SNAP TO GRID

ABSTRACTION, NONCONSCIOUS COGNITION AND COGNITIVE ASSEMBLAGES IN 3D MODELING

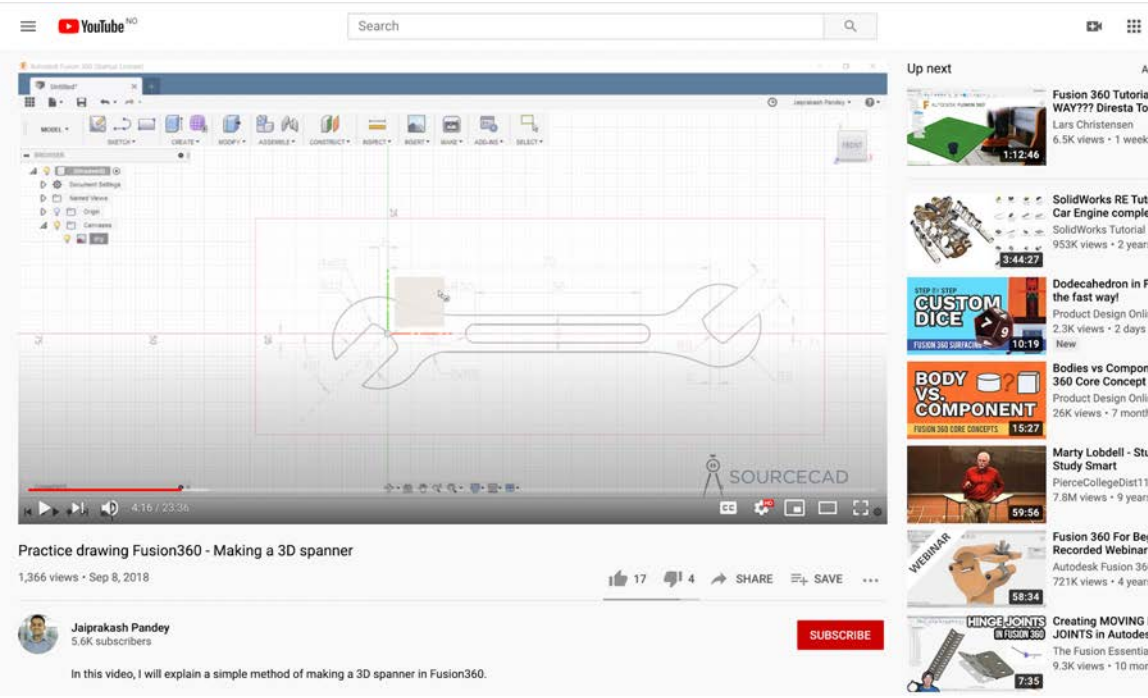

FIGURE 1- SCREENSHOT FROM YOUTUBE TUTORIAL ON HOW TO 3D MODEL A SPANNER

In this essay I will explore how N.Kathrine Hayles' concepts of *nonconscious cognition* and *cognitive assemblages* can be useful for analyzing 3D modeling software, a tool used in practices ranging from science and medical industries, to film, animation and gaming, architecture, interior design, construction, product development, digital fabrication, maker culture and art. I will also use these concepts to look at the process of learning how to work with this tool, and at the informal YouTube channels on which such learning takes place.

Hayles introduces the concepts nonconscious cognition and cognitive assemblages in her book *Unthought: the power of the cognitive nonconscious* and in the prologue she explains how conceptualizing interactions between humans and technical systems can "enable us to understand more clearly the political, cultural, and ethical stakes of living in contemporary developed societies"[1]. She describes nonconscious cognition as a kind of thinking without thinking, a capacity humans share with

[1] N.Kathrine Hayles. (2017). *Unthought: the power of the cognitive nonconscious*. Chicago and London. The University of Chicago Press. Prologue.

plants and technical systems, and more specifically defines cognition as "a process that interprets information within contexts that connect it with meaning"[2]. She defines cognitive assemblages as "collectivities through which information, interpretations and meanings circulate"[3] and gives examples of them such as traffic control systems, digital assistants and autonomous drones.

