CREATURE EFFECTS AS POSTHUMAN PRACTICE

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Abstract

With the ultimate aim of contributing to positive change in human-animal relations, this paper examines how creature effects (CFX) reflects and shapes contemporary attitudes towards animals. Drawing on biologist Jacob von Uexkull's concept of "umwelt", the paper analyses four of the author's recent animation projects and explores the diverse perspectives, or lifeworlds, elicited by contemporary CFX practices. The paper describes how different aspects of creature FX production (including modelling, rigging, texturing, and animation) elicit umwelts loosely aligned to the lifeworlds of naturalists, trackers, mathematicians, and painters. Through this description, the paper fosters a deeper understanding of the socio-cultural forces shaping CFX and suggests how these forces can be disrupted. The paper finds that CFX can be considered a "posthuman practice" when it rejects the notion of human mastery over technology and positions the artist/animator as an integral part of a complex assemblage. Approached as posthuman practice, CFX challenges human exceptionalism and explores the entangled relationship between humans, technology, and animals. In conclusion, the paper reflects on the future trajectory of CFX and briefly contemplates the potential impact of AI-based methods.

Keywords: Animation, 3D Animation, Visual Effects, Creature Effects, Posthumanism, Uexskull, Umwelt, Australian Animals, Animals in Animation, Critical Animal Studies, Artificial Intelligence

Introduction

Following Heidegger, we know that technology is never neutral and it's dangerous to assume that the tools we use are simply a means to an end (Heidegger, 1977). Always part of a vast network, technologies afford and encourage particular ways of revealing the world. This paper is concerned with computer animation technologies, specifically the software, hardware, and practices used to create photoreal animated animals; also known as creature effects, creature FX, or simply CFX. This paper is written from the perspective of an experimental CFX animator. Rather than focusing on the narrative content of finished animated films, this paper explores the "stories" or biases implicit in animation tools and workflows.

As well as the human-technology nexus, I am concerned with human-animal relations, including the way creature FX reflects current attitudes towards animals and how it might contribute to positive change. Some ways in which CFX positively impacts the lives of real animals are obvious. For example, photoreal digital animals fit seamlessly into live-action films, relieving the need to have real animals on set. Animators can create naturalistic performances, or they can make animal characters who talk. Examples include "Babe", the talking pig (Noonan, 1995) and the primate stars in *Rise of Planet of the Apes* (Wyatt, 2011). In her book chapter *Babe: The tale of the speaking meat*, philosopher Val Plumwood marvels at the film's capacity to give meat a voice and unsettle the ease with which humans make killable selected animal others (Plumwood, 2012). Both these films have an animal-friendly message and there is some evidence that they have inspired change in the hearts and minds of viewers (Wyatt, 2011). We could say that these films represent incremental shifts towards increasing our "compassion footprint" (Bekoff, 2008), but there are obviously forces at play that make meaningful change very difficult.

The design, marketing, and orthodox use of CFX technologies reflect broader cultural forces and, like all technologies, these tools are replete with implicit biases. For example, CFX technologies encourage users to objectify real animals by analysing them as component parts, taking them out of context, and reducing them to their use value. This coincides

Fig. 1 *Phantom*, installation created by Mikala Dwyer featuring animated koalas by Gina Moore, 2021. Photography by Christian Capurro.

with a common human tendency to treat animals as objects or property, "like backpacks, couches, and bicycles" (Bekoff, 2008. p.2). CFX technologies encourage close observation, which is often used in the service of objectification, but it can also be a way of "minding animals", which means recognising that they have active minds and feelings (Bekoff, 2008). In other words, observation can be a way of collecting data for a human-centred project or a way of noticing how animals notice their world. The way that CFX artists see and think about animals varies from project to project or even within a single project. It is influenced by software architecture and the qualities of practice sort by the artist. In short, CFX reflects and encourages objectification of nonhuman animals, while also affording the opportunity to empathise through close observation.

