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An In-depth Look at Graph Editor Animation in After Effects

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ABSTRACT

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An In-depth Look at Graph Editor Animation in After Effects

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The graph editor is a tool in animation softwares. One of its key features is the ability to manipulate keyframe interpolation between individual keyframes. The purpose of this method is to refine the movement and apply the so called animation principles in the animation. The purpose of this thesis was to study animation workflows using two different graph editors in After Effects, the most commonly used software for creating motion graphics.

The most optimal graph editor workflows for different animations in After Effects were discovered. The results suggested that using the Value Graph is more intuitive and precise, but relying on the Speed Graph is necessary with more complex animations. In addition, alternative workflows for combining the advantages of these two with third-party scripts were discovered.

Moreover, the results reinforced the initial statement that the understanding of animation graph editing is a crucial skill in motion design. This thesis introduces effective methods and could be used as a guideline for the study of graph editor animation in After Effects.

Key words: animation, motion design, After Effects, motion graphics

CONTENTS

GLOSSARY

Bezier curve	A parametric curve used in computer graphics, typically to draw shapes
Compositing	Combining visual elements into a single output such as video
Easing	The practice of adjusting animation between keyframes
Exporting	The process of transferring the animation data for viewing
Interpolation	An estimation of animated values between keyframes in computer animation
Keyframe	A point in the timeline which holds information on when and how an animation starts in computer animation
Motion graphics	Animated graphic design and illustration
Motion design	The art of creating motion graphics
Motion path	The visualisation of an object's movement in space in computer animation
Script	A series of commands that makes a After Effects and other softwares perform a set of tasks
Plugin	An external addition that adds new functions for After Effects and other softwares
Vector graphics	Computer-generated images defined by mathematical points to form shapes

1 INTRODUCTION

The purpose of this thesis is to thoroughly study the graph editor workflows and methods used in animation, particularly in Adobe After Effects software, and research possible options for optimizing the workflows.

The graph editor is a tool in animation softwares used to visualise the temporal and spatial interpolation between individual keyframes. This simulates the in-between drawings in traditional 2D animation. The in-betweens visualise the timing and spacing, the two basic elements of animation (Williams 2009, 37). For this thesis, the focus is on the graph editors of Adobe After Effects, the most commonly used 2D software in motion design.

After Effects has two different graph editors. The Value Graph is an intuitive tool for most animators and can be used to directly animate the properties of a layer. The Speed Graph, as its name suggests, is used to tweak the speed of the animation and can’t be used in a similar way to change values directly.

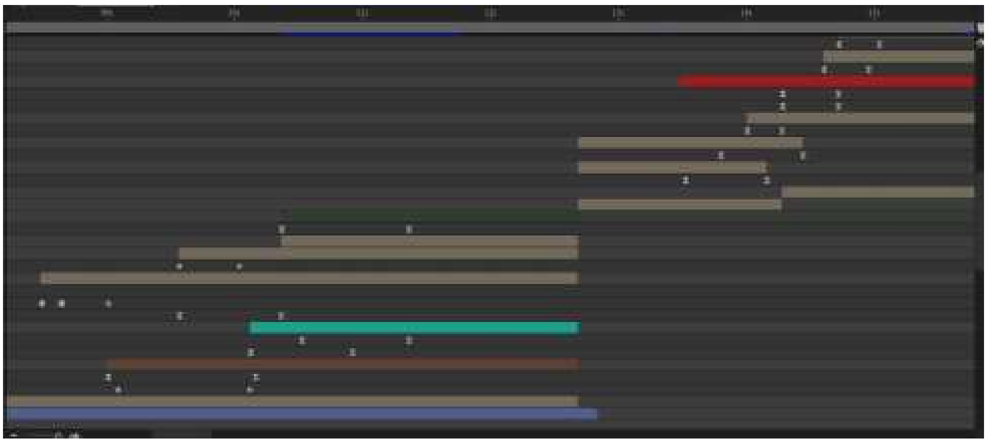
For the practical part of this thesis, short animations were created using both graph editors. The aim was to study the strengths and limitations of each, and find out the most suitable use cases for each. The Speed Graph is sometimes considered less intuitive, which is why this thesis also aims to find intuitive workflows for the tool. In addition, some of the most common scripts for graph editor animation are introduced.

2 THE GRAPH EDITOR AND ANIMATION PRINCIPLES

2.1 Animation principles in digital animation

The so called animation principles, as named and categorized by former Disney animators Frank Thomas and Ollie Johnston, are the core of all good, fluent animation regardless of the output and medium. When it comes to applying the principle of timing in digital computer animation, the majority of the work is typically carried out with the dope sheet and graph editor tools of the software. While achieving good looking animation without using a graph editor is possible to some extent, it is a necessary tool for a professional animator. Due to its mathematics-based nature, it can, however, be considered difficult to learn, and is therefore sometimes overlooked (Create 3D Characters.)

The dope sheet derives from a dope or exposure sheet of a hand-drawn 2D animation, acting as a planning sheet with written instructions on where the character and camera movements are to happen. In an animation software this information is not only planned, but also executed by recording all the movements with keyframes (Picture 1). By moving the keyframes across the timeline or dope sheet, the animator can quickly alter the timing in a way that wasn't possible with traditional animation.



PICTURE 1. Dope sheet in After Effects showing various objects animated with keyframes

In pose-to-pose method of traditional animation, the animator would draw in-betweens between the key poses. The in-betweens are drawings that, as the name suggests, fill up the movement between the the most important poses, usually those of a character. In computer animation the in-betweens are obsolete as the animation software interpolates the movement between the keyframes recorded by the animator. Whereas in traditional animation the timing of the movement is defined by the sequence of the inbetweens and the relation of the drawings' relations to each other, this task is done digitally with the graph editor's animation curves.

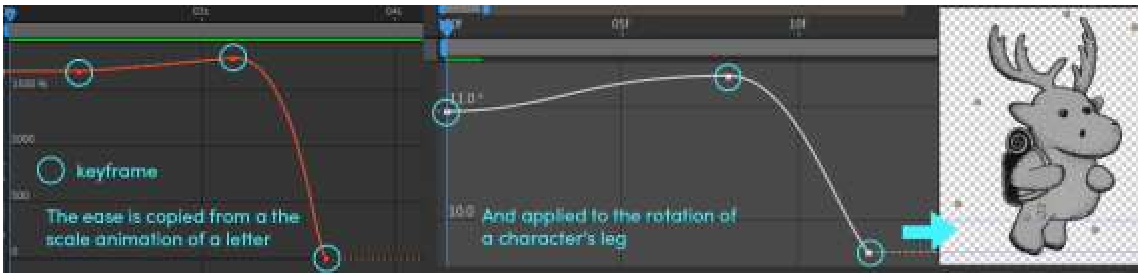
Although usually overlapping and inseparable, if we look at the animation principles individually, the graph editor is mainly used for applying the principles of timing and slow in–slow out. These are the principles that are also commonly taught to students with the graph editor although not the only ones where the graph editor can be utilized. In addition, professional animators constantly use the graph editor to apply the principles of squash and stretch, anticipation, follow through and overlapping action, and exaggeration. In motion design, slow in and slow out is referred to as ease in and ease out, or simply easing, and will be referred to as easing in this thesis.

When it comes to digital animation and After Effects, the animated objects can have several animated properties which somewhat separates the methods of digital and traditional animation. For example, a digitally animated 2D character is usually set up, or rigged, in a way where the animator only animates position, sometimes called translation in 3D animation, scale, opacity or rotation of each part of the character in contrast to traditional cell animation where the drawings would cover each property of their digital counterparts.

It could be argued that position is the most essential animated property as it deals with the movement of objects or characters over a period of time, and after all animation is an art of motion. In addition, animating position is where the differences of After Effects graph editors are best highlighted, and thus this thesis mostly uses examples of position animation.

2.2 Common graph types

Several similar, or entirely same curves are used on a recurring basis to animate different actions. The animator can build a library of these animations and save it as presets in After Effects and other softwares, avoiding repetitive manual tasks (Boone 2017). The curves can be applied creatively to different animated properties (Picture 2). As more complex presets require tuning in the graph editor, being able to animate with the graph editor is crucial. Moreover, with the same principles and timing, the same animation curve can be applied to seemingly very different animations, from character to typographic animation. The most common graph types are introduced in this chapter.



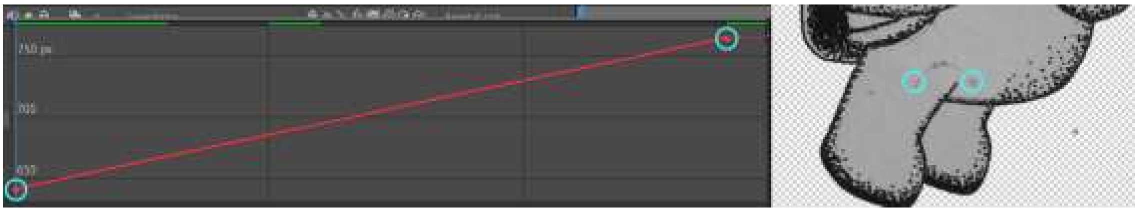
PICTURE 2. An anticipation of a scaling glyph used as a typical motion design transition with the red curve on the left, and applied to the rotation of a character's leg in with the grey curve on the right.

2.2.1 Linear curve

Completely linear movement, where the object or character moves at a constant, never changing phase, almost never occurs in nature due to the laws of physics. A commonly used example of a linearly moving object in animation teaching is a robot. In addition, linear keyframes are often used with more abstract things, and in corporate or documentary style videos or in montage-type of shots that feature frequent or rapid cuts, for example a scene that cuts from a talking head to the next as they zoom in at a constant speed. This is where linear keyframes are used for the movement to not be too distracting. As a rule of thumb, linear movement should never set anything in motion as a first keyframe.

As animation can be seen as an art that illustrates, communicates and exaggerates what we perceive, linear movement is something that is generally avoided is professional animation work, although there are some exceptions such as those mentioned previously. It should be noted, however, that many animation softwares, including After Effects, have set the default keyframe type to linear by default. Therefore, beginner animators commonly only work with linear keyframes in the early stages of their learning curves.

