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Incorporation of Storytelling into a Game Environment

Bachelor of Business Administration

Fall 2018

Tiivistelmä

Tekijä(t): Saikko Beata

Työn nimi: Tarinankerronnan sisällyttäminen peliympäristöön

Tutkintonimike: Tradenomi (AMK), tietojenkäsittely

Asiasanat: peliala, videopeli, 3D-mallinnus, peligrafiikka, peliympäristö, tarinankerronta

Opinnäytetyö keskittyi käsitteisiin, jotka liittyvät tarinankerrontaan ympäristön avulla. Ympäristöt ovat tärkeä osa pelejä. Teknologian kehittyessä keinot, joilla peliartistit voivat kertoa tarinoita, lisääntyvät. Opinnäytetyön päätavoitteena oli oppia, miten toteutetaan kerronnan välittäminen ympäristön kautta eri menetelmiä käyttäen. Tämän opinnäytetyön kaksi pääosaa olivat teoria- ja projektiosat. Projekti tehtiin yhteistyössä Tampereella toimivan pienen videopeliyrityksen Catlandin kanssa.

Teoria käsitteli erilaisia tarinankerrontamenetelmiä ja antoi joitakin esimerkkejä niiden käytöstä eri tilanteissa. Se korosti tutkimuksen ja valokuvaviitteiden tärkeyttä, ja skeeman konseptia käsiteltiin myös. Tämän pohjustuksen jälkeen käytiin teoriassa läpi myös sitä, mitä ympäristö voi paljastaa ja mitä pitäisi ottaa huomioon, jotta tämä onnistuu.

Projekti keskittyi käytännön toteutukseen teorian oppimisesta. 3D-peliympäristö tehtiin Catlandille tulevaan peliin, The Spy Who Shrunk Me. Ympäristön keskipisteenä oli yksi pelin hahmoista, kenraali Bolscotchkovich. Tämän vuoksi tarinankerronnan elementit keskittyivät paljastamaan häntä koskevia asioita. Projektin prosessi dokumentoitiin tutkimuksesta ja suunnittelusta alkaen. Se jatkui mallintamisella ja teksturoinnilla ja päättyi viimeistellyn ympäristön kokoamiseen.

Maya Lt:tä hyödynnettiin 3D-mallinnuksessa ja Blenderiä kangassimulaatioita varten. ProBuilderia käytettiin Unityssä seinien, kattojen, ja lattioiden luomiseen. Digitaaliset maalaukset ja muu 2D-taide tehtiin käyttäen Kritaa. Muut tekstuurit luotiin Substance Painterin avulla, ja kokonaisuus koottiin Unityssä. Tämä opinnäytetyö ei sisältänyt teknisiä ohjeita millekään näistä ohjelmista.

Opinnäytetyössä opittiin erilaisista ympäristön tarinankerronnan menetelmistä. Nähtiin myös, kuinka peliartistit voivat käyttää näitä menetelmiä lisätäkseen syvyyttä ja kerrontaa työhönsä. Havaittiin, että näiden käsitteiden ymmärtämisessä on suurta hyötyä kaikissa vaiheissa ympäristöä luotaessa.

Abstract

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Title of the Publication: Incorporation of Storytelling into a Game Environment

Degree Title: Bachelor of Business Administration, Business Information Technology

Keywords: game industry, video game, 3d modeling, game graphics, game environment, storytelling

This thesis was centered on the concept of environmental storytelling. Environments are an important part of games, and as technology progresses, the means by which artists can tell stories increase. During this thesis, the main goal was to learn how to implement storytelling methods into an environment in order to convey narrative to players. The two main sections of this thesis are the theory and project sections. The project was created in cooperation with Catland, a small video game company based in Tampere, Finland.

The theory section discussed various methods of storytelling and gave some examples of their uses in different mediums. It highlighted the importance of research, photographic reference, and touched on the concept of schema. After this foundation, it was discussed what an environment can reveal and what should be taken into consideration in order for this to be done successfully.

The project section focused on the practical implementation of what was learned in the theory. A 3D game environment was made for Catland for their upcoming game, The Spy Who Shrunk Me. The focus of the environment was one particular character, General Bolscotchkovich. Due to this, the storytelling elements focused on revealing information about him. The projects process was documented from the initial research and design, through modeling and texturing, and finished with the assembly and polish of the environment.

Maya LT was utilized for 3D modeling, and Blender for the purposes of cloth simulations. ProBuilder was used in Unity to create walls, ceilings, and floors. Digital paintings and concepts were made using Krita. Other textures were created using Substance Painter, and the scene was constructed in Unity. This thesis did not include technical guides for any of these software programs, or how they were used in this work.

Through this thesis, theory of different methods of environmental storytelling were learned. It was also seen how these methods could be used by an artist to add depth and narrative to their work. It was discovered that having an understanding of environmental storytelling has great benefits in all stages of environment creation.

Content

Attachments

Symbol list

Albedo   Defines the base color of a texture.

Alpha texture   An image that can determine translucency or transparency.

Ambient occlusion   Soft shadows on a 3D model without the presence of light. Most commonly baked from the model itself.

Asset   All of the objects which make up the visuals of the game.

Baking   A method used in texturing to add detail from one 3D model to another. Texture maps such as ambient occlusion do not require a second model.

Blender   An open-source 3D modeling software.

Cutscene   A non-interactive video sequence in a videogame that breaks up gameplay. Often used to further the narrative.

Easter egg   An intentional inside joke or reference in the form of a feature, image, or message. They are called Easter eggs to reference traditional Easter egg hunts.

Edge   The connecting element between two vertices. A face on a 3D model is comprised of at least three edges.

Edge loop   A collection of connected edges, most often circular in shape.

Face   A flat surface on a 3D model, made up of at least three vertices and three edges.

FBX   A common file format for 3D objects.

High poly   A mesh that has many polygons.

Immersion   The perception of being physically present in a non-physical world. This includes a feeling of being able to actually interact with a game world, and a sense of being pulled into the world.

Krita   An open-source software that has digital painting capabilities.

Low poly   A mesh that has a low number of polygons.

Maya	Software for 3D modeling that is developed by Autodesk.
Mesh	The shape of a 3D model as determined by faces, edges, and vertices.
Moodboard	An arrangement of images, much like a collage, that show a particular theme, style, or concept.
Normal map	An image that contains surface information for a 3D model. Often used to create the illusion of detail that does not exist in the mesh itself.
Pivot	The point where a 3D model moves, rotates, and scales.
Plane	A flat 3D mesh that only contains faces on one side.
ProBuilder	A Unity extension that allows the building and editing of geometry within the engine.
Scene	The space in the game engine that includes all models, lights, and cameras.
Sculpting	The process of manipulating a 3D model using software that closely resembles working with real substances including clay.
Substance Painter	A 3D texturing software developed by Allegorithmic in which it is possible to paint textures directly onto a model.
Unity	A widely-used game engine.
UV island	A separate two-dimensional piece of an unwrapped 3D model.
UV unwrapping	The process of opening a 3D model and laying it flat to create a two-dimensional representation.
Vertex	A point on a 3D mesh which helps define its shape. A vertex is the meeting point of two or more edges.

1   Introduction

Environments are an important part of games, and in recent years with the development of technology, can make or break a game. Research and thought is put into textures, props, and structures among other elements with the intention of communicating something to the player. Often times all of this attention to detail and planning goes unnoticed, but still adds to the experience. Nearly everything in an environment is intentionally put there to say something, and this is the basis of environmental storytelling. This thesis aims to first discuss environmental storytelling methods and theory, then apply what has been learned to parts in a game environment.

The theory section will examine how a game's environment can utilize different design elements as effective storytelling tools. These elements include the benefits of references, an environment's non-verbal communication, and immersion. Other visual elements are lighting and color and their effects on the mood of the game. The mood in turn contributes to the storytelling. It will be examined how deliberate decisions in the design can have a meaningful impact on how it is perceived. These decisions and how to make them can be learned by examining environmental storytelling and design from different perspectives.

The project section of this thesis consists of the creation of one environment with elements from the theory applied in order to tell a narrative. More specifically in this case, to tell players about a game character. The goal is to show the effectiveness of non-verbal storytelling and what it means to treat the environment as an extension of a character. The structure of the project follows a logical progression from the research and design stages, through modeling and texturing, and finally concluding with the assembly and finishing touches.

There are many ways to tell stories in videogames non-verbally. This includes the environment, props, animation, characters, and music. The author recognizes these methods, but will not touch on the topics of animation, characters, or music. The purpose of this thesis is to examine how game environments alone can be utilized as powerful storytelling tools and narrative devices. While environmental storytelling is effective, it is not the only method available. This thesis regards it to be used in addition to traditional narrative devices. While the benefits of using the environment will be discussed, it is unlikely that it will take over as the sole means of storytelling in videogames.

2 Theory

Humans have always felt the need to tell stories. The mediums and possibilities in which those stories can be told have increased as technology has progressed, but the act of storytelling itself remains. With these new mediums, there is much that can be told without a single spoken word. Videogames all have a story, some more straightforward than others. Technology has evolved to the point where non-verbal storytelling is easier to accomplish than ever before. Artists are telling more and more stories through the game spaces.

2.1 Defining environmental storytelling

Environmental storytelling simply put, is the concept of telling a story through the design of the environment. This is non-verbal communication through design and attention to detail. It is everything the player sees. Telling stories without words can be accomplished by utilizing props, animation, and characters. The information conveyed does not have to benefit the main character, though it should aim to echo the world at large (Smith & Worch, 2010). Storytelling elements should add to a meaningful whole. The term overall refers to how the narrative is shown and built up while passing through a game.

Exploration is a big part of games and environmental storytelling involves piecing clues together. These clues are found throughout the game space. This engages and involves the player in understanding the information (Smith & Worch, 2010). Naturally there is the danger that the player does not find these clues. They can also have different meanings to different players, and according to Smith and Worch (2010) humans draw conclusions instinctively. However, as mentioned before, pieces of environmental storytelling are not always crucial to advancing in the game itself. Therefore, overlooking some does not hinder the player's progression in the game. Environmental storytelling can be used for several different purposes. It can also communicate a lot to the player. This includes what has happened in a place, who lives there, how they live there, what could happen next, and the mood (Smith & Worch, 2010).

2.1.1 Importance of background research

Reference and what it can reveal about an environment are important to understand. Background research and reference gathering is one of the first concrete steps to making an effective environment. Research and decisions about things such as art style should be completed before beginning the creation of the space. Reference material and inspiration can come from many different sources such as movies, television, videogames, and books. This can bring new ideas and confirm whether or not ideas work well together.

Gathering references into a moodboard helps in maintaining a cohesive look and can generate new ideas. This locks in the style and feeling of a particular environment. There can be several different moodboards for a videogame, this can include one for the game world as a whole and separate ones for different settings in that world. Once theme and the general look have been established, the moodboard serves as reference. This established the way the environment looks, and artists can ensure it does not stray too far visually from what was planned. Some of the things a moodboard can show are color palettes, atmosphere, geography, and architecture for an environment.

Researching also helps artists understand different real-world cultures and customs that may be relevant to the game world. The more that is learned about the background of the environment through research, the more this understanding brings depth and meaning. This in turn helps create a more immersive experience for the player.

2.1.2 Photographic reference

By looking closely at photographic references, it is possible to recognize the details that make it an effective whole. An easy example of this is to look at abandoned spaces. In the picture below (Figure 1) is a room from a long-abandoned hotel. A closer examination reveals what details make the environment look abandoned. The walls are dirty and most likely moldy and the wallpaper is peeling, exposing the bare wall underneath. The room looks dusty and there are pieces of debris littering the floor. The room is also lit only with natural light coming in from the window. One of the most telling signs of abandonment is the fact that nature has begun to reclaim the space. The type of plant life can even suggest what the geographical location of this environment is.

Figure 1. Abandoned hotel room, photograph by Mirebs. The photo shows a room that has fallen into obvious disrepair, likely untouched for a longer period of time.

References can show geography or location. They can also show the age of a building, older buildings would use stone or brick while newer ones would most likely use metal and glass (Horton, Lynch, Olguin, & Recktenwald, 2017). Recktenwald (Horton et al., 2017) speaks about the impact of age and the layers of history that can be found in materials. What this means is how the impact of age is shown in materials. In the hotel room pictured (Figure 1), the order of the layers of history of the walls are the bare wall, peeling wallpaper, and mold and dirt. References bring many opportunities to add a human element with details that would otherwise not be thought of on one's own (Horton et al., 2017). These details can contribute to the answer of one of the core questions in environmental storytelling: what happened here? Discovering stories from reference images and the positive effect of creating captivating situations for players is also something Recktenwald (Horton et al., 2017) explains.

2.1.3 Schemata vs reality

Using photographs as reference prevents artists from creating worlds that tend to look the same and are based on the same stereotypes. People use generalized aspects of the world to create simplified versions of it in their minds, this is referred to as schemata (Gard, 2010). Of course, when creating art without a reference, artists fall back on these schemata. This can result in inaccurate or boring environments that may feel like they are missing something, though the artist will most likely be unable to identify the problem. The main issue with relying on schemata when creating environments, is the assumption that others will view it through a similar schema (Gard, 2010). People from one country creating locations from another country can pose difficulties (Gard, 2010). This is because without proper research, the creators would fall back on their schemata when making an environment based on unfamiliar cultures or countries. They would use what is in their experience. The lack of research is painfully obvious to any native to that country or familiar with that culture. Images online, movies, and television shows can give someone a schema of what another country looks like. That schema is more than likely to be varying degrees of inaccurate.

