroscuro, which is when there are *"extremely dark and light regions within the image"* [Bordwell and Thompson, 2013b, p. 136]. It is to be said, however, that most often is the light set somewhere in between the two extremes; high and low key lighting. [Bordwell and Thompson, 2013b, p. 136].

A last remark about lighting is that the hue the color of the light can be changed, it is most often, though, desired to have as pure a light as possible shown in the frame. Sometimes the light is given e.g. an orange tint when there is candlelight in the scene or completely altered in order to create a certain mood within the film. [Bordwell and Thompson, 2013b, p. 136].

A.1.4 Staging

Staging is when the director can control the behavior of the figures in the mise-en-scène (in the frame). This gives the figures the possibility to convey both emotions and thoughts [Bordwell and Thompson, 2013b, p. 138].

When these figures the actors perform, they use both their bodies (the actors performance and their position within the frame) and their voices, which mean that the acting consists of visual elements and sound, though, acting can also consist of only one

of the two. Mise-en-scène is often judged by its realism, but the view upon the acting being realistic or not change through time. According to Bordwell and Thompson we should instead *"try to understand what kind of acting style the film is aiming at. If the functions of acting in the film are best served by a nonrealistic performance, that is the kind that the skillful actor will strive to present."* [Bordwell and Thompson, 2013b, p. 140]. [Bordwell and Thompson, 2013b, p. 139-140].

A.1.5 Mise-en-Scène In Space And Time

As mentioned in Appendix A.1 What Is Mise-En-Scène, the purpose of mise-en-scène is to guide the viewers attention to the important parts in the frame, build up interest, suspense and give feelings to the movie itself. This is done by using all of the four aspects of mise-en-scène in both the space of the frame and in the time of the shot, the scene and the whole movie. [Bordwell and Thompson, 2013b, p. 147].

A.1.6 Space

Often, the filmmaker desires to spread out the point of interest in the frame, so that there are multiple points of interest spread out evenly, though in general it is assumed that the viewer naturally will have most attention to the upper half of the frame, where they often find the characters faces. This means that it is often wanted to balance the elements in the frame, though sometimes it can even be desired to have an unbalanced shot instead, in order to e.g. let the viewer know that there will most likely soon be something in the frame, which changes position. [Bordwell and Thompson, 2013b, p. 148-149].

Figure A.1 shows an unbalanced shot from The Dying Swan [Bauer, 1916]. The character is placed in the right side of the frame with nothing to balance out the shot in the left side of the frame [Bordwell and Thompson, 2013c, p. 144].

Figure A.1: An unbalanced shot from The Dying Swan. [Bordwell and Thompson, 2013c, p. 144]

Figure A.2 shows a balanced shot from The Dying Swan [Bauer, 1916]. A man has entered the room and now balances the shot as he stands in the left side of the frame.

Even though a frame is two dimensional, humans naturally perceive the frame as being three dimensional; this is due to the depth cues in the frame. The depth cues

Figure A.2: A balanced shot from The Dying Swan [Bordwell and Thompson, 2013c, p. 144]

are created by using the aspects of mise-en-scène and these indicate the volume (the shape, the movement and the shading) of a given element and show the distinct planes (foreground, middle ground and background) in the frame [Bordwell and Thompson, 2013b, p. 151-152].

A.1.7 Time

When talking about mise-en-scène it is of obvious reasons not only controlled by the director what is shown in the frame, but also for how long. It is here that time comes into the picture. When watching a film the viewer tries to scan the frames for information. How much information one can scan from a shot depends on the time. A very short shot will force us to take in all the information in the image in very short time, where usually we get a first overall impression, which is then changed as our eye continue to scan the frame [Bordwell and Thompson, 2013b, p. 155+157].

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Appendix B

Cinematography

Cinematography includes many different elements in a film production. This section will shortly go through cinematography, which is divided into the topics found relevant. Cinematography opens up for many decisions and elements needed to be controlled during the recording process. Decisions are needed to be made regarding the camera settings and the frame as soon as something is being filmed. Even when it is just the preset settings for the camera, which is used, it is still a decision involving cinematography. [Bordwell and Thompson, 2013c, p. 160].

B.1 The Photographic Image

Cinematography is influenced a great deal by photography. This includes being able to change the perspective, speed of motion, and the range of tonalities. [Bordwell and Thompson, 2013c, p. 160].

B.1.1 The Range Of Tonalities

The range of tonalities covers both the colors in the frame, and the grey-scale. For this is some specific keywords used, which are:

- **Contrast** is the comparison between darkness and lightness in a frame. This can vary from film to film and image to image. It is a technique, which can be used for both black and white films - working with bright white, clear black, and everything in between - as well as color films where it is the change of hue that matters. Contrast can be used as a guide leading the viewers eye throughout the movie. It can also be used to impact on an emotional level. [Bordwell and Thompson, 2013c, p. 160-162].
- **Exposure** is when the tonalities of the film image are changed; the way to change it relies on the amount of light getting through the camera lens. If too much light gets through it is called overexposed and if it is the other way around, where too little light gets through it is underexposed and the image will hence be darker. [Bordwell and Thompson, 2013c, p. 162-163].

- **Tonality after filming**; it is possible to change the tonality after the filming is done. For this, different solutions are available. These solutions include tinting, which is putting the developed film into dye coloring the light parts of the film, and toning, where the dye is used while developing the film and this colors the dark areas leaving the light areas white or slightly colored. [Bordwell and Thompson, 2013c, p. 163-165].

B.1.2 Speed Of Motion

Speed of movement relies on the control used to create the photographic shown on the screen. The speed of the motions seen on the screen depends on the connection between the rate that it is filmed in and the rate of which it is projected, in both cases the speed is measured in frames per sec. To gain the most truthful movement is by matching the shooting rate with the projection rate. The speed of motion depends on the frames used in the shot per second. [Bordwell and Thompson, 2013c, p. 165].

