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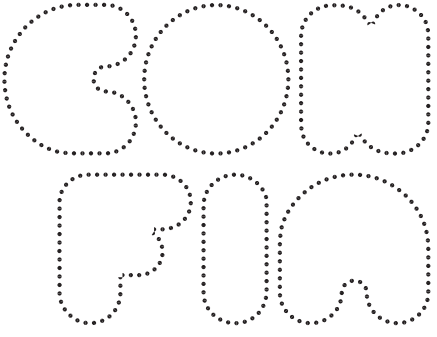

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CONTENT

The problem of Realism in animated characters

has the Uncanny Valley been crossed?

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Abstract

When computer generated animation (CG) emerged in the early eighties, and because of technical limitations, the creation of animated characters that fell into the realm of what is known as the Uncanny Valley was not an issue. Early examples such as Lucasfilms The Adventures of André and Wally B. (1984) or Pixar's Tin Toy (1988), the first CG animated short to win an Oscar, portrayed characters based on simple geometric shapes, which inherently lent them a cartoon-like appearance. At the beginning of the 21st century, however, CG technology had evolved enough in is multiple technical aspects (rendering ability by ever-faster computers, textures, lighting, and even features such as the simulation of hair or cloth) as to allow for animated characters to become closer representations of humans. A frequently quoted milestone in this respect is Final Fantasy - The Spirits Within (2001), a film in which the characters, albeit not based on specific human actors, look eerie and move a little too smoothly, placing them within the constrains of what the Japanese roboticist Masahiro Mori defined as the Uncanny Valley. We argue that in the past decade, animated feature film directors have adopted a different stance, learning from the relative box-office failures of films such as Polar Express (2004) or Beowulf (2007), and readapting CG technology to create characters more in keeping with the visual language and movement syntax of animation. As such, we expect that this drift away from the Uncanny Valley will continue over the next years, leading to the appropriation of cutting edge CG technology by animators and directors by acknowledging its possibilities and limitations, rather than by falling victim to the problems it can cause in character development for animation.

Keywords

CG Animation, Motion Capture, Uncanny Valley, Character Development, Realism

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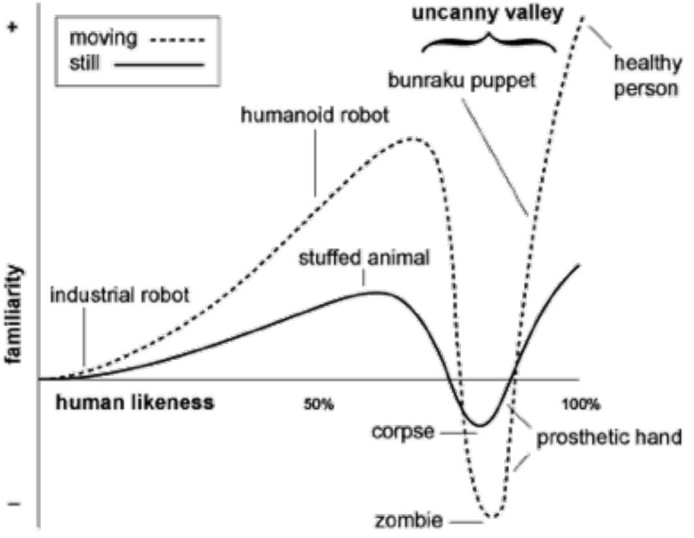
1 · INTRODUCTION

The Uncanny Valley theory was proposed by the Japanese roboticist Masahiro Mori in his paper Bukimi no Tani Genshō (1970) [1]. In it, he describes how the progressive approximation of the design of a robot to human characteristics will eventually lead to a reaction of disgust by those interacting with it – this is what he called the Uncanny Valley. In his hypothesis, he presents two aspects of the Uncanny Valley, one regarding a representation that is immobile, and one of a representation that is moving. He describes the reaction of the human interacting with this representation according to two axes, one of increasing familiarity and another of increasing human likeness (Fig. 1).



F.1 Masahiro Mori – Uncanny Valley Graph (Mori, 1970: 1)

He places the industrial robot at the beginning of the graph, as it bears little familiarity, and no human likeness at all. As the curves progress, the peak for non-moving representations is the stuffed animal (which is very familiar), and at the top of the curve for moving representations we find the humanoid robot (which has a greater likeness to humans). The peaks of both curves drop of sharply as soon as he introduces the example of a prosthetic

hand: ”So maybe the prosthetic arm has achieved a degree of human verisimilitude on par with false teeth. But this kind of prosthetic hand is too real and when we notice it is prosthetic, we have a sense of strangeness. So if we shake the hand, we are surprised by the lack of soft tissue and cold temperature. In this case, there is no longer a sense of familiarity. It is uncanny” [2] For example, a corpse is situated in the valley for a non-moving representation, and a zombie for a moving one. So, the fundamental difference between a corpse (less uncanny) and a zombie (more uncanny) is the fact that the second one is in motion, which arouses more feelings of disgust and uncanniness in humans than when observing a non-moving object.

