

Lifting the uncanny vale

An in-depth exploration of the uncanny valley phenomena and why the formual requires updating.

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Abstract

to explore the peak of the uncanny valley and how this is not in fact a set statistic but a movable spectrum depending on audiences variables and technological aspect of development and how we are becoming more accustomed to that level on CGI and how it to integrate later advances.

Chapter one focuses on the uncanny, the uncanny valley and the different technology's associated with it. Chapter two takes an in-depth look into how our minds process the uncanny valley and its potential causes and finally chapter three concludes with an in-depth discussion on how the current measurement system is flawed and other options of measurement.

Introduction

CGI stands for computer-generated imagery meaning that any kind of model created using a digital medium with this system however there has been a need or for lack of a better term want for people to create the perfect instance of a human made completely through CGI however this has so far always met with failure due to a phenomena known as the uncanny valley which has prevented us from reaching this goal. There are several instances where our current understanding of how the uncanny valley has some flaws for example the system is very broad and any not cover all of the areas which we need it to make a formative dissension on where in which a CGI film lies on the uncanny valleys value system.

In this dissertation we hope to clarify this value system and properly discuss how the system works and any possible flaws it may have. This will be split up into three distinct chapters focusing on individual elements which affect the uncanny valley and discuss how they affect how a film is assets through the system. Chapter one will mainly look at the idea of the uncanny and what it has meant to people over time and what happens for a film to fall into the valley. Chapter two will then move on to look at the idea of perfection and how that has an influence on how the uncanny valley affects us and what possibly reasons there could be for its affects. And finally, chapter three will explore the route of the uncanny valley and it perhaps isn't what it appears to be. And hopefully prove that the chart which we have been using to chart the valley is incorrect and is in fact a system more similar to a spectrum which the data presented in the graph is also subject to change depending on circumstances.

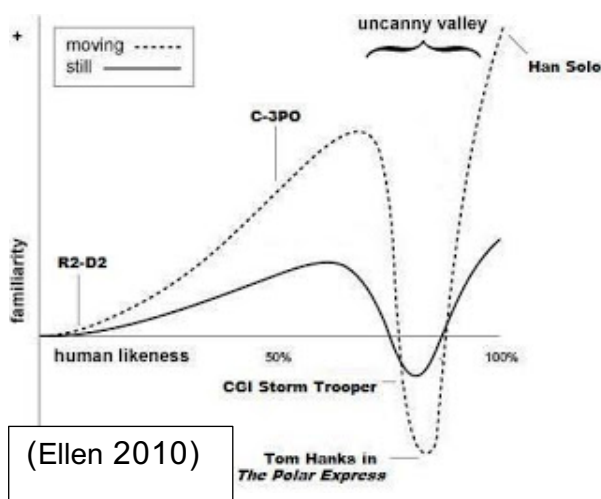
The Uncanny Valley

Uncanny isn't it

When we think of the uncanny what is the first thing which comes into mind?

Nicholas Royal (2003) describes it as “ghostly” (Royal, 2003,p.1) and that “it is concerned with the strange weird and mysterious” (Royal, 2003,p.22) however Sigmund Freud describes the uncanny as “being both Frightening, yet familiar” (Freud, 2003, p. 72) . Yet both these instances describe our current understanding of the uncanny being an amalgamation of something which causes a disturbance in our minds but yet we have a longing to connect with it on a subconscious level even though it has a disturbing affect. People have described this feeling as both a mixture of fear yet curiosity, but why do we feel this way towards human looking entitles? In short, we don't really know; it could be a manifestation of deep psychological phobias or it could be an evolutionary trait which allowed our early ancestors to distinguish between their own species and another or as a survival tactic so they would avoid sick people.