As seen in Picture 3, an object is animated moving horizontally from its initial position of 0 pixels until it reaches its final position of approximately 2000 pixels. The red curve represents the position visually. The straightness of the curve means that the animated value – in this example, position – is growing at a constant speed. In other words, it moves the same distance between every frame.

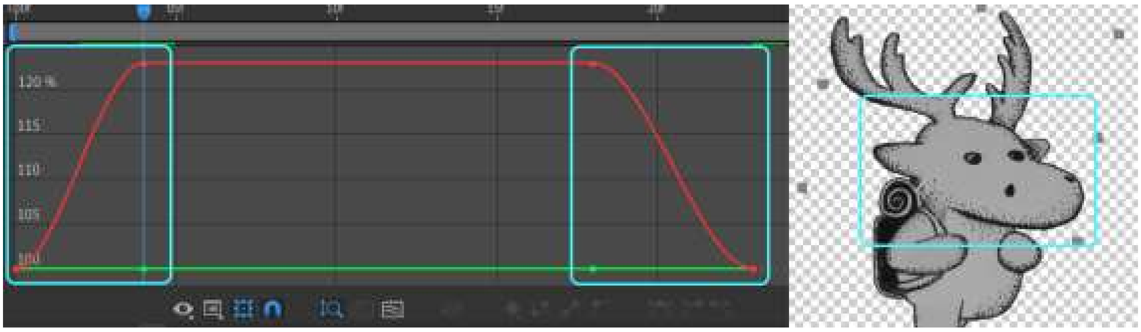


PICTURE 3. A linear animation curve representing a character's steady horizontal motion on the X axis. The animated distance can be seen on the right.

2.2.2 Easy ease

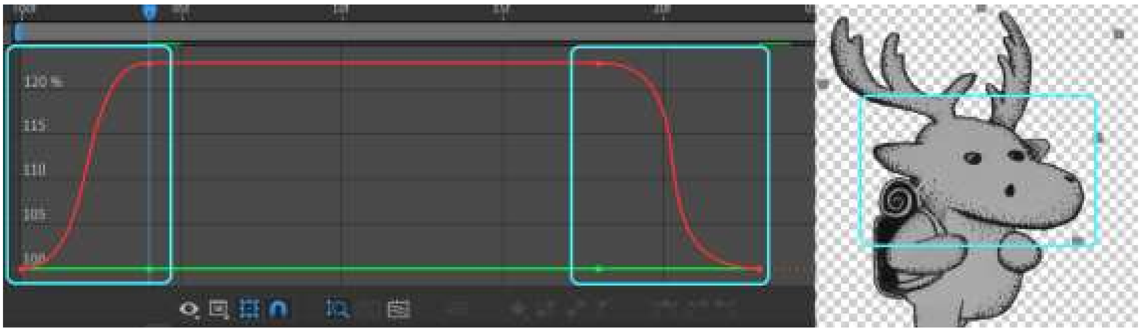
Another common graph type deals with the principle of easing. Picture 4 shows what is known in motion design as easy ease, the name coming from After Effects. Easy ease is often used by beginning animators and editors because it can be applied easily and looks slightly better than default linear keyframes. It can be used as a basis for polishing animation but is as such rarely the desired outcome (School of Motion). It is useful for fast movements where some easing is desired but the eases happen between only a few keyframes, where a stronger ease would appear jerky. The slightly curved start and end points of the graphs show the reduced speed of the movement in the beginning and end, where the object's distance, measured in pixels, increases less than in the middle. The steepness of these curves controls and visualises the speed of the acceleration.

For a more extreme ease, slower start and end and faster midpoint, the yellow handles would have to be longer. For a shorter ease the handles would have to be shorter.



PICTURE 4. A character's scale on the X axis is animated in and out with an easy ease.

When the yellow handle is considerably longer, creating a harder ease as seen in picture 5, the speed of the animated property is very slow at the beginning and increases as the curve grows steeper towards the middle to two thirds of the animation. This helps to direct the viewer's eye to the upcoming animation (Raju 2019). This is a more commonly used variant of the standard easy ease, and the harder initial ease anticipates the upcoming animation, directly applying the principle of anticipation, in addition to timing, plus slow in and slow out. When used together with eye tracing, anticipation with a curve like this makes the animation feel natural to the viewer.



PICTURE 5. An object's scale on the X axis is animated in and out with a hard, anticipating ease.

2.2.3 Oscillation

One very common graph type is the so called oscillation curve, depicting a repetitive action, the graph of which is often symmetrical or partially symmetrical. Animations based on an oscillation curve typically aim to be physically accurate, following a rule of thumb where, as the speed of the animated property decreases, the curves cover a quarter of the distance in half of the time. Using a pendulum as an example in picture 6, the pendulum loses kinetic energy according to this rule, and its each swing happens in approximately half of the time compared to the previous, and decreases so that it covers approximately a quarter of the distance of the previous.

PICTURE 6. The oscillation curve depicting a decreasing motion on a character's leg with the keyframes circled. An estimated visualisation of the movement in space can be seen on the right.

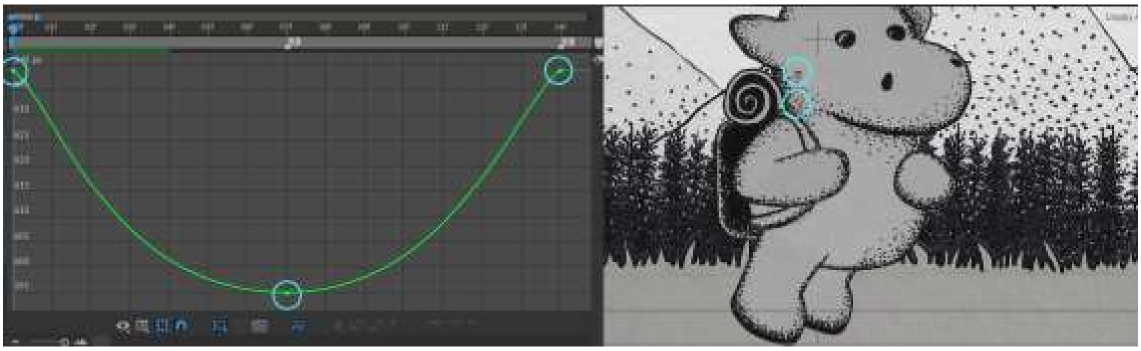
While this rule results in quite physically accurate animation when applied correctly, it is artificial. To avoid manual graph tweaking in physics-based animation, one can turn to a plugin called Newton. Newton is a 2D physics engine for After Effects which allows the creation of several different kinds of physics simulations (Motion Boutique N.d.).

2.2.4 Bounce

One of the most common exercises for animation students is to animate a bouncing ball. A seemingly simple but in reality a really in-depth study of motion, a bouncing ball animation puts into practice the principles of timing, spacing, arcs, and often squash and stretch as well. While its relevance is not always stressed appropriately in education, the easing foundations from a bouncing ball animation are very commonly used in blocking out the key movements of shots. In addition, the bouncing ball forms the basis of characters' hip animation, and thus the basis for characters' walks (Chase 2016).

The basis of a bouncing animation always follows a curve such as the one seen in picture 7. Much like, if not a variant of the oscillation curve, it features parabolic symmetrical curves which, in reality, wouldn't be exactly symmetrical due to air resistance. Exactly like the oscillation curve, the object's motion slows down following roughly the *quarter the distance in half the time* rule. The motion can be tweaked for example a more cartoony feel by adjusting the angle of the curve handles, as well as by tweaking the timing by moving the keyframes.

For a more elastic object with more squash and stretch for example, the subsequent curves after the initial curve would be steeper, and there could be more subsequent curves and keyframes before the object stops. On the contrary, a heavier object such as an iron ball falling to the ground might settle quicker after the initial bounce, or it might not bounce at all. The curve seen here is a basic curve aiming for realistic motion.

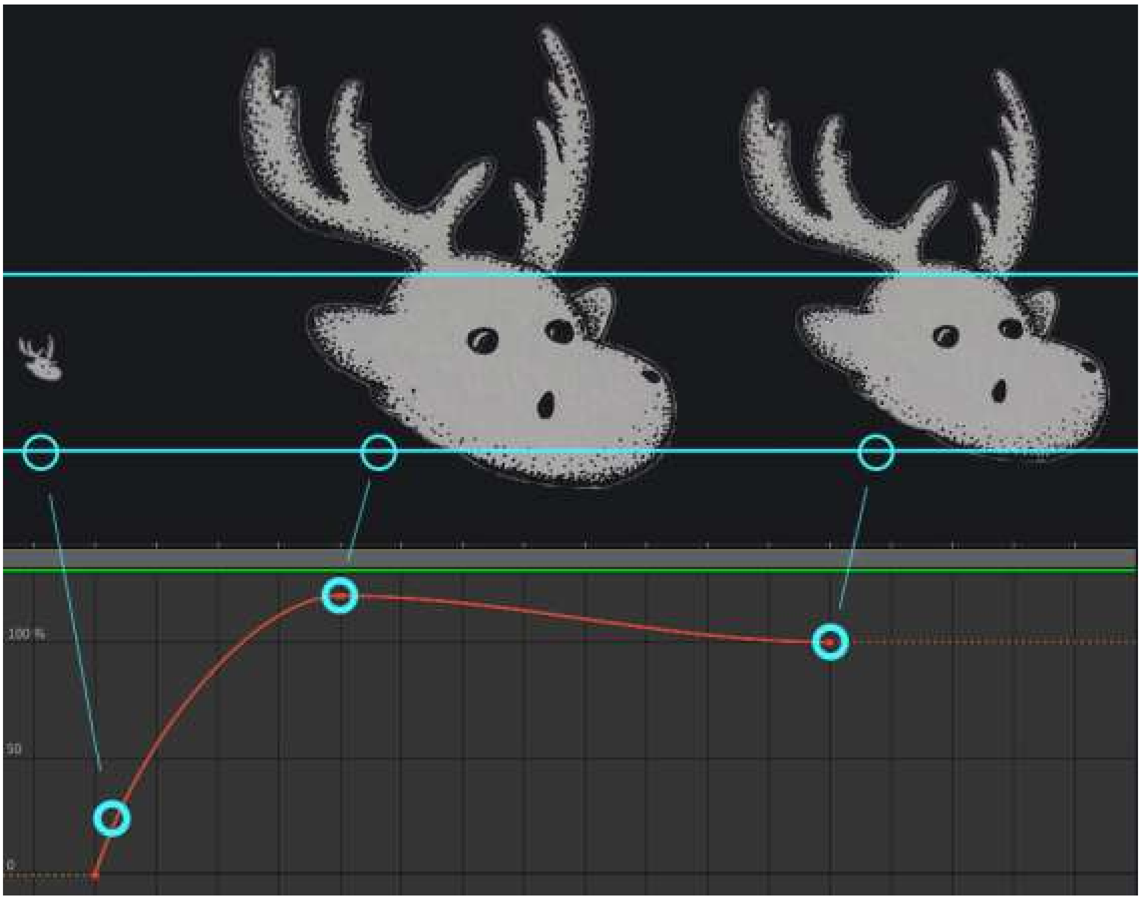


PICTURE 7. A somewhat realistic bounce curve controlling the jump of a character. The distance it covers vertically can be seen on the right.