Applying Hayles' theories to the use of 3D modeling tools I will suggest that the abstraction process of digitizing a shape is a nonconscious cognitive process performed by 3D modeling software, and that this abstraction is a main attribute and primary reason for using 3D modeling tools. I will address how screens and user interfaces of 3D modeling tools constitute parts of the environment that their users are embedded in during their own nonconscious cognitive processes, and connect this to what Hayles writes about hyper-attention and neurobiological changes in "the mindbodies of its users"[4]. Moreover I will contextualize these human and technical cognizers as actors in a larger cognitive assemblage constituted by 3D modeling technology, the people who use them, the platforms on which they circulate and the industry built around it.

Finally, by telling the story of the computer graphics icon *The Utah Teapot,* I will draw lines between the abstraction occurring in the process of using 3D modeling tools and the standards and styles emerging in the software systems, communities that use them and what is made using them. I will argue that these standards are not only affecting these complex human-technical assemblages, but that they also make visible to us the situatedness of the actors within it.

I will write about this from my perspective as a sculptor using 3D modeling tools, and as a practice- based artistic researcher in visual art whose PhD project makes use of and reflects upon abstraction in 3D modeling technology.

Nonconscious Cognitive Processes in 3D Modeling Software and Their Users

Defining cognition as "the interpretation of information within contexts that connect it with meaning" Hayles includes both technical systems, humans and other life forms. By making this analogy as well as a distinction between nonconscious cognition and human consciousness[5], Hayles shows not only how humans and computers are alike, but also different.

---

[2] Hayles. Unthought, p 22.

[3] N. Kathrine Hayles (personal communication, September 26, 2020) responding to my follow up question after *Technologies are Us* seminar.

[4] Hayles. *Unthought*, p119

[5] Hayles. *Unthought*, p28

Although technical cognition is often compared with the operations of consciousness (a view I do not share, as discussed below), the processes performed by human nonconscious cognition form a much closer analogue. Like human nonconscious cognition, technical cognition processes information faster than consciousness, discerns patterns and draws inferences and, for state-aware systems, processes inputs from subsystems that give information on the system's condition and functioning. Moreover, technical cognitions are designed specifically to keep human consciousness from being overwhelmed by massive informational streams so large, complex, and multifaceted that they could never be processed by human brains.[6]

In 3D modeling technology, the most fundamental thing that the software does for us is to create a mathematical representation of a 3-dimensional object or shape. This abstraction process, the extraction of x, y, z coordinates from the object, I propose, is a nonconscious cognitive process performed by the software. It is an essential function, because it is what makes these drawings readable by computers and convertible into other formats, which in turn means we can do things like digitally manipulate or animate the models, upload them to Thingiverse[7], feed them to digital fabrication machines that can turn them into physical objects affording the use of less manual labour, higher accuracy and opening up for the possibilities of infinite reproduction.

