CREATING ENTERTAINING ANIMATIONS FOR SAFETY EDUCATION

A Thesis

by

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ABSTRACT

There has been previous research on how to make animation entertaining and engaging for a variety of industries, not just for the entertainment industry. There has also been an extensive use of imagination in books, film, and animations that are meant to bring excitement to stories. In order to make the animations entertaining for industries other than entertainment, I am presenting a methodology to use traditional storytelling techniques for safety education, where technical information and/or directions need to be expressed in a creative way. My goal is to provide a foundation of knowledge that could help artists create interesting and engaging visual stories based on any script, which can lead to the creation of entertaining animations for safety education.

My research work is based on a project given by the Texas Department of Transportation that included creating seven individual 2D safety education animations. The animations were about mice siblings, Harley and Hobbit, who learn new safety lessons and procedures. As I worked on the storyboards for the animations, I thought about several methods to make the safety animations more entertaining, such as establishing a relationship between characters, incorporating dynamic compositions, establishing familiar settings, and incorporating imagination sequences.

Overall, by combining traditional concepts used in entertainment animations and implementing new methods for creating engaging stories, I hope to make the educational animations informative and fun to watch.

DEDICATION

To my parents, my sisters, and my family, who have always supported and encouraged me.

CONTRIBUTORS AND FUNDING SOURCES

Contributors

This work was supervised by a thesis committee consisting of Professor Ergun Akleman and Professor Felice House from the Department of Visualization, and Dr. Eva Shipp from the Texas A&M Transportation Institute. Myunghoon Ko and Amber Trueblood, also from the Texas A&M Transportation Institute, served as additional advisors for the thesis work.

The methodology given in chapter 3 and the results thereof were employed by the student, with the input of Professor Ergun Akleman.

Help and feedback for the implementation were given by Paige Ericson-Graber, Lydia Bryan-Valdez, Carol Campa, Terry Pence, Michael Chacon, the Texas A&M Transportation Institute, and the Texas Department of Transportation.

All other work conducted for the thesis was completed by the student independently.

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1. INTRODUCTION AND MOTIVATION

1.1 Motivation for Education Animation

Animation has long been considered as an effective education tool [14]. As soon as animation became an important medium in the early 20th century, educational animations have been created [10]. Such animations have really grown over the last couple of decades, with many different types and styles created for all ages [9]. With the introduction of electronic games in the 1970s, interactive education games quickly become commonplace [3]. In those games, the audience can interact with the characters or objects in the environment. The key issue in both entertaining and educational animations and games is that they should be understandable. The main focus of educational animations and games is the lesson or information. However, it is critical for educational animations and games to be interesting and engaging in order to be successful [4]. Therefore, for all educational animations or games, there is a need for making the final pieces understandable and interesting to be successful in conveying lessons and tips to the audience.

Even though the animations may be targeted for a certain age group, we want the animations to be entertaining for all ages. In order to entertain audiences of different age groups, it is important for the animations to be engaging and relatable [2]. The animations are meant to teach lessons in a fun and engaging way, using bright colors, unique environments, and stylized characters. While toddlers who watch the animations might not understand exactly what is taught in the safety lessons, they still could be engaged with the animations due to the animal characters and the exciting environments [11].

This means we need engaging stories and interesting compositions. For instance, characters, character interactions, camera angles, and environments are all key to creating engaging stories and interesting compositions that allow the audience to become drawn in.

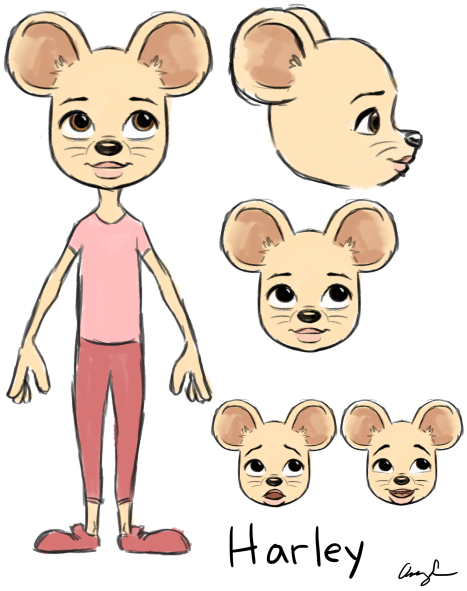
For educational animations, the right choice of a composition can showcase important information, while entertainment compositions highlight key visual cues and where to direct the audience's eye so that the story can be interpreted accurately.

1.2 Introduction

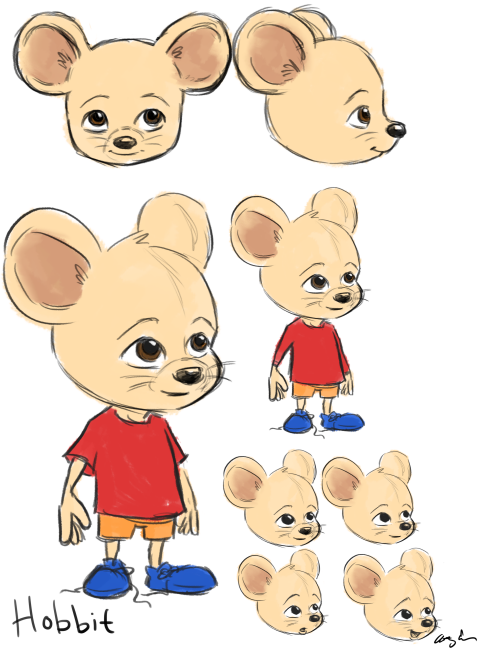
In this thesis, I have created seven different animations about safety education for the Texas A&M Transportation Institute (TTI) and the Texas Department of Transportation (TxDOT). At the start of the project, two characters were already chosen by Texas Department of Transportation (TxDOT): Harley and Hobbit. They were both anthropomorphic mice, Harley being the older sister and Hobbit being the younger brother. The main idea throughout the animations was that Harley would be teaching Hobbit safety lessons as they go about their day in their neighborhood and nearby environments.

To make the stories for these animations more engaging and the compositions more interesting, I have developed a set of methods. In this thesis, I present those methods and explain how they were used in the assigned project. Initially, the project started with storyboards, then moved into animation production. Once I started to create the storyboards for the animations, I realized that there would be many challenges creating visual stories that were not meant to just entertain audiences, but also portray important educational information. However, even though the project presented new challenges for story development, it also resonated with the fact of how important visual storytelling is when creating an animated feature. The important principles of traditional movie making and animation, such as interesting compositions, posing, camera angles, and research or study of characters and environments, are just as relevant to safety education scripts as they are to any major animation studio's story scripts.

By identifying what important principles of animation I needed to apply to the safety animations, I was ready to start storyboarding. As I began with the first animation's story-



(a) Harley concept by Anthony Eason



(b) Hobbit Concept by Anthony Eason

Figure 1.1: Character concept art versions for Harley and Hobbit. Dr. Ergun Akleman first began with the concepts and received feedback from TxDOT about the colors and styles of the character's clothes. I then worked off of Dr. Akleman's designs and created concepts in my own style

boards, I kept in mind where I was placing the characters in the frame and determined the camera angle for the shot. By thinking about how I set up the frames, I was able to apply the traditional principles of animation to achieve more interesting compositions. After I completed the first storyboard and presented it to my advisors for the project, they were very happy with the results and found the camera angles and compositions more interesting. I went on to create the second storyboard for the project using the same traditional principles of animation.

After I created the first two storyboards, keeping in mind to use dynamic compositions in each frame, I ran into a little roadblock. While I was drawing a diversity of compositions and poses for the characters, the content of the script made it difficult to tell an interesting and engaging story. Most of the scripts had lots of dialogue with just a few instances of actions between the main characters and neighboring characters. I thought about what needed to be added to the initial stories so that they would be more engaging and entertaining.