2.2.5 Overshoot

Frequently used as both primary and secondary animations to exaggerate, or to direct the viewer's eye, the overshoot animation refers to an animated property which first exceeds, and then settles to the stable value. For example, as seen in picture 8, and object's scale is animated from an initial value of 0 – meaning the object is invisible – from where it overshoots with a hard initial ease to around 110 to 120 per cent of its starting value, and then settles to one hundred per cent.

This exact animation is extremely common in motion design for three reasons. First, it can be copied directly by copying the keyframes from one object to another. Second, it can be applied to any object. In After Effects, different objects, animated as layers, have different animatable properties. For example, shape layers contain several different path-based properties which pixel layers don't have. An overshoot animation like this is not limited by the nature of the layer. Finally, it is a simple, and extremely easy animation to execute, and can be found broadly speaking in almost any piece of motion design work.



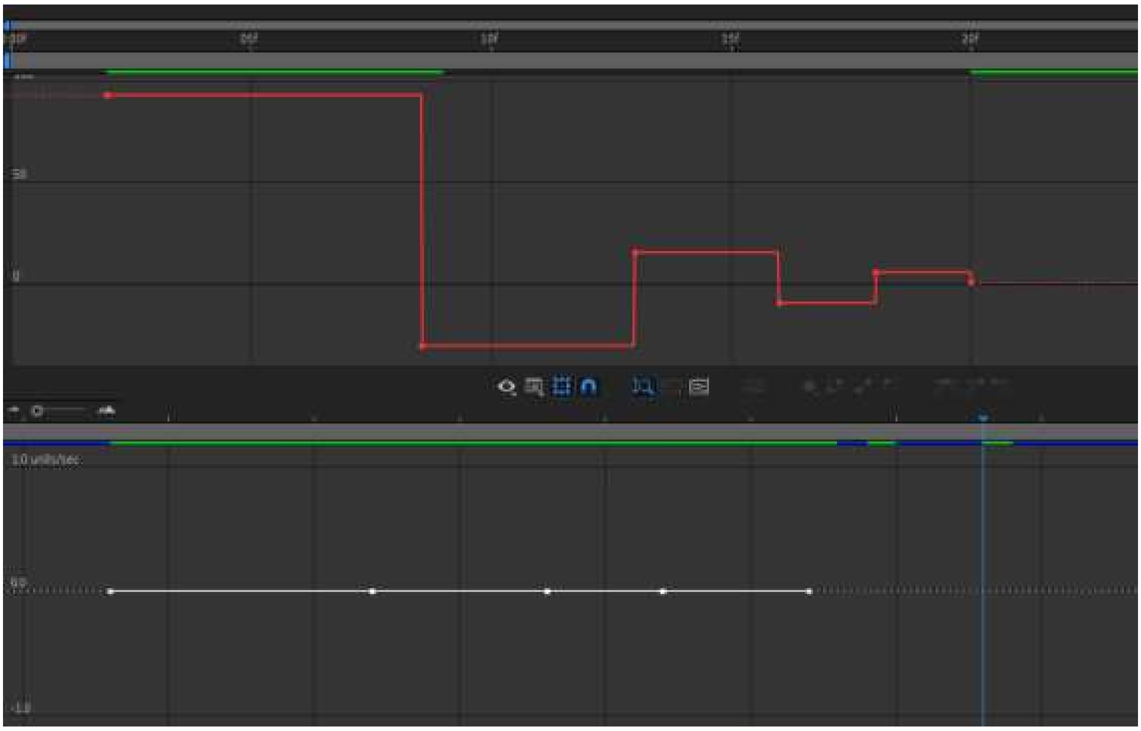
PICTURE 8. An overshoot animation used for revealing an object. Above is a visualisation of a curve like the one depicted below, with the keyframes and their visual counterparts circled.

2.2.6 Hold, or freeze

Occasionally objects are animated in a way in which they appear to move, but the actual movement between keyframes is left invisible, and they only appear to jerk from one position, or scale or rotation value, to the next. This can be used to convey a stop motion feel, and is also often used with collage-type of imagery and heavy use of grainy textures, as well as animating the grainy textures themselves. In After Effects this is done with Hold keyframes, where the line representing the ease is completely straight between the keyframes as seen in picture 9. The lower part of the image shows an example with Hold keyframes where they are used to reveal text word by word. In this case, however, the animated property is the path of a mask that brings on the text, and unlike position, scale, or rotation, it only appears as a straight line with keyframes in the graph editor as its keyframe values can’t be depicted.

In addition, hold keyframes are extremely useful in blocking animated scenes before further refinement takes place (Williams). Blocking is a term used for rough initial planning and animation of a scene, where the key movements and in case of character animation, poses, are placed on the timeline to get an overall feel of the timing and spacing of the scene. A key stage in animation, according to Shawn Kelly of Animation Mentor, it covers 80 per cent of the scene’s animation already (Kelly 2018).

Animatic is a preliminary version of the final video, with either storyboard frames or ready designed assets placed over the timeline with soundtrack. Often used with live action films heavy with visual effects, it is also a common deliverable in motion design, to share the rough initial animation with a client for approval. I have found that limiting all keyframes to hold with animatics is often advisable, as it makes it obvious that the product is not final, as opposed to having preliminary easing which might frighten the client to think the animation is plainly poor.



PICTURE 9. Graphs depicting Hold keyframe animations common in typographic animations timed with a voiceover.

3 AFTER EFFECTS ANIMATION FEATURES

3.1 Introduction to After Effects

After Effects, developed by Adobe Systems as a part of their Creative Cloud software package, is a timeline-based program used for animation, motion design and visual effects work. After Effects is used by over 10000 companies in the United States alone (Enlyft N.d.). While the actual number is likely much higher with individual users included, it is fair to state that the use of After Effects is widely spread. It is also common knowledge that After Effects is the most commonly used software in motion design.

Deeply integrated with other Adobe creative programs like Illustrator and Photoshop, After Effects can be and is typically used to animate assets created with other programs. The ability to read Illustrator and Photoshop files directly without exporting them ensures a streamlined workflow across the design and animation software. In addition, After Effects has basic tools for creating vector shapes. It is the ability to animate these shapes as well as type, created inside the program or not, which makes it a popular choice for motion design.

As stated before, After Effects is usually used for animating or editing footage created outside of the program. As the name suggests, it can be used for creating visual effects for video. While originally created for footage compositing – the art of merging video and other visual assets together – After Effects is hardly ever used as a primary compositing software in film production as its compositing features are considered inadequate by today's standards.

Being such a widespread tool, After Effects has attracted a number of external developers to enhance its capabilities. Several scripts and plugins have increased the program's capabilities in for example character animation, 3D compositing, and audio editing.

While it is outside of the scope of this thesis, it should be noted that the basic animation features of After Effects, including the Value Graph, are very similar to most animation softwares. However, some features native to After Effects are not typically found elsewhere, and thus require some introduction. Before exploring the graph editor in detail, it is worth explaining the basic animation features of After Effects to form a basis of understanding the attributes affected by the graph editor.

3.1.1 Bezier curves

Bezier curves, consisting of a curve and control points controlled with handles, are used across design softwares to manipulate vector paths typically either to draw objects or to adjust animation properties as with the After Effects Value Graph, where the shape of the curve determines the velocity of the keyframes, as seen in the previous examples. A Bezier curve contains an infinite amount of points on a path between its control points, and the computer calculates the path so that it appears smooth.

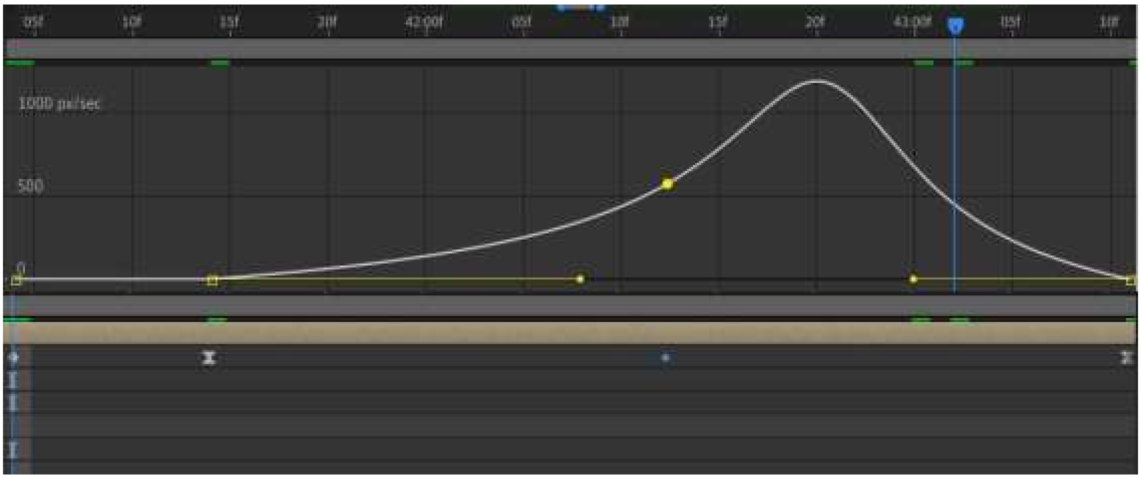
Bezier curves are used not only in After Effects but broadly in computer graphics for drawing and refining paths and other shapes (Javasrcipt.info 2019). Usually created with the Pen Tool across Adobe softwares, it could be said that Bezier curves are one of the core fundaments of digital design and animation workflows and understanding them is essential for the topic of this thesis.