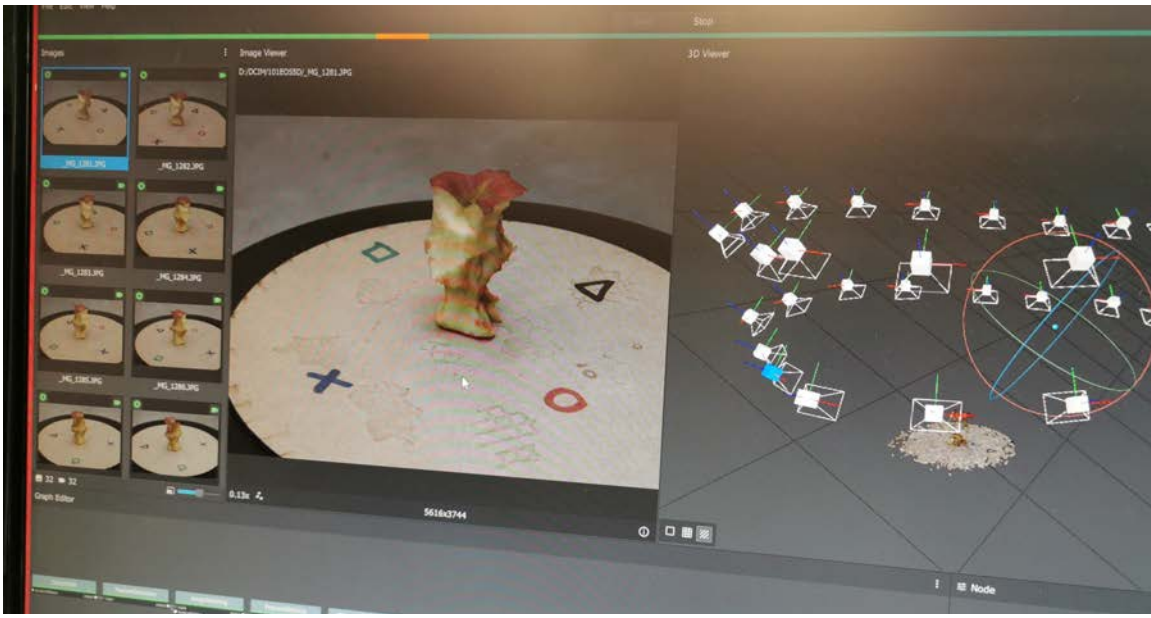

FIGURE 2- SCREENSHOT FROM PHOTOGRAMMETRY SOFTWARE MESHROOM

[6] Hayles. *Unthought*, p 11

[7] Thingiverse is an online platform where people can upload and download 3D models for free and for purchase.

How the abstraction process occurs varies depending on what kind of 3D modeling I am doing, and I will now compare the two main types I am working with. The first one Fusion 360, is a computer assisted drawing (CAD) software and the other one, Meshroom, is a photogrammetry software made for “3D scanning” physical objects.

When using CAD software to build up designs by digitally drawing them, hand gestures made with the mouse, keypad or even VR controller are registered as points in a coordinate system, which, if I enable it, will “snap to grid”. This means that your drawing will lock onto a fixed coordinate system and that the lines and points are unable to move around until you delete this constraint[8]. Because the software has created a mathematical representation of this drawing or shape, this information can be sent to a machine and turned into an object using digital fabrication techniques. In sum, a gesture becomes a mathematical abstraction, which becomes object. Using 3D scanning and photogrammetry, the abstraction works in the opposite direction, as a mathematical model is made out of a physical object. Most of the object’s material properties are lost on its way to the computer, such as smell, taste, temporality, surroundings, symbolic meaning and so forth. In the computer the object has taken on a new embodiment and a digital materiality. Artist and researcher Rebecca Nadjowski describes this translation beautifully when speaking about her project Echo where she 3D scans plants in the botanical gardens of Melbourne: “Depth, texture, color and form of the plants along with the atmospheric conditions that affects the intensity of photons bouncing off of flora all become transformed. They move from a plane of environmental matter and force to a plane of digital materiality, where data is encoded and continually refigured and assembled as manipulatable, visual objects on a screen.”[9]

In the case of both these methods for making 3D models, we have externalized a human cognitive process to the technical noncoscious, namely working with abstract reasoning to create mathematical representations. This is a time consuming and comparingly inefficient process when performed by humans and thus an operation which makes sense to automate with help from computers.

For humans nonconscious cognition is based on input from our senses, much of which is not filtered onto consciousness, and it operates on a level below our different modes of awareness. As a sculptor I see this as a well functioning description for my own sensory engagement with tools, materials and spaces, their affordances and limitations, that make up a distributed cognitive system[10] which allows an unplanned and process based making to occur. I am not consciously

---

[8] A constraint is a function you can place on a sketch element that keeps it in a fixed relation to other elements in the sketch.

[9] Rebecca Nadjowski, Indeterminate, eco-media 2020 online conference hosted by Screen & Sound Cultures and the Critical Intimacies Reading Group at RMIT University, Australia. Accessed zoom recording via Youtube 1.Sept 2020 https://www.youtube.com/watch?v=-O_sMjD8l9I&t=4654s

[10] Applying the term Distributed Cognitive System as used by Hayles in *Unthought,* p2.

reflecting upon everything that goes on in my studio, but this environment is absorbed by my nonconscious cognition and affecting me and the work that I do. The screens, the mouse, keyboard and the 3D modeling software systems make up parts of this environment, and in the next paragraphs I will follow Hayles' thinking when examining how this might affect myself and others embedded within similar working situations.