B.1.3 Perspective

The human eye creates the image of space and the objects in it; the eyes absorb light reflected from the screen, which constructs it. Human vision shows a perspective view of the scene on screen and the spatial relations between the objects on screen. In the case of a photographic camera, the lens do the work that the eye does for humans, represents the size, depth and dimensions of the scene. When doing so is the focal length *"the distance from the center of the lens to the point where light rays converge to a point of focus on the film"* [Bordwell and Thompson, 2013c, p. 169]. When deciding on the depth, size, and proportions it is the focal length, which is changed. There are three main lenses: the short-focal-length, which is the wide angle, the middle-focal-length, which is the medium, and the long-focal-length, which is the telephoto. Besides those three there is also a lens known for zoom which combine the three already mentioned focal-length lenses (see Chapter 6.2.2.1 Perception of Space). [Bordwell and Thompson, 2013c, p. 169-173].

- **Depth of field and focus**; when working with the effect where some parts of the image is in focus, while the rest is unclear; it is once again because of the focal length of the lens. Each lens has its own unique depth of field. Depth of field is represented by the distance from the object to the camera. The objects can be set and be photographed with a sharp focus and at certain exposure setting. [Bordwell and Thompson, 2013c, p. 174-175].

B.1.4 Framing

Getting the perfect frame is something every filmmaker or photographer can relate to, since that is something that needs to be considered every time a picture is taken or a film is made. It is needed to consider what is wanted to have in the picture and to make

sure that nothing is cut off, for example when taking a picture of your uncle Carl; it is preferred that the head is not cut out of the frame. When making these decisions it is the frame, which is being decided upon. [Bordwell and Thompson, 2013c, p. 178].

When deciding upon a frame multiple things need to be thought through including the size and shape of the frame, the onscreen and offscreen space, the vantage point, together with the distance, height, and angle, which is what will be covered in the next sections. [Bordwell and Thompson, 2013c, p. 182].

B.1.4.1 Shape and Dimensions of a Frame

- Aspect ratios are the different combinations of the frame height to the frame width and this can differ in size/values. An example is an aspect ratio of 2:2:1, which is a widescreen, in this case it means that the width is two times the height of the image. [Bordwell and Thompson, 2013c, p. 182].

- Masks and multiple images are used to avoid the image being a rectangle, which it normally is when showing on a screen. The actual picture is still a rectangle, but by adding a mask to the camera or the printer it is possible to block out the light getting through these devices. By doing so the image will only show the part, which is relevant for the production. Another way to break the common rectangle shape is by adding multiple images together as a collage. [Bordwell and Thompson, 2013c, p. 186].

B.1.4.2 Onscreen and offscreen space

Works with what is visible for the viewer onscreen and how the offscreen space is perceived. Normally it is possible for a human to have a view of 180° (see Chapter 6.2.2.1 Perception of Space); however a camera lens does not even come close to that. This is not considered as a negative thing, since it makes it possible for the filmmaker to decide what is important for the viewers experience of the occurring event in the film. Even though it is not possible for the viewer to actually see what happens offscreen, it does not mean that the offscreen area cannot be used by the filmmakers. This is doable because of the viewers awareness of the frame taking place in a continuous world and it therefore helps the filmmaker to use offscreen space as a tool. The filmmaker only needs to add very few hints in the frame, in order for the viewer to be aware of the offscreen space. There are multiple ways to indicate what is happening offscreen, such as using sound, which does not seem to fit something onscreen, having a character gesturing something offscreen. The viewer is most affected by the offscreen space, though, when working with suspense and surprise (see Appendix D Narratives). It is also doable to create offscreen space within onscreen space; this is done by e.g. placing a closed door in the onscreen settings. With the use of the camera, offscreen space can also be created; having the area around the camera unknown for the viewer, this is often seen when having an optical viewpoint of a character. [Bordwell and Thompson, 2013c, p. 186-188].

B.1.5 Camera Position

There are multiple things to consider when finding the perfect camera position. These considerations do not only count for filming in real life, but also when working with animations, since the frames in an animation also revolves around a specific point of view in space. [Bordwell and Thompson, 2013c, p. 188].

The things needed to be taken into consideration for the camera position are:

- **Level**: can be parallel to the horizon or canted, which is also known as the Dutch angle. This angle appears when the camera is tilted to the side. [Bordwell and Thompson, 2013c, p. 189].
- **Angle**: there are three different angles: high angle, low angle, and straight ahead. [Bordwell and Thompson, 2013c, p. 189].
- **Height**: When deciding on the height of which the camera should be positioned it often also depends on the angle of the camera, since some angles require the camera to be in a certain height compared to the subject in the frame. [Bordwell and Thompson, 2013c, p. 190].
- **Distance**: when talking about camera distance it is referring to the distance between the viewer and the subject in the frame image. There are different categories of distances regarding camera distance and they are as followed: extreme long shot, long shot, medium long shot, medium shot, medium close-up, close-up, and extreme close-up. These categories are a matter of degree. It should be remembered, though, that the size of the photographed material within the frame is as important as the actual real camera distance. [Bordwell and Thompson, 2013c, p. 190-191].
- **Functions of framing**: It can be thought that all different camera positions (e.g. straight on the characters, from a low or a high angle) might have a specific meaning or an emotion attached to it. This is not the case and - if it had been so - it could possibly have removed some of the uniqueness and the experience of a given film. [Bordwell and Thompson, 2013c, p. 191].

The placement of the camera is used as a tool for storytelling; for example a camera position can be used to create a point of view shot making the viewer see through the characters eyes. [Bordwell and Thompson, 2013c, p. 192].

B.1.6 The Mobile Frame

Mobile framing is used to change the cameras position during the shot, which can make the viewer perceive the shot as they are actually moving as well and thereby cheat the viewer. [Bordwell and Thompson, 2013c, p. 195].

Mobile framing is also referred to as camera movements. Camera movements are often gained by physically moving the camera while filming and it can be done in the following ways:

- The pan; which is short for panorama
- The tilt
- The tracking or dolly shot
- Crane shot (see Chapter 6.2.2.1.2.6 Motion Cues, Camera And Object Movement) [Bordwell and Thompson, 2013c, p. 195-196].