1.3 My Contributions

In order to make these stories engaging and interesting, I have developed four methods to implement into the storyboards. The methods are:

1. Establishing a Relationship between Characters
2. Interesting Camera Angles
3. Identify Familiar Setting
4. Using Imagination Sequences

I will go into more depth of each method in a later chapter. These methods helped the animations reach a level of interest and entertainment that was satisfactory.

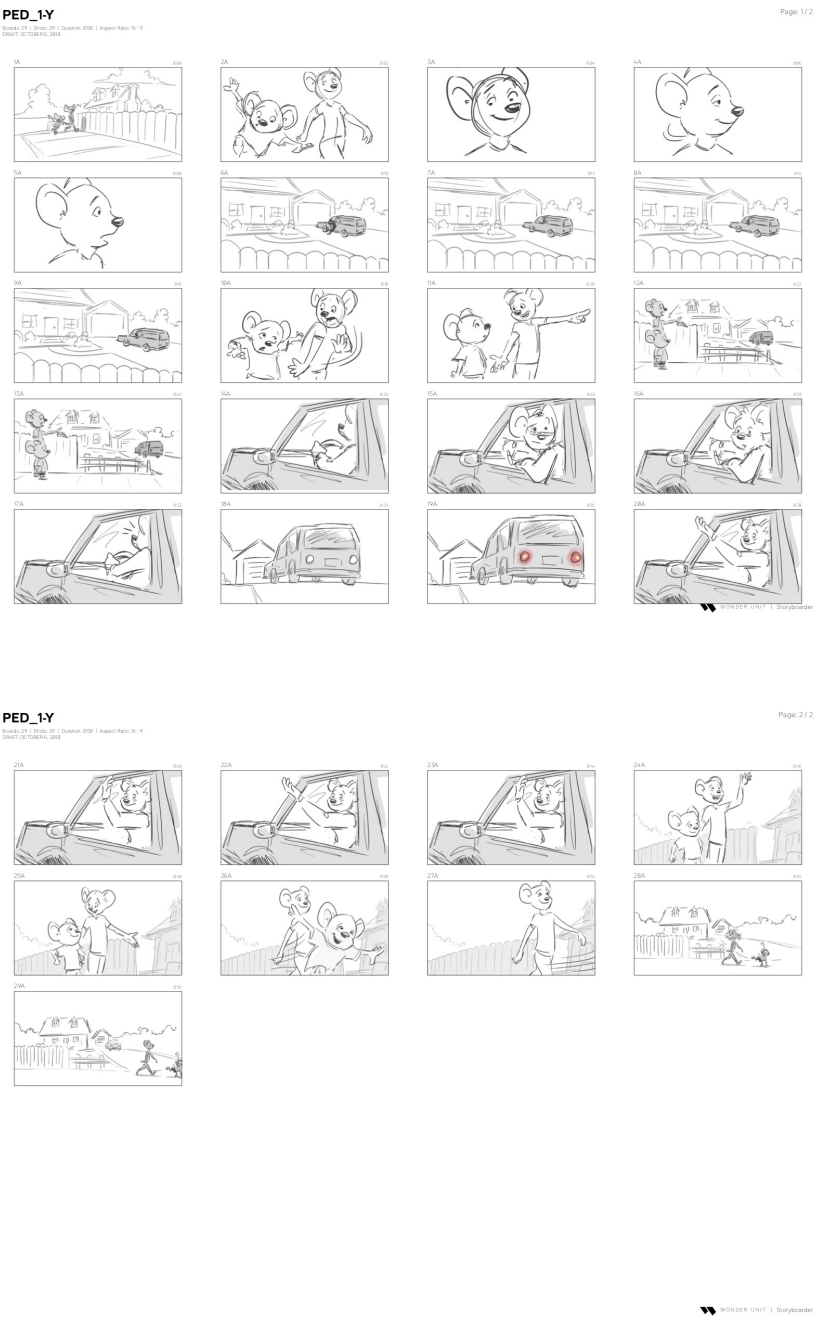


Figure 1.2: One of the first storyboards I created for the animations. I implemented interesting camera angles and compositions, but haven't started to use imagination sequences at this point in the storyboard development.

2. BACKGROUND AND PREVIOUS WORK

2.1 Animation for Education

Lirong Xiao has classified animation used for educational purposes into three categories: interactive, quizzes, and expository animation [14]. Expository animation is an animated video that conveys a concept to an audience. She claims that there are mixed reviews about whether or not animated videos are more beneficial than static graphics and images, but the main reasoning is depending on the content that is needed to be taught [14]. Interactive animations are more enhanced experiences in which the user can actually control the narrative while learning about a topic. The advancement of 3D software and technology, especially virtual reality, has pushed the limits of storytelling and has allowed students to become even more immersed in whatever topic they are learning about [8][14]. Finally, animations can help serve as quizzes to test students in a variety of topics. Whether it is using expository or interactive animation methods, students could also watch animated videos to test their knowledge over a particular subject.

Richard Lowe and Wolfgang Schnotz have explored how users comprehend animated visuals to convey a concept. Ultimately, there needs to be a system where the visuals are allowing a flow of understanding to the concept conveyed [5]. They proposed a term called "mental animation", in which users take an animation and break it down into its key components and chain of events, which in turn results in spacial visualization and realization of the concept[5].

Gary Fisk has explored using animation for forensic pathology and for science education. In his research, he has developed steps for using animations as instructional aids. The first step is to gather all of the educational objectives that need to be conveyed in the animations [1]. Second, the animator must understand the audience that the animations

will be conveyed to, and the capabilities of how well the audience perceives animations [1]. Third, the animator must create animations that meet both the educational objectives as well as the capabilities of the audience [1]. As the presentation of the animation is conveying information to the audience, it is important for any narrative stories to incorporate events that will facilitate the educational objectives [1]. Finally, it is important to review how well the animations were received and understood by the audience [1].

Fisk has also explored multiple ways animations can be used, as well as recommendations for the conditions to use these animations. Some examples of the instructional roles of animations include as an attention guide, an aid for illustration, a device model for forming a mental image, or a visual analogy for a complex of abstract concepts [1].

2.2 Imaginative Stories

Later in my thesis, I will describe how I used imagination sequences to make the storyboards for the animations more interesting. There have been several inspirations through my life where imagination was used to enhance stories. First is the PBS TV show "Arthur" [13]. I loved to watch Arthur as a kid because throughout the episodes, you could watch Arthur and other characters use their imagination to create new environments and situations. The imagination sequences were used in bad situations, such as a bad dream or thinking about mean teachers, or in good situations such as when the characters were dreaming about something they aspired to be. Sometimes the show would use imagination sequences that I have used in my own life. The various uses of the imagination sequences made the show not only made the show relatable but highly entertaining.

Growing up I loved to read, and one of my favorite books was "Edward and the Pirates" by David McPhail [6]. In the story, the main character, Edward, loved to read books, and every book he read he would imagine himself in the story. The illustrations for the book depicted Edward with Robin Hood, fighting Pirates, and with Dinosaurs. I also loved to

read comics, and one comic that my dad introduced me to was "Calvin and Hobbes" [12]. There are particular times in the comics where Calvin would imagine himself as alter-ego's, my favorite being Spaceman Spiff, a space ranger who battled aliens. Similarly to the show "Arthur", sometimes Calvin would imagine the mean aliens were his teachers or some authoritative figure. Another story that gave me a lot of inspiration is "Bridge to Terabithia" [7]. In the story, the main characters use their imagination while playing in a forest and imagines magical creatures living and fighting around them. I could relate to this story as well because just as the characters used imagination to enhance the surrounding environments, I would do the same as a kid.