There are many things that come to mind when imagining an alleyway in a large city. However, the imagined space is most likely stereotypical and lacking in detail. The alleyway pictured (Figure 2) shows things that may not have been included in an artist's schema. There is trash littering the overflowing dumpster and the dumpsters themselves have stickers and graffiti on them. There are manhole covers and the asphalt is damp in places. Reference can be used to fill in small details to make spaces feel authentic. Relying only on schemata when creating an environment is sacrificing authenticity and uniqueness. The idea is to identify the essence that make the reference real, authentic, and cool (Horton et al., 2017).

Figure 2. Photograph of an alley that shows many details, photograph by Magaña.

2.2   What an environment can reveal

Environments can reveal answers to the questions, who, what, where, when, and why. They create depth for the characters and the world itself. Environments can show personality, lifestyle, and background. When examining a room, it is possible to discover things about who lives there before even meeting them. Players can make assumptions and come to conclusions on their own from large or small environmental indicators. An environment that encourages curiosity and exploration is one that also allows players to take in details of the world at their own pace. If consistently used, these components allow the world to speak for itself (Smith & Worch, 2010).

When seeing a character's home or residence, it is possible to recognize similarities to situations or locations outside of the game world. Environments may bring to light living conditions of the habitants of that space. Bad living conditions may cause players to empathize or recoil in disgust. Good living conditions may be welcoming and make players let their guard down. The state of cleanliness and order of a character's home can give

insight into their personality, while their décor can reveal interests, hobbies, or career. The image below (Figure 3) from the game The Last of Us (Naughty Dog, 2013) clearly shows the bedroom of a young girl. Everything from the wall decorations to the skateboard leaning against the wall gives insight into the character who lives in the room.

Figure 3. A young girl's bedroom in The Last of Us, made easy to interpret as such with carefully thought-out details.

In the process of designing the environment, it can be helpful to think about who built certain objects or who arranged the room. According to Horton (Horton et al., 2017) all choices in the design of a space should have meaning and serve a purpose within that space. What those objects tell about who lives there should also be taken into consideration. It shows when a lot of thought has been put into a space and thinking about these details can shed even more light on the people of the game world.

The environment can reveal some of what has happened prior to the player arriving there. It can also foreshadow events that have yet to happen. The state of the materials of the assets can give clues. This can include wear and tear, dirt, mold, or water damage. If there is evidence of violence, violence can be expected to appear later or there may be a need for the player to inflict it. This can show what acceptable behavior in the game world is, what must be done to survive, or what lengths the world's inhabitants are willing to go to. In this way, environments help shape player identity in the context of the world (Smith & Worch, 2010).

The movie 28 Days Later (Boyle, 2002) introduces the viewer to the setting without using dialogue. There is a slow reveal (Figure 4) of more of the trashed and desolate hospital interior until the main character leaves and it becomes apparent that the entire city is in the same state. Upturned chairs and papers littering the floor imply chaos and panic, making the now quiet and empty spaces feel ominous. The viewer can start to piece clues together to form an idea of what might have happened.

Figure 4. Stills from 28 Days Later that slowly reveal more of the state of the environment.

It is usually possible to infer the location geographically from an environment. This can be as simple as climate, whether it be tropical or temperate. The location can be a recognizable one on Earth, an alternative universe, or a fictional location. It could be an alien planet or a fictitious Earth-like planet. Often the genre of the game is well known before starting it and the environment should of course support the genre. Naturally, alien planets would have environments that show that the genre is science fiction. If there is a dramatic disconnect between genre and environment, there is a loss of believability and the storytelling suffers for it. Game environments also often communicate a mood. This mood should be consistent with what the rest of the space is conveying, and more importantly with what needs to come across in the narrative.

Location in time may be more vague and harder to tell in abstract games for example. Many times, inferring time period is the only option. These could be distant past, distant future, or current time. It could also be a combination of these or an alternative universe or timeline. Technology and other items in the environment can give enough context clues

for deducting a mostly accurate time period. The Fallout game series has items from the culture of 1950's America. However, the context in which they are presented is more than enough to deduce that the game does not in fact take place during that time. The barren wasteland and overall state of the environment show the truth, that the game takes place in a futuristic post-apocalyptic setting.

Portal 2 (Valve Corporation, 2011) is excellent as an example of environments that show the past and imply what may have happened. The game is set in the same testing facilities that its predecessor Portal was set in. Only now it is clear from the environment alone (Figure 5), that those events took place a while ago and the facility has fallen into disrepair. Underneath the plants and debris there are remnants of the game world from when it once comprised of pristine white walls. The player does not need to be explicitly told that is it the same area in which the first game took place, the visual clues are more than enough.

Figure 5. Environment in Portal 2, still identifiable as the same setting as the first game.

Environments may answer why something happened. Answers like these require there to be sufficient storytelling in the environment to make the player ask the question in the first place. The answers may not be apparent at first, but exploration of a space may reveal why something happened or why something is the way it is. An overturned chair in an otherwise orderly room raises this question. The question may also be answered at a later stage in the game. Why something happened can also be among the things most difficult

to discern from an environment alone. This is because every player brings unique views and experiences and may come to different conclusions.

The room in the image below (Figure 6) is from the game The Last of Us (Naughty Dog, 2013). Even without knowing the plot of the game, there are many things that can be inferred from the room. The most jarring is the state of the room, which is filthy. Trash litters the floor and every surface is dirty. That coupled with the fact that nature is reclaiming the space suggests that it has been abandoned for some time. There are two sleeping bags on the ground and laundry hanging in the corner, which implies the room has been lived in since it was initially abandoned. The candles by the television set suggest that the electricity no longer works. All of this can be communicated to the player non-verbally. The Last of Us takes place in a post-apocalyptic world, this room perfectly echoes that.

Figure 6. A room in The Last of Us, the details allow the player to draw conclusions about the game world.

Good environments can answer these questions, but they can also choose to omit a key detail that will be revealed later in the game. This creates mystery and makes the player ask questions. Planet of the Apes (Schaffner, 1968) famously does this by revealing the true location of the planet to have been Earth after a nuclear war the whole time. This reveal has a strong impact on the viewer, and as it is near the end of the movie, it gives the entire film a different context.

It can be better not to always give all the information about a world when first introducing it. Game environments work well when they make players ask questions and allow them to fill in the blanks using clues in their surroundings. These clues can have different meanings to different players. Exploration of the space develops understanding of the overall narrative, creates the feeling that there is a bigger world and gives context. The story is uncovered by exploring, this is engaging for the player.

2.3 Set dressing

The production quality of games can often be compared to that of films and are now expected to tell good stories (Hight & Novak, 2008). Often this storytelling is slowly revealed as the game progresses. The game world as a whole moves the story along and it is useful to think of these environments as movie sets. Every part of the environment can be taken advantage of as an opportunity to communicate information about the world. This can be more about the world at large, its story, and history.

Set dressing is adding items to a space in order to create a more genuine environment. These details can convey much about the world and its characters non-verbally (Pluralsight Creative, 2014). The picture (Figure 7) from Pluralsight Creative's (2014) video, shows the impact of dressing the same bathroom sink with different props. The sink on the left is dressed in a way to show that a single man lives there, while the one on the right clearly shows that two people live there. Set dressing can have a powerful effect on how a space is viewed and is therefore a valuable part of storytelling.
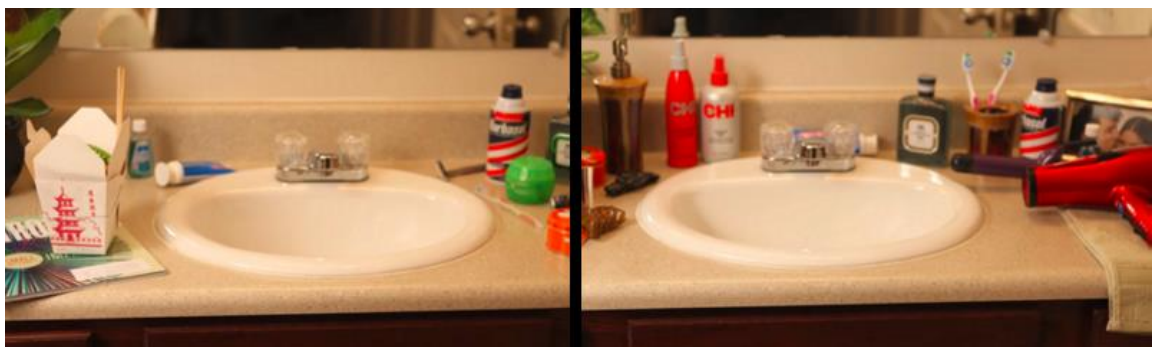

Figure 7. The same sink with different dressing, an example of how changes in props can tell completely different stories.

Setting props in a game environment can easily be compared to set dressing in movies and television. Videogames allow players to look around for themselves and do not have

a directed gaze, unlike films (Smith & Worch, 2010). What this means is that the player is not forced to see a fixed angle and point of view. In games there is freedom to look around, the player is encouraged to explore. Fixed camera angles may appear in games as well. However, even with a fixed camera angle it is still possible to explore the surroundings. The same point can be made about cutscenes, but this is irrelevant because games do not consist of cutscenes exclusively. Furthermore, if games revealed story through cutscenes and dialogue only, they would be more akin to films with interactive segments (Shepard, 2014). While games are different from films, it can be helpful to think about comparable environments players have seen in movies or other games. The way films dress their environments can be used as inspiration to influence the way game environments are thought about.

2.3.1   Props and details

Props and details can have a powerful impact. This includes manmade items such as furniture or natural props such as flowers. The interaction between these two item types can create interesting storytelling opportunities. Weather worn furniture, a home that has been reclaimed by nature, blood and dirt covered clothes. The more attention to detail these objects receive, the more they can potentially add to a story. This detail can show the age of the object and how that age might affect its appearance. While most certainly not all storytelling comes from props, they do add a layer of depth.

There is a beauty in clutter, but a lack of it can be quite intriguing. The clutter free white testing facility spaces of the game Portal (Valve Corporation, 2007) give off a sterile feeling which suits the game's narrative. This contrasts with the hidden rooms (Figure 8) that can be found behind walls. In these rooms there are messages and pictures written by someone that can be assumed to have been a test subject themselves at a time before the player. The pictures and writings on the wall give the impression that whoever wrote them was not in a stable state of mind at the time. The discovery of the hidden room also reveals more of the story to the player, clearly something more sinister is happening. It also raises questions about the final fate of the inhabitant of that room and what exactly drove them to an apparent madness. The player pieces a few things together and forms conclusions from the details in the room. These conclusions may come with a feeling of unease, the discovery that there are areas beyond the walls that the player may never see and that they might not be alone (Shepard, 2014).

The most straightforward stories are told through calculated placement of art (Gard, 2010). In the Portal example, this would be the writings on the wall. It could also be overturned furniture. These things do not affect gameplay, but they add to the atmosphere and depth of the space (Gard, 2010).
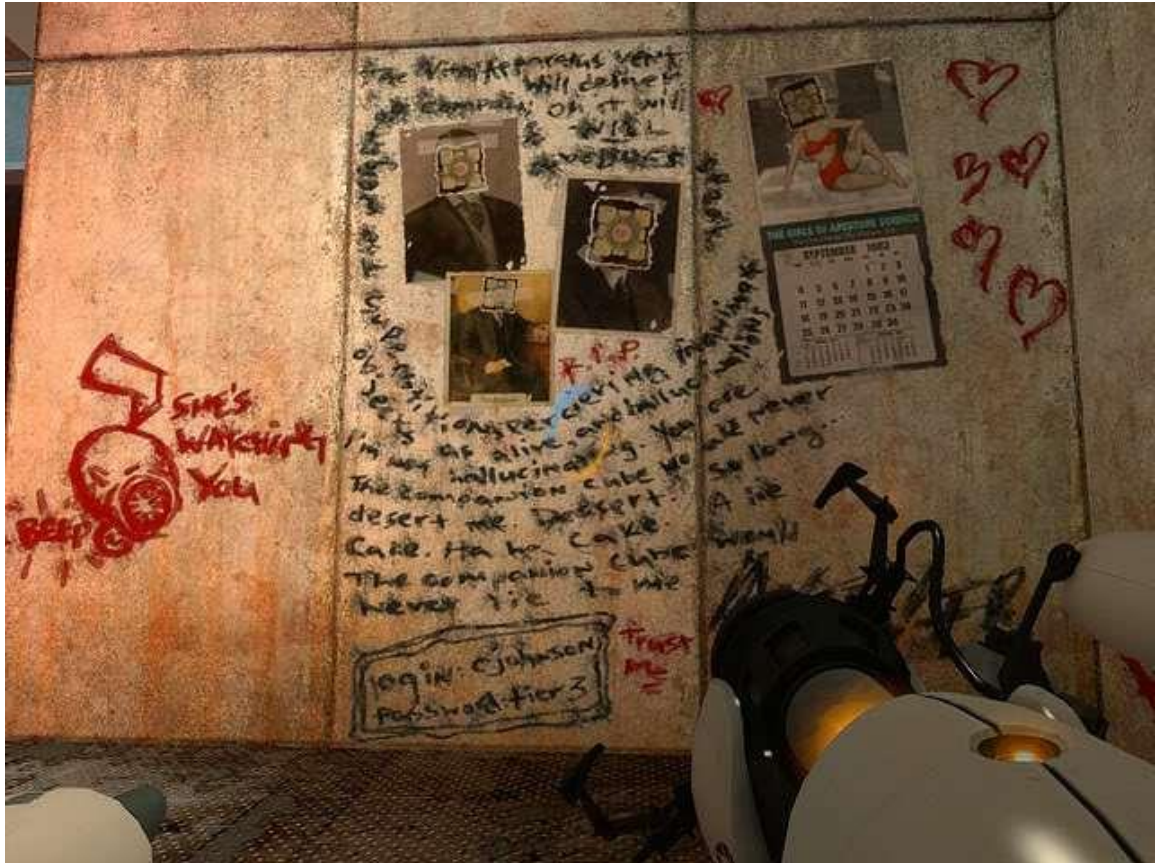

Figure 8. Hidden room in Portal.