The workplace of a person doing 3D modeling often consists of elements like two different screens with the 3D modeling software on one laptop and the YouTube tutorial on the second screen, perhaps with the screens placed on a desk that is too small to fit them both, a chair that doesn't match the working table and other things that reveal something about the person living in this environment. On the YouTube screen she can see the instructor's face and screen recording and listen to their dense and technical explanations only relieved by short breaks of muzak, jingles and YouTube advertising. On the laptop she simultaneously navigates a user interface, finding menus in a version of the software that might be different from the one being demonstrated, finding tools in menu bars, changing user settings, remembering short cuts, following the instructor by copying what they make as best as she can, and constantly shifting back to the YouTube screen to rewind and rewatch when it all goes too fast. Having all of this sensory stimuli coming towards her all at once, makes the task of the nonconscious cognition, that of filtering out what is essential and what is not, ever more important. That shoulder pain, then, is only felt at the end of the day, when multitasking stops. Moreover, this high speed multitasking requires what Hayles calls *hyper attention.*[11] Having this capability may be a necessary skill in a contemporary information-intensive society, or at least for a learner of 3D modeling. But as Hayles demonstrates, by referring to studies on neuroplasticity and epi-genetics[12], it may come at the cost of our *deep attention*, the ability to concentrate on one single task over a longer period of time without losing focus. The simple neuroscientific explanation Hayles offers us is that when we do a thing often, we train neural connections in our brain to grow and strengthen based on this task, and by the same logic we "forget" the existing synapses that are not in use, ultimately leading to lasting neurobiological changes in people. This cognitive shift may be why I find it difficult to watch these tutorials through to the end, or to read a number of pages in a book without checking my phone. Hayles calls this shift nothing less than a crisis in pedagogy for our colleges and universities, and with a large portion of the world's students and school children currently having their classroom activities replaced by screen based learning, this should be an especially contemporary concern.

---

[11] N. Kathrine Hayles. (2012). *How We Think*. Chicago and London. The University of Chicago Press, p 98-100

[12] Hayles. *How We Think*, p 100

Cognitive Assemblages involving humans and technical systems - Informal YouTube channels sharing How-To videos on 3D modeling

When moving the perspective from individual actors over to the systemic effects of human-machine interaction, Hayles uses the term *cognitive assemblage*. In the following paragraphs I will examine the informal YouTube channels where teaching and learning and many people's first encounters with 3D modeling software takes place, as one of these complex human-technical assemblages.

Hayles describes a cognitive assemblage as "...an arrangement of systems, subsystems, and individual actors through which information flows, effecting transformations through the interpretive activities of cognizers operating upon the flows. A cognitive assemblage operates at multiple levels and sites, transforming and mutating as conditions and contexts change."[13] And moreover, "Hybrid by nature, they raise questions about how agency is distributed among cognizers, how and in what ways actors contribute to systemic dynamics, and consequently how responsibilities - technical, social, legal, ethical - should be apportioned."[14]

Involved in my above-mentioned assemblage are human and technical actors such as people who make Youtube tutorials, the 3D modeling program they use, the people who follow and comment on their tutorials, the laptops they work on, the user data collected when they work, the people and industry who develop the software systems, the designs and the knowledge that is being transmitted, and the various infrastructures of electricity, internet, dissemination platforms and economy allowing this all to exist and evolve. The assemblage is flexible and adaptable, it involves nonconscious cognitive processes performed by humans and technical systems as well as conscious thinking. It is based on material processes and it has concrete material outputs, such as a digitally fabricated thing or discarded plastic support materials from the 3D printer.

When learning to work with the 3D modeling software Fusion 360 I watched a lot of tutorials on YouTube, and I became curious about the people who make them, the unexpected things that they pick as exercise objects to demonstrate the software, the strange elevator music playing in the background and the active participation by their followers in the comment fields. It was especially the repeating occurrences that struck me, for example how the exercise object was often a practical, functional object, such as a wrench, a cup holder or knife, and how the instructor usually was white, male, and European or American. This assemblage included some standards that were anything but neutral, and I was curious about how the systemic effects in an assemblage could either reproduce or challenge these. Technology is not neutral, so if the view of "the maker" enters into an assemblage as white, male and European, my assumption is that this may be reproduced in the assemblage; The tutorials may appeal to white men more than women and men of colour, teach more men than

---

[13] Hayles. *Unthought,* p118

[14] Hayles. *Unthought*, p119

women, make more new male instructors than female instructors, and repeat that cycle again. Working further with *Holder* (2020), an art project searching to investigate and also to break with some of these standards, I was relieved to see that this assumption did not cover the entire picture.