For some time, the theory he proposed was mainly applied to the design of humanoid robots, but more recently, with technological developments in the field of CG computer animation, it has often been used to describe the effect a certain type of animated characters may have on the viewer. In the early years of the 21st century there has been a trend towards a greater “realism” in CG animation, with directors and animators aiming for increasingly lifelike characters in their productions.

The issue of realism in animation is not a new one. Paul Wells speaks of this issue, defining realism in animation as the relation it holds both with the representations one can find in live-action film and in the ‘real world’ itself, holding Disney animation as a standard, whereas “Realism (...) is a relative term, but within animation it is useful to locate the ‘hyper-realism’ of the Disney films as the yardstick by which other kinds of animation may be measured for ‘realism’” [3]. One has to consider that the films produced by the Disney studios aimed for and increase in the realism of their portrayal of characters and settings, which was, at the time, a product of contemporary technological innovations such as the multi-plane camera, rotoscopy, or the use of more frames (in-betweens) in their animated features.

Still within the context of this type of animation, he goes on to clarify the desire for hyper-realism in animated films, and how they related to live-action films and the “real world”: “Informing the hyper-realist style are some key codes and conventions which enable these kind of comparisons to take place. These are: - The design, context and action within the hyper-realist animated film

approximates with, and corresponds to the design, context and action within the live-action film's representation of reality; - The characters, objects and environment within the hyper-realist animated film are subject to the conventional physical laws of the 'real' world; (...) - The construction, movement and behavioral tendencies of 'the body' in the hyper-realist animated film will correspond to the orthodox physical aspects of human beings and creatures in the 'real' world". [4] These are aspects that interest us as being especially relevant in current animated films,, as both the technological possibilities of an era, and the desire to create realistic characters and movement continue to be the goal of some CG animation directors.

2 · THE UNCANNY VALLEY IN ANIMATION

In his theory of the Uncanny Valley, Mori speaks of issues that can be transversal to animation and animated characters. In his definition of the peaks surrounding the Uncanny Valley, the second peak (where a healthy person is located) should not be the target for designers (animators). The first peak (when in motion a humanoid robot, when still a stuffed animal) is the design target he believes one should aim for in order not to fall into the Uncanny Valley.

Animation can be viewed as being situated in the most "dangerous" region of the valley, as it necessarily implies motion. As Mori puts it: "Since these effects are apparent for just a prosthetic arm, the strangeness will be magnified if we build an entire robot. You can imagine going to a work place where there are many mannequins: if a mannequin started to move, you might be shocked. This is a kind of horror." [5] He also especially speaks of the effect moving robots can have on the viewer:"(...) slight variations in movement can cause a robot, puppet, or prosthetic hand to tumble down into the Uncanny Valley." [6] and strongly advises robot designers to consider an approach in which: "I recommend designers take the first peak as the goal in building robots rather than the second. Although the second peak is higher, there is a far greater risk of falling into the Uncanny Valley." [7] This recommendation aims for a less life-like representation of a human as a design target, preventing the eventuality of creating a representation that falls into the valley. As his chosen representation for this

first peak is the stuffed animal, and drawing inference from that to the design of animated characters, a certain degree of cartoonization of characters seems desirable in order to avoid the pitfalls of the Uncanny Valley.

As far as CG animation goes, with the increasing technical capabilities achieved in recent years, the fall into the Uncanny Valley has been a very real and present issue. Starting as early as in 2001, Hironobu Sakaguchi's film adaptation of the popular Final Fantasy game franchise, Final Fantasy: The Spirits Within (2001) tried to showcase the ability to produce realistic and life-like animated representations of humans. In 2004, Robert Zemeckis's Polar Express and later, in 2007, Beowulf (also directed by Robert Zemeckis) were box office failures, despite the investment in cutting edge technology and hyper-realistic representations, this time of actual Hollywood actors such as Tom Hanks and Angelina Jolie. Significantly, also in 2004 DreamWorks released Shrek 2, directed by Andrew Adamson, Kelly Asbury and Conrad Vernon, and Disney/Pixar Studios released The Incredibles, directed by Brad Bird, both of which went on to be, respectively, number one and four in global grosses [8]. Whereas The Polar Express went in at number fifteen, grossing less than a third than Shrek, and less than half of The Incredibles. A great amount of speculation of the reason for this relative failure by such a reputed director such as Robert Zemeckis has occurred, but one can argue that the failure of these films could lie in the fact that its characters are sitting comfortably within the Uncanny Valley.