2.3.2   Interior design

The role of an artist can often resemble other professions and require knowledge in a multitude of fields. Character artists need an understanding of anatomy and the study of different clothing and time periods can also be a great benefit. Cox (2016) argues the point that understanding interior design is critical when environment art is concerned. While it is possible to create effective interior spaces without such knowledge, it is certainly beneficial.

There are many aspects of interior design that can easily be applied to game environments. Contrast of value, shape, and color can be used to either bring attention to elements or to blend them into their surroundings. Cox also speaks about how repetition of color or shape can help bring unity. He introduces the main ideas of interior design and explains that they do not appear in spaces separate from one another; these ideas are order, enrichment, and expression.

Order is what helps a player maneuver around a space. This could be with the help of a feature that stands out in the environment, or guiding the player using patterns and implied spaces (Cox, 2016). A unique statue near the entrance of a space can be a helpful navigational point for a player that allows them to see where they have come from. Cox explains that enrichment makes spaces interesting by utilizing novelty, mystery, and spatial composition. Compared to designing real-world interiors, enrichment in games often has much fewer limitations. A sense of mystery can be created by showing a part of something interesting at the end of a hallway. The goal is to construct spaces that the player wants to explore. Regarding novelty, Cox warns artists to use it sparingly, noting that "if everything is memorable, nothing is memorable". Simply put, expression is what the space communicates about the world around it and its occupants. According to Cox this can be the world's history, time period, and culture in addition to the occupant's personality. Careful and thought-out interior design in games can add to immersion and atmosphere of an environment, further enriching the experience for players and complimenting the narrative.

2.3.3 Easter eggs

Hidden details that may be challenging to find are often referred to as Easter eggs and can either further the environmental narrative or serve to lessen immersion. An example would be the previously discussed room with writings and pictures on its walls in Portal. It is not essential to game progression and is possible to miss. It can be argued that immersion suffers if Easter eggs are unrelated to the game world or do not make sense in its context. Finding these may make the player feel smart, but it can take them out of the game even if only momentarily. However, these different cases of Easter eggs are not mutually exclusive. One that is a joke shared between developer and player does not necessarily break immersion.

2.4   Atmosphere

There are many ways to convey atmosphere and mood visually. These include the use of tangible props and clutter and intangible elements such as weather and light. Color theory, harmony, and associations with the two are also contributors. These aspects can also easily be used to help the player navigate better and make correct decisions. Film is a medium which utilized these concepts before games. This is why movies are an excellent reference source, it is also useful to draw inspiration from various mediums. Many narrative driven games share similarities with film in many areas. How games make players feel is important. If a game does not illicit any emotional response from the player, then it can quite quickly become boring.

2.4.1   Material and immaterial

Mood can be affected by tangible and intangible elements alike. This includes props and assets, tangible things that the player could theoretically touch of they were real. Not only are the assets themselves important, their textures are as well.

Weather and time of day can affect mood and can involve mood associations. People tend to feel sadder during poor weather, and happier during good weather. Seeing a beautiful sunny environment in a game will have a vastly different effect on mood than a rainy one would. Night time gives a more ominous and mysterious feeling than the daytime. Sunrises can signify hope and new beginnings, while sunsets can imply an ending. A foggy forest in the middle of the night feels quite different to one on a clear day. Fog feels spooky and mysterious, it is often used in horror games and mysteries to set the mood.

The picture below (Figure 9) from Telltale's The Walking Dead video game (2012) is an excellent example of mood in many forms. Light can be used for mood and directing the player's attention. Lighting is used here to draw attention to the back left, where the light from a television with no signal is glowing blue. This contrasts with the darkness around it and the orange daylight on the right side of the image. As mentioned, objects can also effect mood. In the example below, chairs and stools are overturned. Players can use this to make assumptions about what has happened. All of these things together, in addition to the large amount of blood on the floor and wall, create a rather ominous scene that has the player on edge from the moment they enter.

Figure 9. Atmosphere in The Walking Dead.

A beam of light from somewhere in a hole in the ceiling can have a dramatic effect on the mood. This can also be used to draw the player's attention to something in a room. It could be an object, the correct route to advance in the level, or a small story created using props. A single light in a dark environment acts as a beacon, it creates mystery. Mystery invites the player to ask questions and seek answers. By actively seeking these answers the player puts pieces of the narrative together for themselves.

2.4.2   Color meaning and theory

Use of color can have a powerful impact on an environment. Color contrast can be used to make objects of interest pop out and draw the player's attention. These objects can also be used to guide players. This effect can be achieved by using a color that stands out from the rest of the environment. Understanding color theory and color harmony is important in picking the appropriate color palette for a game. The easiest way to have this effect is to use the contrast between cool and warm colors.

Color meaning and color psychology can also be taken advantage of in environments. Cool tones, such as blues and purples are calming. Colors can have a subconscious effect, making players draw conclusions without realizing it themselves. The color blue is seen as trustworthy, clean and peaceful. The color red on the other hand has associations with blood, fire, love, and war.

A rather subtle example of use of color can be seen in The Shining (Kubrick, 1980). This example can be interpreted as psychological and revealing information about the main character's mental state. In the top half of the image (Figure 10) the main character, Jack, is in the lobby of the movie's primary setting, the isolated Overlook Hotel. Throughout the movie it can be seen that red is the color primarily used in association with the hotel. Here Jack is seen wearing green surrounded by an overwhelming amount of red details. In fact, he does not wear red in the movie until he begins losing touch with reality and succumbing to the influence of the hotel. This example gives an idea of how colors can be used in revealing change or progression in a character or environment.

Figure 10. Stills from The Shining, in which the use of red in the environment is clear. The incorporation of red with the main character Jack combined with his declining mental state can be seen as a visible representation of the effect the hotel has on him.

Blade Runner (Scott, 1982) is another example of a film that uses colors to its advantage for storytelling purposes. The image below (Figure 7) shows two scenes in the movie that have distinctly different moods and meanings. The meaning of course can vary depending on the interpretation of the viewer. The main colors used in the film are orange and blue, this is a classic warm vs. cool contrast. Orange and blue are also complementary colors, meaning they are opposites on the color wheel. It is unlikely a coincidence that the scenes featuring the love interest (Figure 11) are usually in orange tones. There is of course also

the divide between classes and power that the use of these colors establishes. Blue is used in association with the city, its people, and replicants. Replicants are humanoid robots who are not allowed to legally remain on the planet. This contrasts with the orange that is used in association with power: the police, people in power, and the main powerful corporation in the film. The contrast is shown even further by the state of the environments pictured below.

Figure 11. Stills from Blade Runner that show clear contrast in color and atmosphere.

Research is again an important part when it comes to using color. This is especially true when incorporating different cultures into the environment. Colors may have dramatically differing meanings across different cultures. While red signifies love and passion in Western cultures, it can mean sacrifice and mourning in South Africa (Kroulek, 2016). White is traditionally used to mean innocence and peace in Western culture, but this is the color of death in Eastern cultures (Kroulek, 2016). It would create unintended interpretations to environments based around Eastern cultures to use white to signify purity or goodness. This could also show ignorance on the part of the game developers.

Being aware of different cultural meanings of colors can be used as an advantage in environmental storytelling. Colors can be used for an additional layer of narrative in relation to the culture or cultures in the environment. This can also be incorporated into the creation of fictional cultures. The environment can be used in communicating how a culture perceives a color. Using a color in association with shrines or sacred areas signifies its importance in the culture's context. However, this requires a stronger background and foundation for the fictional culture.

2.5   Immersion

When playing a game, there are no expectations of how the world of the game works or what its rules are. The world defines these and tries to convey them to the player at least partially visually. The player accepts the world's truth, and anything deviating from this truth brings the player out of the game by breaking the immersion. Carefully designed environments add to the story as a whole and through it create immersion and credibility. This being said, a game does not need to be immersive to be a good game; some games may even be better if they are not (Madigan, 2010).

Research plays a substantial role in immersion and cannot be overlooked. It helps add to the world and creates the illusion of a larger world outside the current game environment. Gard (2010) writes that it is important for the level to first feel genuine to its creator in order for it to feel genuine to the player. Believability is also partially created when the players see things that echo the real world. An earlier section of this thesis touched on research and its importance. A large part of immersion comes from the results of research. Immersion is reached when the player can be assured that the game space is genuine (Gard, 2010).

Details are clues for players that can create 'a-ha' moments. There is a satisfaction to discovering details and filling in the gaps through assumptions. This is a fundamental reason why environmental storytelling is important. Players tend to find it more meaningful to find things themselves rather than have the story handed to them. It is the difference between handholding and letting the player's curiosity lead them. There is a golden middle ground between the boredom of too much clarity and the frustration of too little of it (Horton et al., 2017).

Making players responsible in part for discovering things about the world would be referred to as a 'pull' narrative, as opposed to a 'push' narrative. The major difference is

whereas one situation may push information to the player in the form of dialogue, the other allows it to be pulled from the environment (Pitzer, 2011). Meaning, instead of telling exactly what the situation is and what needs to be done, the player can come to the conclusion themselves by piecing together context clues from their surroundings. If all the necessary information is handed to the player and the situation is set up in such a way that they cannot fail, it ceases to be a game (Pitzer, 2011).

There is of course the risk that small details will go unseen. However, it is more satisfying to trust that the player will find it. These small details can be more subtle or hard to find. It also means the choice of finding more pieces of the story is the player's responsibility. As Pitzer (2011) explains, finding things becomes significant when it is possible to miss them completely. Nevertheless, even if players do not see all the details, they will feel them, and this will add to their immersion.

2.6   Theory summary

In summary, there are quite a few ways to utilize environmental storytelling in video game environments. This theory section aimed to cover some of the main methods that can be used. There are many ways to use storytelling in an environment. Even the smallest things, when taken into consideration, can add layers to the story and give it more depth.

It is important to pay attention to references and conduct the research necessary for the environment. References provide much needed details and combat a person's flawed and incomplete schemata. Environments can communicate a lot, it is good to have a clear idea of what the space should say about the game and the narrative. Mood can make an environment feel more alive and help tie all the elements together as a cohesive whole. Once it is known how the player should feel in the environment, then weather, color, and lighting can be used to enhance that feeling. Good environments are a strong foundation for immersive games.

3   Game and project

The purpose of the following part of this thesis is to utilize the storytelling methods dis-cussed in the theory section. I will be designing and creating an environment for a game. The process will begin from the research and planning stage and end with the assembly of the finished environment in Unity. The parts of this project that will require the most reflection of the theory are research and design. Of course, storytelling methods can and will be implemented throughout the process. This environment and its creation are what I will be referencing when I refer to 'the project'.

The structure of this project is very straightforward. I will begin with research and reference gathering of the visual style, followed by designing the space based on those results. After this, I will model the environment and texture it. The final stage of this project is to assem-ble everything in Unity and polish any remaining details.

The company I am completing this work for is called Catland. Catland is a small video game company based in Tampere, most well-known for their VR title Taphouse. I have been employed full time by them after the beginning of this project. The game that I am creating this environment for is called The Spy Who Shrunk Me, which follows the adven-tures of British spy Audrey Smoothspy in 1980s soviet Russia. The game's tongue-in-cheek sense of humor is something I aim to echo throughout this project.

General Boris B. Bolscotchkovich (Figure 12) is the character who is the resident of the environment that I will create. The rooms are a part of an underground bunker, and have been designed to Bolscotchkovich's specifications. The space consists of a bedroom, bathroom, sitting room, and small greenhouse area. Bolscotchkovich comes across as a powerful man who is not to be crossed. However, I want the space to show that perhaps he should not be taken as seriously as he would like.

Figure 12. A digital painting of General Bolscotchkovich completed during the project.

The environment should show the character's preference for aesthetics and give the player an idea of his personality. I see Bolscotchkovich as a very wealthy man who idealizes communist icons and has a taste for the opulence of the era of Russian tsars. My aim is to have the design of these quarters reflect those aspects of him. I will use what I have learned about the theory of environmental storytelling and transfer that knowledge to what I am trying to convey.

4   Research and planning

Day 1:

As the first day of this phase and the project itself, it was mostly dedicated to rereading previous work and research on environmental storytelling. I found new potential references, including information on game design to hopefully better help with the flow and maneuverability of the space. This day was the beginning of collecting visual references and inspiration and as a result, I have formed a vague idea of what the area's visual aesthetics will be. Searching for photographic references early on helps me avoid relying on my own faulty schemata, which is something that Gard (2010) mentions and is discussed in the theory section of this thesis. Creating an environment purely from my imagination would likely have boring results that feel as if there is something missing. Everyone's schemata are different, so while the design would make sense and feel right to me, other people would not share that experience. I am not surrounded by opulence in my day to day life, so without reference I do not have much to draw from.