I got to know the mechanical engineer, entrepreneur and 3D modeling teacher Sirisha Allamneni, who runs the YouTube channel DesignSangam. As part of my research I interviewed her and two other YouTube instructors who I commissioned to make 3D modeling tutorials for me.[15] Her way into being a YouTube instructor shows a more optimistic side of this assemblage; After becoming a mother in 2007, Allamneni needed to work from home to combine work and childcare. After working with making an online directory of kindergartens in India for some time, she started making online tutorials on 3D modeling. In that way she found a way to combine home office with her professional training of mechanical engineering, and could pursue a career as an online 3D modeling teacher. She is now a role model for women aspiring to learn 3D modeling, she has been a speaker at an AutoDesk India event and contributes to breaking with stereotypes and diversifying the field 3D modeling, maker culture and mechanical engineering. Although the inequality of *who has access* - to a computer, 3D modeling tools, YouTube, internet or even electricity - reflects global economic and social inequalities, this assemblage does include and offer platforms for many people who otherwise might have been left without one.

Kevin Kennedy, another one of the Youtubers that I interviewed and asked what kinds of objects he would choose as example designs answered that “Most of my beginner tutorials focus on “every day” or common household objects. I’ve found this to be beneficial as a greater number of students have a visual perception of the object. Things like screwdrivers, legos, etc… objects that are used globally.“[16] This fits with my own impression of what the standard exercise object is, as I modeled many digital wrenches on my quest to learn how to use this other tool, the 3D modeling software. It also corresponds with Allamneni’s answer to the question, “real life components like pen stands, photo frames, keychains and what not.”[17] To me these seemingly random objects tell a story about the environment that the YouTube instructors are embedded in, environments that evidently consist of more than two screens, a desk and a chair.

---

[15] Youtube videos, Product Design Online, *Fusion 360 for Digital Fabrication, Beginner CAM Project,* (2020), Design Sangam, *Make a wooden sculpture- Design to Manufacturing using Autodesk Fusion 360* (2020) and MufasuCAD, *Tape Holder Modeling + Manufacture Simulate, Fusion 360 for Digital Fabrication* (2020), accessed from my website https://www.magnhildnordahl.com/ua-vid

[16] Magnhild Øen Nordahl, Interview with Kevin Kennedy by published 2020 on https://www.magnhildnordahl.com/ua-txt

[17] Øen Nordahl, Interview with Sirisha Allameini by published 2020 on https://www.magnhildnordahl.com/ua-txt

In the next chapter I will look at one of the most iconic standards in 3D modeling, the "Utah Teapot". Through this seemingly out of context piece of stoneware, the situatedness of the actors in this complex human-technical assemblage becomes visible to us. According to digital historian Jacob Gaboury the Utah Teapot "offers a lens through which we can better understand how computer graphics articulates and standardizes the object world"[18] .

FIGURE 3-SCREENSHOT FROM "HOW TO MAKE A UTAH TEAPOT" (2016)

THE UTAH TEAPOT - A STANDARD 3D MODEL

The following anecdote from the early days of 3D modeling also served as a starting point for my artwork *How To Make a Utah Teapot* (2015), a 13 minute long video showing ceramic artist Anne Lise Karlsen wheel-throwing a ceramic copy of this computer graphics icon. The project began while learning the 3D modeling software 3DStudioMax, and being puzzled about a teapot sitting next to cubes, cylinders and spheres, as one of the "standard primitives"[19] from which to build compound shapes.

In the 1970s Sandra Newell bought a Melitta teapot in Salt Lake City which her husband Martin Newell, one of the pioneers in 3D modeling, brought to the lab and

---

[18]"Interview with Jacob Gaboury," Primary Materials (2017), eds. T. Asmussen, M. Buning, R. Kett, and J. Remond, www.primarymaterials.org. http://www.primarymaterials.org/blog/jacob-gaboury accessed 3.11.2020

[19] Standard Primitives is the name of the basic building blocks in 3DStudioMax.

digitized at the Utah university.[20] He drew the teapot on graph paper and wrote down its x, y and z coordinates before making it available to download for free. This ready-made abstraction was especially welcomed by the people working in this emerging field of computer graphics who otherwise needed to manually type in the x,y,z coordinates of the objects they worked with. As 3D modeling technology advanced it also became apparent that the teapot had many attributes making it perfect for testing how the 3D modeling software works, such as a combination of convex and concave surfaces allowing the user to see how light bounces off the object in a virtual scene. Through its widespread usage in computer graphics the Utah teapot gained its status as a cyber-cultural icon, and it still remains in the standard shapes libraries of many 3D modeling software programs today. In an interview about his forthcoming book *Image Objects*[21], in which the teapot figures as one of 5 objects from the early history of computer graphics, Jacob Gaboury says that "While every year graphics seems to inch closer and closer to a kind of simulated realism, many of the algorithms and equations that structure computer graphics remain – like the teapot – unchanged over the fifty year history of the discipline."[22]