In a study conducted by Shawn A. Steckenfinger and Asif A. Ghazanfar (2009) examined the effects of uncanny imagery on monkeys to study the effects on their



subjects and how they reacted to the stimuli. Their study consisted of showing the monkeys three images to base their information. The first being an unrealistic CGI version of another monkey, a realistic CGI version and finally a real image of monkey. To their surprise the monkeys

also exhibited a distaste for the realistic CGI model. Confirming that we are not the only species to experience this affect also meaning there is a likely chance that this feeling when faced with something which can be deemed as uncanny is a genetic aspect which has been hardwired into our brains for centuries and could be one explanation why we are off put by these kinds of creations (Steckenfinger, Ghazanfar, 2009, p. 2). This phenomenon has also been documented as far back as the fifth century where “plays by Euripides and Aeschylus caused some old men to be frightened by realistic animated statues” (Mayor, 2018). But with the innovations in computer generated imagery (CGI) created characters this has in some cases estivated this uncanny phenomena which left people wondering what this phenomenon was, is there a way to know what causes the affect before we do it and how do we know before something hits this point of the uncanny.

Enter Masahiro Mori a robotics designer who in 1970 produced a hypothesis on a phenomenon which he called the uncanny valley. This phenomenon came about from his research into humanoid robot where he found that things such as robots and CGI character which were close to resembling caused a negative affect toward them but those with lo resemblance to humans where met with a positive affect from onlookers the idea of the uncanny valley comes from. It is the point where a robot or CGI character are close enough to looking like a real person but have slight things which cause the us to have negative creations toward them in this case us being repulsed by the character which in the short term is the uncanny valley affect.

The fall of the valley

the uncanny valley doesn't affect every kind of CGI created film for example Disney's *Incredibles* (*Incredibles*, 2004) was made entirely through the use of CGI however it doesn't have this uncanny affect even though they are human CGI characters. The main reason why this doesn't affect the character is because of their overall design the uncanny valley works similarly to a degree system if something is purposefully



(Dalin 2017)

cartoon like it doesn't affect them and we instead see them as cute

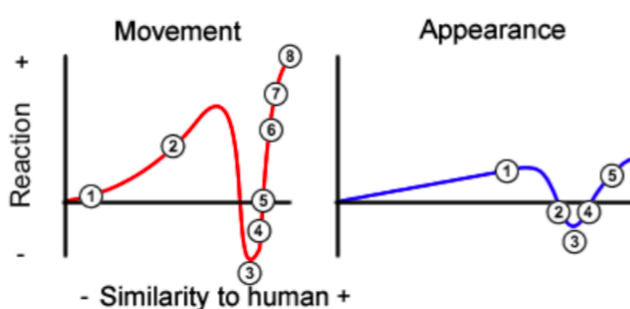
but the more realistic they get the more we are discouraged by them it also depends on how they were animated

Motion capture is one method of animating CGI whereby actors are overlapped with animation, making the movements more realistic. The process involves the actor being fitted with a motion capture suit which is specially design with markers for the animation software to track the actor's movements which then allows the software to mimic the actor movements and apply the movement onto the CG model.

The 2009 film *A Christmas Carol* (*A Christmas Carol*, 2009) was actually made using motion capture to animate it. However, this film also fell into the uncanny valley and this is not the only case. One very well-known case where a motion capture and CGI character has caused this phenomenon is in *The Polar Express* (*The Polar Express* 2004) with the conductor character however many other characters also give this

affect within the film. Another example of the uncanny valley in CGI films is Disney's *Mars needs Moms* (2011). What is it about these films which causes this uncanny valley to affect when compared to other CGI characters like the character Alita in *Alita battle Angel* (*Alita battle Angel*, 2019) In that film this uncanny valley does not affect the character but why is that? It could be argued that it is because the character's movement has been tracked and applied later so its movement is a direct translation of the original actress. However, if that were the case then why does this valley affect the *Polar Express* as that film was created using the same technique? So, the main questions what it about these CGI is created characters that cause the uncanny valley phenomena? Well if we look at two examples of films in the valley for instance; *Monster House* (*Monster House* 2006) and *Tintin* (*The Adventures of Tintin: The Secret of the Unicorn*, 2011), both films use motion capture to animate their films,

however only *Tintin* is really affected by the uncanny valley. That said, the film *Monster House* has some instances of the uncanny because of its characters