The function of zoom is considered as mobile framing, so even though the camera does not change position it is still considered as a movement, since some viewers are not able to distinguish between a zoom and an actual movement of the camera. The filmmakers, however, know that there is a big difference between physically moving the camera and the zoom function. When zooming in or out it does not change the vantage point whereas when moving the camera the viewer *"experiences"* the movement in space. [Bordwell and Thompson, 2013c, p. 199].

B.1.7 Frame Mobility

Using frame mobility creates a flow and makes it possible to give the viewer new information by changing the camera position and thereby also changing the point of view. Specific camera movements can at times give objects onscreen more volume and solidity. Frame mobility is also used to convince the viewer as much as possible about movement in space, and even though it is not completely possible to cheat the viewer since the viewer never forget that he or she is watching a movie. The movements of the camera can, however, still make cues of movement, thus indicating the movement through space. still indicates the feeling of the movement. [Bordwell and Thompson, 2013c, p. 200].

B.2 Time and Long Takes

There are different ways to work with time on film. The filmmakers can use real time meaning if it takes five seconds to reach the door in real life it will also take five seconds on film. Another way to indicate time is by using one shot lasting for one and a half minute of real time seem like multiple hours in the film, this can be achieved using for example light or sound. This is done by starting out with bright light coming through a window, and the light then becomes darker and darker indicating that a day has passed. Real time can of course also be affected by slow motion and fast motion. [Bordwell and Thompson, 2013c, p. 211].

Even though it would be easier to just cut, some filmmakers like to extend the shot with multiple minutes. This means that a movie taking 80 minutes can for example

consist of only 10 different shots taking eight minutes each. Using long takes often becomes a part of the film itself. Mobile framing can be a very important tool when working with long takes, since it makes it possible to change camera position and the vantage point, which would normally be changed in the editing process. [Bordwell and Thompson, 2013c, p. 210-213].

Appendix C

Ray Tracing

The refraction is calculated a bit different from the reflection formula. Refraction is calculated using the formula C.1.

$$T = \frac{\eta_L}{\eta_T} N \cdot L - \sqrt{1 - \frac{\eta_L^2}{\eta_T^2}(1 - (N \cdot L)^2))} N - \frac{\eta_L}{\eta_T} L \tag{C.1}$$

In Figure C.1 it is possible to see an example of refraction.

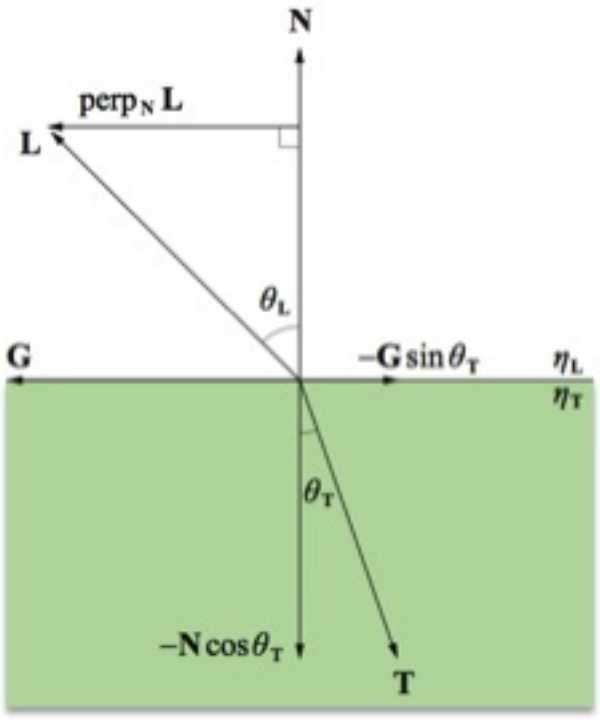

Figure C.1: Graphical representation of the refraction formula [Lengyel, 2012, p. 152].

Here is T the refraction vector, N is the normal vector, and L is the direction towards the incoming light. This formula is based on Snells Law [Lengyel, 2012, p. 151] where η

is the refraction index.

The formula called Refraction Vector Calculation [Lengyel, 2012, p. 152], is derived from a couple of different formulas. We are going to derive this formula in order to see how it has been created.

The formula contains different variables and constants and before starting to derive it, these variables need to be defined. There are three variables, which are interesting to look at; N, L and T. N is the normal vector, L is the direction towards the incoming light and T is the direction of transmitted light.

The directions of transmitted light can be expressed as the components parallel and perpendicular to N. This is shown in Equation C.2 and C.3 respectively. Because T is the components of these two equations, it is possible to combine them into Equation C.4.

$$T_{parallel} = -N * cos(\theta_T) \tag{C.2}$$

$$T_{perpendicular} = -G * sin(\theta_T) \tag{C.3}$$

$$T = -N * cos(\theta_T) - G * sin(\theta_T) \tag{C.4}$$

Looking at the formula for T there is a new variable called G. This variable is known as the unit length vector parallel to $perp_N L$. G can be seen in Equation C.5.

$$G = \frac{perp_N L}{sin(\theta_L)} \tag{C.5}$$

It is known that $perp_N L = L - (N \cdot L)N$, which means that G can be rewritten to Equation C.6.

$$G = \frac{L - (N \cdot L)N}{sin(\theta_L)} \tag{C.6}$$

It is now possible to exchange G from Equation C.4 with Equation C.6, and move some things around. This results in Equation C.7.

$$T = -N * cos(\theta_T) - \frac{sin(\theta_T)}{sin(\theta_L)} * (L - (N \cdot L)N) \tag{C.7}$$

To continue deriving this formula Snells Law [Lengyel, 2012, p 151] is going to be used. Snells Law is used to describe the relationship between the *Angle of Incidence* (θL) and the *Angle of Transmission* (θT) [Lengyel, 2012, 151].