3.1.2 Keyframe types

As briefly covered in previous chapters, After Effects has different types of keyframes for different purposes, with the most common types being Linear and Bezier/Easy Ease, to which the program resorts to by default (Paul). As explained previously, it looks jagged and is typically avoided in animation. The Linear keyframes, as seen in picture 3, execute a steady motion without any easing. The Easy Ease or Bezier keyframes, on the other hand, ease in and out by default, and the hardness of the ease is controlled with Bezier curves, as seen in picture 4. To execute any of the customised eases introduced previously, Linear keyframes first need to be converted into Bezier. They hourglass icon represents both Easy Ease and Bezier keyframes.

Hold keyframes, represented by a square as seen in picture 9, do as the name suggests, and freeze the animated property until it is altered with the next keyframe which may be of any type. In addition to text and stop motion style animation, they are used with video footage for freeze frame effect. Hold keyframes are generated automatically if the user enables Time Remapping on a layer or applies Freeze Frame effect.

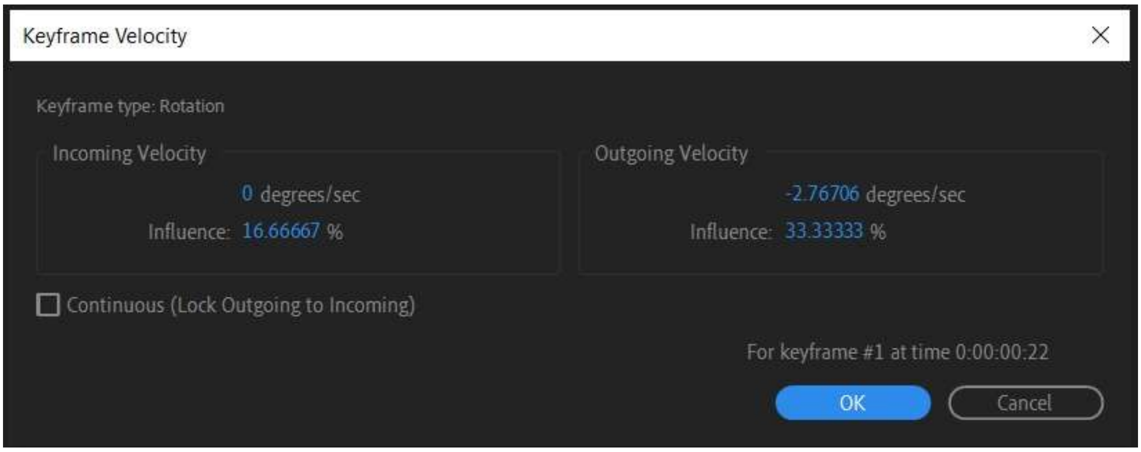
Roving keyframes, as seen in picture 10, represented by a circle, are typically used to automatically smoothen motion where it would otherwise be difficult (Bolante 2009). They can only be used to animate the position of a layer. However, they do not affect the layer’s position but timing, calculated from the keyframes before and after the Roving keyframe. This way, the timing of the main keyframes can be tweaked while the Roving keyframes between them retain their timing proportionally, without a need to adjust them separately.



PICTURE 10. A Roving keyframe between manually adjusted keyframes.

3.1.3 Keyframe velocity

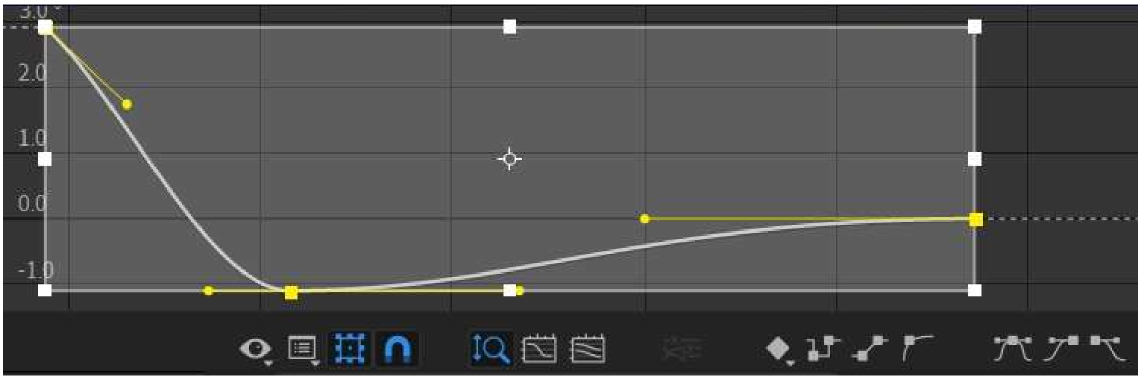
The graph editors adjust keyframe values and velocity visually, but it is not the only method of keyframe fine-tuning. If maximum precision is required, however likely with the cost of a slower workflow, the user can make the adjustments with a dialogue box for Keyframe Velocity, as seen in Picture 11 (Boone 2018). The amount of influence is equivalent direction of the graph handles in the graph editor.



PICTURE 11. The dialogue box allows the adjustment of a keyframe’s values and influence.

3.1.4 Keyframe transformations

Timing of the animations can be adjusted in the dope sheet or timeline of After Effects by controlling the horizontal distance between keyframes. Similarly, spacing of moving objects can be adjusted in the Composition window by adjusting the motion paths. A more advanced method involves the graph editor. In Picture 12, keyframes of an object’s rotation are selected, as indicated by the transparent selection box. They can then be modified using transformation tools to for example rotate or scale the handles, working the same way as they in design softwares like Adobe Illustrator or Photoshop. This is a quick method for easing multiple keyframes simultaneously.



PICTURE 12. Keyframe handles are transformed, simultaneously easing multiple keyframes.

3.1.5 Layers

Video editing and animation softwares are typically timeline-based. The timeline in any professional software can consist of multiple video and audio layers, and normally a layer can contain more than one object, or piece of media. In After Effects, only one object can be added to a single layer, differentiating it significantly from other softwares.

3.1.6 Animation presets

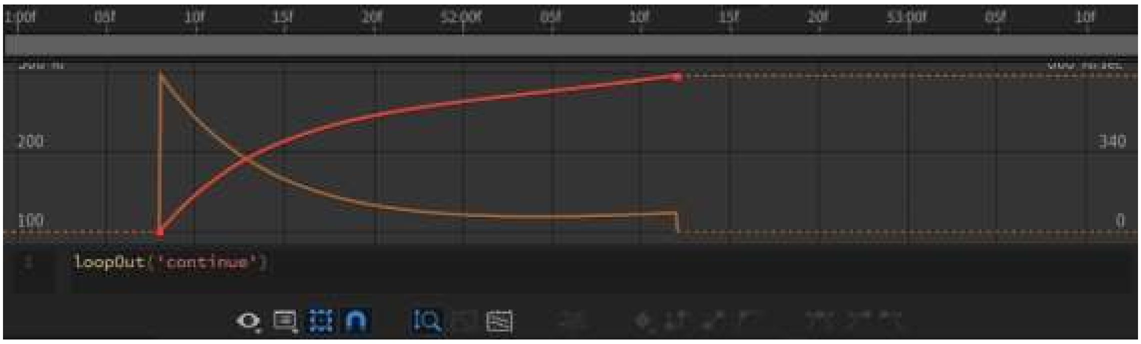
Animation presets are files which contain specific information about a layer's animation (Adobe After Effects User Guide). For example, an animation of an object scaling down as seen in Picture 2, can be saved as a preset and applied to another layer independent of the project file. Using animation presets retains a layer's eases.

3.1.7 Text animators

Text animators are After Effects' presets for animating text for example word by word or letter by letter. The user can assign different states to the text, and then animate the text between these states with keyframes. As an example, an initial state can be that of position, followed by another position, and the animator defines what part of the text is animated between the two positions. The easing of text animators is less controllable than with graph editor based easing, although graph editor can certainly be used with text animator keyframes.

3.1.8 Expressions

An important feature of After Effects, expressions are a code-based system used to perform repetitive tasks or tasks too complicated to do manually with keyframes. In terms of graph editing and easing, expressions are typically used to create looping cycles, or endlessly looping animations at its simplest, as seen in Picture 13. Features performing similar tasks appear in most animation softwares, although their nature may be different.



PICTURE 13. An object's scaling animation includes a looping expression which causes it to scale indefinitely with the velocity of the last determined keyframe.