When embarking on making an art piece based on this story, I asked ceramicist Anne Lise Karlsen to make a Utah Teapot after seeing an image of it. The teapot became taller and more slender than the Utah Teapot, and to my surprise it looked much more like the original Melitta teapot. That was no coincidence, however. During a demonstration of their research Newell and his associates presented how one could alter one of the digits in the dataset describing the teapot, and thus reducing the teapot's height by ¼ of the original height. They decided that they liked this new look better, and so their aesthetic preference in addition to which object Sandra Newell happened to buy at a department store in Salt Lake City, became decisive factors in the development of this new industry.

Following the thinking put forward by feminist STS scholar Donna Haraway in her seminal essay "Situated Knowledges"[23], the Utah Teapot is interesting because it demonstrates the non-neutrality of the tools and the people who develop them. Furthermore, it indicates that these human-technical assemblages are not deterministic, but situated in a geographical, temporal and cultural context. The other thing that the story of the Utah Teapot shows us is the significance of abstraction, and of externalizing this task to the technical nonconscious. In the next

---

[20] Read about the story of the Utah Teapot at http://www.primarymaterials.org/blog/jacob-gaboury Primary Materials, 3.11.2020 or https://3dmodelinganimation.weebly.com/the-utah-teapot.html

[21] Jacob Gaboury. (2021). *Image Objects: An Archaeology of Computer Graphics*. MIT Press.

[22] Primary Materials blog, 3.11.2020

[23] Donna Haraway, "Situated Knowledges, The Science Question in Feminism and The Privilege of Partial Perspective" Published in *Simians, Cyborgs and Women,* 1991, Free Association Books, Great Britain.

and final chapter I will draw some lines between the process of abstraction and the creation of standards.

Abstraction and standards

The etymological roots of abstraction is the latin *abstrahere*, which means to draw away. Our ability to extract something from something else, to simplify complex phenomena into abstract concepts, is, according to Hayles, an essential component in all theorizing[24] and a capacity of higher consciousness[25]. She describes it as a requirement for things such as creating language, which again is a precondition for making compound tools with continuously increasing complexity.[26] Similarly, when 3D modeling software creates a mathematical representation of a physical object, specific information is being extracted while most of the object's attributes are not accounted for. Mathematical abstractions can be read by many different media, it can be manipulated and the information can flow through different material embodiments. This nice attribute makes 3D modeling software systems so useful for us, and therefore used a lot. When something is used a lot, it eventually becomes a standard manifesting also in how we see and think. That is not to say that the digital 3D model necessarily takes privilege over physical objects somehow, but that perhaps the idea that anything can be translated into mathematical information, becomes a dominating one. In his book "The Crisis in The European Sciences and Transcendental Phenomenolgy"[27] Edmund Husserl warns us against a mathematization of nature through geometric abstractions, that this totalizing view of what the world essentially is discards human sensory experience as our existential reality. These concerns seem all the more grounded today, as Hayles demonstrates how powerful computers and virtual reality technologies are a continuation of this "ancient game" of downplaying the importance of embodiment and material instantiation and privileging the abstract as the real.[28]

My proposal then, is that this process of abstraction also produces a certain type of standard objects in 3D modeling, both on the screen and in the material world, and moreover that it produces standards ways of looking at the world and ourselves.

---

[24] N.Kathrine Hayles. (1999). *How we became posthuman: virtual bodies in cybernetics, literature and informatics.* Chicago and London. The University of Chicago Press, p 12.

[25] Hayles, Unthought, prologue p2

[26] Hayles, *How We Think*, p 89-90

[27] Edmund Husserl. (1970). *The Crisis in The European Sciences and Transcendental Phenomenology.* Evanston. Northwestern University Press. Discussed in Part 2 "Clarification of the Origin of the Modern Opposition between Physicalistic Objectivism and Transcendental Subjectivism", Paragraph 9 "Galileo's mathamathization of nature".