Imagination was added to these stories so that the characters could experience extraordinary places and situations. By using imagination sequences, I found each of these stories very entertaining and inspirational.

3. MAKING EDUCATION ANIMATIONS MORE ENTERTAINING

In this chapter, I go over the four methods I used to accomplish creating entertaining education animations.

3.1 Problem of Straightforward Scripts

When we took a look at the initial scripts, we noticed that the actions and dialogue were very straightforward pertaining to safety lessons. If the lesson was about wearing a helmet when riding a bike, the script had the characters standing near their bikes and talking to each other. I thought about how the animations would look if they went completely in line with the script, and it seemed that many of the actions would be repetitive. Since the animations would be too boring for kids if we want to teach them new things, there was a need for a solution to this problem.

3.2 Rearrange and Edit Scripts

At the beginning of the project, we were given seven scripts to work from for each of the animations, which included dialogue of the characters and some descriptions of the actions they performed. We initially found that a lot of the dialogue for the characters was repetitive, and we were afraid the repetitions would take away from the enjoyment of the animations. In order to resolve this issue, we asked the scriptwriters to cut back the repetitive elements of the dialogue, particularly where information and tips had back-stories and buildups. For example, a line that initially had a character saying "My English teacher gave a lesson on bicycle safety, and I learned we must always wear a helmet" would be changed to "We must always wear a helmet when riding a bicycle". If there is too much dialogue that has nothing to do with the visual elements in the scene, audiences could start to get distracted and miss important information. By reducing the dialogue, there

Hobbit and Harley have their helmets on ready to get on their bikes.

Harley:	Hobbit, today in school Jack told me that according to Texas law bicyclists have the same rights and duties of other vehicles.
Hobbit:	What does this mean?
Harley:	It means a bike is a vehicle just like a car or truck. We have to stop at stop signs and red lights.
Hobbit:	So a bike is a vehicle?
Harley:	Yes, a bike is a vehicle. The law also says to ride at night we must have lamp on the front and rear of the bicycle and a red reflector, just like a car has special lights at night.

(a) An original script.

Hobbit and Harley have their helmets on ready to get on their bikes. (sound effect: excited Hobbit for new vehicle imagination)

Harley:	(Storyboard 1a-?) Hobbit, did you know bicyclists are vehicles
Hobbit:	Like cars or trucks?
Harley:	Yes, just like cars or trucks. We should stop at stop signs and red lights. Our bikes should also have a light on the front and a reflector on the rear, just like a car has special lights to be seen at night.

(b) Updated version of the original script.

Figure 3.1: Example of an original script and a revised edition. The script writers condensed the original script to that the story could be told as clearly as possible

could be more actions and performance of the characters, which in turn could increase the audience's attention and interests.

3.3 Initial Contributions for Educational Story Development

After I created the first couple of storyboards for the animations, I realized that I needed to use more than just interesting poses of characters and compositions to achieve entertaining stories based on the original scripts.

In order to make these stories engaging and interesting, I have incorporated four methods into the storyboards for the animations:

1. Establishing a Relationship between Characters
2. Interesting Camera Angles
3. Identify Familiar Setting
4. Use Imagination Sequences

In the rest of this section, I will explain each of these contributions in detail.

3.3.1 Establishing a Relationship between Characters

It was introduced at the beginning of the project that the characters were brother and sister, with Harley being the older sister and Hobbit the younger brother. However, it was not established how their relationship would be portrayed in the animations. I decided that in order to portray the main character's relationship in an interesting way, I needed to give each character a unique personality.

Whenever Hobbit is about to do something dangerous, Harley is cautious and protective over him. She then calmly explains what Hobbit should do in each situation to remain safe. The protective nature of Harley towards Hobbit helps to indicate she cares about her younger brother, and that even though he's much younger than she is, she understands that he does know as much about safety.

Harley usually has a smile on her face whenever she is explaining to Hobbit about safety procedures, and also whenever he is pretending to do something else with his imagination. Some siblings could act annoyed by their younger siblings, but the understanding accepting qualities Harley displays as Hobbit pretends and almost gets into trouble helps establish her protective and caring personality.

Since Hobbit is the younger sibling and is full of energy and imagination, I wanted to him to portray an innocence that is recognizable to the audience. As Harley gives Hobbit constructive criticism and safety tips, Hobbit is very attentive and respectful of his sister.

The fact that he listens to Harley instead of disobeying shows that he is a caring brother and also eager to learn. Hobbit's eagerness to learn from his mistakes can encourage young kids how important it is to listen and respect older family members.

3.3.2 Interesting Camera Angles

Since the initial scripts simply included descriptions of the actions and dialogue of the characters, I decided to incorporate interesting compositions in the camera angles. Rather than stick remotely to the straight on views, I took inspiration from animations where camera angles were more dynamic and expressive.

In many educational television shows or computer games, the camera is placed directly perpendicular to the characters as they are explaining a situation or teaching a lesson. Since our project involves animations, I wanted the cameras to break free from this straightforward approach to composition.

One camera placement I decided to use was over-the-shoulder shots. Particularly in dialogue or shots of the characters, I drew camera angles in the storyboards that showed characters from behind as they were looking to a point of interest. This allowed for an effective way to draw the viewer's eyes. If the characters were in a conversation and the camera was directly perpendicular to them, it would not have the same effect whenever a character is explaining important information. The same goes for whenever a character is looking at something far away; from viewing the situation over the character's shoulder, we are more immersed in what is happening in the story.

Adding on to keeping away from the straight-on camera angles, I wanted the environments that characters were placed in to have dynamic and interesting perspectives. The use of the camera angles to create perspectives in the shots would allow the environment to direct the viewer's eyes. It was beneficial to have the animations take place in neighborhood settings because the streets could help direct the line of action and the points of

Figure 3.2: Examples of storyboard frames where I intentionally steered away from straight-on compositions.

interests in the animations. There's a shot in on the of the animations where we are looking over Hobbit's shoulder down a street, which then turns into an imagination sequence of Hobbit in the jungle looking down a rope bridge. The perspectives created by the camera can help the viewer relate to Hobbit as he's experiencing this amazing transformation of environments.

3.3.3 Identify Familiar Setting

Another aspect of the script that was not established was the setting for where the animations would take place. There were many settings where characters could have lived, such as in a huge city or a small rural town. However, a small neighborhood seemed like a good middle ground that could be familiar with any audience.

In addition to the setting as a whole, it was important to decide where the characters

would be placed in the setting during the animations. For instance, in the animation where the characters are throwing a football, I decided to have them throwing the ball in the front lawn of their home. Establishing a direct location for where the characters' actions take place can help the audience have a connection to the animation. For instance, whenever I created the storyboard for the football-throwing animation, I remembered back to my own childhood where I would throw the football in my own yard or my next-door neighbor's yard. By placing the characters in a similar setting, audience members could relate to similar settings where they would play with their friends and family, therefore establishing interest in the animation.

For the setting, it was important to also maintain a familiarity with the objects used in the animations. Just as the audience can relate more to the animation by the environment, the objects placed in the environment were drawn heavily from real-world inspiration. The bikes, for instance, used in the animations were inspired by a bike that I used whenever I was young, and one that my sister had whenever she was a pre-teen. The bright colors and decorative handle on Hobbit's bike compliment his energetic and lively personality. Similarly, Harley's not as brightly colored and is evenly balanced, which is intended to complement her more mature nature. Vehicles are heavily used in the animations, it was important not just to create them accurately for familiarity reasons, but for safety reasons as well. Special care went into designing the school bus and the cars to include all the necessary parts and design elements so that they could be easily recognizable. Even the way the objects are laid out in the environment is meant to be realistic. For instance, the way Hobbit and Harley's house is drawn so a driveway is connected to the garage, or the park has a "Park" sign right before the parking lot.