I want to echo the luxurious interiors of imperial Russia and the best way to do this is to gather relevant images. These images will help me pick out common color palettes and recurring elements. The pictures I gather can help me add a human element to the spaces that I would possibly not have thought of myself (Horton et al., 2017). These details can add up to help answer one of the main questions in environmental storytelling, "what happened here?". The environment will consist of three main areas, these spaces combined create a personalized living space for the character Bolscotchkovich.

Day 2:

Storytelling in games is not an uncommon thesis topic, I wanted to look through some published works to see how it has been written about and if there are some that can help with my project. I ended up finding quite a few references from older thesis papers that seem like promising places to start.

The main goal of the first days is to gather as much new material that supports my thesis. This means internet resources as well as movies and video games to draw inspiration from. Movies can help with creating atmosphere and using light and color effectively. Video games on the other hand can show how other games have utilized the storytelling methods effectively.

Day 3:

The goal of the day is to look through older notes and theory to see if there is something that can be added or expanded on. Since environments storytelling is completely visual, more images would help demonstrate theory in practice. After examining stills from video games and movies, it is safe to say there is not much difference in what each medium can do as far as storytelling. This being said, movies continue to have much more control over what is seen and from what angle, while details in games can easily go overlooked all together. As Pitzer (2011) explained, while it is true that games make it easier to miss details in environments, this fact alone makes finding those details significant. Smith & Worch (2010) point out this difference between observing storytelling in games and movies, where games allow the player to look around unlike films, which have a directed gaze.

There is an uncertainty about what the mood will be for the environment. I would prefer the player to feel as though they are intruding and that they should not be there. Minimal lighting and evidence that the room is lived in can help accomplish this. Cooler tones in overall light will give a mysterious feeling and perhaps make the player feel as though they are snooping. I would like the environment to hint at the morning routine of the character who lives there. Raising the question perhaps, whether or not the Bolscotchkovich has returned to his quarters since that morning. I would like there to be the possibility of the player interpreting a chain of events, something Smith & Worch (2010) discuss in regard to the exploration of a space.

Day 4:

Many of the references I have gathered have turned out to be disappointments as far as information that is relevant to this project. While they are about environments, they focus more on the technical rather than design aspects which would relate to storytelling more. At this stage it was useful that I had collected many more references.

Something surprising, though obvious as an afterthought, is the link between environment art and interior design. The conference presentation by Cox in 2016 on the topic was quite interesting and I look forward to seeing how I could implement the methods in the environment.

Day 5:

Quite a bit of time was spent reading over notes acquired over the past few days and watching more conference presentations. Since I wanted to possibly expand on the theory

and methods of environmental storytelling, I read more about it to see where I could relate different points to one another. I am becoming satisfied with the number of visual examples I have gathered, they should help demonstrate different storytelling methods.

I have gathered more reference images for what the environment could look like. Keeping in mind the aspects of interior design Cox (2016) speaks about, such as novelty and tension in a space.

Day 6:

I want to avoid having to do too much additional reference gathering once I begin the next phase of this project, which is why this day was divided between writing additional theory and searching for more reference images. In my opinion it is better to have more reference in the end than necessarily needed, than to find that more time needs to be spent on searching later. The areas which were lacking in reference were the greenhouse and bathroom. How I would like these to look is a gray area when compared to the bedroom. Overall, I want the entire environment to be open, meaning there are few doors to open. However, there should still be a clear divide between the separate spaces.

4.1   Concluding thoughts

The foundation that I began the theory section on was much more solid than I initially thought it was going to be. It had been a while since I had researched the topic of environmental storytelling and I did not remember how thorough the results had been. The goal of this phase was to ensure that I had the resources necessary and a comprehensive understanding of the topic that would allow me to successfully complete the project. Knowing what needed to be accomplished by the end of this phase helped me keep track of my progress and allowed me to divide my time logically.

I was able to gather several new references and revisit old ones for information I may have missed. The only disappointment in these sources were the ones about game design. None of them seemed to have relevant or new information regarding environment layout or structure, which is what I was initially looking for. The information would have been useful in other situations and I now have the benefit of having read it, even if it is not information I can use in this thesis.

Luckily storytelling in games and game environments is not an uncommon topic, and I was able to find new sources and learn new information. It is good to look to sources other

than games for inspiration to avoid recycling the same concepts. This is why I have used both games and movies as examples. I was even able to find a lecture on the relation between environments in games and interior design and its benefits by Cox (2016). The incorporation of interior design principles into game spaces was something I had not considered before and I will definitely be making use of what I learned.

During the six days of this research and planning phase, the personality and lifestyle of the character Bolscotchkovich became clearer. This made it easier to look for visual reference and inspiration for the space. The layout and mood however still remain unclear. This is acceptable because those decisions will be much easier to make once the design phase begins and I am able to create concepts and see how all of it works together.

5   Design

Day 1:

This first day was dedicated to drawing floorplans. I wanted to have the layout of the spaces figured out before creating any concepts. During this process, I tried combinations of different shapes and single and multi-level environments. This included angled walls and tension which are two concepts Cox (2016) mentions in relation to universal enrichment in interior design. Tension referring to spaces closing in and opening up again, such as hallways or doorways leading to large open areas. I also experimented with floor plans that only had one possible path to walk compared to ones that branch out into different directions. The results were positive, though unfortunately inconclusive. I had hoped to have decided on a floorplan on this day. However, during the next day I plan on making very rough 3D versions of the two that I think are most promising. This means mainly the walls and room shapes, to see how they feel compared to each other. From there I will begin to make concepts of the interior.

Day 2:

I was able to settle on a final floor plan design for the environment with the help of fast 3D versions of the two designs I was unable to decide between (Figure 13). Creating these models was very helpful and certain things I thought would stand out negatively based on the floor plan were not an issue. Then I began drawing rough concepts for the interior furnishings. The floor plan designs had some furniture and clutter, but being able to see how things fit or do not fit in 3D is important. I want there to be a balance between shapes and object heights in the spaces. It may seem odd if one side of a room only has tall objects while the other side has objects close to the ground. This can be an intentional design decision, but not one I want to use in these spaces.
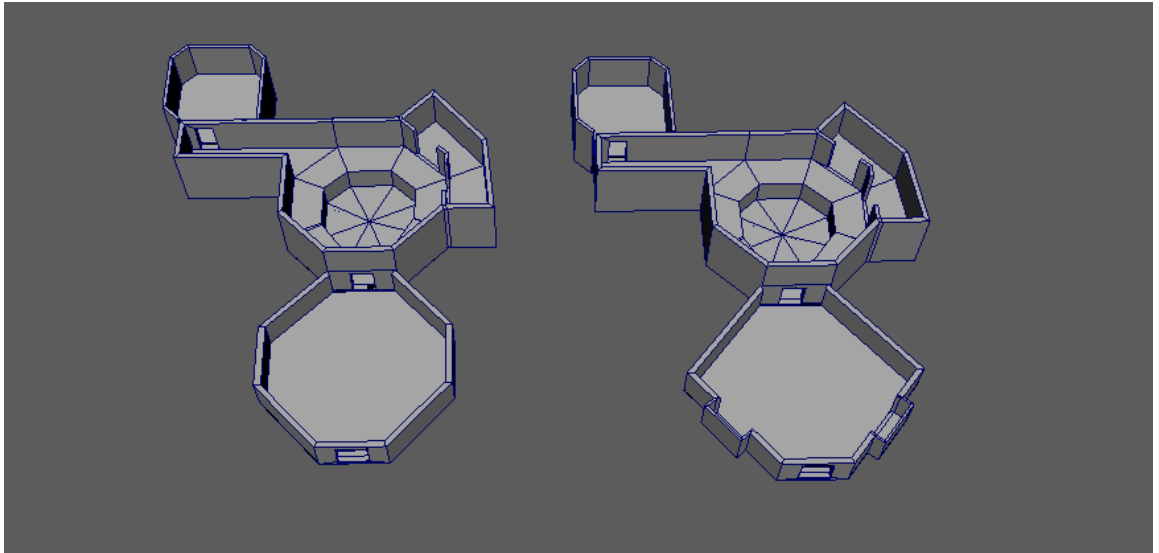
Figure 13. Two slightly altered versions of the final floor plan compared side by side to see which is visually more interesting.

Day 3:

Unfortunately, due to time constraints I am unable to make concepts as detailed as I would like. Since I am the one who has to create the environment based off the concept, this is not a bigger problem. Issues with interpreting the concepts would come up if somebody else had to continue from where I left off. When designing the furniture for the spaces I am paying attention to creating pieces that can be reused throughout the environment as well as unique ones. Cox (2016) points out the problem with having too many unique elements, stating that in that case they would all cease to be memorable. I have designed props with this in mind. There are some assets that do not repeat in the environment, adding interest and novelty. However, there are also others will be placed throughout the environment and will provide consistency and harmony through repetition. I will not be able to draw detailed concepts for every asset or prop. Instead, I will draw rough sketches for myself to figure out shape and form before modeling if needed.

Day 4:

While the use or even overuse of red would not be an issue in the context of the game, I felt it would be too overwhelming to have all of the walls in the environment be red. According to reference images I gathered, light blue-gray walls would not be out of place in imperial Russian living quarters. Having the sitting room's (Figure 14) walls echo the blue details in the first room is a good way to keep the color palette consistent and it serves to clearly divide the two areas. The large paintings that I want on two walls would be of

classic paintings featuring Bolscotchkovich, these would help to further show his arrogance and feelings of superiority. Gard's (2010) comment that the simplest stories in storytelling are seen in the placement of art is particularly relevant in this case. It says a lot about a character, that the only art he has on his walls are paintings of himself.

Figure 14. Colored sketch or the sitting room.

5.1   Concluding thoughts

As a whole the design process of the environment did not have many bumps in the road. The floor plan and layout differ greatly from what I had first envisioned. However, I do not think this is a negative thing. Experimenting with top-down floor plan designs allowed for interesting variations and new ideas to emerge. I believe the final floor plan has a better flow to it in regard to how a player would walk around the environment.

I had not originally planned on creating the rough 3D visualizations of the floor plans. The idea came to me when I was torn between two very different designs. It is difficult to tell how a player will experience a space and whether it will be effective from a two-dimensional drawing. After creating the layout, including doorways and ceiling heights, I was able to zoom-in in Maya and see how the spaces would look from the point of view of the

player. This, coupled with feedback from the company helped in the final decision. Overall, feedback on the designs was positive and helpful.

As this phase came to an end I realized I wish I had planned for at least one more day so that I would have been able to create more detailed asset concepts for all of the assets. Since I was unable to do this, I will have to settle for roughly sketching assets on paper or digitally. This way it is clearer and easier to see if the design of an asset has a visually pleasing shape and proportions, rather than coming to the realization that it does not half-way through the modeling process. This also applies to the details such as gold trimmings in the assets that do not properly come across in rough sketches (Figure 15). Fortunately, I was able to make a few slightly more detailed concepts on the last day.

Creating the colored sketches of the environment also helped lock in the color palette. It was easy to see how all of the colors worked together and the ratios which were suitable. The main colors are shades of red, brown, and gold with details in white, blue, and green. I was also able to create a preliminary list of assets based on the concepts, which will greatly help with scheduling the modeling phase. This means I can make sure I do not leave the most challenging models for the end and risk running out of time.

Most of the design choices were made intentionally in order to show the personality of Bolscotchkovich and tell a small story through the arrangement of objects. The bedroom (Figure 15) is the first room the player enters. The main color in the environment is red, I made this decision because it fits with the game's plot and the character's identity. Red is a color associated with war and blood, and also the Soviet Union. Bolscotchkovich is a General of the Soviet Union in the game's narrative. Yellow also has the same associa-tion, which appears in the environment in the form of gold details and trimmings. As green is the complementary color of red, the plants help break up the red of the environment with the contrast the two colors create. The color green is often associated with envy, sickness, and greed. Gold also serves to show Bolscotchkovich's wealth, combined with the style of the furniture this indicates his appreciation and perhaps longing for another era.

Figure 15. Sketch of the bedroom. This is the first room the player enters.

Portraits and paintings of himself further show his arrogance and narcissism. The purpose of the solid gold ostrich is to give the impression that Bolscotchkovich indeed has a vast amount of money and spends it on such objects simply because he can even if they are not very tasteful. Every choice in the design should have meaning, as Horton et.al. (2017) explained. My aim was for each element to be intentional and to say something about Bolscotchkovich. The ostrich, paintings featuring Bolscotchkovich, and a few other details are meant to make him look ridiculous in the eyes of the player, even though from the design of the space it can be assumed that he would like to be taken seriously. Cox (2016) speaks about expression in space, and specifically in relation to who lives there. The way the space is designed and decorated reflects the inhabitant's taste and the aesthetics they admire.

According to Gard (2010) immersion happens when players are convinced the space is genuine. I tried to do this by utilizing the references I had gathered and adding touches to make the rooms feel lived-in. In the bedroom, the bed is unmade: sheets crumpled, and pillows thrown about. Almost everything has a gold trim, and items such as Fabergé eggs show Bolscotchkovich's immense wealth.