(Brenton, H., Gillies, M., Ballin, D. and Chatting, D., 2005,)

movement. This means that there is in fact not one variant to cause the uncanny valley but two; the first being the characters overall design and the other being the way in which

the character moves on screen. This graph shows the uncanny valley phenomena from two different perspectives one from the view of the characters appearance and the other from the characters movement

.As shown the movement of a character greatly influences the effect of the uncanny valley rather than the character overall design but most of the movement was done using motion capture. So why are these pieces still in the uncanny valley when we know for a fact that their movement is a direct mimic of real-life people, meaning that the movement should be out of the valley? The only logical conclusion that these two variables need to work in harmony with each if they want to get out of the uncanny valley and from looking at all this, it is quite clear that the appearance is still the main issue for the uncanny valley.

If we look at the models used in these films, we can see that many of them have either a clay or glassy affect to them but with more recent films and innovations in CGI we are able to add more detail to the models. Ultimately this has led to the character being more disturbing and ultimately pushing them deeper into the uncanny valley.

How do we get out?

Trying to get out of the uncanny valley isn't an easy feat there are several different things which could help to improve the way in which these kinds of models are scene for example if we look at films such as Disney's *Moana* (*Moana*, 2016) that films had incredibly realist water system to a point in fact where it is difficult to distinguish it from real water and that is due to the aspects such as polycount and other areas and physics engines which were created this was also then added into their 2019 film *frozen two* (*Frozen 2*, 2019) which actually gave the impression that in fact the characters surroundings were that of real life beach. This proves that we are in fact capable of creating scenery which moves and interacts like its live counterparts. So,

it is safe to say that we are able to create realistic environments which are no par with real life but we as of yet are unable to do the same in our own image.

If we were to apply the same kind of understanding of physics to how human skin looks and reacts to light, then it may be possible to negate the effects of the uncanny valley. For example in films such as *Mars Needs Moms* they there skin in the film has too much of a shine on it compared to human skin and that is down to the way in which our skin is able to disperse light the only issue is it would take a lot of processing power to recreate this and adding this to a CGI model may actually not be an effective way for us to get out of the uncanny valley however these aspects still don't explain how taking a live action movement causes an exacerbation of the uncanny affect. One prime example where we have created a living creature is in Disney's live action Lion King film (*The Lion King, 2019*) where all the animals shown in the film are made using CGI but each of them to our eyes are on par with their real life counter parts and almost indistinguishable however this again can be linked to the idea that the uncanny valley is a species related affect and you are only able to notice the affect with your own species as we discussed earlier. But then how can much more detail cause a more drastic affect when we look at CGI people. in short why does more detail cause this discomfort? In other words; can we get to the perfect CG human?

Perfection Warts 'n All

Perfection in lies

The word 'perfection' is often used very loosely when describing things that we like. For example, when discussing food, we claim that it could be 'cooked to perfection' or with describing a piece of artwork, many describe Van Gogh pieces as pure 'artistic perfection'. However, his work was not well received until after his death (Klein, A.G., 2010. p. 4) His pieces became something different; they went from nothing to becoming something beautiful which is the idea that we will explore in this chapter. The idea of beauty is in the eye of the beholder, or in our case 'perfection'. It could be questioned what the point of this sentiment is when looking into the uncanny valley and the idea of perfection. Well there is a very simple answer to that question; it has everything to do with the idea of perfection and the uncanny valley as we as a species have strived for this idea of perfection for centuries but yet many of us believe that perfection is an impossible goal. Even so, people still strive for this idea. Should that not be the point of making something; to try and strive for better, for the perfect version it or even in ourselves? However, this is not always something which can be helped. Sometimes in the pursuit of perfection in CGI we can fail and miss our mark, and that is where we fall back into the uncanny valley.