Using Snells Law it is possible to exchange $\frac{sin(\theta T)}{sin(\theta L)}$ with $\frac{\eta L}{\eta T}$. This can be seen in Equation C.8.

$$T = -N * cos(\theta_T) - \frac{\eta_L}{\eta_T} * (L - (N \cdot L)N) \tag{C.8}$$

To continue deriving we need to know about the *Pythagorean identity*. This can be seen in Equation C.9.

$$cos^2(\theta) + sin^2(\theta) = 1 \tag{C.9}$$

This can be rewritten into Equation C.10 and combined with Equation C.8 to form the new Equation C.11.

$$cos(\theta_T) = \sqrt{1 - sin(\theta_T)^2} \tag{C.10}$$

$$T = -N * \sqrt{1 - sin(\theta_T)^2} - \frac{\eta_L}{\eta_T} * (L - (N \cdot L)N) \tag{C.11}$$

It is again possible to use Snells Law, but this time rewrite it so it looks like Equation C.12.

$$\frac{\eta_L}{\eta_T} * sin(\theta_L) = sin(\theta_T) \tag{C.12}$$

The equation now looks like Equation C.13.

$$T = -N * \sqrt{1 - \frac{\eta_L^2}{\eta_T^2} * sin(\theta_L)^2} - \frac{\eta_L}{\eta_T} * (L - (N \cdot L)N) \tag{C.13}$$

It is now possible to exchange $sin(\theta L)^2$ with $1 - cos(\theta T)^2$ and then replace $cos(\theta T)$ with $(L \cdot N)$ using the formula for the angle between vectors. This results in Equation C.14.

$$T = -N * \sqrt{1 - \frac{\eta_L^2}{\eta_T^2} * (1 - (L \cdot N)^2)} - \frac{\eta_L}{\eta_T} * (L - (N \cdot L)N) \tag{C.14}$$

Finally this is rewritten using simple arithmetics into Equation C.15.

$$T = \left(\frac{\eta_L}{\eta_T} * N \cdot L - \sqrt{1 - \frac{\eta_L^2}{\eta_T^2}(1 - (N \cdot L)^2)} \right) * N - \frac{\eta_L}{\eta_T} * L \tag{C.15}$$

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Appendix D

Narratives

The focus in this section will be upon narratives in films. This includes an explanation of what narrative is; the principles of narrative construction, the three aspects of narrative, shortly touching upon patterns of development, and ending with the flow of story information. An important aspect to why it is a good idea to look into such information is to check whether the story or scene, which will be chosen, will follow the narratives theory and such have flow in the story and a clear plot.

D.1 What Is Narrative?

Narrative is, according to Bordwell and Thompson, defined as: *"We can consider a narrative to be a chain of events linked by cause and effect and occurring in time and space"* [Bordwell and Thompson, 2013a, p. 79], and they also state that this means that the most important parts of narration is time and causality, which is what connects the events to each other. [Bordwell and Thompson, 2013a, p. 79]. From the quote, however, it can also be believed that space is another important aspect of narration along with cause and effect, and time.

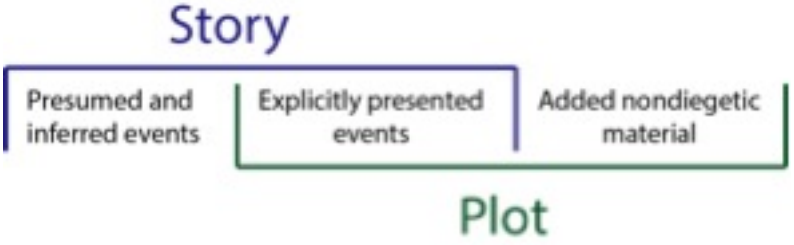

Figure D.1: Shows how story and plot overlap each other.

Story and plot are the two main subjects connected with narrative. There are two kind of events when speaking of story and plot; the events that the viewer sees and the ones that the viewer does not see, but instead comes up with on his own. *Plot* is basically all the things, which are shown to the audience and is audible within the film,

while *story* is all the things shown by the plot *and* the things that the audience derive themselves. *Story* and *plot* do, however, also overlap in some aspects, and this can be seen illustrated in figure Figure D.1. [Bordwell and Thompson, 2013a, p. 80-81].

D.2 The Three Aspects of Narrative

There are three aspects of narratives that need to be taken in consideration, which are; space, time and causality. These will shortly be explained below.

- **Space**: can refer to three different types of space; plot space, story space and screen space. There can very well be spaces and places in the plot and/or story space that are never shown in the screen space, which forces the viewer to imagine the space himself. Most of the time, however, story and plot space overlap. [Bordwell and Thompson, 2013a, p. 86+90].
- **Time**: is mainly used to engage the viewer in trying to put the events shown on screen - the plot - into chronological order and assign them duration and frequency. [Bordwell and Thompson, 2013a, p. 84].
  - *Temporal order*: the order of the shots.
  - *Temporal duration*: Can be the plot duration; how long time, the plot takes place, the story duration, the actual story time, and the screen duration which is how long time it takes to watch the movie.
  - *Temporal frequency*: how often a specific event is shown to the viewer. [Bordwell and Thompson, 2013a, p. 84].
- **Causality**, referred to as *cause* and *effect*, and is usually made of the characters, as they create and react to different events occurring in the film. A character usually consists of someone or something with a body, but that is not necessary; some characters are only represented by e.g. their voices or a character can be represented by multiple actors, playing the exact same character. [Bordwell and Thompson, 2013a, p. 82].

D.3 Surprise vs. Suspense

By manipulating the amount of information that is given to the reader, the narration can achieve an effect of surprise or suspense. An example of how such effects can be achieved is given by Francois Truffaut. He describes a scene with a table where some people are having a chat. It is not known that a bomb is located underneath the table and then suddenly an explosion takes place, see Figure D.2. This example can cause surprise to the audience, since they did not know that a bomb is located under the table. [Bordwell and Thompson, 2013a, p. 90].

Figure D.2: Here a series of shots showing the case of surprise can be seen.

However, in the case of suspense, the audience is notified from the beginning that the bomb is located under the table and therefore the audience would just feel suspense rise while they feel the need to save the characters, who do not know that there is a bomb underneath their table, see Figure D.3.

Figure D.3: Here a series of shots showing the case of suspense can be seen.

[iStock], [2mnka], [News], [Douglass].

D.3.1 Patterns of Development

Films usually have a specific way they develop. This is called patterns of development and often the pattern is as this:

1. Exposition; the beginning of the film, the story, the characters and the characters different traits get introduced to the viewer.

2. Setup; the films setup is given in the first fifteen minutes or so of the films plot. It is here where the possible causes and effects (the causality) are set up.