Upon entering the bathroom (Figure 16), the player is greeted by a wall-sized recreation of the famous painting The Birth of Venus featuring Bolscotchkovich in place of Venus. An element which is in line with the humor of the game and suits the character's eccentric personality. I wanted to add bizarre things such as this in order to get the player to ask

more questions about their surroundings. How they answer those questions and the con-
clusions they draw will vary, because the clues in the environment will mean different
things to different people (Smith & Worch, 2010).

Figure 16. Sketches of the bathroom. The room furthest from the entrance.

Interior design uses mystery and novelty as a part of enriching a space. An example of
mystery Cox (2016) gave was having something interesting at the end of a hallway. This
would draw a player's attention and prompt them to investigate. I have applied this to the
hallway leading to the bathroom. The end of the hallway has a bust of General Bol-
scotchkovich on display, and there are several doors along the way. Only one of which
will open to reveal the bathroom.

The large rooms and high ceilings, as well as the ornate furniture tell quite a bit about
Bolscotchkovich. I wanted to use set dressing to show a chain of events, which would also
help the space feel lived in and genuine. Pluralsight Creative (2014) explains the impact
of details on how real an environment feels, and how these elements can reveal a lot
about a character or world. The unmade bed shows that either Bolscotchkovich has not
had the time to tidy up yet or more likely he has people who will do that for him. There is
a breakfast tray on the sitting room's coffee table, with empty dishes that only have crumbs
on the plate. All the way in the bathroom, a towel draped over the tub suggests it has been

recently used. The small table next to the bathtub has a diary and candies on top, pointing to how Bolscotchkovich passes his time while bathing. A toothbrush lies on the side of the sink. The placement of all of these props combined can be interpreted as Bolscotchko-vich's morning routine. From the environment itself the player can learn about the man's personality, and from the placement of items they can see how he spends his time there.

6   Environment modeling

6.1   Modeling

Day 1:

The start of the day was used to assess the asset situation. I know there are many unique assets that need to be modeled, so I created an excel sheet (Figure 17) that lists all the assets I would like to include in the environment. There are a few that I am willing to cut or replace with another asset in the environment if it comes to that. I arranged the assets by room and marked the ones which I assume will be more time consuming in red. This way I can keep track of which assets I have created and how many remain. I can also ensure that I do not spend too much time on one asset and fall behind schedule.

Bedroom	UV status	Lounge	UV status	Bathroom	UV status
Bed		Sofa		Diary	
Ostrich		Coffee table		Bathtub	
Antlers		Bar cart		Towel	
Large decorative vase pillar		Bottles and clutter for bar cart		Toilet	
Armchair		Breakfast tray		Sink	
Carpet		Stairs railing		Slippers	
Bench		Special plants and plant boxes		Toothbrush and holder	
Plant Pot		Bust statue			
Plant					
Dresser					
Pillar					
Door					
Window					
Curtain					
Framed portrait					
Small round table					
Chaise lounge					
Table lamp					
Small vases					
Faberge egg					
Small frame					
Moblie from ceiling					

Figure 17. Excel sheet of assets with time consuming assets marked in red.

There are days set aside for UV unwrapping after the modeling phase, but I will clean assets as I finish them. This means I remove extra vertices or fix holes in the mesh. I calculated that I would have to average approximately two and a half assets finished a day to stay on schedule. At first glance this seems completely reasonable, however, I believe I should finish as many as I can during a day. This leaves me with more time to tackle the more challenging models and any unexpected difficulties.

Day 2:

In order to keep the ornate furniture consistent, I am keeping them in the same Maya scene as I work on new pieces. This way I can be sure they fit together visually and look like they could be a part of the same set. It would be unfortunate if I were to model the assets separately only to find out none of them fit together visually when they are together in the game engine. In the unlikely event I run out of assets to model on my list, I have additional content in mind. I could also use the extra time to further polish already made assets.

Day 3:

At this point the asset that has given me the most problems has been the lounge chair. When it was not finished, I was not entirely sure what was wrong with it, perhaps I had not been able to get the curves of the chair to the right angles. In the end it turned out the issue had to do with how many edge loops and extra vertices were in the model. These were necessary while creating the initial shape but created problems when trying to adjust the model in another place. The image below (Figure 18) shows the model in progress, after removing many unnecessary edge loops. There is still much that can be and must be optimized in the model before it is compete, however, it is much easier to work with now.
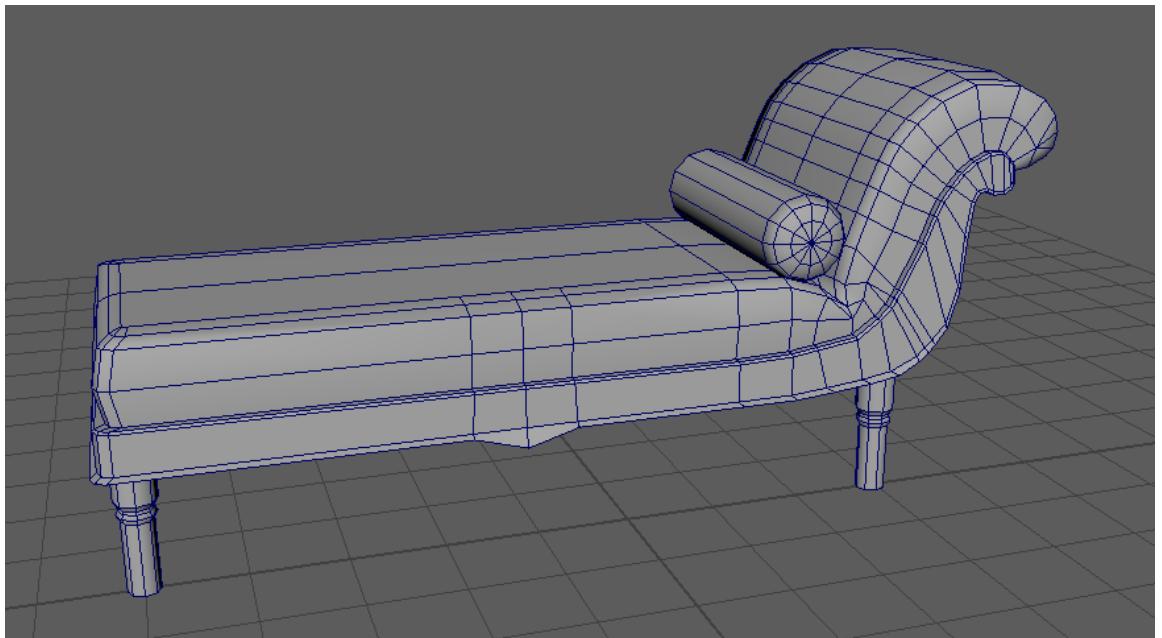

Figure 18. The lounge chair asset still in progress.

The next problem came not too long after, in the form of the cloth I wanted draped over the chair. I found out that the version of Maya I was working with did not include cloth physics. With the help of a colleague I was able to accomplish the cloth physics in Blender and import the results back into Maya to clean up the final mesh.

Day 4:

Many of the designs for the assets have curves or rounded details, this has proven to lengthen modeling time sometimes. Fortunately, this has not been a problem when it comes to the amount of time that I have. I welcome the chance to challenge myself to create the environment the way I designed it. It would be boring and tedious if everything was simple shapes and easy to model.

Clutter helps make a place feel lived in, which contradicts the open and clean spaces of a wealthy man's opulent living quarters. However, there are different types of clutter. I can use restrained clutter while still maintaining the clean and large open spaces. Decorative vases and pillows will help fill out the space and keep it true to the character. The props in the environment help to tell the player about the character Bolscotchkovich, different elements can be pieced together to show a larger picture of his personality and lifestyle.

Day 5:

I am trying to model each asset with the same amount and details proportionate to each other. As an example, assets such as an armchair and coffee table are meant to be approximately the same size in game. They are both medium sized assets, while vases and coffee cups would be considered small assets. The assets would not work well together visually if the coffee table's mesh was significantly more detailed than the armchair's. I am aiming for consistency in the level of detail in the assets. This means none of the assets will stand out for being too detailed or not detailed enough. Since I am familiar with the style of the game's other environments, I can tailor my models to suit that style as well.

Day 6:

I was able to utilize some assets I had made during my time at the company before the start of this thesis. I repurposed them for the breakfast tray asset set, with slight modifications to suit what I wanted. The toilet asset is also not made from scratch. With the permission of the original artist, who is also my colleague, I made modifications to the original form of the asset. I am able to save time by using and modifying assets that I have already made or exist within the game project. If an asset is already available, it does not make

sense to create it again for the sake of having made everything from scratch. I am also aware that the company would disapprove of wasting time in this manner.

Day 7:

The previously mentioned toilet asset can be seen in the image below (Figure 19). The original is on the left and the new version is on the right. It maintains a semblance of its original form, but with the modifications I have made to suit the aesthetic of the environment it will be placed in. My asset developed some black spots as I was creating it, and it remains to be seen whether this will be a problem in Unity. I may want to test it there early on in case it is a bigger issue.

Figure 19. The old toilet asset (left) next to the new toilet asset (right).

The bathtub has a used towel hanging off the edge. I was able to make a decent looking high poly mesh for this using the Blender cloth physics once again. The low poly version has some bumps on the surface and does not look very good. I can fix this during the texturing phase by baking the normals from the high poly onto the low poly in Substance Painter.

Day 8:

Some assets, such as the antlers pictured below (Figure 20), make use of the mirror tool because of the symmetry in the object. With assets such as this, I should make note during the UV unwrapping to unwrap only one of the symmetrical pieces. I can then delete the

other piece and replace it with an identical copy of the unwrapped version. This way the unwrap will transfer to the other piece and I will save time by not having to unwrap the same thing twice or more.
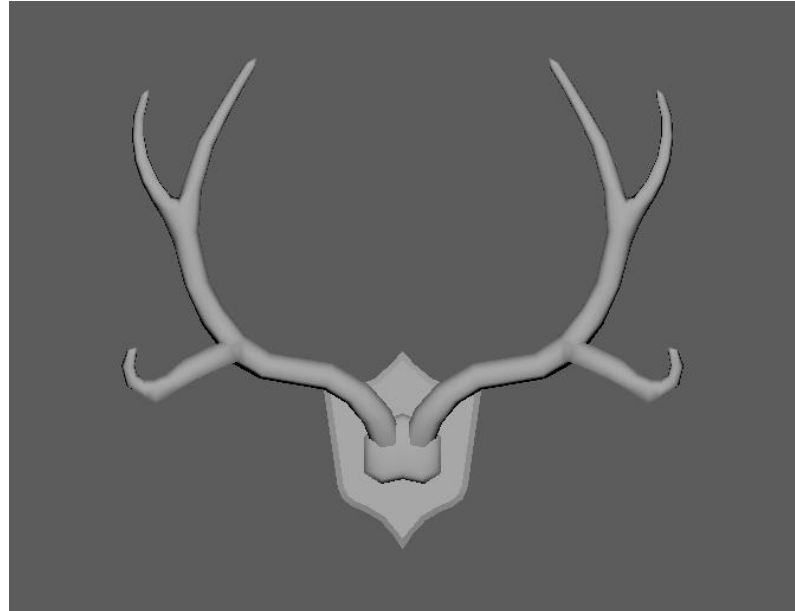

Figure 20. Antler asset, mirrored pieces for symmetry.

As was the case with the toilet asset previously, I am utilizing previously made bottle and glass meshes for the clutter for the bar cart. I am, however, adding a few of my own in addition which should further relay the image of wealth.

Day 9:

While I can model the pillar asset at this point, I have to keep in mind that I will need to make adjustments to the model's height at a later time. The reason for this being that the walls and ceiling of the room have not been made yet and I do not know the exact height at which they will reach the ceiling.

For the sink I am reusing the faucet handle from the bathtub model. I am doing this for a few reasons: the two models will fit together visually as though they are from the same set, and it saves me some time. The sink has also been given small details that appear in furniture such as the dresser and coffee table. Further showing it is a small part of a whole rather than a random separate piece of furniture.

Day 10:

There is not too much clutter in the environment, one reason for this is time constraints in this project. I am the only one working on this particular environment. While I can borrow and modify a few things for my own use, the assets I am creating are my own design and do not exist in the project yet. It is also not advisable to create clutter assets that are all unique, it is a better idea to subtly re-use assets throughout the environment. This also creates a visual cohesiveness to the space. With the limited clutter I have, I plan to use them to tell the player more about the character Bolscotchkovich.

Day 11:

After some time struggling with creating a rope that will swing when hit and not finding the correct menus in Maya LT, I have decided to see if a coworker can help me with the this process. The idea is to create a simple effect that when items suspended from the ceiling are hit, they will swing on their strings. However, it is something I am unfamiliar with and is made more difficult by the fact that the version of Maya I am working with does not appear to have the correct functions for this. Perhaps the solution will be similar to the one with the cloth physics, and I can import the model into Blender and create the desired effect there. The alternative is to abandon the idea, at least temporarily, due to time constraints.