Holy grail of CG

When we look at the idea of perfection in CGI characters, what is it that we are really trying to strive to create? In short, it is the perfect representation of a person in CGI. And from years of work it appears that we have a solid method of capturing real people's movement to animate characters to a human standard, so in this case we

have the perfect movement. However, characters still fall into the valley even when they take their movement directly from a person. With this being the case, let's rule out the idea that movement is an issue for the moment and look more in-depth at the characters designs. When we look at the characters which have fallen into the uncanny valley, many of them are incredibly detailed and more realistic. However, that is only with more recent films. If we look at older films such as *Final Fantasy: the spirits within* (*Final Fantasy: the spirits within*. 2001) the film is also in the valley, but its reasoning is that the characters in the film have a waxy, almost plastic appearance to them. So why then do both eras of films fall into the uncanny valley?

Through skin texturing and other movement systems, we have eliminated this issue of waxy looking skin, however there are still other issues; the latest being that character's eyes look 'dead' and 'lack soul'. In other words, they still are not 'perfect'. When we think of perfection, we think of flawlessness, and symmetry for lack of a better term. We see it everywhere, in buildings and in many modern art pieces but why do we think this?

"Evolutionary biologists have proposed that a preference for symmetry would also be adaptive because symmetry is a signal of health and genetic quality (Rhodes, G. 1998) This idea again goes back to the idea that the uncanny valley and its affects are a deep psychological trait which we have inherited over time. It explains why we like the idea of symmetry as it is a sign of good health. However, when we create CGI models in this manner they seem to fall into the uncanny valley. Evidence suggests that it is this very idea of symmetry which is the cause of it.

Yes, symmetry to us is attractive to us it is one of the reasons why we like modernistic art and buildings, it's also why some people find these kinds of this calming because it creates order out of chaos and over the years we have become a



Bader, I. (2014) custom to this minimalist symmetrical style and it all boils down to the idea of symmetry. But symmetry is not a normal occurrence in nature but our taste for it is something which we have developed over millions of years and can be seen in many of our ancient buildings and painting because it presents an idea of order and clarity however when this occur in nature, it is incredibly rear. To give an example, below is an image of a man who appears attractive because what we are perceiving when we look at him is symmetry. But is he really symmetrical?

If we in fact split the image down the middle paste the left side over the right and do the same for the left, what do we see now? The two images look rather unsettling to look at and the eye is drawn back to the original image, even though we initially saw the original image to be symmetrical. There is in-fact subtle differences which the brain attempts to make sense of and from this we get the illusion of symmetry when in-fact there is no symmetry to the human face. This is because the we are a species born from nature so we follow the same systems on growth meaning the human body is not symmetrical.

It is the belief that CGI characters have an overcompensation of symmetry When it comes to their design. As you can see from this image from *Tintin*, there is no difference with either side of the face meaning they are symmetrical, and it is this which could cause the issue off the uncanny valley. If this is the case it also explains why movement exacerbates the affect. because we see the



model from more angles this allows us to see more of the characters design.

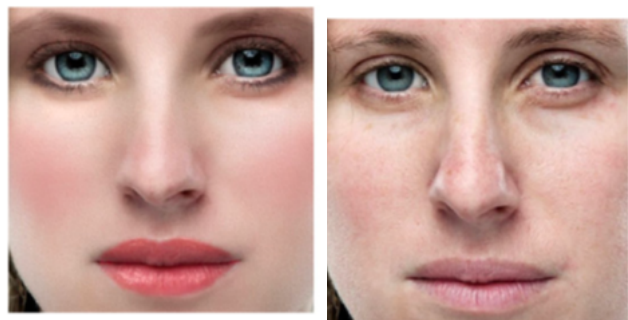
Meaning we then subconsciously notice the symmetry in the characters face it causes the uncanny valley affect. Now this could be due to our brain over compensating to create a symmetry in faces but as of now this is not a fact however it seems to be a solid reason why this could be a reason for the affects as the human brain is able change our perception of things for us to understand. For example, the phenomena known as pareidolia which is and affect where the brain tries to find faces in random objects like in cars or in some cases vegetable. It is this which could

cause and exacerbation of this affect because of the character symmetry and our brains then overcompensation for it