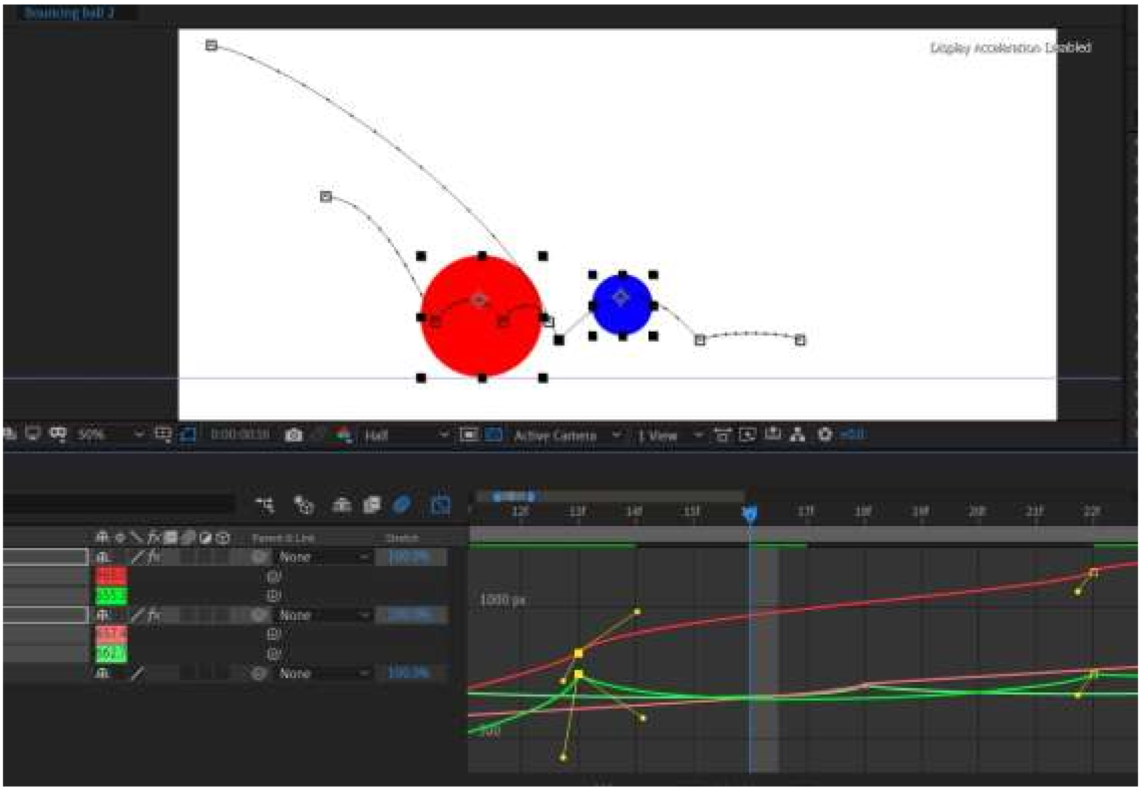
3.2 Value Graph

After Effects doesn't let the user control the actual position or other animated property directly with the Speed Graph (BZwork 2017). An exception to this is adjusting the keyframes itself, which of course are editable in the graph editor, but not the easing. This is only possible with the Value Graph, the examples of which have been previously introduced with pictures. In terms of position, the animator is adjusting the so called spatial interpolation (Ward 2015). In other words, the curves of an object's motion path in the 2D or 3D space are controlled with the graph editor as seen in Picture 14, and only the position value itself can be adjusted in the composition window. In other words, adjusting spatial interpolation with the Value Graph is a direct application of the principle of spacing.

PICTURE 14. A text layer’s X and Y positions are animated using the red and green graphs for X and Y positions respectively. With the position dimensions separated, controlling the motion path in the above composition window is not possible.

In the Value Graph, as the name of the tool suggests, the tweening is done not with adjusting the distance of individual inbetweens like with the Speed Graph but by changing the actual values of the inbetweens, visualized with the graph. A keyframe’s position on the Y axis is a numeric representation of the animated value and the curve shows the tweened value between the keyframes (TDU 2019). With the Value Graph, the animator controls both the easing as well as the motion path’s curves directly with the Graph Editor. In other words, the Value Graph enables very precise numeric control over the exact values that are animated. This, however, is not ideal for animations with complex motion paths.

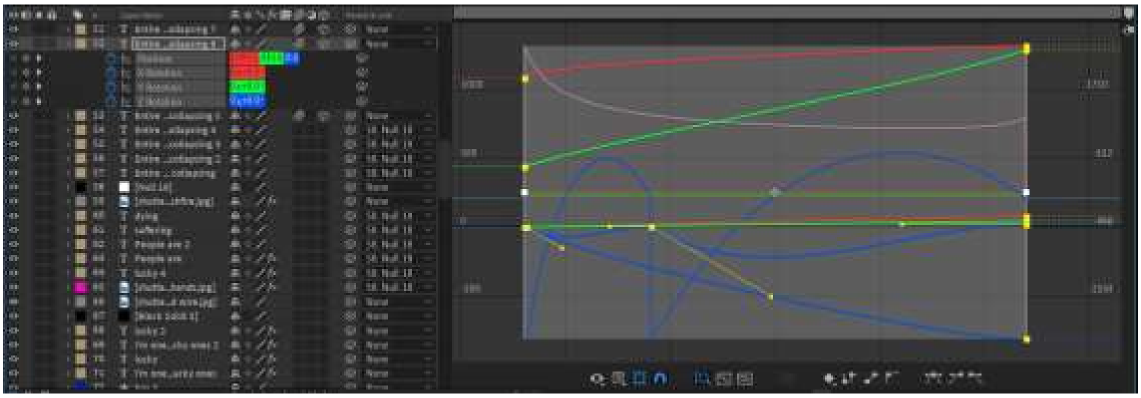
It could also be argued that it should be avoided for animating position in the first place, as it lacks the benefit of adjusting the position visually in the composition window. The motion paths of the two bouncing balls of Appendix 1 overlap, and although a simplified example, Pictures 15 and 16 respectively illustrate how animating the position of several layers with overlapping motion paths is arguably better done without only relying solely on the Graph Editor.



PICTURE 15. With separated position dimensions, the position keyframes of the bouncing balls can be adjusted visually in the composition window but the tweaking of their motion paths' curves is then done with the Value Graph.

Changing the spatial interpolation with individual axis controls and animating the position of a layer with the Value Graph is only possible when the X, Y, and in case of a 3D layer, Z dimension have been separated. This feature is not enabled in After Effects by default but must be selected separately under the position property switch. This might confuse animators coming from a 3D background, where it is typical to animate each axis with the graph editor separately.

Some users may find it easier to animate separate properties simultaneously in order to maintain a consistent ease across all properties which can be done accurately with the Value Graph. A downside of this is that it can easily clog the user interface as shown in Picture 15. An argument against this, however, could be that such practice is not uncommon in 3D softwares and thus a lot of animators are already comfortable with it. On the other hand, After Effects is predominantly used by motion designers and to some degree visual effects compositors whose background tends to be more focused on graphic design for example. As Tom May of Creative Boom states, motion design is a fairly new industry in the field of design (May 2019). It is also rarely taught as a main subject at a higher education level, meaning that motion designers or graphic designers involved in motion design work might not have adequate exposure to animation principles or the graph editor when starting out – another reason why the saturation of the user interface with numerous graphs could be seen as not ideal.



PICTURE 16. A layer's rotation is animated simultaneously in the X, Y and Z axes which makes the user interface confusing.

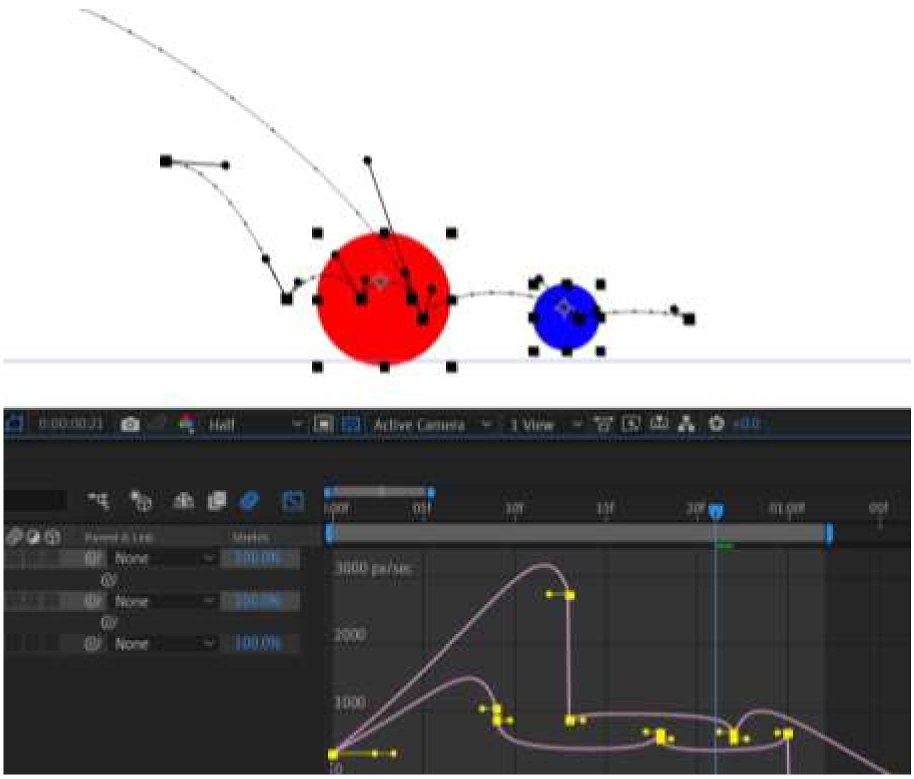
An important matter to note about the Value Graph is that it can only be used when the animated property has a numeric value. Almost any property of a layer in After Effects can be animated. Using type as an example, this can include tracking and line spacing in addition to the previously introduced text animators as well as the default position, rotation, scale and opacity. Vector shape layers have the greatest amount of animatable properties, of which the vector paths themselves are noteworthy. This way, shapes can be animated quickly without complex rigs by keyframing the shapes with the default transformation tools. The animated shapes, however, don't have numeric values that could be represented in the graph editor. This is why their easing cannot be controlled with the Value Graph. Other examples include type, when the text itself is animated, and some expression controls.

3.3 Speed Graph

Whereas the Value Graph controls the spatial interpolation of the animated property, the Speed Graph only affects the temporal interpolation. Temporal interpolation is a term for how the easing and tweening are affected over time

(Ward 2015). When position dimensions are not separated, After Effects will default to the Speed Graph. The Speed Graph the curve represents how the inbetweens are spaced between the keyframes. A longer yellow handle at the beginning represents more inbetweens closer to the keyframe and a longer ease, whereas a shorter handle naturally represents fewer inbetweens and a shorter ease as seen in Picture 17.

The advantage of the Speed Graph is the ability to control the motion visually with the motion paths in the After Effects user interface as seen in Picture 17, which is a more intuitive way of animating for most animators. Controlling the motion path is a direct application of the principle of spacing, the distance which the animated object moves between the keyframes (Saylor 2018). This, and the lack of control of the actual animated values, as well as the absence of Bezier curves in the Speed Graph are the main differences to the Value Graph.