Day 12:

I had to rely on Blender once again for the blanket draped over the bed. This time I ran into some problems with the blanket not colliding with itself. Thankfully the problem was solved simply by turning on and adjusting the self-collision attribute. While this fixed the problem, I wish I had looked into this while creating any of the other cloth assets. Blender shape keys were useful in creating realistic looking folds in curtains (Figure 21). Shape keys allow for transformations in a mesh via a slider, in this case the effect that the curtains are held open by something. It will remain to be seen whether or not those curtains can be used in engine as they may have problems with the lighting.
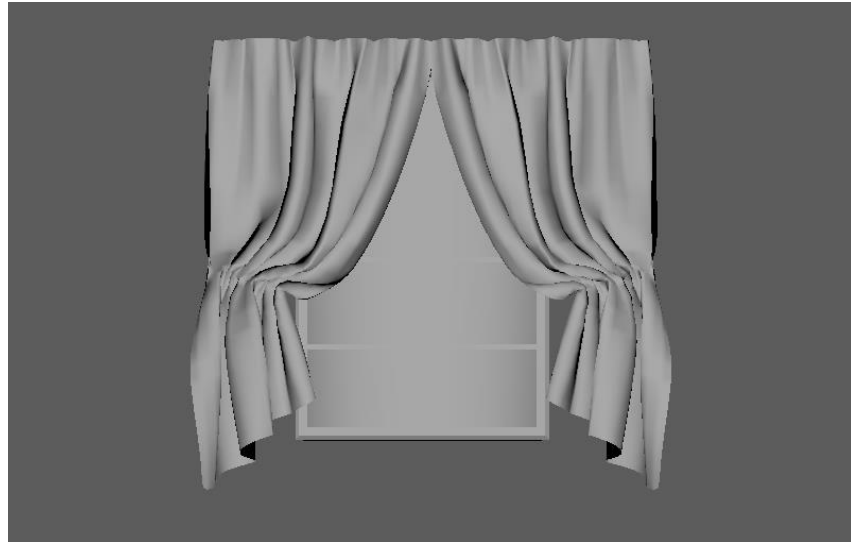
Figure 21. Realistic folds in plane using cloth physics and shape keys in Blender.

Day 13:

Probably the most challenging asset to model will be the ostrich. Character models in game aren't realistic in style, meaning the ostrich does not necessarily need to be either, which is helpful. I will begin the model by creating a rough and simple low poly version that I can then add detail to with more polys and sculpting. The high poly version can be used to bake normals onto the new low poly model. I had temporarily given up on the sculpting of the ostrich, as Maya's sculpting tools are not doing a satisfactory job. I may even have to settle for relying on Substance Painters normal map painting to give the ostrich some detail. At the beginning of the day and throughout the modeling of the other assets, I had anticipated the ostrich to be the most difficult. However, the ones that caused the most challenges were the ones that included cloth physics.

Day 14:

Creating the walls for the environment is the next step. This will be done in ProBuilder in Unity because that is how the rest of the game has been built. It is true that the walls and floors could be made in Maya and the whole environment could be imported into Unity already built. In that case all of the assets would still have to be sorted into the correct folders, and for the sake of consistency it is better to create the structures as they have been done in the game previously. ProBuilder also has many editing functions that 3D modeling programs have, such as manipulating vertices, faces, and edges.

Day 15:

In order to create openings in the walls suitable for doors and windows, I have to import the untextured models of those assets. These need to be adjusted for scale and can simply be replaced with the unwrapped versions when they are available. I will probably need to import some others as well, including the sofa and coffee table so that the sitting room does not accidentally end up too small.

Unfortunately, I only learned hours into my use of ProBuilder that the pivot can be set at any edge or vertex. This is very useful when snapping objects to the grid. A coworker and I also accidentally discovered the shortcuts for changing between object, vertex, edge, and face selection. This allowed our work to progress more efficiently.

6.1.1   UV Unwrapping

Day 1:

As mentioned earlier, with assets such at the antlers where there are pieces mirrored, I can unwrap one of the pieces and copy it which will transfer the UVs to the new piece. This means I will not have to unwrap the same shape multiple times. There are also other cases such as the railings in the sitting room, where I have unwrapped the pieces before duplicating because of the number of duplicates I had to make. I am exporting the assets as I finish the UVs, this saves me time when assembling the scene because I will not have to open the Maya files again and export everything individually.

Day 2:

As I work on the assets I have to keep in mind how I want to texture them. For example, wooden sections should have the UV islands facing the same direction so that the wood grain in the texture is positioned the way I want it to be. If the faces are in the wrong direction I would have to spend time during texturing to create two layers of wood texture in Substance Painter. One layer at the correct angle, and another identical layer that has been rotated. I would prefer to avoid this type of situation. The same goes for parts of furniture that I want a golden detail to. I am separating those sections in the UV completely to avoid having to paint the precise lines by hand or select the faces individually in Substance Painter.

Day 3:

Unwrapping for the most part has had very few difficulties in this project. The props have clear shapes and have relatively low poly counts. In the case of some smaller asset sets such as the breakfast tray and the vases I made the decision to put them in the same UV space. In the image (Figure 22) the breakfast tray asset is on the left and its corresponding UV is on the right. While the asset is exported as a single fbx file, all of the items on the tray are still separate. This will let me texture the assets as a whole. The props themselves are so small that it would be tedious and pointless to assign them each a separate UV. After texturing, I will return to Maya and export them individually so that they may be used throughout the game if needed. The UV islands are arranged so that the pieces of a single item are all within close proximity to each other. This makes texturing easier for me because I will not have to search for the right UVs when there are so many small islands.
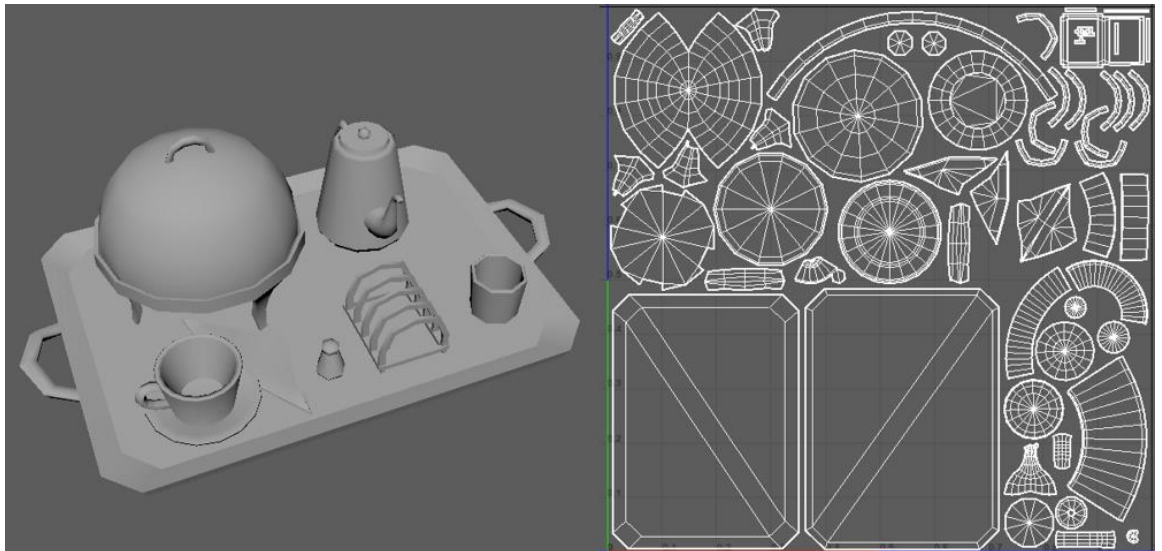
Figure 22. Breakfast tray asset (right) and UVs organized by item (left).

6.2   Texturing

Day 1:

I can speed up my texturing process by creating material presets in Substance painter. This means when I begin texturing a new asset, I will have access to materials used in previous assets. These materials will already have the correct color, normal intensity, roughness and so on. Being able to do this is very useful in maintaining the cohesiveness of the environment.

The chaise lounge caused problems yet again. Substance Painter was unable to generate decent looking ambient occlusion onto the plane. In this project, in order to have a two-sided plane such as this cloth I need to duplicate the original and reverse the direction of its normals. There was a slight issue with this. I believe it began when I mirrored the original cloth in Maya and this caused an interesting effect that made it seem like the normals of the plane were wrong when by all accounts they were facing the correct direction. This mirrored cloth created strange ambient occlusion effects and shadows in Substance Painter. Creating a new cloth in a similar shape would have been too time consuming. However, I had luckily saved the original mesh in my Maya file. I did not encounter any problems in its texturing.

Day 2:

For the decorative vases, I created custom alphas of laurel leaves to use in Substance Painter. I am quite satisfied with the end result (Figure 23). It was difficult for me to not over-design the texture on the vases. Too much detail in the texture would not suite the simple texturing style of the rest of the environment and game. However, I still wanted them to have details that echo the Russian imperial style and opulence. I also made alternative textures for each vase. The alternatives are the same patterns with different colors. This will allow me to duplicate the asset more throughout the environment without it being as obvious that it is the same vase. By doing this I am also utilizing the concept of repetition of shapes that Cox (2016) speaks about

Figure 23. Color swap on large vase asset to add more variety.

Day 3:

A small inconvenience I have run into has to do with asset materials. In some cases I have failed to make sure all pieces of the model that should have the same material are marked as such. I am only now noticing the issue in Substance Painter when there are multiple texture sets for one model. This means I have to open the Maya file and manually fix the materials. However, some assets such as the framed portrait (Figure 24) have two different materials intentionally. These two materials belong to the frame and the painting that will be inside it. This is easier in the long run because it allows me to texture the frame before the painting is done. If they were both in the same texture set, it would have to be a large texture and the scale of the painting would have to be quite large as well. This would leave the frames with little room and the detail I would be able to add to them would be limited.

Figure 24. Picture frame with a different material for the frame and the painting. A deci-sion made for texturing to be easier.

Day 4:

I find myself going back to Maya to separate some of the assets. A perfect example of this is the breakfast tray (Figure 25). I want to texture all of the pieces of this asset at the same time. However, I do not want to bake ambient occlusion in Substance Painter that has all the separate components interacting. This is because I want the option to move the pieces away from each other. What I can do is import the separated version into Maya, bake the ambient occlusion, then replace the mesh file in substance painter with the original. This will preserve the previously generated maps and allow me to texture the asset as a whole.
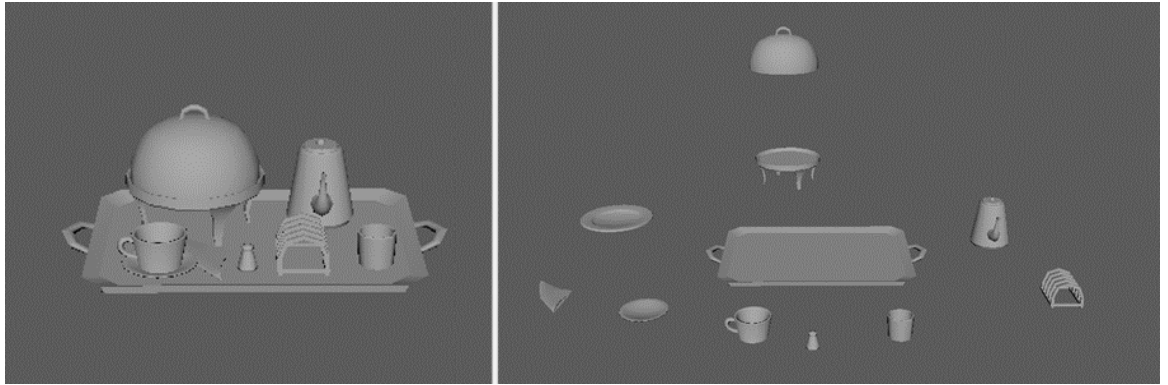
Figure 25. Asset with many components (left), separated for baking ambient occlusion (right).

If I were to bake ambient occlusion maps with the asset assembled, the result would be undesirable (Figure 26). The items have cast rings onto the tray that would of course remain there were the items to be removed in Unity. Furthermore, I have decided against importing this asset as one fbx into Unity. The reason being that if the pieces of this asset are imported separately, it is much easier to possibly re-use them later. As for the breakfast tray, I will assemble it and create a prefab for it as a whole in Unity.
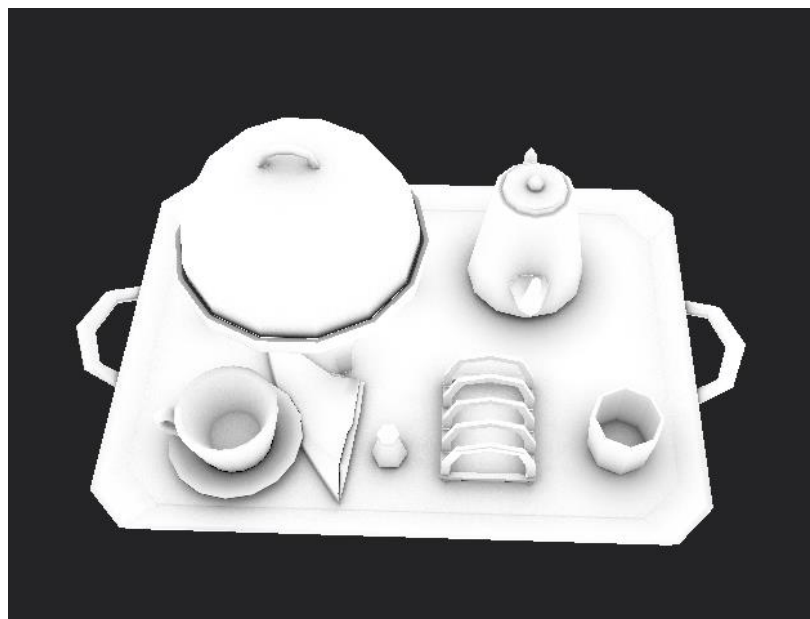

Figure 26. The problem with baking while asset is assembled. Shadows on the tray are not wanted in the final texture.