Change for the better

From the evidence gathered throughout this chapter, it is safe to assume that there is no such thing as perfection when it comes to the human body or when it comes to a CG model. As soon as the model appears to be the perfect representation of a human it then falls into the uncanny valley. But what if this was not the case could it be possible for us to rule the effects of the uncanny valley in such a way that it does not affect us anymore.

The brain is an amazing organ. When it comes to the idea of change it is able to adapt itself extremely well to the circumstances presented. However, when the change is drastic it does not fare as well this is why some people have issues with the idea of change.



Richard Martin (2012) an ex-military

business owner talked about “how gradual change is more affective as it allows for a more gradual and effective transition period and causes less of a back-lash affect”.

So, when this is applied to the uncanny valley does this dose it lessens its affects?

(Coon, D. and Mitterer, J.O., 2012)

(MacDorman, K.F. and Chattopadhyay, D., 2017)



In-fact In an experiment done by Karl F. MacDorman and Debaleena

Chattopadhyay they found that through a gradual progression from a human face to symmetrical 3d model they found that when having a drastic change as seen here can have a negative affect because we are able to find all the changes which have been made however is we have a gradual progression as seen here is allows the mind to see less of the imperfections and allows us to better orientate ourselves with the look of the model and thus negate any uneasy affects from looking at the image. However, there are style aspects which need to be taken into consideration with this for example that this CGI image is based on a real person where most of the instances found in the uncanny valley are not. There are some other ways in which the uncanny valley can be avoided, however.

Its Genetic

Exposure to something in the uncanny valley at a younger age can also play a role in how we see these models later on in life. In august of 2019 Kimberly A. Brink, Kurt Gray and Henry M. Wellman set out to prove that the uncanny valley is something which is acquired during child hood they claimed that out of a study of two hundred and forty children aged 3 to 18 and shown different kinds of robots one in the valley one almost and one not the research found that 90% of the children under the age of 9 didn't find them creepy "Before 9 years of age, robot type did not predict feelings of uncanniness...At 9years,however, the uncanny valley effect emerges with robot type

significantly predicting uncanniness” (Brink, K.A., Gray, K. and Wellman, H.M., 2019). This holds some promise that perhaps the uncanny affect is dependent on an age system. The next question to ask though were the under 9-year-old kids tested on later and do they intend to get the same result.

This shows that though the uncanny valleys affect are a natural occurrence in our biology it is not necessarily something we are born with and is instead something which is developed as we get older and depends on what we are exposed to as a child.

As a hypothetical what if these kids (under 9 years of age) still didn't find these robots creepy after they turn 9. What this essentially would mean is that they will always be ok with the look of these machines not have the full the uncanny valleys affect when shown them however the next versions with more realistic features an attribute could still be seen as creepy. so, unlike the other kids who viewed the stimuli over the age of 9, they will find that they find both versions of the stimuli to be creepy. Whereas those under 9 will only feel the affect with the newer model. This essentially means that the uncanny valley can be subjective and is determined by our previous experiences and exposure to things in the valley at a young age can alter how we see them. For example, many kids show have this uncanny look, yet children do not have an issue with them.

There is mounting evidence to show that we can strive and strive for the idea of the perfect CGI human however through all the evidence presented through we may never actually reach this goal of a perfect CGI model. But could there be a way in which the things which were previously developed be less off putting to us if we take this idea of gradual change, if we look back at the progression chart and added a

more extreme version of the perfect CGI model and add more to the progression to the chart then what was at one point the peak of the uncanny is no longer as extreme as before and is now just another part of a progression scale or if we expose younger people to films that we find fall into the valley then does that mean the film has changed position in the valley. And if this is the case then technically speaking the way in which we measure the uncanny valleys affect is affectively wrong.