[28] Hayles, How We Became Poshtuman, p 13

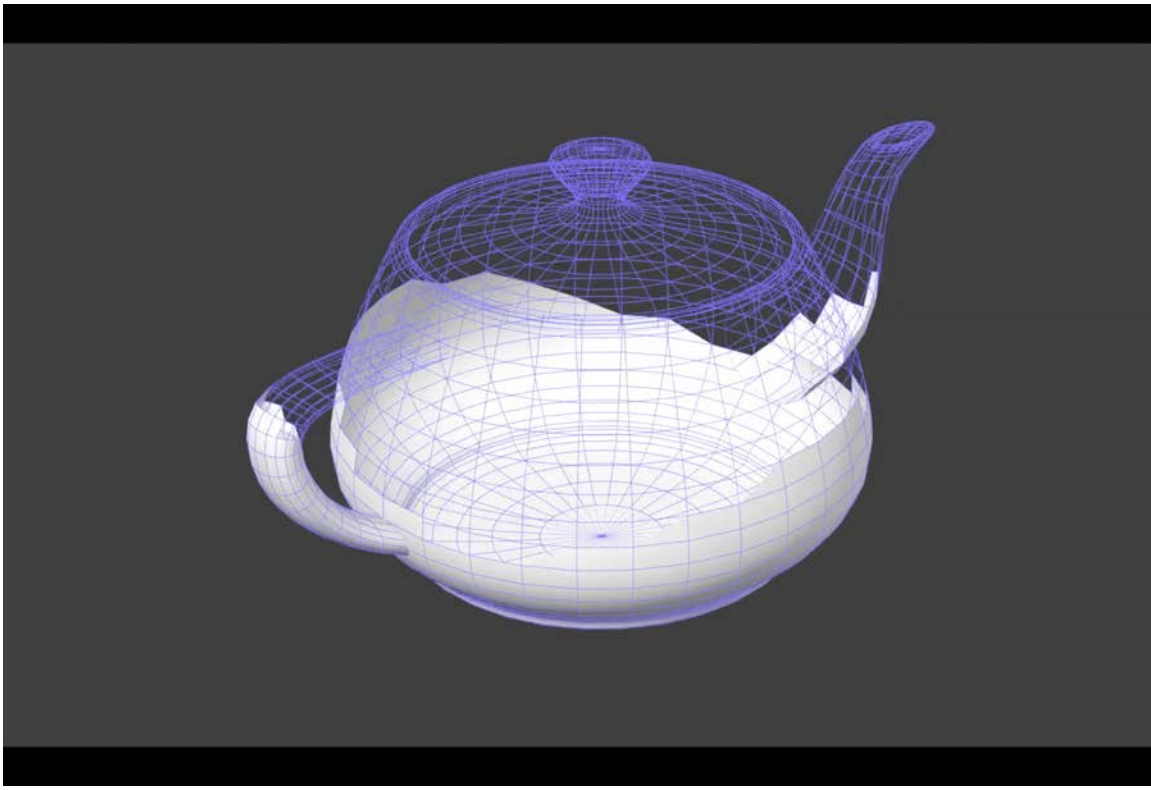

FIGURE 4- SCREENSHOT FROM "HOW TO MAKE A UTAH TEAPOT" (2016)

One of the attributes making The Utah Teapot useful for programmers was that it was a simple object that could be described using relatively few coordinate points, producing a small file requiring little computational power. Objects that are compatible with the way that computers work can be assumed to have a privilege in computational media. That doesn't mean they always should be as "light" as possible. Sometimes standard objects are created specifically to challenge and improve the technology, as indicated from the rapidly increasing polygon count on the wikipedia page "standard 3D test models"[29]. One of the objects on this list, the Benchy boat, is made with attributes that require the 3D printer to be calibrated correctly in order to get a successful print, and thus it can be used to adjust and find the best settings for your printer. 3D Studio Max, the software where I initially discovered the Utah Teapot, also had other strange "standard primitives", such as the "ringwave". This disk with a parametric flower/star shape in the middle, is a standard object made to animate explosions in the universe.[30] It is not difficult to

[29] On Wikipedia site "standard 3D test models" you find an overview of 3D models used to test functionality of 3D modeling software, scanners, printers and more. Polygons are triangles that the model is built up from, and as the technology and computational power has advanced over the years this number has increased drastically.