This also raises the issue of viewer engagement with animated characters, which can undoubtedly be connected to aesthetic engagement, evidence of which can be found in the research of animation scholars Matthew Butler and Lucie Joschko: "Aesthetic engagement in animation can be seen to focus fundamentally on the appearance of the characters. Although the overall appearance of animated films (including backgrounds) contributes to the viewer's level of immersion and depth of their cinematic experience, it can be argued that true engagement is primarily derived from the portrayal of characters. Researchers confirm that the animated version of reality needs to remain sufficiently abstract to allow audiences to employ their imagination and create unique bonds with characters." [9] This study reveals that viewers are

more interested in the design of characters, rather than in how they move. Animation has evolved immensely over the past 100 years, but mostly the characters it portrays have featured characteristics that clearly distinguish them from live-action characters, such as a degree of caricaturization and overall simplification of their features. This means that an animation character designer must take two factors into consideration: firstly, he has to be aware that the design of his character cannot fall into the Uncanny Valley through the inclusion of excessively familiar human traits; secondly, he must design the movement of the character in such a way as not to resemble a human too closely (i.e. using the language and movement syntax of animation). In a study of computer generated faces, Human-Computer Interaction (HCI) professor Karl McDorman suggests that: "Without the strong activation of a human model, proportions that look ideal could drift from human norms with perhaps other aesthetic principles coming into play instead. We see this in cartoon depictions of human beings, which can be beautiful despite having grossly diminutive or exaggerated proportions (e.g., Jessica Rabbit in the film Who Framed Roger Rabbit)" [10]. As such, the "ideal" animated character should not resemble a human model too closely, and if it does resemble it in some ways, some precautions should be taken: "The human face is capable of producing an astonishing variety of expressions—expressions for which sometimes the smallest difference changes the perceived meaning considerably. Producing realistic-looking facial animations that are able to transmit this degree of complexity continues to be a challenging research topic in computer graphics." [11]

Interestingly, characters that are better known to viewers though prolonged exposure (more familiar), appear to resist falling into the valley more strongly: "Within this update on the Uncanny Valley subject, it was possible to validate its persistence under a contemporary scenario: CG generated characters and animations are a rich environment to observe the phenomena. Also, during the study we found an interesting correlation between the effects of the Uncanny Valley and the familiarity a given character has between the public, where the curve tends to be moderate for those characters previously known by the subject." [12] This study seems to suggest that if a character has been known to viewers for

a longer period of time, they will be more tolerant of its features, even if they can cause some uncanniness, whereas a new character will have to be designed more carefully in order not to cause unpleasant reactions.

With some of the previous consideration in mind, we will now analyze some examples of films that, in our opinion, are representative both of the failure and of the success of animation in relation to creating characters located within the confines of the Uncanny Valley.

3 · CAN WE LEAVE THE VALLEY THROUGH MOTION?

We believe that the beginning of the current century brought about certain experiments in CG animated feature films that failed to have the desired success and impact on viewers for two reasons: firstly, following spectacular improvements in CG technology in the early 2000's (such as Motion Capture, for example), a trend towards increased "realism" implying mainly more realistic character design, motion, texturing and lighting in animated features was sought for in animated feature films; Secondly, the possibility of creating these more realistic looking animated characters (often modeled upon and based on performance capture of real actors) led to a certain abandonment of the practices of animation such as cartoonization of characters and traditional motion syntax, which lead to increasingly "Uncanny" depictions of humanoid characters in animation. The first example of this trend was Final Fantasy: The Spirits Within (2001), directed by Hironobu Sakaguchi. This film has often been quoted as the main reference for animated feature films located within the Uncanny Valley, although many other examples were to follow.

We will analyze a group of films insofar two main categories are concerned: firstly, the "realism" with which the characters are portrayed (considering factors such as likeness to humans, textures and lighting), secondly, the way the movement of these characters is portrayed, and how this movement affects the viewers reaction to them. This analysis relates to the two curves in Mori's diagram, in which the curve pertaining to movement delves far deeper into the Uncanny Valley than that pertaining to non-moving representations.