The Uncanny plain

An impossible goal

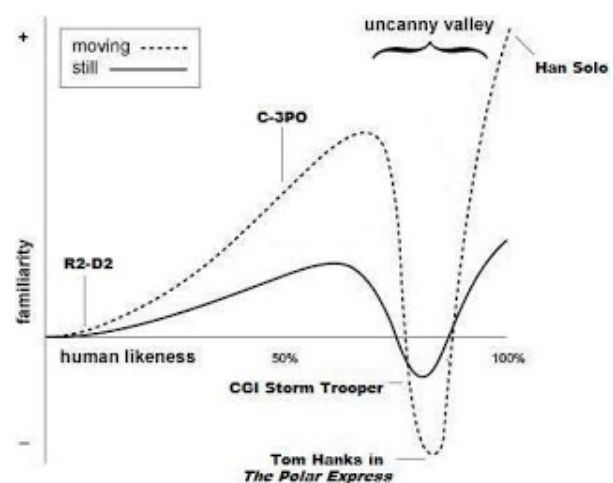
So, to recap what we know so far and what we've learned from all this so far. We know that the uncanny valley is something we have known about for decades and was only given a name in 1970, we also know that there are two different aspects which come into diagnosing the phenomena the character movement and there style and we know that most of the issue may strand from over use of symmetry in the models and finally we know that exposure at a young age can negate these affects. So, what does all this mean for the uncanny valley well when we look back at the original graph for the uncanny valley from all the research presented and evidence toward there is much more evidence ruling toward the idea that the up portion effectively being human is actually not possible. Yes we are able to get incredibly close to human likeness however this dose in-fact fall short at the last hurdle and perhaps this is just something which we are never able to be able to accept however as previously discussed we are able to accept it just takes some time for the generations to catch up so it may not be possible to create the perfect CGI person but over time it can be less of a harsh transition.

In short there isn't an up to the uncanny valley much of the research presented shows that no matter how close we may get to human likeness we will never actually make that jump where we are unable to distinguish between a CGI model and a real person but that is not to say that we shouldn't try to achieve this it is style a possibility that something such as this may happen but as of now it is not likely. However that hasn't stopped previous pieces from losing some of their affect if we look back at the study mentioned in chapter two, many younger children didn't have

the uncanny affect when show the video meaning that there is a possibility that we have reached this point of perfection and human likeness but it requires time until it is accepted.

Slow and Steady

If we were to look back at some of the instances of the first CGI models let's use the games tomb raider for these examples as you can see the oldest version is very blocky and pixilated and people didn't mind this as yes it was the first attempt at creating people in CGI but



it was not so advanced that people found them discomforting. Now if we look at the most recent version she is almost human looking and yet people still don't have this uncanny affect with the character and it is believed that this isn't an issue because with each game a little change was made each time enough for the character to look more realistic but not enough to make the player uncomfortable.

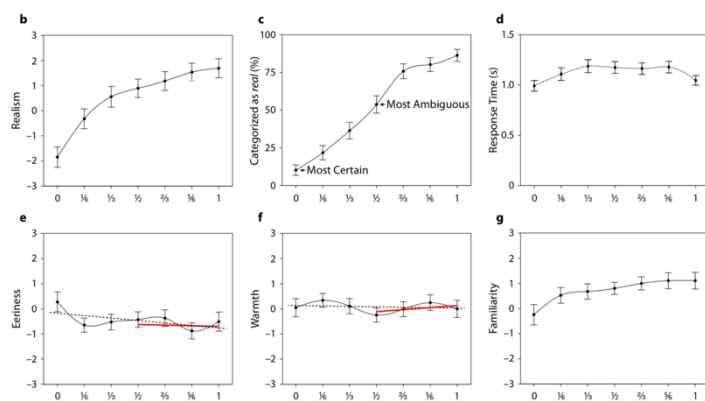
A possible way that we can make the uncanny valley less of issue could be through a similar method as this slowly introducing these advances as discussed in chapter two people are more susceptible to gradual change so if we do make a large leap in technological advancements then we could slowly introduce this to the public you similarly to the graph system thus allowing people to accept these and not notice them as much however this dose bring up the idea that perhaps our initial methods of understanding the uncanny are in fact flawed for example looking at the chart it is