Most of the CFX techniques described in this paper are conventional and are currently being practised in visual effects studios all over the world. Despite using conventional tools and techniques, I describe myself as an experimental CFX animator because I embrace reflexivity and improvisation. While creating the works described in this paper, I recognise myself as part of an assemblage, rather than positioning myself as the agent in control of animation technologies. This self-reflexive approach allows me to discern technological biases (or tendencies) and amplify, play with, or disrupt them. In each of the four works described below the digital animal's form and performance emerges through careful observation of real animals, close attention to the software, and to the emerging work. Instead of focusing on my preconceived intentions (as if they emanated fully formed from my mind or imagination), I explore CFX as a suite of embodied practices through which digital creatures emerge and take on a life of their own. In summary, my approach rejects the notion of humans as autonomous agents positioned above other life forms and separate from technology. Due to these entangled and empathic qualities, I am calling this approach to creature effects a posthuman practice.

There are two main strands of posthuman thought, technological posthumanism (which is closely aligned to transhumanism) and critical posthumanism (Simon, 2019). I am interested in the latter which is inspired by a philosophical critique of European humanism and the liberal humanist subject also referred to as the Cartesian subject. Characterised by mastery, agency, and reason, the Cartesian subject is positioned as exceptional and superior to other lifeforms. We find echoes of the Cartesian subject in animation studies when the animator is positioned as an autonomous agent who is master of their tools and animated characters (Mihailova, 2013). By contrast, critical posthumanism recognises that humans have co-evolved with technologies and are enmeshed with other life forms. Critical posthumanism blurs boundaries between human and machine (Haraway, 2016), and human and animal (Wolfe, 2010). In the face of unprecedented environmental and existential challenges, critical posthumanism (henceforth posthumanism) urges us to challenge the hubris of human exceptionalism and rethink what it means to be human; this is the project of creature FX as posthuman practice.

Jacob von Uexkull is a biologist from the early 20th century and an important precursor to posthuman thought. Most scientists of his era approached nonhuman animals as automata or machines whose behaviour is purely instinctive. In contrast to this mechanistic view, Uexkull insisted on the subjective experience of animals as the starting point for biology. According to Uexkull, each species inhabits a unique social and physical environment which he calls an animal's "umwelt" (Uexkull, 2010). Translated literally as "environment" or "surrounding world", an animal's umwelt is their subjective universe, phenomenal world, or lifeworld.

The concept of umwelt applies to nonhuman animals and to humans. Each species (and each individual within a species) inhabits a world that is structured by what is perceptually and meaningfully available to them, and none of these worlds are objective or universal. For example, a dog's umwelt is

dominated by scents that are completely invisible to humans. A human's umwelt is shaped by their sensory capacities and influenced by their skills, practices, and profession. For example, a carpenter perceives a forest differently than a hiker or an urban planner because training and attention determine what each person sees as relevant. A tick's umwelt is notoriously limited, consisting of temperature, butyric acid, and the tactile sensation of fur or skin; these are the cues a tick uses to locate a host (Uexküll, 2010). Uexkull explains, "From the enormous world surrounding the tick, three stimuli glow like signal lights in the darkness and serve as directional signs that lead the tick surely to its target" (Uexkull, 2010, p.51). As this description suggests, the umwelts of humans and animals are selective, consisting of a subset of the surroundings.

An animal's umwelt depends on its cognitive and sensory capacities as well as the meanings it finds or projects. Uexkull describes the complex relationship between senses and meaning by contrasting the "perception image" (or "perception tone") with the "effect image" (or "effect tone"). The *perception image* is based on sensory input; for humans, we can think of it as light hitting the retina or sound waves stimulating the inner ear. The *effect image*, on the other hand, is based on the animal's capacity for action and it folds back on the perception image. As Uexkull explains, "The perception image provided by the sensory organs can be completed and altered by an 'effect image', which is dependent on the next action that takes place" (Uexkull, 2010, p.93). To elucidate the workings of perception and effect images, he describes an experiment where a dog is trained to jump and sit on a chair on command. When the chair is replaced by various other objects (including boxes, shelves, and overturned footstools), the dog jumps and sits on these objects when given the command (Uexkull, 2010, p.94). Chairs, boxes, shelves, and footstools obviously look, smell, and feel different, i.e., they each produce a different *perception image* but in this experiment the dog alters or completes the perception image with a consistent *effect image* and the objects all take on a "sitting tone".