3. Plot proceeds; when the plot proceeds, the possible directions the movie can go into are narrowed down. The further in the movie we are, the less possible directions there are for the plot to go into.

4. Climax or anticlimax; climax is reached when the action only has a very small range of likely outcomes, and it is wanted to create tension or suspense at the viewer during the climax. An anticlimactic ending, however, often have a very open ending, which is to make the viewer imagine what would happen next, even though it is never shown on the screen.

[Bordwell and Thompson, 2013a, p. 90-92].

D.3.2 The Flow of Story Information

There are different ways to create a flow of story information. Mainly it is, however, done by controlling how much information that the viewer will get, and one of the ways of doing this is by using specific kinds of narrations, which is more or less restricted or unrestricted. An **omniscient** narration is unrestricted, and often does the viewer know more than the characters in the film, which can function very well, if it is wanted to create suspense. On the other hand it is possible to have a narration that only **follows a single character**, so that the viewer only knows what he/she knows. This kind of narration has a tendency to create curiosity and/or surprise at the viewer. [Bordwell and Thompson, 2013a, p. 93-94].

Another way of controlling the flow of story information is by looking at the depth of the story information, which is how deeply the plot goes into the characters psychological states. There are two ways that the plot can introduce the viewer to the characters:

1. Subjectively: shows what the character see and hear and it might even be filmed from the characters point of view[1] (perceptual subjectivity). Sometimes, the film might go even more into depth with the character, when they go into the characters mind and thoughts. This way of introducing the characters can make the viewer sympathize with the characters and give the audience expectations about how the characters react to different events.

2. Objectively: what the character say and do (their external behavior), and is a good way of withholding information from the viewer.

[Bordwell and Thompson, 2013a, p. 95-97]

[1] Point of view can both mean the range of knowledge or it can be referring to depth. When speaking about depth, is point of view often called subjective point of view instead and can be called a so-called POV shot. [Bordwell and Thompson, 2013a, p. 95].

Appendix E

Uncanny Valley

Masahiro Mori, a former professor of engineering at Tokyo Institute of Technology, defines the term uncanny valley in an article from 1970 [Kageki, 1970] [Kageki]. Although the article is more than 40 years old, the basics of it still hold today [Nagayama].

The term describes the relation between how something resemblances a human and how appealing it is to us, as humans, and it was originally applied to robots. It states that the more a robot is familiar to that of a human being, the more we, as human beings, find it appealing. That is until a certain point, where the robot is so familiar; it almost looks like a human but not quite. Here, the uncanny valley applies, and we happen to find it strange, unfamiliar and show a dislike towards it all of a sudden, as illustrated on the figure below. If one then goes above that and creates something that looks exactly to that of a healthy human, it will leave the uncanny valley and will then again be very familiar to us. [Kageki, 1970].

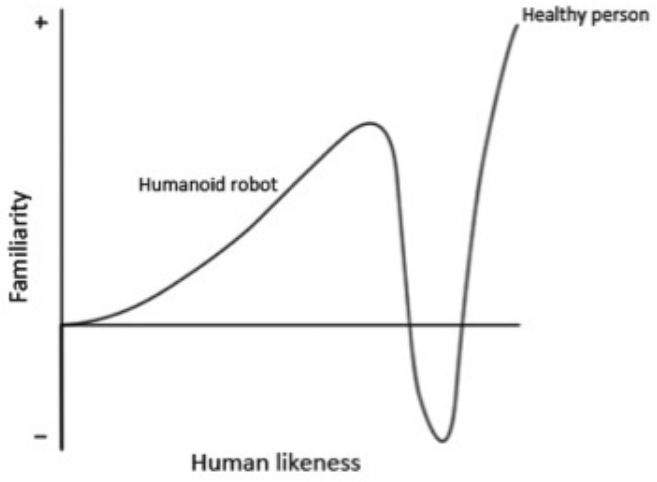

Figure E.1: Uncanny valley represented.

Mori also states the effect motion has in the aspect of the uncanny valley. If something is already down in the valley, when applying motion to it, it will only further increase the sensation of being strange and unfamiliar. Adding motion to something

that is already appealing and familiar will, however, add to the likeness of the object if the motion fits with our expectations of the movement. [Kageki, 1970].

Appendix F

Lighting

How light is used in regular cinema and the difference of light in animation films will be described in this appendix The light sources of a film are all the lights visible within the scene, such as streetlights, and extra lights added behind the camera. If a light in the scene is not bright enough, extra lights can be added to fake its light. Normally the light design is created to seem consistent with the scene, avoiding fake, unrealistic lights. [Bordwell and Thompson, 2013a, p. 124-131].

When you are working with light, you are simultaneously working with the shadows they cast. There are two basic types of shadows; attached shadows and cast shadows. Attached shadows appear when light fails to illuminate parts of an object due to its shape or surface features, such as the nose in a characters face, thus creating a patch of darkness on the opposite side. Cast shadows are when an object completely blocks the light and cast a shadow on e.g. a wall with the objects shape. [Bordwell and Thompson, 2013a, p. 124-131].

F.1 Qualities Of Light

Quality is the intensity of the illumination, such as hard lighting and soft lighting. Hard lights create clearly defined shadows where you can easily see when the shadow starts and stops. With soft light, on the other hand, it is basically impossible to tell where the shadow and light split, as they fade into each other. Light has five main qualities, which can be noticed when looking at a scene or a picture. These qualities can determine the mood or the feeling the scene gives the viewer or it can be used as hints of information. These qualities are[Birn, 2006, Chapter 1, Section Motivation];

- **Color**; this refers to the color of the light. By combining colored light sources can a certain color for the light be achieved. The colors mostly worked with in films are white and soft yellow lights. Other colors are used if it is fitting for what is present in the scene, such as an orange tint of candlelight. Colors can also be used to show or enhance emotions in a scene. Using unexpected colors not fitting in

with the lights of the scene can be very effective to convey an emotion, but can also come off as unrealistic and unfitting for the scene.