Day 5:

There is an issue with the way the light hits one of the curtains. It is similar to the problems I had with the cloth on the chaise lounge. I believe it originates from the plane the cloth is

made from being mirrored. The issue is solved by deleting the curtain that looks bad and replacing it with a duplicate of the good one. However, after doing this a portion of the UVs for the asset are not being fully utilized. I have decided to leave the asset as it is for now, and if I have the time I will return to it either later in the texturing phase or in the polish of the project. The unused UV space is not significant enough to be a high priority fix.

Day 6:

The ostrich's texture was challenging. This was due to discovering the issue with sculpting earlier in the project. The time required for me to familiarize myself with and become comfortable with a new program would not have worked with my schedule. Not being able to sculpt meant that all of the detail in the model would have to come from normal map details created in Substance Painter. Thankfully the game's art style is not photorealistic, and I was able to take some artistic liberties with the texture.

Day 7:

ProBuilder's textures are tiled, and the pieces are already unwrapped. This means if I want to create custom textures, the easiest way is to make the texture in Substance Painter on a 1:1 plane. Once I make sure the texture will tile, I can export it and I will have a texture to work with. This also makes things quite easy for me, because I do not have to unwrap the walls, floor, or ceiling. Painted walls and ceilings need little to no detail. The walls in the other parts of the game, for example, are for the most part only base color. The ceiling texture I am sure can be found in the project, so it would be pointless for me to create another one.

Day 8:

The bathroom walls have a wooden panel that comes approximately halfway up the wall. There are a few ways I can accomplish this, and I am not sure which is the optimal one. For this reason, I did not do this earlier in the modeling phase. The panels have a slight indent to them. The most logical way to create this is with a normal map detail in the texture. This is why the first method I am going to try involves modeling the border separately in Maya and importing the custom model to Unity with the detailed texture. First, I exported the bathroom I made with ProBuilder, this would let me make the border the exact size and shape it needs to be. I imported the mesh into Maya where I created the border and from there I imported the border into Substance Painter where the indented

detail could easily be added. Finally, the border was imported into Unity to check that it was indeed the correct scale and fit.

Day 9:

Since the furniture and clutter has been textured, that only leaves me with the paintings that hang on the walls. I left these digital paintings as the last part of the texturing phase because I was not sure how long the process would take. Now that I can see how many days I have to complete them I can work an appropriate pace and adjust my workflow accordingly. There are three paintings I aim to complete, one of them is a portrait of the character and the others are parodies of famous paintings altered to feature Bolscotchko-vich. The paintings will be completed using Krita.

I painted a digital portrait of the Bolscotchkovich during my work placement. Since I do not want to use the same one, I need to paint another one for this project. The reason for this being, I feel I will be more satisfied with the second painting. During the time between these paintings I have learned more about digital painting and I want to practice those methods and techniques. The purpose for these paintings is also different. The first was for a book cover and was meant to be a more realistic depiction of the character. The second is meant to be a commissioned portrait that is more flattering.

Day 10:

One of the paintings is a parody of the Creation of Adam originally painted by Michelan-gelo. I have opted out of painting the additional characters behind God in the original, simply for the sake of time and clarity in the final product. I want to stay true to the look of the original painting while not getting too stuck in the finer details. I am doing this by using larger brushes and not zooming too far into the canvas. By tracing the painting to begin with and color picking from the original I can save time in my process. Normally I would try to avoid tracing an image at all costs. However, in this case it is clear that the painting is not meant to be an entirely original and unique piece of art but an adaptation of a very well-known one.

Day 11:

To look at the painting process as a whole I will use the completed Michelangelo painting as an example. I begin the painting process by loosely tracing the original work. After this I make the necessary changes, in this case I change the subjects of the paintings. In this case the painting now feature Bolscotchkovich and Stalin. The reason behind this is that

Bolscotchkovich feels entitled to greatness, he looks up to communist figures from the past for guidance. He hopes that in some way, he can continue their legacy, whatever that may mean to him. As an example, below (Figure 27) I have included the modified sketch for the painting. I mentioned earlier that I opted out of the additional characters in the original. This meant I had to come up with something else in their place, this was mostly repetition of what I could see of the background; cloth. Symbols of communism were an obvious fit to add to the composition with Stalin. He has his right arm around a globe while in his hand a red pamphlet marked with a gold star, implying that he is holding propaganda.

Figure 27. Modified sketch of the original painting. The changes are already very evident.

Rough colors which I have picked from the original are added underneath the sketch layer (Figure 28). This helps with the painting stage and can highlight troublesome areas. I can also see at this point if the color palette works. Since I am mostly picking colors from the original, I know they will for the most part. However, my additions and modifications should not stand out too much. In this part of the process it is still easy for me to switch colors around to find ones that work best. The globe Stalin is holding is a green-blue shade to echo the green cloth and balance the colors because there are mainly red hues on the right side of the painting. Bolscotchkovich's pants are a deep blue on the character model, here I am again attempting to create balance by making them slightly lighter and less saturated.

Figure 28. Rough colors under the sketch, while not meant to be entirely clean, they establish the palette and make sure the colors all work well together.

The last step is the most time consuming, painting on a layer above the sketch layer. Figure 29 below shows the result. During this step I can freely adjust and make corrections to the original sketch. The painting layers are divided by background, middle ground, and foreground. This is so that I can freely paint the background without disturbing the subjects in the foreground. In each of these separate layers most of the painting happens on a single layer. I believe this decision is mostly dependent on personal preference. I prefer to use brushes that have a slight blending effect and working on a single layer allows me to blend more efficiently and achieve the results I am looking for. The finished painting has thicker outlines than the original does. I did this to give a more stylized look and to try to keep the painting from being too realistic in a game that does not have a realistic style.

Figure 29. The finished painting featuring Bolscotchkovich and Stalin in the place of Adam and God respectively.

Day 12:

The other painting is The Birth of Venus originally by Sandro Botticelli. The style is different from the Creation of Adam and it will take me some time to adjust to that way of painting. It is definitely much easier to recreate these paintings digitally than to go through the process traditionally. Again, I have decided to exclude people other than the subject from the painting in order to save time. If I had unlimited time I would stay as true to the original as I could. In this case Bolscotchkovich in the place of Venus is the only one in the painting. This also serves the purpose of placing him in the center of attention, reflecting how highly he thinks of himself.

6.3   Concluding thoughts

Modeling, unwrapping, and texturing are quite closely intertwined. In other circumstance I would advise against first modeling everything for an environment, then UV unwrapping, and finally texturing it all. It does not leave much room for error as far as time constraints. In my project I am in control of the schedule and deadlines which allows me to create the assets in this way. Different situations run the risk of unexpected problems. This could mean running out of time before all of the textures are finished. The reason why I did the project in this way was for the structure it provided my project.

I began these phases with a set list of assets, which helped with time management. The list had been previously approved by the company, and the environment is mainly my responsibility. This means I knew that during the modeling and texturing that any possible additions or subtractions to the list would come directly from myself. The list was quite flexible, and I had a few assets which I was willing to cut from it in case that was necessary. Since I had a predetermined list and I was the only one working on these assets, I felt it was most efficient to complete the phases separately. This also meant I did not have to constantly switch between modeling and texturing software. Feedback at regular intervals form the company was of course not ignored. Any additional assets wanted or suggested by coworkers would be added at latest during the polish phase unless the schedule allows otherwise.

Due to time constraints, the concepts I was working with were quite vague. To make things easier for myself I created more detailed sketches in my notebook as I worked. These sketches helped me form the final designs. I tried to avoid taking shortcuts in modeling with assets proved to be more difficult that expected. I pushed myself to stay as true to the original designs as I could. The challenge of creating the environment as close as possible to the one I had envisioned in the beginning of the project was enjoyable. Attention to detail in the assets was important, I wanted to ensure that the models were consistent and complemented each other. Using knowledge and familiarity with the game's other environments, I was able to determine the baseline for the appropriate level of detail and complexity in models.

While most of the assets were made specifically for this environment there are a few that are pre-existing assets that were modified. It is important to set aside the pride of having made everything by myself for this project, instead focusing on the efficiency and logic of using something that already exists. On a similar note, it is important to know when to let go of an idea. An example of this would be the swinging rope I was looking into during the modeling. It was an idea that came up but inevitably had to be abandoned. I did not know how much time I could devote to another foreign concept. I made the decision to postpone it in case there was time for it later. I had also planned to sculpt the details of the ostrich asset, but ended up having to adapt to what I had the time and current skills for.

I faced some unexpected difficulties working with Maya LT version, and found solutions through Blender. This was one of the few things I had to adjust to; learning to work with a lack of cloth physics in my preferred modeling software. I had to work with the limitations of Blender's cloth physics. On the bright side I now know more about the software and the capabilities of its cloth physics simulations. I also learned to use ProBuilder, which was

very intuitive and just as useful. Its use mostly eliminated the need to export and import from modeling software. I ended up learning a lot that will benefit my work in the future.

When it came to unwrapping the models, I wanted to work smarter, not harder. I practiced thinking ahead to what would be the most efficient way to do unwrap to make the whole process easier on myself. For example, unwrapping repeating elements before duplicating them in the model. This saved me from doing repetitive work needlessly. I also paid close attention to UV island orientation. If I wanted the wood grain in a texture to be facing a certain way, I had to make sure the UVs reflected that. The model shapes were all quite straightforward and were therefore easy to unwrap. I had no significant problems regarding UVs in this project.

I adapted to unexpected limitations of how I could texture certain assets. After coming to the conclusion that I would not be able to sculpt the details of the ostrich as originally planned, I did the best I could with the tools Substance Painter has. The one consistent issue in regard to texturing was related to cloth sections of assets. In this project a cloth will appear as two planes; each plane having the opposite normals direction. The problem occurred with the normals, often after the use of the mirror tool. This was easy enough to solve by looking for alternative solutions until it was no longer an issue.

In the beginning of the texturing stage I used my knowledge of Substance Painter's material presets to create materials with the correct colors and texture attributes I wished to use throughout the scene. Meaning, even when I started texturing a new asset, I still had access to the textures. This saved time and contributed greatly to the consistency of the assets. I also utilized the fact that Substance Painter allows the user to use custom alphas. This can be seen in assets such as the vases, in the form of the laurel leaf details. The vases, as well as other assets, also have alternative textures in the form of palette swaps. This allows for the semblance of more variety with the use of fewer unique models.

Determining the style for the 2D paintings required me to study the original well-known paintings I would be mimicking and adapting my style accordingly. I was able to add more humorous elements to the environment with these paintings while developing my digital painting skills. By analyzing the process, I was able to explore a more streamlined and efficient painting workflow.

7   Assembly

Day 1:

Originally the polish phase came after the texturing, however I have decided to postpone the polish until after the assembly. Before assembly it would be difficult for me to spot things that need to be fixed. I have already found parts of the tiling wood floor that do not tile well. I would not have noticed this any earlier in the process. As I add more assets into Unity, I will keep a list of things I should go back and fix. I am organizing the scene with individual folders for assets. These folders will contain the mesh and corresponding textures and materials.

Day 2:

For the sake of organization and clarity, I am renaming all of the texture images. The default names Substance Painter has given them are, in my opinion, unnecessarily long. For example, in place of albedo transparency I am using "alb". This would mean an asset's albedo texture image would be named "asset_alb". Consistency through the scene will make it easier to find individual files if needed, and this way I can avoid long file names where they are not needed. Materials, texture files, and meshes share a similar name aside from differentiation between textures. This is to ensure that searching the project using this name will bring up all corresponding files.

Day 3:

The scale of the object is a small problem I have been having. Everything looks to scale in Unity until play mode is activated and things are seen from the perspective of the player. I decided to bring one of the enemy guard models into the scene as scale reference. I realize now that I could have saved myself time had I done this to begin with. For the most part assets were to scale with the guard. However, one of the biggest issues was to do with the doors, which had handles that were far too high to be realistic. This was already quite clear from the player's perspective.

7.1   Polish

Day 1:

I was done with the initial assembly of the scene one day ahead of schedule, so I have decided to add the extra day to the polish stage of the project. This changes the length of the polish stage from three days to four days. During this time, I can make use of the list of problems I compiled previously.

Before I get to that I begin with making door frames and wall strips that will give accents to otherwise plain walls and help better separate areas. These particular details appear elsewhere in the game and will not be out of place in this environment. To fix the tiling issue in the floor I merged the ProBuilder pieces and exported it. I separated the floor from the rest of the exported object and fixed the UVs so that the seamless texture would work seamlessly.

Day 2:

Some polishes are faster and easier to complete than others. Moving vertices in a model can be done without having to touch up the texture if that area of the model does not have texture detail. An example of this would be the toilet asset (Figure 30), where I felt the top of the asset was too low from the player's perspective. I was able to raise this part without distorting the texture because the pipe is a solid gold texture and has no detail that would become distorted.

Figure 30. The toilet asset's water tank appears to sit too low when viewed in game.