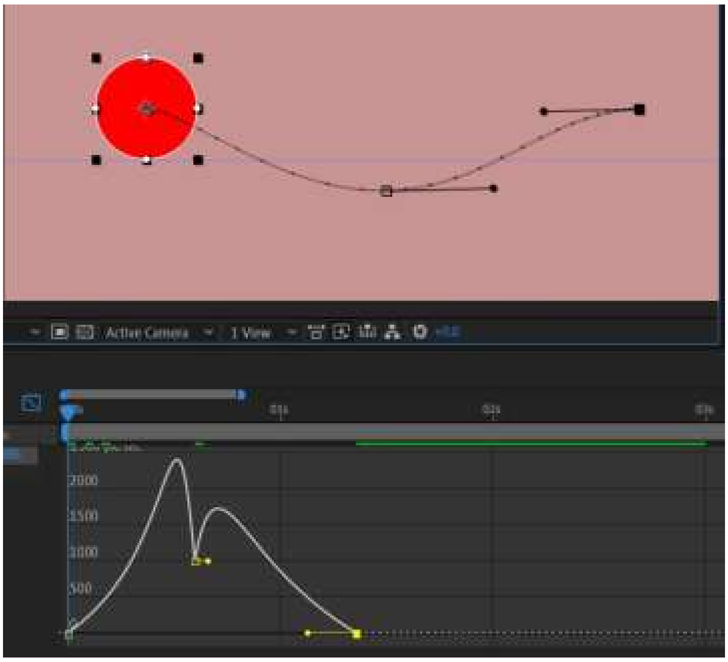


PICTURE 17. The overlapping of the two bouncing balls' motion paths is controlled with the motion path in the composition window when the position dimensions have not been separated. Easing is controlled with the Speed Graph editor.

The separation of where the motion path itself and the easing is controlled in the user interface differentiates the Value and Speed Graph workflows. With the Speed Graph these have to be done in separate user interface windows, allowing more precise control over the motion paths but arguably less intuitive easing.

A key difference compared to the Value Graph lies in the curves themselves as they behave very differently to Bezier curves. Instead of being rotatable from the center of the keyframe, the Speed Graph handles can only be pulled horizontally. The length of the handles affects the parabolic curve between the keyframes.

Another key difference between the different graph editors is how they visualize smooth animation between keyframes. This is where the Speed Graph is less intuitive as the values of the easing on each side of the keyframes are not directly legible as they are in the Value Graph. As Picture 18 shows, the curves on both sides of the middle keyframe are far from symmetrical despite their motion path being close to symmetrical. The easing of the keyframe’s motion is smooth. If it wasn’t, the keyframe handles would be at different heights, and there would be a yellow keyframe icon for each handle at the same point in time. In other words, the key to reading smoothness with the Speed Graph keyframes is not in the shape of the curve but their incoming and outgoing velocity values being the same. When they are, only one yellow keyframe icon is seen as in Picture 18.



PICTURE 18. The view of the composition window above shows the object's motion path and how it is almost symmetrical, unlike the curve of the Speed Graph below.

4 UTILIZING THE GRAPH EDITORS IN MOTION DESIGN WORK

4.1 Introduction and purpose

The differences between the Value and Speed Graph editor and how they handle eases have been compared in the previous chapters. To further understand the opportunities and limitations of each in practice, a short motion graphics animation was created for the practical part of this thesis (Appendix 2). The animation represents the so called kinetic typography genre, with rapidly animated text offering opportunities for numerous different types of eases. The animation is an extract of the Swedish activist Greta Thunberg's speech at the United Nations' headquarters in late 2019. In the process, both graph editors were used extensively and comparably to determine the optimal uses for each.

Rich text animation, often called kinetic typography, has been increasingly applied in motion design in the 2010s, and according to Dana Kachan of Muzli, it's one of the top trends of animation and motion design in 2020 (Kachan 2020). Professional motion graphic videos rarely consist entirely of kinetic typography with the exception of lyric videos for songs. Common in short form social media videos as well as non-commercial visualisations of famous speeches, either historical or fictional, it could be argued that execution of the majority of kinetic typography videos lacking in professional quality despite the potential the genre offers. This is mostly due to elementary keyframing and lack of proper easing. One goal of the animation is to explore how proper easing can elevate the quality of a kinetic typography animation. Moreover, the nature of type is often viewed from a too narrow perspective, and no advantage is taken of type being treated as shapes or characters, but that is outside the scope of this thesis.

4.1.1 Design notes

The animation was designed to support the heavy and emotional tone of the speech with the use of selected stock images and video, contrasting black and white colours to highlight the juxtapositions of the speech, as well as very literal animations for some of the heavily stressed words. The typeface Futura was used predominantly due to its suitability and good legibility when animated. In addition, its letter O is perfectly round, making it suitable for circular shape transitions as seen it Picture 19. An additional advantage, although not used in this project, is its clean sans serif glyphs that can be converted into vector paths and then animated manually. A serif typeface Baskerville was chosen as a supporting typeface.

Kinetic typography videos often give the impression of text set in the same 3D or so called 2.5D space, with the camera panning and zooming with the text as it animates. For this project, this effect was used sparingly, following only connected sections or paragraph of the speech to break it apart into different sections. In addition, wider creative possibilities were utilized in transitions.

Moreover, seamless transitions typical in high end 2D animations were used. As an example, individual glyphs of words are used to frame and crop scenes as seen in Picture 19. This effect binds the elements together and when used to animate a scene both in and out, it adds to the continuity.

PICTURE 19. Screenshot from the middle of a seamless transition as the camera zooms inside the letter ‘O’ which forms the frame for the next scene.

While using real video footage would have been ideal and offered a lot of opportunities for compositing and having the animation interact with the footage, the use of video footage was avoided for copyright and licensing reasons. Some stock images and copyright free photographs was used instead for the beginning, end, and additional key moments.

Possibly started as a trend after Apple’s famous animated brand film “Designed by Apple in California”, published in 2013, highlighting exact words or phrases either abstractly or literally, has been increasingly popular. The literal animating of words or sentences is a common element in kinetic typography, and extensively used in the project. Examples seen in Picture 20 demonstrate the literal animations. They were planned carefully to enforce the message, although this might only be noticeable to the viewer subconsciously. As stated in Media Button’s article concerning branding, it is important to consider what connotations the visuals have (Media Button 2015). This of course applies to motion design as well.

PICTURE 20. Examples of literal animation. With the voiceover saying “I shouldn’t be up here”, the words move up and a cross is drawn over them. In the second example the text flips as the voiceover mentions “the other side”.

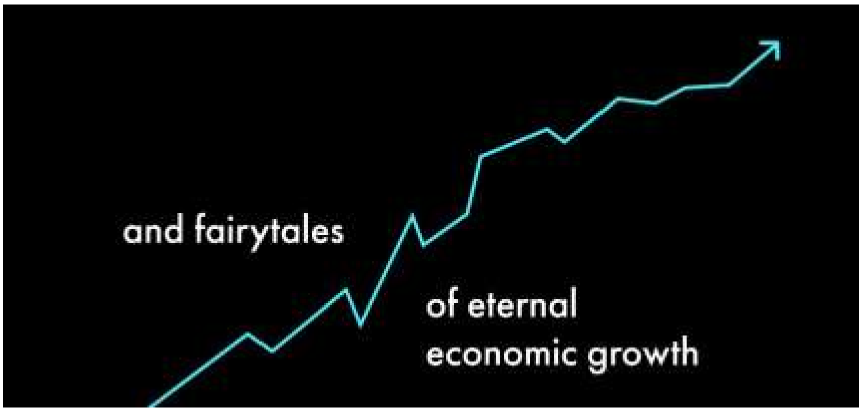
To accompany the feel of the literal animations, the words were broken down to individual glyphs on a few occasions. This allowed great flexibility with how the type could be animated, and added a lighter and more playful feel to add contrast to the overall dramatic and heavy tone. In Picture 21 the initial ‘Y’ of the word ‘yet’ stays in place as the rest of the glyphs animate out, making space for the next word to form. This technique of splitting words into characters is very common in logo animation where more precise control is desired than what could be achieved with text animators.

PICTURE 21. Example of how words animate from one to another using the same initial glyph.

To implement the principle of anticipation, eye tracing was used throughout the animation. Eye tracing refers to the art of composing the elements on the screen in a way that anticipates the next movement, or as Ryan Plummer and Jacob Richardson of School of Motion phrase it, it is the art of directing the viewer to where they should be looking (Plummer & Richardson n.d.). In the example of Picture 21 this is achieved by animating the kerning of the word 'lucky' while the rest of the sentence remains static and is animated out with the black shape under it. The subtle movement in the word focuses the viewer's attention there as it acts as the focal point of the next scene. To accompany this, the animating out of the rest of the sentence happens so that the black shape recedes from its edges towards the centre of the word 'lucky'.

PICTURE 21. Example of eye trace from one scene to the next.

A simple technique already used in visual art for centuries to complement the eye tracing is the use of arrows and similar elements to guide the viewer's eye. As seen in Picture 22, a line that flows through several scenes, morphs into a graph with an arrowhead as text animates along it. Furthermore, the arrowhead points towards the direction where the camera pans to reveal the next scene.