- **Brightness** is connected with the cameras exposure settings. Exposure occurs when the cameras shutter opens and allows the light to reach the film. Lighting in movies is what helps guide the viewers attention to certain aspects of a scene (see Chapter 6.2.2.1 Perception of Space). Brightly illuminated areas may draw their attention to key gestures, while shadows may conceal a detail or build suspense.
- **Softness**, which is basically a setting of a light, determines whether there are soft shadows or hard shadows in the scene.
- **Throw pattern** occurs when the light shines through objects, such as blinds on a window, and creates a light pattern.
- **Angle of the light** can be used to determine which way the light is coming from. This can be used to give a hint to the viewer of the time of day or it can be used to achieve different emotions in the scene or image. Direction is the path of the light from its source to the lit subject. Frontal lights have a tendency to eliminate shadows, but can make characters look flat. Adding sidelights will sculpt the characters features, so they appear with more depth. Backlights add the silhouette of the character. Backlights are also called edge or rim light, as they make the characters edges look more noticeable. Underlights and toplights both distort features of the character and may indicate realistic lights, such as a flashlight or campfire.

As mentioned, these qualities are used to give certain characteristics to a scene; however, an approach to illuminate a character could be the three point lighting.

F.2 Difference Of Light In Animation Films

A difference between working with lights in real movies and light in rendered movies is that, when rendering scenes, time and quality of the rendered images play an important role. Rendering a high quality scene with proper lights and shadows will take a large amount of time, so - in order to solve the issues caused by rendering scenes - it is encouraged not to focus a lot of time into perfecting parts of the scene that will not be shown to the viewer. There are, however, some techniques usually used to simplify the designers task when creating CGI scenes, known as motivation and cheating.

Motivation refers to the process, which takes place before adding any light to a rendered scene. It is referred to as motivation because it is important to know the motive of the light, which will be added to the scene, and which lights are required according to the scene. Once it is clear what kind of light is required, it will allow the creators to easily implement a realistic light with all its characteristics. For example when trying to depict the functions and effects of a lit match, the environment in which

it is set will also be lit, but it must be clear how each object is affected when it comes to shadows. The light on the top of the lit match should be realistically represented with color temperature, softness, brightness, angle and throw pattern; the main qualities of light.

Cheating is a way around creating the planned light and making it seem realistic, thus hiding all the errors, which could be seen, and allowing the models to be lit properly. An example of this would be when creating a scene with fruits placed on a table to the right of a window, as the light from the original angle might not shape the fruits as well as a light that would be altered and positioned closer or further away from the fruits, see an example of this in Figure F.1.

Figure F.1: Figure to the left shows illumination from the original angle. Figure to the right shows the angle with the cheated light.

Off screen space (see Appendix B Cinematography) is another way to realistically create light in rendered scenes when it comes to how much of the scene is visible to the viewer and which parts should be carefully planned. The light sources in scenes are usually not seen directly in the frame; therefore it is an important step for rendering scenes to pay attention to the lights, which could enter the scenes from other places. For example some lights are still added to the scene, when creating a rendered image including only a vase as seen in Figure F.2. The off screen space does in this example include a wind window and the sun light is depicted through it, therefore it gives a much more realistic feel to it.

Area Light, direction light, spotlight, and ambient light are all types of light that can be added in rendered scenes and can be manipulated into giving realistic lights and shadows. However, when adding lights to scenes one must properly choose which kinds to use for certain types of light sources, in order to portray them realistically and make sure they are placed at the correct distance to create realistic shadows and beams (see Figure F.3).

Modeling with light is another specific subject when it comes to light and CGI rendered scenes. The main idea is to use light to give a realistic full representation of the CGI models, therefore can it make the characters look flat and therefore give a 2D feeling to it or give it a three dimensional depth feel to it with curves and edges,

Figure F.2: Off screen space lighted frame.

Figure F.3: Sunbeams spreading from an unnatural perspective.

depending on how the lights are used. If there e.g. is a curved object, it should not have a flat light, but each key component should be modeled with light properly, in order to indicate the curvature of the object as seen in Figure F.4.

Figure F.4: Figure depicting a CGI model with a flat look (left) and a curvy look (right).

Appendix G

Render Settings

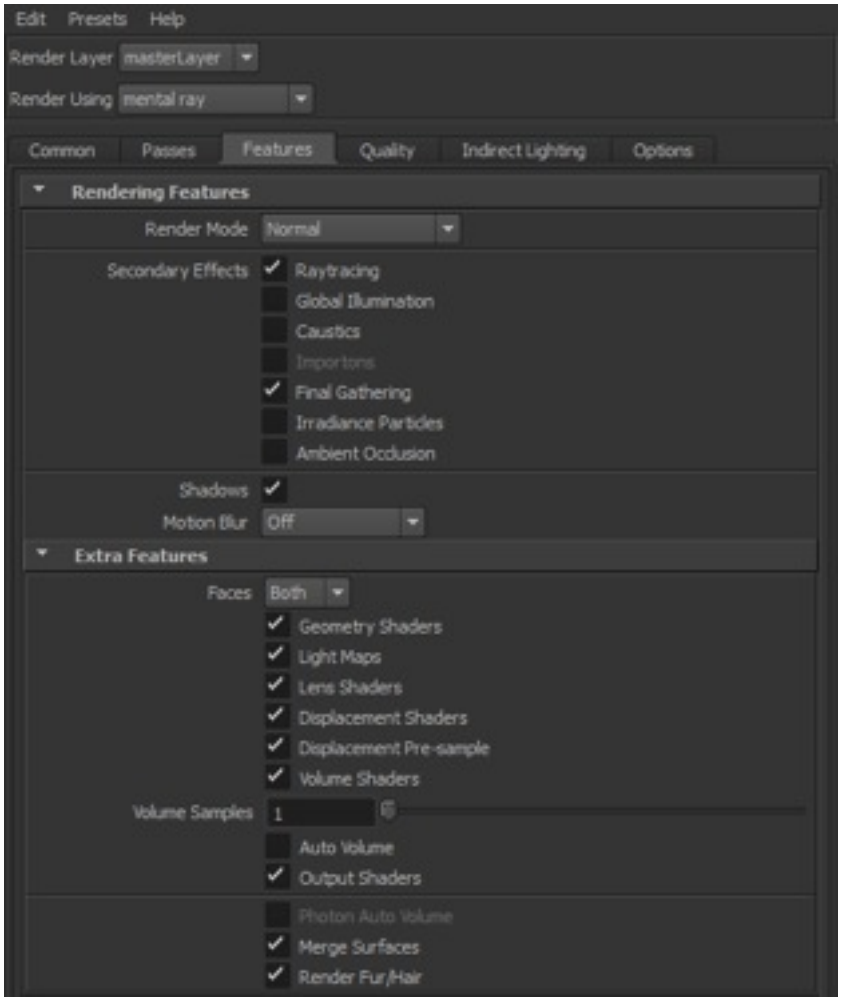

Figure G.1: Render settings showing the rendering features and extra features used.