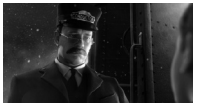
These examples are by no means a complete list of all the films

F.2 Final Fantasy: The Spirits Within (2001) Hironobu Sakaguchi

that could be included in this category, but rather provide a comparison between different styles of character design and animation in regards to their placement within the Uncanny Valley.

Hironobu Sakaguchi's Final Fantasy: The Spirits Within (2001) was based on Square's Final Fantasy game franchise created in 1987. The characters were designed specifically for the film, within the universe of the games. American Film critic Roger Ebert describes his impression of the main character, Dr. Aki Ross: " Not for an instant do we believe that Dr. Aki Ross, the heroine, is a real human. But we concede she is lifelike, which is the whole point. She has an eerie presence that is at once subtly unreal and yet convincing. Her movements (which mirror the actions of real actors) feel about right, and her hair blows convincingly in the wind. (...). If Aki is not as real as a human actress, she is about as real as a Playmate who has been retouched to a glossy perfection. [13]

When viewing this film, one notices that the characters were created using a limited amount of Motion Capture (at the time, Performance Capture of expressions was still not technically possible). Insofar as realism goes, and although great care was taken in some details, such as Dr. Ross's hair (individually animated), the textures and lighting of the film make it impossible to confuse this characters with human actors. What really gives their artificiality away is their movement, by far too smooth and calculated, without the ticks and mannerisms a human would display. Final Fantasy: the Spirits Within, portrays characters that are neither here nor there, not human and certainly unlike a more typical animated character.



F.3 Polar Express (2004) Robert Zemeckis

Directed by Robert Zemeckis, Polar Express (2004) was the first feature CGI film to use full Performance Capture for all actors [14]. It is based on an illustrated children's book by Chris Van Allsburg (1985) which in itself boasts quite realistic, Norman Rockwellian illustrations. As far as character realism goes, most main characters in the film were played by Tom Hanks, including the one named "Hero boy". Textures are rendered in a smoothed over and somewhat simplified manner. As far as movement goes, as the whole film is based on Motion and Performance Capture, it is still quite smooth, although some expressive variations are present. In this film, the main "mark" of Motion Capture use is visible in a certain amount of swaying of the characters- this

"swaying" is very characteristic of Motion Capture based performances, as a human will rarely be able to stand absolutely still – in real life this is perceived as "natural", but when translated to the large screen it becomes uncanny and very noticeable.

F.4 The Incredibles (2004) Brad Bird

In The Incredibles (2004), Brad Bird chose a type of character design that: "(...) focused on caricature. To highlight both the individual personalities and personal conflicts of each character, their physical characteristics were exaggerated, with Bob Parr being the most obvious example." [15] Both the character's design and movement are exaggerated and caricaturized, and most textures are kept to a minimum (perhaps hair is the texture more realistically portrayed). This gives this film an eminently "cartoony" look and feel, even though characters in it are profoundly relatable and have complex dilemmas. As we mentioned earlier, this film was an huge commercial success, vastly outselling Polar Express in the year they both were released.

F.5 Beowulf (2007) Robert Zemeckis

Again directed by Robert Zemeckis, Beowulf (2007) benefited

from technological advancements that allowed actors and even horses to be recorded through Motion Capture. The character design is progressing towards increasing realism, as their virtual avatars are meant to represent the specific actor that portrays them. In the words of New York Times critic David F. Gallagher: "The movie's animation is otherwise so sophisticated that it is hard to pin down just what is missing. (...) The motion-capture work in "Beowulf," (...) is clearly leaving something out. People who are meant to be enraged, or who are at risk of plummeting to their deaths, just look a little out of sorts." [16] One can observe a disturbing lack of involuntary or spontaneous eye movements, made more obvious by the plentiful extreme close-ups in the film, which may be part of the reason for this lack of emotional range. Also, the characters movement is extremely smooth, creating a "gliding" sensation.

F.6 Rango (2011) Gore Verbinski

The Man with no Name in Rango (2011) is an interesting example of a relatively realistic portrayal of a human actor in a CG film. In this film, no Motion Capture was used, as actors were filmed acting out the scenes, and animators later on used that footage as reference. Apart from this character, all the other characters in Rango are caricaturized, retaining minimal features of the actors that lend them their voices. The Man with no Name is based on Clint Eastwood's character from Sergio Leone's western trilogy - For a Fistful of Dollars (1964), For a Few Dollars More (1965) and The Good, the Bad and the Ugly (1966). In terms of realism, he enters into a realm that could be called Hyper-Hyper-realism, as his main features are exaggerated in design and emphasized through the use of extremely realistic textures. His

movement is animated and not captured, which makes him appear to be more lifelike than Clint Eastwood himself.