3.3.4 Using Imagination Sequences

In the second storyboard, I realized that simply adding interesting camera shots, establishing relationships between characters, or creating familiar settings were not sufficient enough to make stories engaging. Therefore, I thought about another device to make stories more exciting.

While trying to find a way to create entertaining stories based on the safety scripts, I thought about what could make the scenes more interesting, and I remembered books, comics, and movies I used to watch as a kid. Most of the stories that drew me in and kept me captivated were imaginative and fictional. Just as Bill Watterson created the Spaceman Spiff imagination sequences in "Calvin and Hobbes"[12], or Marc Brown used extensive imagination sequences in "Arthur"[13], my plan is to take the entertainment elements of the imagination sequences and channel them into the animations about safety education. While it is possible to create the animations based solely on the scripts depicting everyday actions and dialogue, most people watch movies and animations because it engages their imagination, and allows them to enter a world they couldn't visit otherwise.

In order to decide the type of imagination sequence to implement into each animation, a decision needed to be made about the location in the script where the sequence would be placed. Since Hobbit is the youngest of the main characters, it seemed reasonable for him to imagine the sequences.

In each individual animation, the characters are performing actions in a variety of environments. With the unique settings and stories, this allowed for Hobbit to imagine himself in different locations. In fact, the two types of imagination sequences used helped enhance either the location of the animation or the scenario at the hand of the characters. In every animation, there is a safety lesson being taught. In most cases, the process of the characters instructing each other and explaining what to do can be repetitive and monotonous. Even

though the safety tips and lessons are vital for kids to learn, the challenge was coming up with a way for the lessons to be explained in an entertaining format. To solve this, some animations have the imagination sequence occurring right as the safety lesson is being explained. When Harley explained how a bike is a vehicle, Hobbit later imagined his bike was a brand new sports car. The hope is that the entertaining imagination sequence will help engage the students and therefore retain more of the safety lessons as they're being explained.

Since most of the animations take place in a neighborhood or by the street, another way the imagination sequences could be used is having Hobbit imagine he is in a different location entirely. A street crossing can be a jungle river, or a front lawn could be the turf of a professional football stadium. Breaking the norm of the repetitive setting and establishing a new and exciting environment could help gain kids attention and interest.

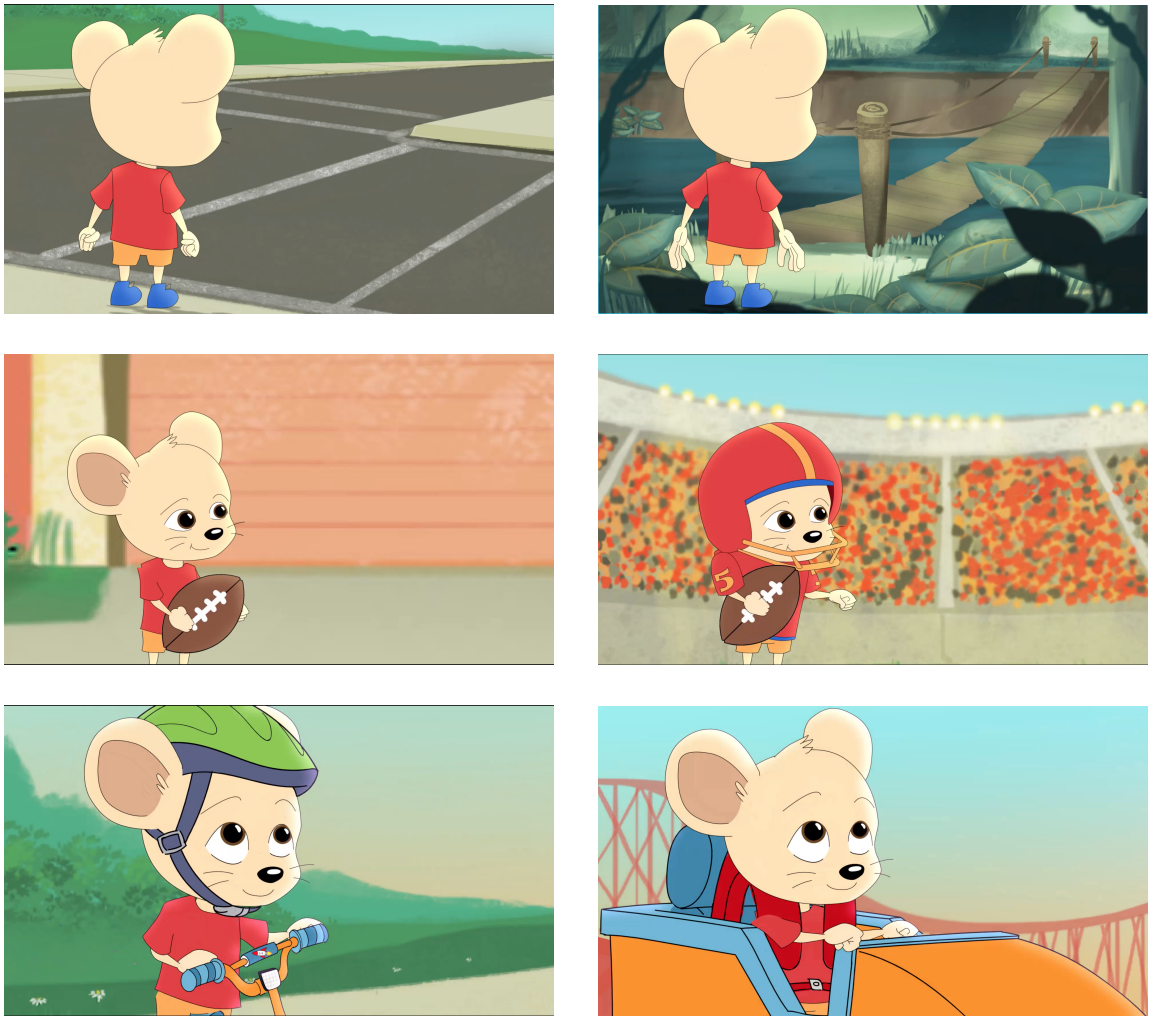


Figure 3.3: Examples of imagination sequences used in the TxDOT animation project, showing how Hobbit uses his imagination to enhance the world around him.