clear to see that it does not cover many aspects which have been found to play a key role in how something is assessed as being uncanny so if this is the case what could the optimal system for understanding this phenomena.

It's an ocean not a cliff

In a study done by Christoph Bartneck, Takayuki Kanda, Hiroshi Ishiguro and Norihiro Hagita they hypothesised the idea that the uncanny valley is in-fact an uncanny cliff(Bartneck, C., Kanda, T., Ishiguro, H. and Hagita, N., 2007). this idea could actually be promising for the study being presented thus proving that we are not the only one to have noticed that there is a potential error with how we calculate the uncanny valley in there study they found that many instances where there test models we closest too human as possible they were still unable to create the bridge over the uncanny valley leading them to see it more as a cliff rather than a valley only difference being here were are essentially attempting to prove that the uncanny is a spectrum rather than a simple line graph.

It is not surprising that this system of measurement is seen as incorrect seeing as it hasn't been updated since its development and because we have a better understanding of it now we can better understand how

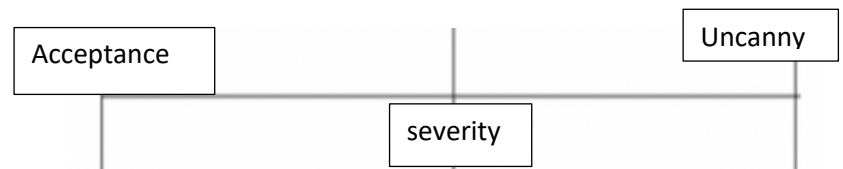


(MacDorman, K.F. and Chattopadhyay, D. 2017)

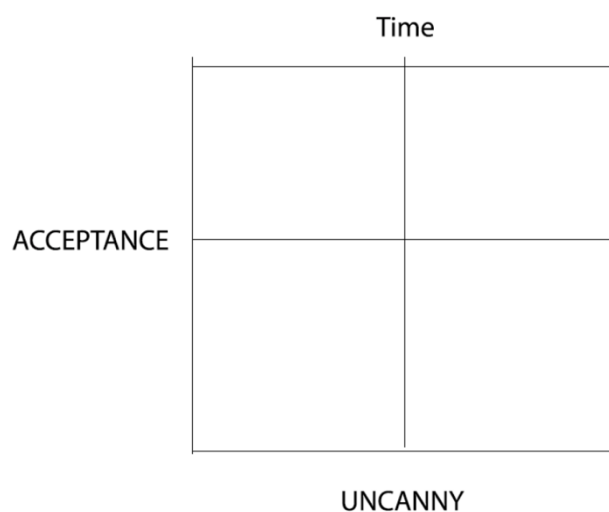
the system should work. Many others have noticed this aspect which is why there are so many for example Karl F. MacDorman and Debaleena Chattopadhyay needed to create 6 different graphs to properly understand and cover as many of the

points as they possibly can to understand their data. The possible reasoning for this could be due to the fact that our how we measure where something should be positioned on the uncanny valley. However, when looking at these aspects we need to keep in mind that consideration has to be taken to properly diagnose the issue in short, we are saying that the system should not be a graph like how it is presented.

to better understand what would work best to determine the uncanny valley affect we first need to distinguish what needs to change firstly the rising and falling of the graph is not one hundred percent accurate a we may have first assumed, yes we are able to use human likeness and how familiar it looks as a measurement but this graph



doesn't take into consideration the ideas that symmetry can cause some of the affect or the fact that age has a proven factor in how we view the uncanny valleys affects. After some research and thinking it is believed that the graph would look more similar to this. At one end we have the uncanny and on the other we have acceptance and between these two points we have time.