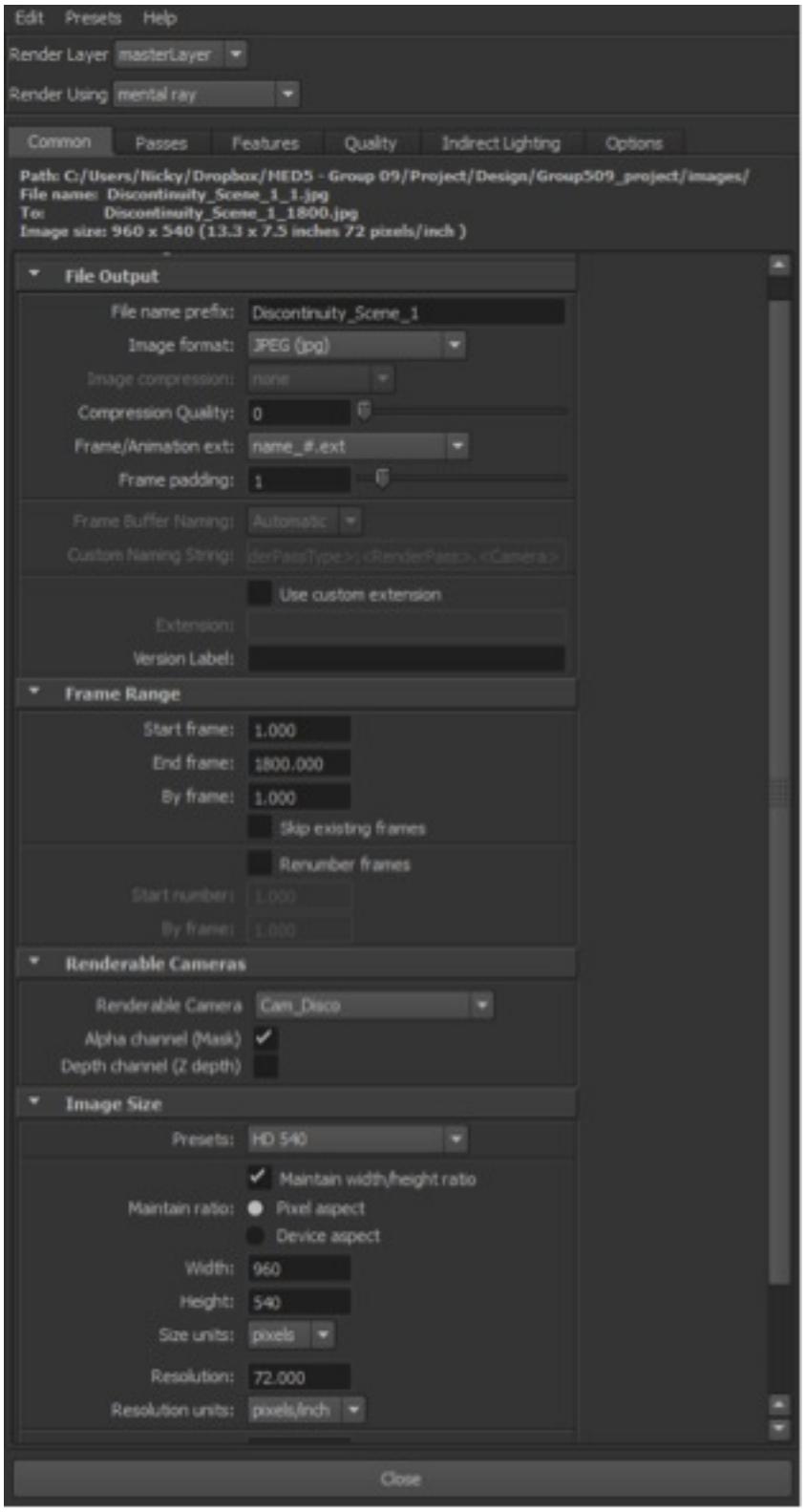

Figure G.2: Render settings showing the output name and file format, together with animation length (frame range), the camera to be rendered, and the resolution of the animation.