F.7 The Adventures of Tintin (2011) Steven Spielberg

Steven Spielberg's The Adventures of Tintin (2011) is based on the characters first portrayed in the comic strip Les Aventures de Tintin (1929-1976) by Hergé. The original characters are drawn in a rather simple line-drawing style. Speaking of Tintin's character in the film, NYMag critic Kyle Buchanan states: "There is something off about this character, and it is clear why he has been minimized in the trailers for his own movie. Aside from the swoop in the front of his hair that lends him some cartoonish verve, Tintin looks simultaneously too-human and not human at all, his face weirdly fetal, his eyes glassy and vacant instead of bursting with animated life." [17] There is an excessive amount of realism in the design of the characters in this film, which are made uncanny by the addition of exceptionally large heads and disproportionate noses. This in fact is applied to all characters except Tintin, who retains a more human appearance. Textures, cloth and hair are hyper-realistic. The characters movements bears the marks of Motion Capture, with traces of some of the typical "swaying". In the case of Captain Haddock, facial movements are disturbingly limited by the size of his nose.

The following two films have not yet been released, so their analysis is based on what could be viewed in the trailers (in the case of Peanuts (2015) [18]) and in an animation test in the case of Popeye (2016) [19].

F.8 Peanuts (2015) Steve Martino

Steve Martino's Peanuts (2015) is based on the characters created by Charles Schulz: Peanuts (1950-2000). They had already been developed in animated format for television by Bill Me-

lendez. The original characters were ink drawings, mostly done in black and white (except for Sunday strip, which was in color). In the film, the design of the characters remains faithful to the original (minus the outline), although some of the surface textures are quite realistic: Snoopy's fur and nose, Charlie Brown's hair, and some of the background textures. Features are "drawn on" the characters, evoking some aspects of the original line drawings. Most interestingly, the characters (especially Snoopy) look more "two and a half dimensional", rather than fully three-dimensional, as they lack some volume and appear flattened out. Insofar as movement is concerned, there is no attempt to attain smoothness, as turns for example are jerky and with almost no inbetweening. Black lines mark speech balloons (Woodstock) and movements, as was more customary in Otto Messmer's Felix the Cat (1919-1936) or early Mickey Mouse cartoons such as Steamboat Willie (1928) or The Gallopin' Gaucho (1929).

F.9 Popeye (2016) Genndy Tartakovsky

Popeye (2016) is based on the cartoon character created by by Elzie Crisler Segar first seen in Thimble Theatre (1929-1994), later animated by the Fleischer Studios (Popeye the Sailor -1933). The characters in Genndy Tartakovsky's adaptation look very faithful to the originals, and retain their cartoony appearance. Some of the surface texture is very detailed and realistic, especially hair, fabric and lighting. As far as movement is concerned, it is interesting to note that this film builds upon the elasticity of movement more typical of 1930's films. Movements are jerky, exaggerated, and full of "elastic" limbs, especially in the case of Olive Oil. Rubber hose aesthetics seem to be back.

4 · CONCLUSION

Although we believe that Motion Capture and Performance Capture will continue to be widely used in CG animated features, we also consider that this is a medium that is slowly turning back to its traditional rules and ways of animating. Even though many of the examples cited here were not easily adaptable as far as Motion Capture use was concerned, because they stem from cartoons or previously traditionally animated (although Tintin is a curious exception) the quality of the movement of characters seems to be the main concern to be addressed in the future of CG animation in regards to avoiding the Uncanny Valley.

However, even when most animation directors are shying away from the Uncanny Valley, whether through a more cartoonized character design or through the use of more traditional syntaxes of animated movement, there are those that will use this uncanniness in their favor. Director Cris Landreth, speaking of his latest film Subconscious Password (2013) states that: "A challenge for me was going into the Uncanny Valley. I wanted to do that as a deliberate stylistic move. (...) I like the idea of exploring the Uncanny Valley because I think there's some stuff in there that's valuable. The Uncanny Valley generally has been viewed in a derogatory way. You get these characters that are real but not quite real. Therefore, they're creepy. I'm trying to find the realism in that part of the film which I think, at least for me, parallels how our internal processes work, where we are processing something that is not the real world." [20]
Perhaps staying out of the Uncanny Valley entirely should not be the ultimate goal of all animators, but rather using it sparingly and cleverly, as another element of the rich language of animation.

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