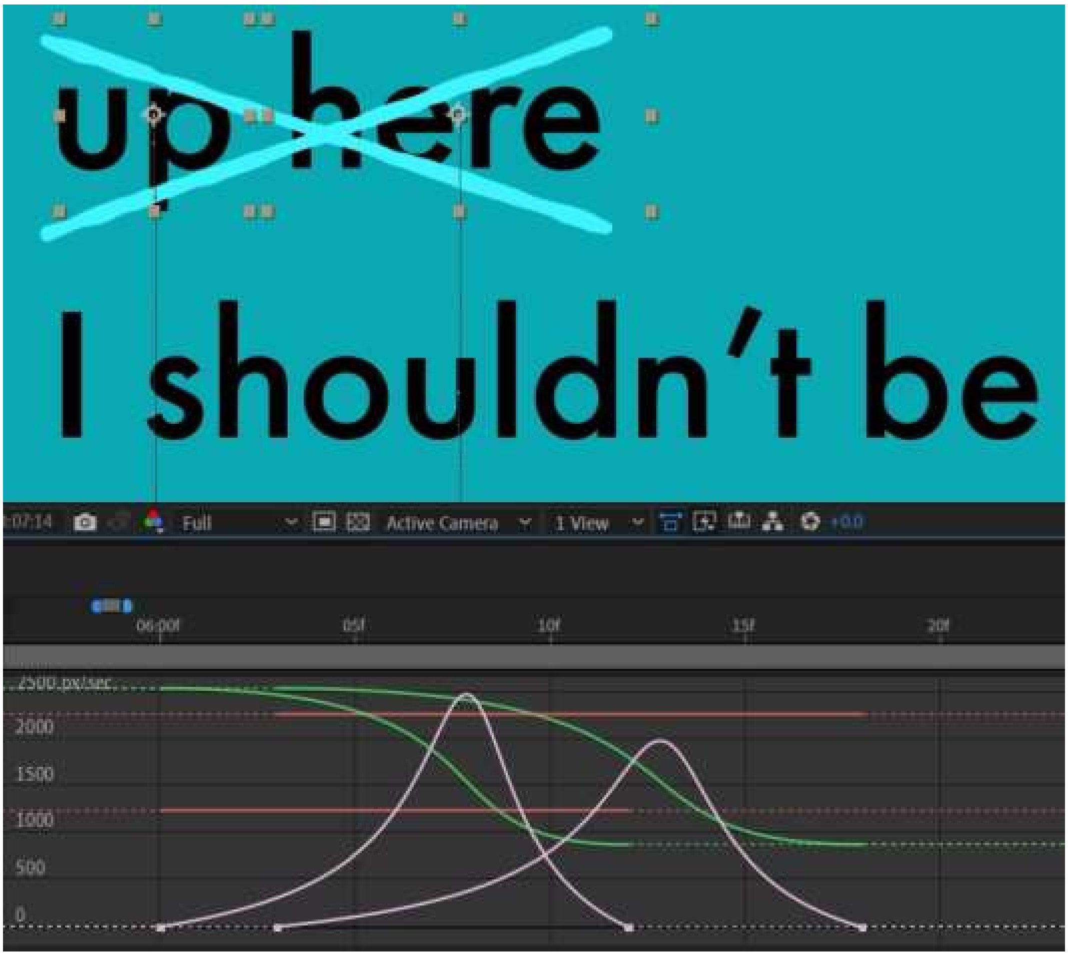
PICTURE 22. The animated line with an arrowhead guides the viewer's eye throughout the scene.

4.2 After Effects workflow

The aim of this chapter is to describe and reflect on the graph editor workflows used in creating Appendix 2, and determine where the use of each graph editor was advantageous, and the reasons for that.

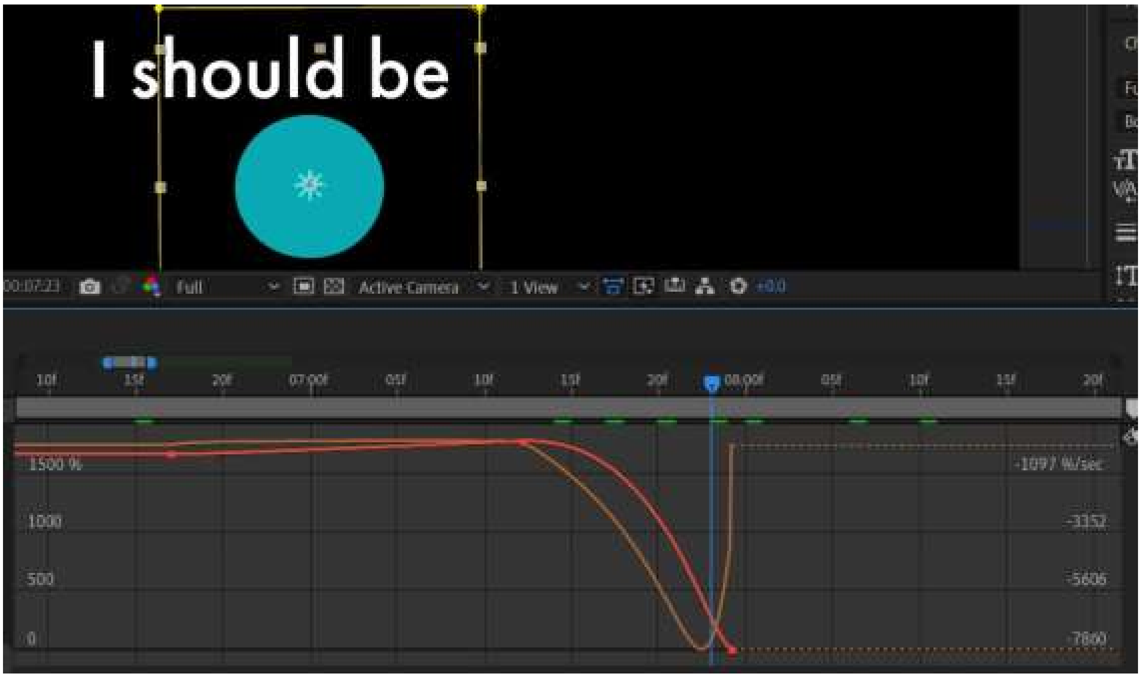
4.2.1 Simple movements with individual graph editors

The first example, shown in Picture 23, deals with a simple position animation. The words build up motion slowly with a long initial ease, followed by a fast accelerating movement in the middle, before slowing down again. As explained previously, when the positions have not been separated, After Effects will only let the user use the Speed Graph to adjust the keyframe handles. With this example it was discovered that for a simple position animation, Speed Graph is the ideal tool. As there was no need to separate the positions, this movement was quicker to animate with the Speed Graph. It is worth pointing out that that in this example, the curves of a Value Graph are seen in the background. This is a feature of After Effects which shows a reference graph from the graph editor which is not in use.



PICTURE 21. The Speed Graph proved to be more advantageous for simple position animation. A reference graph can be seen in the background, showing how the position changes on the Y axis.

The next example is somewhat similar, a simple scale animation of a shape layer where it first anticipates the shrinking by growing slowly, followed by a moment of stillness before a hard ease into an accelerating shrinkage (Picture 22). As scale is something that can be animated with the Value Graph, that is what After Effects defaults to. In a simple animation like this it wouldn't have made any real difference which graph editor tool was used. The conclusion that can be made based on this, however, is that knowing both Value and Speed Graph workflows is extremely useful for a faster workflow. This way the animator can comfortably ease anything regardless of the property's limitations.



PICTURE 22. A simple scale animation with the Value Graph.

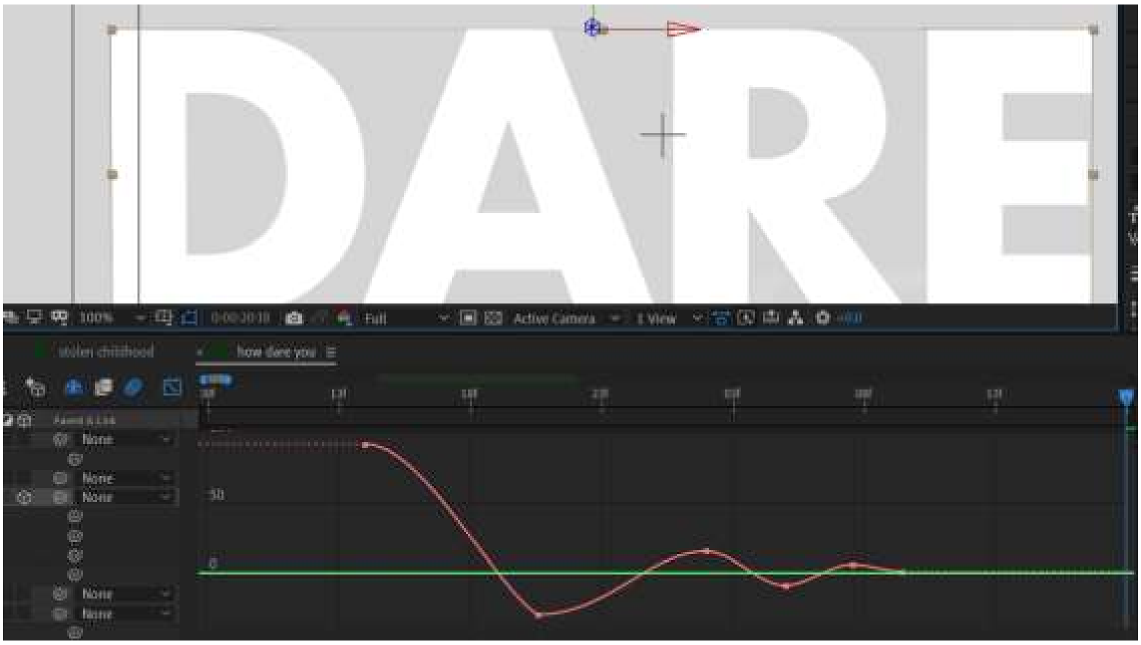
There are instances where the use of both graph editors on one property is justified. A good example is introduced in Picture 23. The text 'Back in school' is first revealed with a mask. A mask in After Effects is a shape which reveals or hides a layer. Unlike scale or position for example, mask paths cannot be depicted with values. As a result, masks can only be animated with the Speed Graph. The keyframes in this example are Hold keyframes, with no easing between them. This results in a completely flat Speed Graph curve as on the left in Picture 23.

PICTURE 23. A text layer eased with both graph editor types.

In addition to the mask, the X rotation of the layer was also animated. With rotation, the dimensions are always separated, which leads to the default use of the Value Graph. The use of the Speed Graph would also have been possible. It makes a small difference, however in this case the Value Graph was a better fit. In the animation, the text rotates 90 degrees, with one line making space for the next, like rolling a dice. By easing with the Value Graph, a precise control of the rotation angle was achieved, more so than would have been possible with the Speed Graph. It is also the only moving element on the screen at that time, making it essential to have it animate as smoothly as possible.

As mentioned earlier, the Value Graph can be used directly for animating properties with animatable values. A good example of this is where a single word is animated rotating like an old-fashioned store sign flapping in the wind or from impact. Picture 24 shows the animation curve for this. The rotation keyframes were set directly in the Value Graph and eased simultaneously. This proved to be the fastest way to animate the described movement.

It is worth noting that this is of course only possible with the Value Graph. With the Speed Graph the workflow would differ, as the keyframes cannot be set inside the graph editor but instead in the properties panel. Only the changing of temporal interpolation by moving the keyframes would be possible. Then the user would have to return to the graph editor to adjust the easing. Likely the user would have to look at the reference graph to avoid guesswork and trial and error to achieve the desired easing.