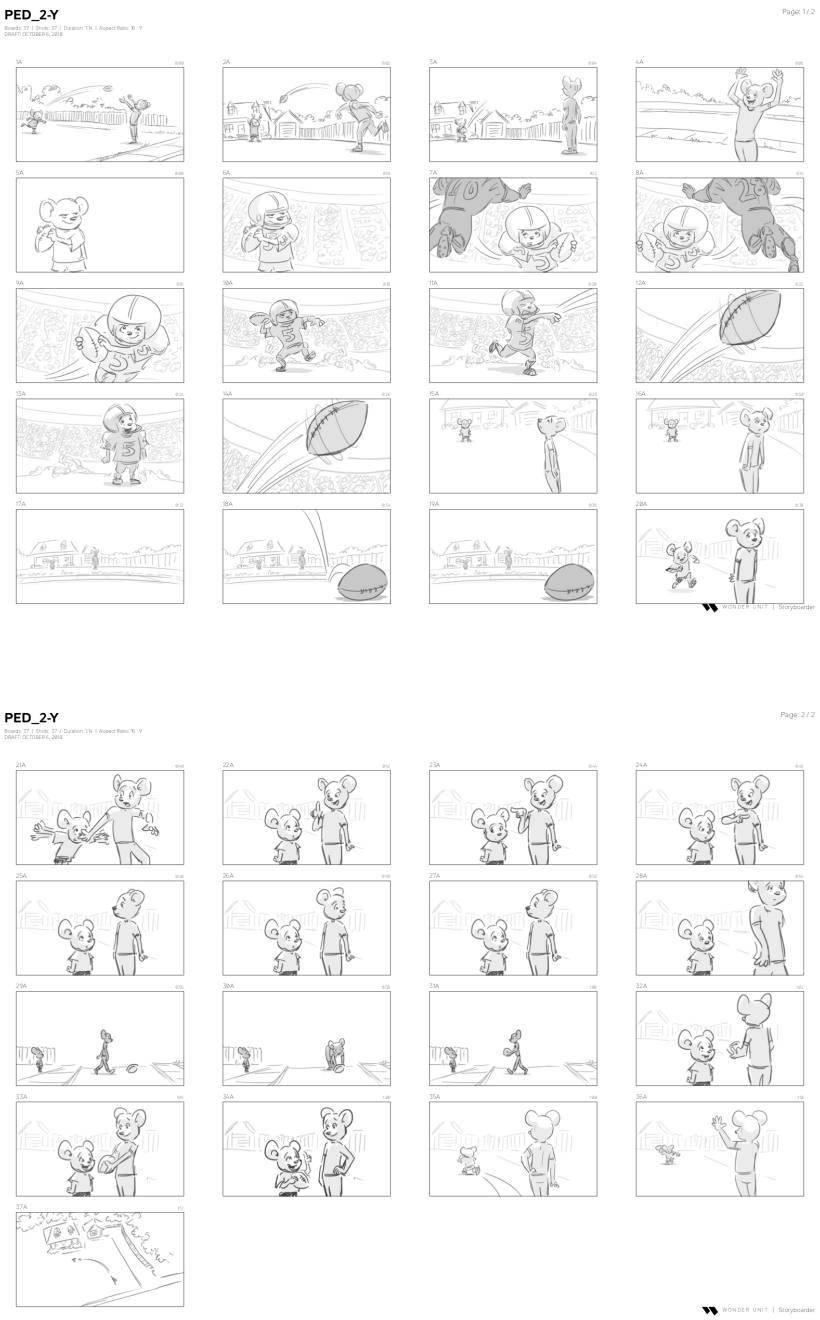


Figure 3.4: The first storyboard I created that implemented the methods I described in this thesis, including imagination sequences.

4. SAFETY PROCEDURES AND REGULATIONS

Creating the safety animations required many revisions in order to comply with safety regulations. Even though we wanted the animations to be entertaining, the information regarding safety is the most vital piece of each animation. In this chapter, I will briefly go over the safety regulations that were conveyed in the animations, such as safety equipment that is important for vehicles, as well as procedures for pedestrian safety.

4.1 Bicycle and Vehicle Equipment

Harley and Hobbit wear safety helmets whenever they ride their bikes. The helmets are designed to have a top with two straps on the side. The straps form a "V" shape coming from the top, which is meant to fit over the wearer's ears. The point of the "V" shape should fit just below the wearer's ear. At the base of each strap, there is the chin strap, which are parts that are meant to connect together. The wearer snaps the connectors together to secure the helmet to their head. There should be a one-to-two finger gap between the strap and the chin of the wearer, that way it is not too loose or too tight.

There is also equipment on the bikes that are important to have, such as a headlight on the front and a reflector light on the rear. These headlights and reflector lights allow bikes to become visible at night to other vehicles, ensure the rider of the bike is safe. Just as bikes have headlights and taillights, so do other vehicles like cars, trucks, and buses.

4.2 Bicycle Safety

There is a whole animation devoted to bicycle safety. When preparing to ride a bicycle, it is important not to get onto the bike unless the rider is completely ready. If the rider is sitting on the bike and still has to prepare to get ready, there is still a chance they could fall off and injure themselves.

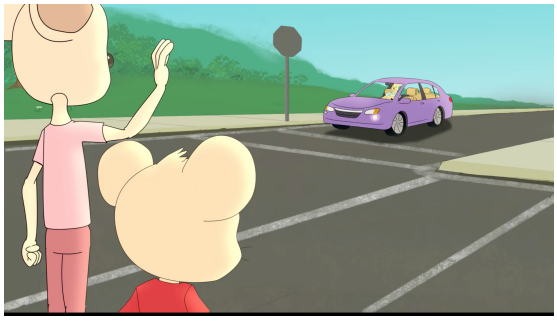
There is a segment in one of the bicycle safety animation when Hobbit is about to ride his bike with untied shoelaces. Harley then immediately tells him to get off the bike and tie them. Loose shoelaces could get stuck in the wheels or gears of a bike, causing the bike to stall and the rider to fall off and injure themself. This goes back to the reason why it is important not to get onto a bicycle until the rider is completely ready to ride on the bike.

At the end of a couple of animations, Harley and Hobbit ride away down in the street into the distance. While riding a bike in the street, it is important to ride as close to the right-hand side of the street as possible. Riding on the side allows room for cars to safely pass by bikers. Also if there are multiple bicyclers riding together, they should ride in a single file line on the side of the street. Whenever riders are approaching a crowded area, such as a parking lot, they should get off their bike and walk it through the area. Riding at high speeds through areas where vehicles could suddenly come into your path is dangerous.

4.3 Procedures for Pedestrian Safety

In one of the animations, Harley and Hobbit approach a three-way intersection. When approaching an intersection, it's important to be aware of your surroundings when crossing the road. If a car is stopped at the intersection, before crossing, it's important to get the attention of the driver to ensure it is safe to cross. By getting permission from the drivers in the vehicles first, the pedestrian knows the driver acknowledges their safety for crossing the road. A pedestrian should also cross only if the car at the intersection has come to a complete stop. When crossing the intersection, the crosswalk is the only area the pedestrian should be walking across.

In the animation when Harley and Hobbit are getting off of the school bus, many of the same rules used in intersection safety are applied. The school bus should be at a complete stop before crossing, as well as any cars next to the bus. The school bus has a stop sign



(a) Crossing street: Shot from the "Intersection Safety" animation.

(b) Bike safety using helmet: Hobbit putting on his bicycle helmet.

Figure 4.1: Examples of animation frames. (a) shows how Harley gets the attention of the driver before crossing the crosswalk. and (b) shows The "V" shape of the strap fits over his ear, with the adjustment right below his ear. Hobbit uses the chin strap to secure the helmet to his head.

on its left side to instruct cars to stop and not go past the bus if it is stopped. If the bus is not stopped at an intersection, and kids need to cross the street, they should cross directly perpendicular from the bus to the other side, ensuring it is the shortest crossing path.

Finally, it is crucial to look left, then right, then left again when crossing any street or intersection. Harley reminds Hobbit many times throughout the animations to look both ways when crossing. It is always important to check and make sure the road is clear before crossing because it is uncertain when an approaching vehicle will become visible to pedestrians.

5. STORYBOARDING FOR SAFETY EDUCATION

For the initial few months of the project, I created seven different storyboards for each safety animation. I was given a short script for each animation, that included dialogue of the characters and short descriptions of what the characters were doing. While I was creating the storyboards and presenting progress to advisors at TTI and TxDOT In this chapter, I will go over the process of creating the safety animation storyboards and the approach to planning animations for safety education.

5.1 Consulting with Texas A&M Transportation Institute and Texas Department of Transportation

The project was established by the Texas Department of Transportation and carried out by the Texas A&M Transportation Institute (TTI). Initially, I was given a script for each of the seven animations that would be made for the project. From the seven scripts, I went on to draw seven storyboards and created seven animatics for each story.