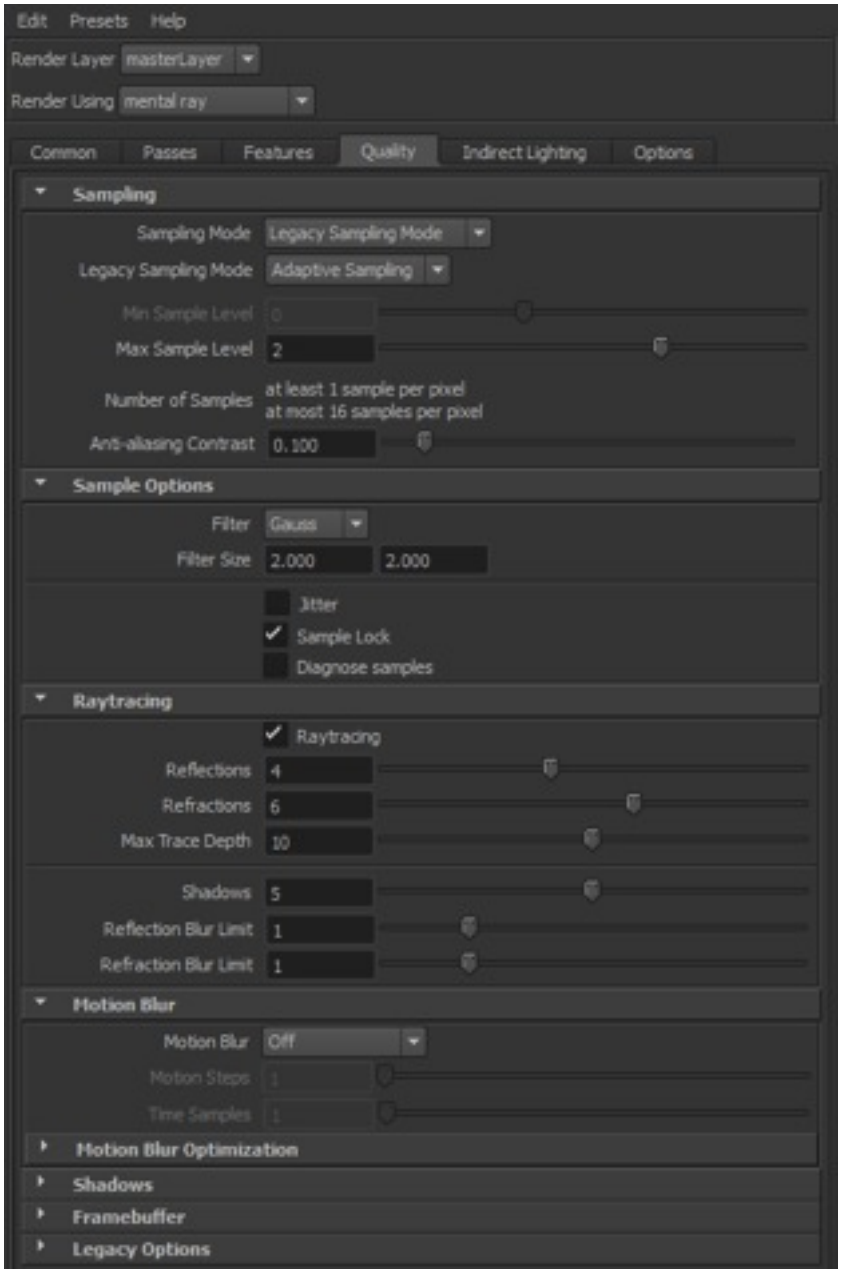

Figure G.3: Render settings showing the chosen sampling mode and its features.

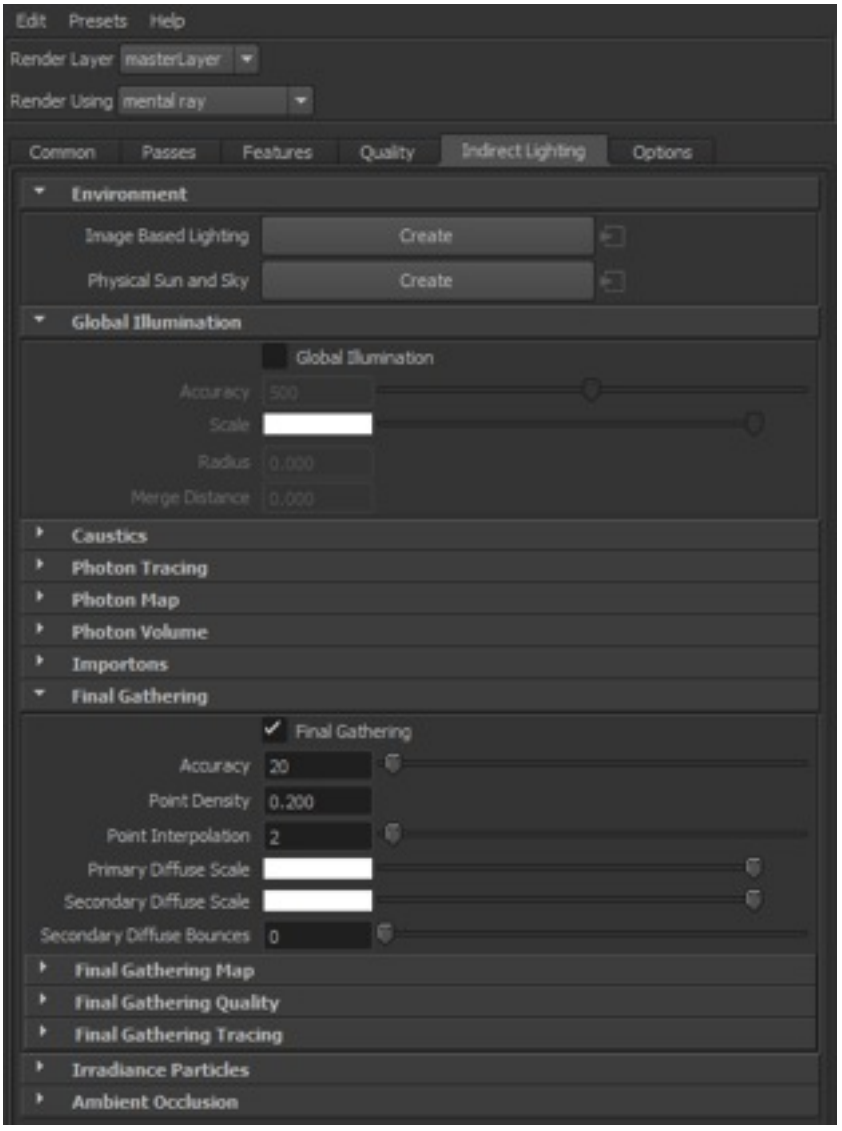

Figure G.4: Render settings showing the options of final gathering.

Appendix H

Kuleshov-effect

What Kuleshov did was to film a man and then show this short clip just before cutting to another clip of either some hot soup, a woman lying across her husbands coffin and a child with a teddy bear. It was the same clip of the man, which was used every time, but yet the clip afterwards created different reactions at the audience. When the man was showed before the soup, the audience responded with that they thought the man had looked hungrily at the soup, while he looked sad at the woman and caringly at the child, see Figure H.1. [Apple, 2004].

Figure H.1: Shows a recreation of the four clips that Kuleshov used in his experiment, in order to prove the Kuleshov-effect. [Apple, 2004]

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