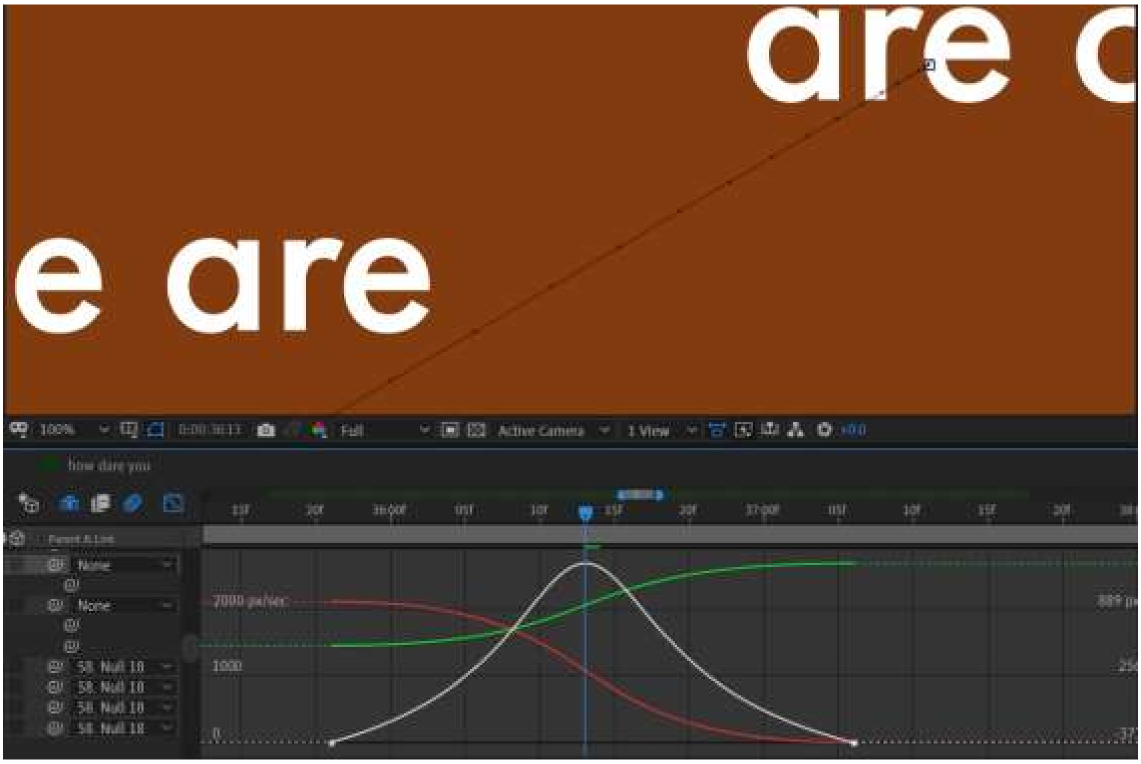


PICTURE 24. The word’s rotation is animated using the Value Graph only.

4.2.2 Workflow using both graph editors and scripts

There are also situations where the chosen workflow depends on the user’s preference. An example in Appendix 2 involves a scene where the camera pans across the scene diagonally. This means that both the X and Y positions are animated. In the example, shown in Picture , the positions have not been separated and the Speed Graph is used. This is the intuitive workflow for the author personally.

With separated dimensions the user would have to set the keyframes both to X and Y position. And to achieve the same ease for both, the Value Graph editor handles would have to be selected and manipulated simultaneously, similarly to 3D animation softwares. As explained before, this might feel too complicated.



PICTURE 25. Both X and Y dimensions are animated simultaneously using the Speed Graph.

If the movement in question is crucial in the scene, the Speed Graph can’t be used, and the easing of two or more curves simultaneously is too confusing, two scripts can be used to overcome this. Scripts are series of commands that tell the program to perform certain operations (Adobe After Effects User Guide, n.d.). Scripts usually feature a bespoke user interface window, and are typically installed separately, as After Effects comes natively with only a few scripts.

Flow is a paid script allowing the user to ease any two keyframes with ready-made presets and a user interface similar to the Value Graph editor (Rendertom n.d.). With Flow there is no need to actually use the graph editor.

Ease and Wizz is another paid script with easing presets. A set of expressions for adjusting the interpolation with values, it requires no use of the graph editor. (Haigh n.d..) While supposedly easy to use, it does not offer as much control as Flow, or the graph editor.

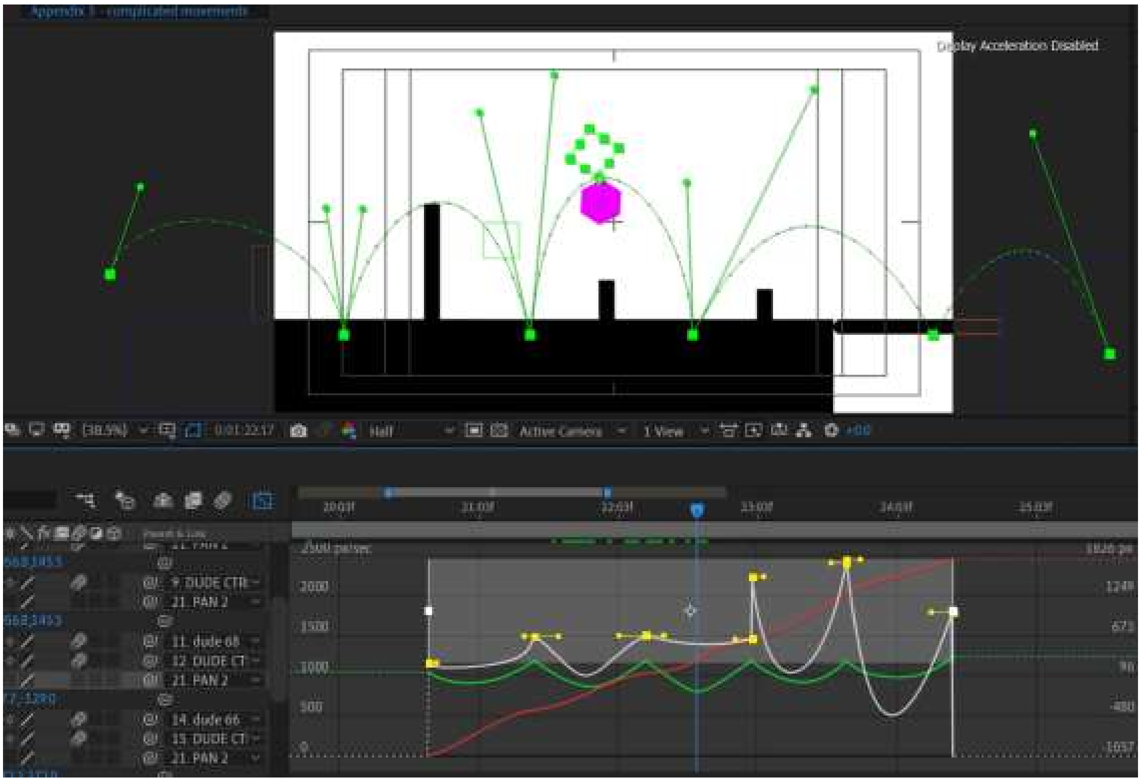
Another method is to use a script called EaseCopy. Developed by Mike Overbeck, EaseCopy lets the user copy the eases from any number of keyframes regardless of the animated property, and paste them to any same number of keyframes. It is one the most popular scripts for After Effects and used by the majority of senior level motion designers. For the example in Picture 25, the user could first create a two-keyframe animation with the desired ease and then apply it with EaseCopy to the actual animation.

4.3 Complicated movements

Not included in Appendix 2, but essential to further understanding the subject of the thesis, a short animation was created (Appendix 3). Appendix 3 features shapes bouncing and moving horizontally. Bouncing is used as example because it involves the principles of timing, spacing, overlapping action and follow through, and exaggeration in this instance.

The use of the Value Graph only would have been possible, but Speed Graph was chosen instead for a faster workflow, however using the Value Graph as a reference. This is also the author’s method for all complex position movements.

Picture 26 demonstrates the graph shape. The reference graph shows the Y values in green. The method for easing was to adjust the Speed Graph handles in order to achieve a pleasant-looking Value Graph curve. As seen in the picture, the Speed Graph curves are significantly different from one another, and because of this, having the reference graph as a guide proved to be of great help. This proves that the understanding of different curve types, as introduced earlier in the thesis, is vital.



PICTURE 26. Speed Graph is used for animating, while the reference graph shows the values.

5 CONCLUSIONS AND DISCUSSION

As stated in the introduction, the understanding of how graph editors work is a crucial skill for a motion designer, and the ability to adjust the easing with a graph editor is what elevates the work from mediocre to good. Moreover, it was discovered that the understanding of different easing and graph types reinforces these skills.

In the practical part, the most optimal uses for both After Effects graph editor tools, the Value Graph and the Speed Graph, were determined. The first conclusion was that in the majority of situations dealing with simple animations, there is very little difference between the Value and Speed Graph workflows, and knowing both well enough is beneficial as it enables to user to quickly rely on whichever is chosen the program.

Knowing when to switch the default tool was also discovered to be important. The Value Graph proved to be optimal for animations that only affect a single property, for example the rotation of an object. It also proved to be adequate for any simple movement, had the position dimensions been separated. In addition, it was discovered that key movements of a scene are better animated with the Value Graph where possible due to its higher precision and the control over the animated values.

For complex movements that affect the position of an object, the Speed Graph proved to be more suitable. This includes movements with complex and overlapping motion paths. In addition, a workflow utilizing both graph editors simultaneously with the aid of a script called EaseCopy was discovered. This method involves creating the desired ease with the Value Graph on a separate object, and then applying the same ease to the complex animation on a layer animated with the Speed Graph.

While the learning of manual easing as well as the two graph editor tools has proven useful, the results suggested that future development of After Effects could enhance the user experience for the animator. Switching between different tools and where applicable, external scripts, is not only slow and unintuitive to learn but inevitably slows the workflow down even for an experienced animator. The main development suggestions based on this thesis is implementing a feature similar to EaseCopy natively, which would allow the copying and pasting of eases across animations. Furthermore, a feature which would allow the adjustment of eases regardless of the animated property using Bezier curves instead of the Speed Graph is recommended.

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APPENDICES

Appendix 1. Bouncing balls

https://vimeo.com/399486259 Password: thesis

Appendix 2. Greta Thunberg – How Dare You? Kinetic typography

https://vimeo.com/382890171 Password: thesis

Appendix 3. Complicated movements

https://vimeo.com/407091852 Password: thesis