5.2 Increasing Safety Awareness of included Objects

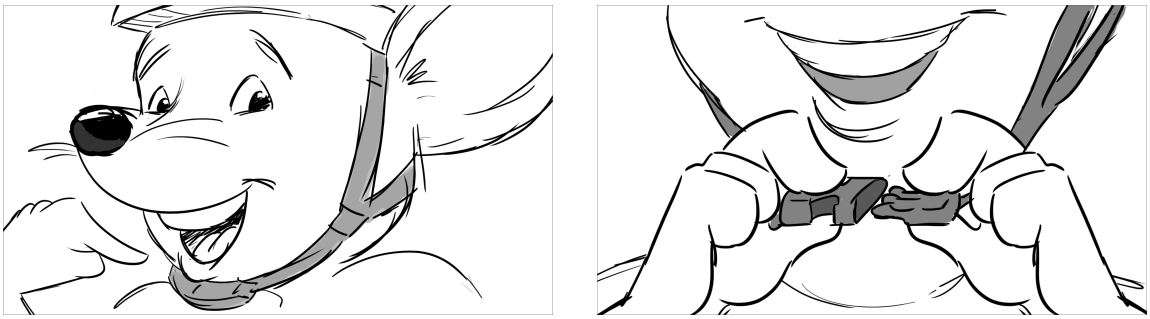
One critique that was given by TTI was that some of the objects in the animation did not have enough safety awareness, or enough details to show that the object is in compliance with safety regulations. There was a storyboard where I had the characters explaining how to prepare to safely ride a bicycle. During a part of the story, Harley describes to Hobbit how we should wear helmets when riding our bikes. The script described how Harley pointed to the major parts of the helmet, such as the chin strap and the adjusters. So I drew a medium shot of Harley explaining helmets to Hobbit, an extreme close-up of Harley putting her fingers underneath her chin strap to test the tightness of the strap, and then a cut to a close-up of Harley pointing to the parts of the helmet. After showing the

storyboard to TTI, it was suggested that during the extreme close-up shot, Harley should also her fingers to clip the chin strap together and then test the space beneath her face and the strap. The purpose of the added shot was to make a note to the audience how to fasten the chin strap together and test whether or not it was secure. The storyboard was then adjusted to go from the full shot of Harley and Hobbit to the extreme close-up of Harley fastening the chin strap, to the close-up of Harley pointing to the helmet parts.

Another example of increasing safety awareness to object is with Hobbit's shoes. In the same animation with the bicycles and helmets, Harley tells Hobbit to tie his shoes before getting on his bike. Originally, I had cut from the medium shot of Harley explaining how Hobbit should tie his shoes to a close-up of Hobbit's untied shoelaces. The animation then proceeded on to Harley explaining the importance of helmets. TTI came back and suggested the close up of the untied shoelaces should include Hobbit hopping off his bike and tying the laces together. The assurance that Hobbit was now safe due to tied shoes would dissolve any confusion by audience members.

What I have learned from getting feedback from TTI and making the necessary adjustments to my storyboards is that it is important to plan to include more shots in your animation if it deals with safety lessons. It is easy to gloss over important information or actions that need to be conveyed if only a single shot is used to explain a safety concept. By using multiple shots to break up a descriptive animation, you not only are showing all the necessary steps of the lesson, but the additional shots will help maintain the audience's interest. The use of close-ups, in particular, can be extremely beneficial if an important piece of the safety lesson needs to be highlighted.

When an animation is concerned about conveying safety information to the audience, the details in the information or procedure are the most important things to portray. Therefore, by adding additional shots to scenes, the chance of a step being overlooked can be decreased.



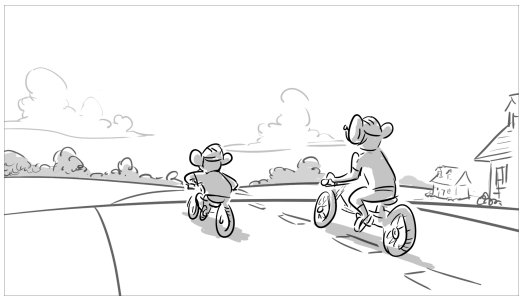
(a) Close up shot (b) Extreme-close up shot

Figure 5.1: The extreme-close up shot would help the viewer see in closer detail how to safely secure the chin strap on the helmet. Adding additional shots like this helps the viewer see clearly how to follow safety procedures.

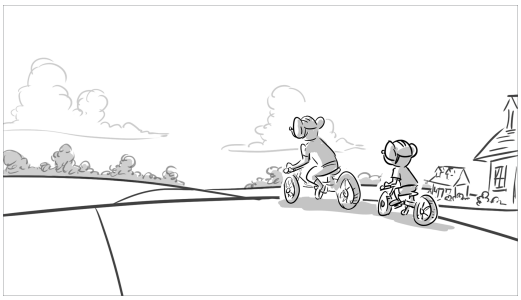
5.3 Adjusting Backgrounds and Environments

Another critique that was given by TTI was to make certain backgrounds and environments safer for the characters. One example was in the animation where Hobbit imagines a cross-walk is a rope bridge in a jungle, and the car across the intersection is actually an alligator. Originally in the storyboard, I drew the alligator sitting on the opposite side of the river, as I intended that the street Hobbit would be crossing was imagined to be the river. However, TTI pointed out that once Hobbit crosses the rope bridge, the alligator would be on the same part of the land, which could potentially be dangerous. In order to fix this issue, the background was oriented to place the alligator in a different location other than the other side of the bridge. In the end, the alligator ended up on a bank on the same level as the river, out of the way from Hobbit as he crossed the bridge. By adjusting the environment, it eliminated any questions about putting the characters in danger.

The street in the animation needed to be adjusted as well. Originally in the storyboard, for the shot when Hobbit and Harley ride their bikes into the distance, I added dotted yellow lines on the road. TTI saw this and said to remove the lines because it seemed like Harley and Hobbit were riding their bikes on a two-lane highway instead of a neighbor-



(a) The original frame of the street had Harley and Hobbit riding freely through the street.



(b) The revised frame of the street has both characters riding single file along the side of the street.

Figure 5.2: Example of storyboard frames where the environment has been modified to follow safety regulations. Here the street has been modified and the characters placed in a safer location.

hood street. By removing the dotted yellow lines, the characters will appear to be in a safer environment. Also, TTI pointed out that it as unsafe for the characters to be riding in the middle of the road. In order to fix the environment, I removed the dotted lines and had the characters riding single file on the side of the street close to the sidewalk.

With the critiques I received from TTI, there were two main lessons I have learned for planning out an environment for a safety animation. First, it is important to research particular environments and to see how they comply with pedestrian safety. For instance, the street with the dotted line seemed logical in my mind whenever I originally created the storyboards; but if I would have researched beforehand on what the roads looked like in that environment, I would have simplified the road to not have dotted lines. Finally, if the story artist thinks ahead and watches over the safety of the characters in every situation, potentially dangerous situations can be avoided. In the animation with the alligator, I placed the alligator in the same frame position as the real-life car, without thinking that the alligator's location could potentially put Hobbit into danger. By keeping in mind how the environment will affect the characters, their safety will be maintained.

6. IMPLEMENTATION

Following the creation of the storyboards for the seven individual animations, the next stage of the project was creating the animation themselves. In this chapter, I will cover the process of creating the seven animations.

6.1 Organizing the Team

In the early stages of the project, it was addressed that seven 2D animations would need to be produced in a professional quality for TxDOT. I realized that the job to create all the animations would be too much on one person's shoulders. Since it was a 2D animation, and I've taken animation studio courses throughout my college career, I thought about the roles/positions that would need to be filled in order to complete the animations. Since the animations are in 2D, we would need artists that have a background in drawing or design. I broke down the roles into the following categories: backgrounds, titles, and animator. The background artist was responsible for creating the environments in which the characters would be throughout the animations. The title designer was responsible for creating the opening title card painting at the beginning of each animation, as well as designing the ending credits. The animators would specifically be working on moving the characters and objects throughout the animations.