Other fixes have included a warped pattern on a large vase. For some reason the texture that was exported from Substance Painter became strongly warped. I believe this was to do with the curvature of the vase's UV. I have not encountered a similar problem before, but from what I have heard it is not that uncommon. I was able to eliminate the warped effect almost entirely by unwrapping that part of the asset again and re-texturing it.

Day 3:

After all assets are in place I will need to provide them with colliders, specifically box colliders as that is preferred by the rest of the team. There are some assets where box colliders are impractical, such as the bed. It is completely round and attempting to give it an even remotely round collider with boxes is a bad idea. Instead I created a mesh collider for it in Maya by modeling a very low poly representation of it over the final asset.

As I suspected, there is need for additional props to the environment. When all current assets were put into place it became clear which areas were lacking. With feedback from my coworkers, we were able to determine a starting point for the additions. It can be difficult to see what is missing, so a second or third pair of eyes really helps. The greenhouse section for example: there are many plants yet no equipment to take care of them, such as watering cans. Adding these small things contributes to the believability of the space.

During the UV unwrapping of the watering can I encountered a problem with Maya. I noticed that the UV tools were acting strange, unfolding one UV island was affecting the entire mesh's UVs. Thankfully the issue was solved by deleting Maya's user preferences, which I learned is a very common troubleshooting action for the software.

Day 4:

The environment has paintings featuring Bolscotchkovich, which he had commissioned by professional artists. In contrast to this I decided to create framed drawings drawn by Bolscotchkovich himself (Figure 31). The contrast will be all the more jarring because he cannot draw, and I want the results to look as though they were created by someone much younger. This small addition is quite revealing about the character. It is another detail that allows the player to learn more about who inhabits the space. Children's drawings are often haphazard in nature with seemingly little to no planning and a complete ignorance to basic drawing principles. To accomplish a similar effect, I drew the pictures with my non-dominant hand. Because of this, I had a lot less control while drawing which I believe contributed well to the child-like style I wanted.
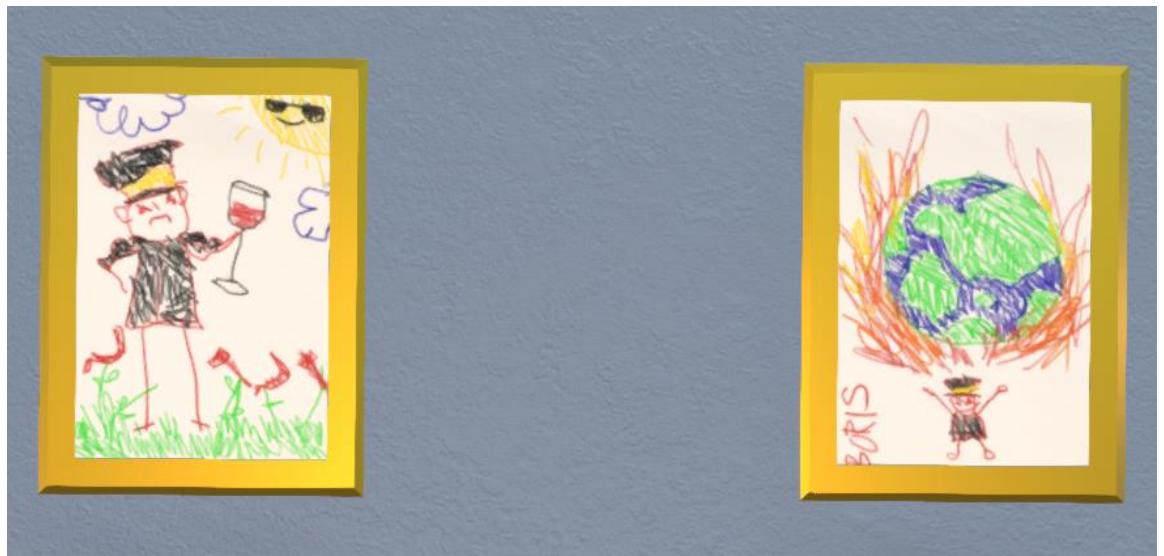

Figure 31. Drawings that mimic the style of a young child. Bolscotchkovich is clearly not as talented as the artists hired for the other paintings in the environment.

I also set up the initial lights in the scene. This means creating prefabs of lamp assets with lights in Unity. I am unfamiliar with how lighting works in Unity, however, my coworkers have been helpful as always. After I have set up the lights myself, I will make adjustments accordingly based on feedback from others.

7.2 Concluding thoughts

I made the decision to swap the polish and assembly phases. It did not make sense to polish the assets and environment even before they were assembled in Unity. I would not even see some problems until the assembly phase. During this time I kept a list of things that needed to be fixed in the polish stage. This way I would not be tempted to become sidetracked on making the necessary changes ahead of schedule.

Consistent naming conventions for textures eliminated unnecessarily long file names that are often a result of exporting from Substance Painter. This makes is easier to search for all the files related to an asset if they have similar names. The names also help differentiate different types of textures. An asset's name remains the same throughout the files, but for texture maps an additional indicator is added to the end of the file name. Such as 'Asset_alb' or 'Asset_mtl' for albedo and metallic texture maps respectively.

The aforementioned list of polish items was incredibly useful. I was able to keep track of what needed to be changed and the list ensured that I did not forget anything. Some polish only consisted of moving vertices and in this case it is possible the texture does not need to be updated. Most fixes to textures were minor, such as texture maps distorted during their export.

Having made the walls of the scene with ProBuilder, the polish phase was much easier. Rather than having to modify the walls and floor in Maya separately, I was able to make the changes needed directly in Unity. This let me see what changes worked best a lot sooner than I would have otherwise. Some changes included adding trimmed details to the tops and bottoms of the walls. This is also something that is elsewhere in the game and thus this detail helps maintain a homogeneous style. Small things such as this added interesting elements to what would have been plain surfaces.

I finished up the final phase of this project by adding lights and colliders to the scene. This was something I do not have previous experience with, and it was interesting to learn something new. Figure 32 below shows the finished bedroom with baked lighting. The dimly lit room adds a mysterious atmosphere. Attachments 1-5 show the final results for the rest of the scene. Box colliders were used for the most part unless a mesh collider was needed. More complicated shapes such as the ostrich or very round ones such as the bed required a mesh collider. I determined which assets needed mesh colliders, which were pickable by players, and which would remain static.

Figure 32. A screen capture of the bedroom with lighting in the scene.

8   Conclusion

The aim of this thesis was to gain experience in creating an environment designed with storytelling elements in mind. The process would begin with the gathering of information and end with the finished scene in Unity. The goal was to learn more about the subject and apply what was learned to the work. As a whole, this thesis was an extensive endeavor for a single person. Although the process from start to finish was a long one, the author feels it was entirely worth it.

Before the beginning of the project, there was some knowledge on the subject of environmental storytelling. However, experience in the practical application of the theory was lacking. One of the project's purposes was to rectify this. The project was also completed for the company Catland, as an environment in their upcoming game.

There are many ways to use non-verbal storytelling. This thesis focused on visual storytelling, where even the smallest details serve a purpose. The research completed in the theory section solidified the importance of knowing what one wants to communicate to the player. Knowing this at an early stage in the creation of the environment is also an advantage.

The project began on a rather solid foundation of theory, due to previous research on the subject. There were, however, difficulties finding sources that discussed the topic from a view other than a technical game design perspective. New research provided insights that had not previously been considered. The author was interested in the information that was found on the link between interior design and environmental storytelling. The gathered information about interior design principles was greatly beneficial to the planning of the space.

The author benefitted from the fact that storytelling is not an uncommon topic to be discussed within the game industry. It was useful to hear about it directly from professionals who use the methods in their day to day work. In turn the author will be able to apply this knowledge directly to their career in the future.

The majority of the difficulties encountered during this thesis process were software related. These were the largest cause of time delays and changes to asset appearance. Maya LT's lack of cloth physics called for the use of an unfamiliar software that required some adjustment on the author's part to become accustomed to. A lack of experience in sculpting should have prevented the plans to sculpt an asset. The idea was discarded

during the project due to time constraints and in hindsight should probably not have been planned to begin with.

The design of the space changed from what was originally planned. These changes were found to be positive, as the new layout had a better flow. In terms of scheduling, there are some times when the author would have had use for more days to work on a particular section of the project. Adjustments had to be made due to this. As an example, asset concepts were drawn on paper conjointly with the modeling phase. A part of the original project plan was also altered slightly. The order of the polish and assembly stages was switched. Polish now came after assembly, which the author sees was a more logical choice.

Keeping the design choices intentional was successful. Research and concepts provided time to put enough thought into the environment. The author was in control of the pacing of the project, which allowed for them to make decisions such as how many assets should be modeled in a day. Tracking progress of assets through the color-coded list that was created was very helpful. There was determination on the part of the author to push themselves to remain as true to the design as possible, even when difficulties arose. Time management was also successful in this project, as the different stages were structured well.

From the point of view of the author, the thesis was completed successfully according to expectation. The final environment incorporated storytelling in a clear way while still allowing players to come to their own conclusions. There is a restrained amount of detail, and all decisions were made with the purpose of saying something about the character. The company that this project was completed for was also satisfied by the end result.

The storytelling in this thesis focused more on an individual. The texturing style for the game was also not very realistic, limiting how much information could be conveyed through texture. Possibilities for further study on this topic include using what was learned and applying it to tell a story about a world or society rather than a singular person: an examination of how world building can be achieved visually.

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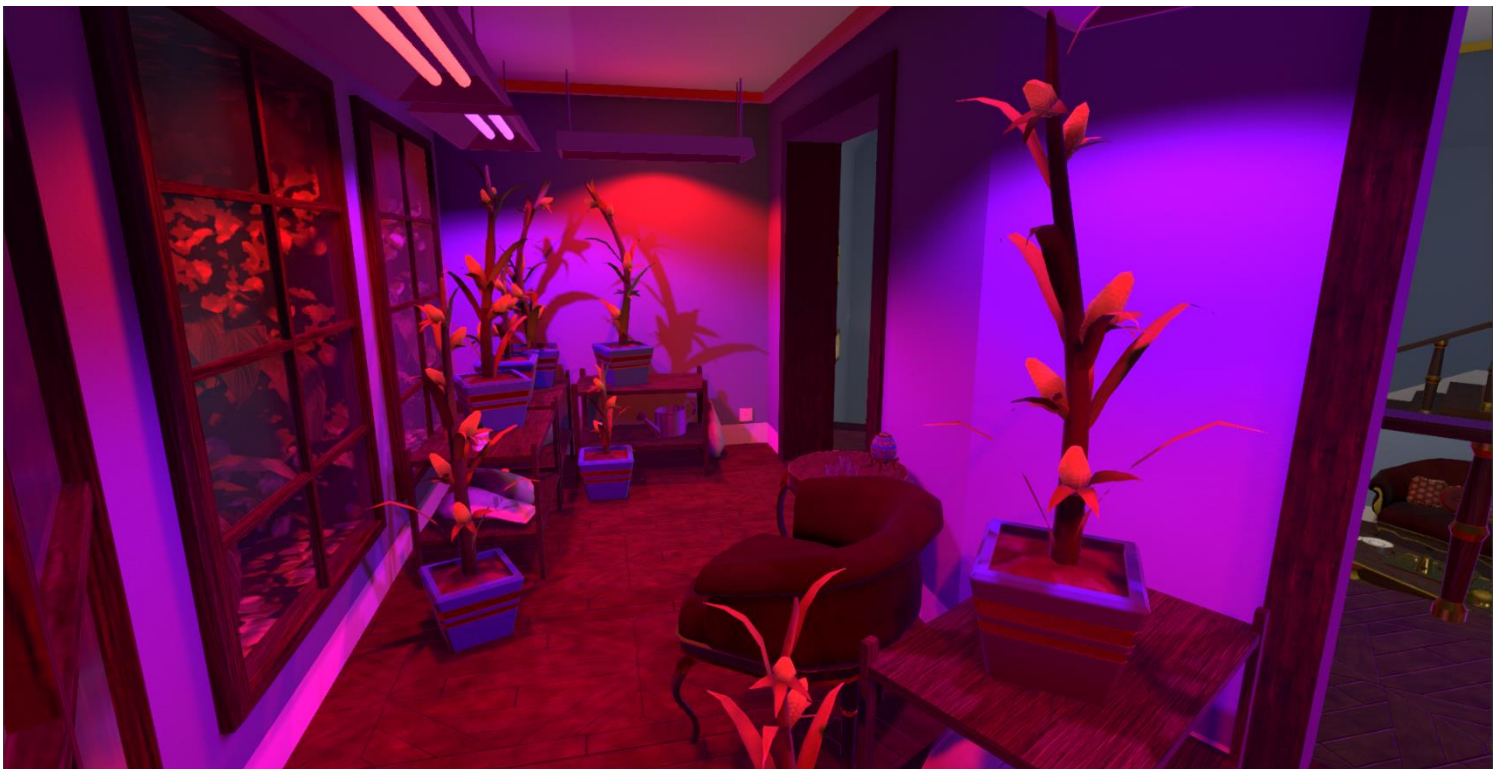
Attachment 1. Screen captures from the bedroom.

Attachment 2. Screen captures from the sitting room.

Attachment 3. Screen captures from the small greenhouse area.

Attachment 4. Screen capture of hallway area.

Attachment 5. Screen capture of the bathroom.