[30] Autodesk Knowledge Network, https://knowledge.autodesk.com/support/3ds-max/learn-explore/caas/CloudHelp/cloudhelp/2016/ENU/3DSMax/files/GUID-8BAF8C36-9102-4A37-BEB2-472F1452E6C7-htm.html

imagine that we have seen a few more explosions in the universe in animations and movies than we otherwise would have, when the market leading software for 3D graphics has a ready-made object to create these. The software systems also go as "industry standards" and the companies are naturally competing to get in that seat. Recently the Swedish company Quixel, creator of the world's largest repository of 3D scans, was bought by the owner of the gaming engine Unreal Engine (UE) and they have thus joined a partnership that might help them get into such a position. Founded on the aspiration of "speeding up how creators build digital environments, by giving them access to a vast and ever-expanding library of 3D building blocks, and easy-to-use tools to greatly simplify the creative process"[31] Quixel are releasing new assets (3D models) on their website to downloadable for free *if* you are working in UE. These assets take about 6 days of professional, manual labour to create, so if you as a game developer are going to create a virtual scene, it is almost unthinkable that you would start on that laborious process yourself, when you can rather download one of these beautiful pieces of seaweed or rock surface texture in a mouse click, free of charge. Therefor there is a good chance that the aesthetics of virtual environments for some time ahead will look like what Quixel/UE decides that they should look like; If you are making an underwater virtual landscape, you'll be using 3D scans of seaweed and vegetation around the island Tenerife, because that is where Quixel went to do their scans. This evokes Hayles' concerns regarding abstraction where she is stating that

Abstraction is of course an essential component in all theorizing, for no theory can account for the infinite multiplicity of our interactions with the real. But when we make moves that erase the world's multiplicity, we risk losing sight of the variegated leaves, fractal branchings, and particular bark textures that make up the forest.[32]

To make explicit some of the ethical stakes in this, we can look at how many computer graphics programs are better equipped to represent white skin colors than darker ones, a topic addressed by Emil Lundedal Hammar and Jamie Woodcock in their text *The Political Economy of Wargames: The Production of History and Memory in Military Video Games.*[33] This brings to mind the posthumanist thinking dedicated to the deconstruction of liberal humanism and the reductionist view of what a human is, as discussed for instance by Rosi Braidotti in her lecture *Posthuman Knowledge* in 2019. In it she first speaks about how the "human" was "not women, not animal, not nature" and then elaborates on how almost everyone

---

[31] Quoted from the "about" section on the company website https://quixel.com/about. Accessed 03.10.2020.

[32] Hayles. *How we became posthuman,* p 12.

[33] Hammar, Emil Lundedal and Woodcock, Jamie (2019). The Political Economy of Wargames: The Production of History and Memory in Military Video Games. In: Hammond, Philip and Pötzsch, Holger eds. War Games: Memory, Militarism and the Subject of Play. London: Bloomsbury, pp. 54–71.

other than the white, already free man was excluded, leaving a narrow definition of who is human and has the associated privileges.[34]

Conclusion

In this text I have applied N. Kathrine Hayles' concepts nonconscious cognition and cognitive assemblages in a reflection around 3D modeling tools, the process of learning how to work with these and the informal platforms on which such learning takes place. I have suggested that the main function of 3D modeling software, the translation of an object or shape into a mathematical abstraction, is an operation we have externalized from human consciousness to the technological nonconscious. Based on Hayles' writing on neuroscience, I have proposed that when people are working with 3D modeling tools, engaged in nonconscious cognitive processes and absorbing information from an environment consisting of screens and user interfaces, this is rewiring their brains and creating lasting neurobiological changes. Moving the focus to the systemic and collective effects of human-3Dmodeling interaction by approaching it as a cognitive assemblage, I have looked at the YouTube channels that share how-to videos on 3D modeling and also at standards that emerge on these platforms and in these tools. By telling the story of the Utah Teapot I have made connections between the process of abstraction in 3D modeling software and the creation of standards. Whether these are white skin colors, wrenches, teapots, explosions in the universe or seaweed from Tenerife, these standards are interesting because they show the situatedness of the human-technical assemblages in which they are produced. More than that, they show how these standards are constantly influencing what is being made using these tools, the people who use them and the ones consuming its products, and ultimately how we look at these assemblages in which we ourselves are key actors. The special privilege of the artist then, recognizing the powers of the nonconscious, is being embedded in this environment and allowed a hands-on thinking through, what it is this thing that we are working with.

---

[34] *Posthuman Knowledg*e, March 2019, Harvard Graduate School of Design, Cambridge, Massachusetts. Accessed 04.06.2020 at https://www.gsd.harvard.edu/event/rosi-braidotti/