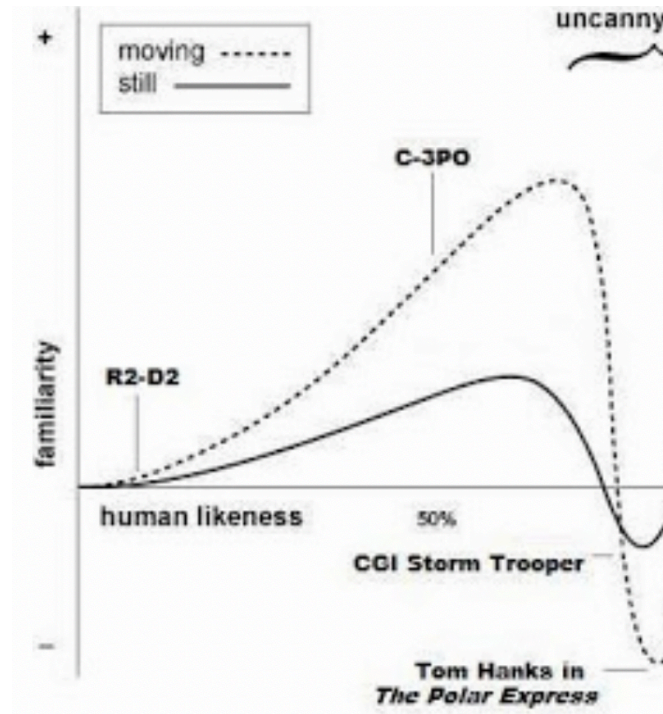


The system would work by a film or model being situated onto the spectrum based on its severity then a this would be added to a scatter graph based on all these points then later this would be done again when another film is made and then

plotted on the graph again.

And from this updating and movement of plot point well be able to see the progression and how gradual change and advances in tech have affected how the film has aged. Thus, giving us a more accurate system in measuring the uncanny valley or if it is presented in this way the uncanny plain.

Another possibility for a charting system for the valley could involve very much of the same statistics however what change would be that the human likeness aspect would be removed time would be the x axis and the chart would move according to how the film ages. This is most



likely the optimal system for understanding how the chart can work as it can take into consideration of age of the film, new technology and the viewers exposed to them.

there is a saying about not fixing something which isn't broken and that saying could be very much applied to how we view the uncanny. But Though many of these charts and graphs may depict some methods of how we could better understand learn how to further our understand of the uncanny as a whole and if we can possibly get to a point in which we can create a model, character or machine which has made the leap and is indistinguishable from humans. But there is still the instance that this is something which should be addressed and not something we should forget about because it works some of the time.

Conclusion

To conclude after reviewing all the information gathered it is safe to say that what we previously knew about the uncanny valley may not have been what we once thought it was and it in fact is more of this moving graph system with a constantly fluctuation depending on what kind of technology is produced and how it affects older films which were developed in a similar manner. The uncanny valley has previously been seen as one distinct system in which when something falls into the valley there is no way in which it can get out of it unless it is remade. This paper has shown through psychology and the understanding of the human mind that the idea of perfection can indeed have a massive impact on how we interoperate things within the uncanny valley and that is in fact there are several ways in which the uncanny valley can be presented and documented depending on how we wish to view it for example chapter two focuses on how symmetry is the leading cause of the uncanny valley affect but also found that when exposure to the material at a younger age the uncanny valley doesn't have an effect and thus brought the idea of the moving spectrum system allowing for the system to be updated is necessary and have made the case that there is in fact no set system for measuring the uncanny valley however when we look back at everything discussed it is clear that many varying factors can play a role in how a CGI film or character is presented in the uncanny valley and that they can definitely change where they are positioned in that spectrum depending of the experiences and previous exposure of the viewer.

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