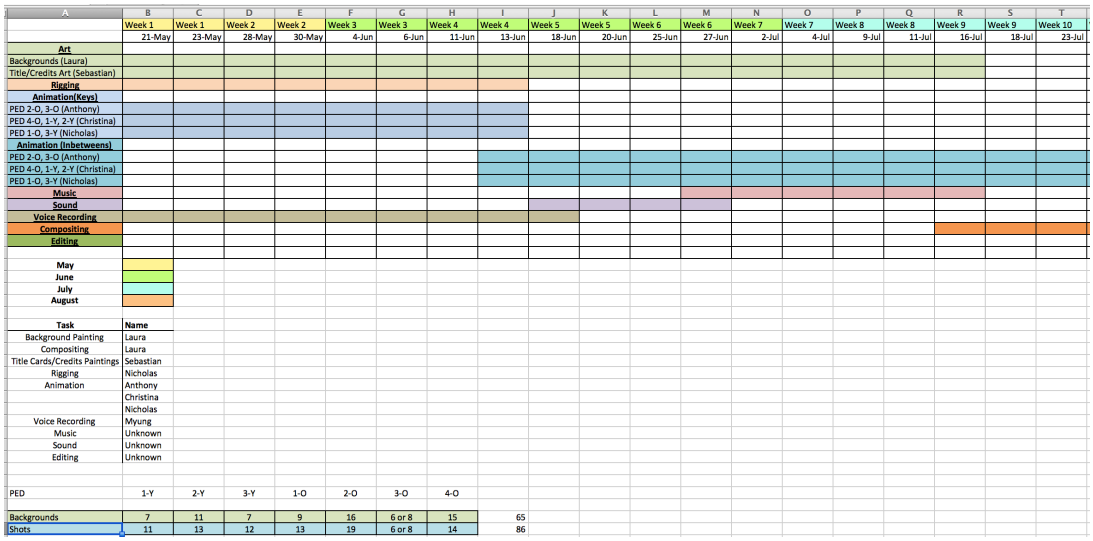
One issue we ran into early in the production was deciding on the animation software to use. I had experience with 2D animation before using Adobe Flash or Animate; however, these were created by drawing on individual frames, and I was worried the amount of time it would take to traditionally animate all seven animations would be too much. After doing research into animation software and what professional studios are using today, I came across Toon Boom Harmony. Toon Boom had a built-in rigging system that allowed artists to create 2D "puppets" that could be animated similarly to 3D characters. All the

animator would have to do is take the puppet and place the desired keyframes, and the software would interpolate the animation between the keys. This would save a significant amount of time rather than traditionally animating every animation. We decided to use Toon Boom for the animations.

After deciding on the software to use, another role that I decided we needed was a rigger or someone to set up the 2D puppets to animate within the Toon Boom software. Taking the initial three animators who signed on to the project, I assigned one animator to work on building the 2D rigs in Toon Boom, while the other two animators would work on creating characters and assets. I knew that it would be a learning curve to learn Toon Boom, not just for the rigging but also creating assets and navigating around the software, but we were able to work diligently and create successful rigs and assets.

6.2 Created Production Schedule

After the group had been selected for the project, I went on to create a schedule for the summer. I created the schedule in Microsoft Excel and designed it to have the calendar of days on the X-axis (Monday's and Thursday's since those were the days we met as a group during the week), and the tasks for the project on the Y-axis. The tasks were color-coded to make them distinguishable. The first thing I did was list out the tasks to be completed for the animations. The categories I used were art, rigging, animation, text (script), music, sound, voice-recording, compositing, and editing. For the art process, I split it into two categories, one being background paintings and the other title cards and credits. I also split up the animation section into key-frames and in-betweens. I split up the animation to make it more organized, so the animators could focus on getting the key-frames for each animation set up and polished, before moving on to the final in-betweens and tweaks. Since there were seven individual animations that needed to be created, I split them up for the three animators. In the end, I was assigned to two animations, the 2nd animator was



	Week 1	Week 1	Week 2	Week 2	Week 3	Week 3	Week 4	Week 4	Week 5	Week 5	Week 6	Week 6	Week 7	Week 7	Week 8	Week 8	Week 9	Week 9	Week 10
	21-May	23-May	28-May	30-May	4-Jun	6-Jun	11-Jun	13-Jun	18-Jun	20-Jun	25-Jun	27-Jun	2-Jul	4-Jul	9-Jul	11-Jul	16-Jul	18-Jul	23-Jul
Art																			
Backgrounds (Laura)																			
Title/Credits Art (Sebastian)																			
Rigging																			
Animation(Keys)																			
PED 2-O, 3-O (Anthony)																			
PED 4-O, 1-Y, 2-Y (Christina)																			
PED 1-O, 3-Y (Nicholas)																			
Animation (Inbetweens)																			
PED 2-O, 3-O (Anthony)																			
PED 4-O, 1-Y, 2-Y (Christina)																			
PED 1-O, 3-Y (Nicholas)																			
Music																			
Sound																			
Voice Recording																			
Compositing																			
Editing																			

May	
June	
July	
August	

Task	**Name**
Background Painting	Laura
Compositing	Laura
Title Cards/Credits Paintings	Sebastian
Rigging	Nicholas
Animation	Anthony
	Christina
	Nicholas
Voice Recording	Myung
Music	Unknown
Sound	Unknown
Editing	Unknown

PED	1-Y	2-Y	3-Y	1-O	2-O	3-O	4-O	
Backgrounds	7	11	7	9	16	6 or 8	15	65
Shots	11	13	12	13	19	6 or 8	14	86

Figure 6.1: Section of the production schedule used for the duration of the animation project. As the project progressed, revisions were made to the schedule for certain roles in order to finish the project in a timely manner.

assigned to two, and the 3rd was assigned to three.

In order to help the artists working on the background paintings, I went through the storyboards and counted how many background paintings and shots there would be for all of the combined animations. The total amount of backgrounds needed added up to about sixty-five, with a total of about 85 shots. The reason that the shot count was higher than the background count was that since the stories take places in similar locations, such as the neighborhood, several backgrounds could be reused throughout the animations. This would save some time for the background artist from creating backgrounds for every single shot.

6.3 Weekly Progress Meetings

Our group met twice a week at Texas A&M, Monday and Tuesday afternoons, from late May until mid-August. Most of the students and faculty were able to physically attend

the meetings; those who couldn't meet on campus called in through Skype or Google Hangouts.

In the meetings, we mainly talked about what needed to be completed for that week, as well as critiqued work that has been updated. I led the meetings along with Dr. Akleman giving help and critiques. It was extremely helpful to meet in person on campus since relying solely on email could cause delays in responses. For critiques, it was vital to get feedback at the meetings, because everyone could give his or her input. Once the artist or animator has the feedback on their update, they could go back and make the necessary adjustments immediately, instead of waiting for email responses, which might take time to receive.

Getting critiques at the meetings were not just helpful for time management purposes, but also for helping the artists work together towards the same goals. The group members all came from different backgrounds and experiences, some with more expertise than others, and allowing time to give everyone a chance to get critiqued on their work helped ensure everyone was on the same page. The seven animations needed to flow together, not just in the way they look but in the way they were animated. By having these critique sessions, we were able to give constructive criticism and advice to each group member. Sometimes a group member would suggest a tip about something the artist hadn't thought of, which is why it was helpful to get critiques from the group as a whole.

6.4 Production Process of Pedestrian Animations

Starting off on the project, I assigned Nicholas, one of the animators on the team, to start creating the 2D rigs inside of ToonBoom. The other two animators, Christina and I, worked on creating character and asset drawings within Adobe Illustrator. The Illustrator drawings could then be brought into ToonBoom and placed into the scenes or be animated with. Nicholas worked on completing the rigs for the characters, with Christina

also helping create rigs and adding enhanced features to Nicholas' rigs.

After all of the rigs were created, each animator started creating the animations they were assigned. The rigs could be imported into the ToonBoom files and placed throughout the shots. Since there were shots in the storyboard with multiple views of each character, there were separate rigs for each orthogonal view of Harley and Hobbit's rigs. The were rigs created for the front view, side view, front three-quarter view, back three-quarter view, and top view.

6.5 Approval from Texas Department of Transportation

The final process for the project to be completed was going through an approval process with TxDOT. After we completed all seven animations for our deadline of August 2nd, we met up with TTI and a representative of TxDOT to show the animations and receive feedback. Overall, the TxDOT representative was very impressed with the look and style of the animations. She did have several critiques to give.

Firstly, there were some safety issues she had with the animations, particularly with some the assets used in the animation. In the animation on bicycle safety, she noted that the "V" shape of Harley's helmet strap was too large and fit too loosely over her ear. She stated that the point of the "V" shape should be just at the base of Harley's ear. We told the representative that the fix was minor and shouldn't take too long.

Another issue we ran into during the review process with TxDOT was having an alligator in the "Pedestrian Safety" animation. In the animation, Harley and Hobbit are about to cross the crosswalk of a street, where a car is waiting on the other side of the intersection. Hobbit has an imagination sequence where he imagines the crosswalk is a rope bridge over a jungle river, and the car is an alligator. TxDOT said that having the alligator representing a car could lead to kids associating cars with scary animals. The point was also made that since most of the animations would be shown in Texas and that alligators

are native to some regions of Texas, kids would be more scared of alligators. Originally, TxDOT proposed to remove all of the imagination sequence to limit the change of getting negative feedback from audiences. However, after consultation with the animation group and the advisors of the project, the final decision was to remove only the scenes with the alligator.

6.6 Project Conclusion

In the end, the team successfully created all seven of the safety animations by our deadline. It took lots of organization, planning, and teamwork to accomplish the goal, and each of the five team-members worked very hard to complete their tasks. The feedback from the advisors of the project, as well as other professionals working at the Texas A&M Transportation Institute, has been positive and encouraging. There have been compliments on the style of the animations, the fun and engaging stories and characters, and how successfully the traditional animation used helped convey safety concepts and procedures.

7. CONCLUSION AND FUTURE WORK

7.1 Conclusion

With the increased uses of animation in the 20th century, there have been many challenges making educational animations as fun to watch as entertainment animations. The point of my thesis research is to find a way where any artist can use certain methods to transform any type of education lesson into an exciting story that can be animated. After being given a project from TxDOT to create seven 2D animations for safety education, I decided to explore methods that would help make the animations be more engaging to audiences.

There have been previous attempts to study how animations for education can be more enjoyable to audiences. One concept to keep in mind is understanding what audience the animations are aimed towards, and what that audience finds entertaining. The use of imagination sequences in entertainment has also helped broaden the narratives and settings of stories and can help create engaging media.

During the creation of the storyboards for the safety animations, I implemented four methods in order to make each story more engaging: establishing a relationship between the main characters, using interesting camera angles and compositions, creating familiar settings where the audience can relate, and using imagination sequences to enhance each story. Using the methods allowed the process of creating the storyboards to be like that of entertainment animations.

Throughout the animations, there were many safety concepts that needed to be addressed and communicated. During the storyboarding process, I found that in order to effectively communicate the concept to the audience, I found that it is vital to increase the awareness of objects in the animations that are used in safety procedures or lessons. In-

cluding additional shots during safety procedures can help give a clear and thorough visual description. It is also important to have an environment where the characters are placed comply with safety regulations, and to adjust any environment if necessary.

With the four methods implemented into the storyboards, I led a group of students to create the 2D animations. It took planning, organization, and teamwork to accomplish the task of creating all seven animations during a summer. Each of the five team-members had their own role during the production process, and in the end, successfully created animations that were well received by advisors and other professionals.

With the rise of popularity of animation in our culture, and the vast fields and applications animation can be used for, creating fun and engaging stories can help keep audiences entertained as they are learning.

7.2 Future Work

Even though the four methods I described in my thesis have successfully helped create entertaining animations for safety education, there are still many more methods that could be researched and implemented. At the beginning of the research process, I looked at art and animated films as a basis for finding what successfully drew the audience's eyes. The problem is that with art, and more specifically animated films, there are so many factors and decisions the artist uses when they are designing a finished piece. By diving into each component of what makes animation and art entertaining, more methods can be derived and implemented to make safety education more entertaining. Specifically, with animated films, live-action films, and literature, finding additional methods for making a story engaging could benefit safety educations in the future.

Since the varieties of animations have grown over the past century, there is no doubt that there will be new techniques of animation and entertainment in the future. With the rapid growth of virtual and augmented reality, audiences can now be fully immersed in

entertaining stories. While these techniques are used for entertainment, they are also used for simulation and education. Just as the methods proposed in this thesis helped to make safety education animations more entertaining, they could potentially help make future productions just as entertaining. By incorporating the new methods for making safety education stories and animations more entertaining, audiences could be more immersed and engaged than ever before.

By adding more to the list of methods, future artists and animators could look back at the list and create fun and engaging safety educations that will keep audiences informed and entertained.

REFERENCES

[1] Gary Fisk. Using animation in forensic pathology and science education. *Laboratory Medicine*, 39(10):587–592, 2008.

[2] Oliver Gaycken and Ariana Killoran. Animating, entertaining, educating: A dialogue between oliver gaycken and ariana killoran. *Discourse*, 37(3):207–220, 2015.

[3] Margaret E Gredler. 17. educational games and simulations: A technology in search of a (research) paradigm. *Technology*, 39:521–540, 1996.

[4] Jeremy Lee, Kathleen Luchini, Benjamin Michael, Cathie Norris, and Elliot Soloway. More than just fun and games: Assessing the value of educational video games in the classroom. In *CHI'04 extended abstracts on Human factors in computing systems*, pages 1375–1378. ACM, 2004.

[5] Richard Lowe and Wolfgang Schnotz. *Learning with animation: Research implications for design*. Cambridge University Press, 2008.

[6] David McPhail. *Edward and the Pirates*. Little, Brown Books for Young Readers, 2008.

[7] Katherine Paterson. Bridge to terabithia. 1977, 1987.

[8] Randy Pausch, Jon Snoddy, Robert Taylor, Scott Watson, and Eric Haseltine. Disney's aladdin: first steps toward storytelling in virtual reality. In *Proceedings of the 23rd annual conference on Computer graphics and interactive techniques*, pages 193–203. ACM, 1996.

[9] Tom Sito. *Moving innovation: a history of computer animation*. MIT Press, 2013.

[10] Frank Thomas, Ollie Johnston, and Frank Thomas. *The illusion of life: Disney animation*. Hyperion New York, 1995.

[11] Patti M Valkenburg and Marjolein Vroone. Developmental changes in infants' and toddlers' attention to television entertainment. *Communication Research*, 31(3):288–311, 2004.

[12] Bill Watterson. *Calvin and Hobbes: Sunday Pages 1985-1995*, volume 5. Andrews McMeel Publishing, 2001.

[13] Kathy Waugh, Micheline Charest, Carol Greenwald, Jacqui Deegan, Peter Moss, Lesley Taylor, Toper Taylor, Pierre Valette, Cassandra Schafhausen, Greg Bailey, et al. Arthur (tv series). *The Vanessa Lengies Handbook-Everything you need to know about Vanessa Lengies*, page 28, 2013.

[14] Lirong Xiao. Animation trends in education. *International Journal of Information and Education Technology*, 3(3):286, 2013.