Uexkull's work suggests that the way we see and think is dynamic and flexible, influenced by training, mood, and attitude or comportment. Umwelts are, to some extent, malleable, especially in the case of humans where technology has a big part to play. Uexkull explains that "in any animal capable of accumulating experiences ... each new experience conditions a new attitude toward new impressions" (Uexkull, 2010, p.96). When animals and humans acquire new habits and practices, new connections between perception images and effect tones are created. In the context of animation, this suggests how new tools and practices bring opportunities for new experiences and meanings. The flexibility suggested by Uexkull's work aligns with the posthuman scholarship which examines how technology shapes experience (Hayles, 2012), and how animals are active participants in world-making (Haraway, 2008). Like Uexkull, posthumanism recognises that every being has a unique way of perceiving the world and ethical consideration needs to extend beyond human concerns.

In the context of CFX, umwelt is a useful framework for understanding how an artist's perception is shaped by software architecture and conventions of practice. In this paper I refer in turn to the umwelt (or lifeworld) of a naturalist, a tracker, a mathematician, and a painter; I imagine what these umwelts consist of and how they differ from one another. I am a visual artist and have been a painter but never a naturalist, tracker, or mathematician. I'm using these professions as a shorthand way of describing how different creature FX practices elicit different umwelts, each with its own unique tone. My approach is necessarily generalised because this paper is written for a nonspecialist audience.

Creature FX is increasingly common in film and TV, and my aim is to bring attention to the way these images are made. Creature FX is a subset of visual effects (VFX) and much has been written about VFX in contemporary film. In addition to explications of finished VFX, the practices behind the way

visual FX are made also deserve attention because they play a powerful part in the constitution of human lifeworlds. With the ultimate aim of negotiating a more equitable future for all lifeforms, this paper explores umwelts that emerge throughout a CFX project and notes how different tasks and activities change what we see and appreciate.

In their paper "The Importance of Storytelling and Speculative Fiction in the Transition into a Posthuman Ecosystem", Damasio and Da Silva point out that stories are a powerful tool in the quest for a more equitable future (Damásio & Da Silva, 2022). Like many others, including Plumwood (above), they observe that stories can inspire empathy by allowing insight into another's point of view. The animations described in this paper also aim to inspire empathy, but I avoid narrative and instead focus on empathic modes of engagement with animation technology and real animals. My focus is on process as much as finished works and, rather than design the outcome in advance, I allow "finished" works to emerge. Examining activities that lie behind a communicated story or rendered VFX image is a way of challenging assumptions about a rational humanist subject who sits above the material world. Acknowledging and exploring the entangled relationship between humans, animals, and technology is a way of challenging the Cartesian subject and its anthropocentric assumptions.

This research is primarily grounded in a practice-based methodology where knowledge emerges through creative activity. Broadly informed by my experience working with 3D animation software since 2001, in this paper I reflect on processes used to create four recent animal animations, working with and against the grain of animation technologies and orthodox practices. With critical posthumanism as a theoretical lens, I describe biases and creative affordances encountered in these projects. Drawing on Uexkull's concept of umwelt, I describe how an animator's perception of animals is shaped by software architecture, conventions of practice, and the animator's comportment. Combining artistic experimentation with theoretical reflection, I note changes in the way we experience animals, the way we experience animation tools, and the way we see ourselves.

Each of the four creature FX projects described in this paper features an Australian animal and was created for a site-specific art installation designed by sculptor Mikala Dwyer. Figure 1 shows one of the four installations, "Phantom", which features my animated koala and her joey (Dwyer, 2021). Descriptions of all four installations are provided in the notes[1]; this paper focuses on the animations which I refer to simply as *Possum*, *Koala*, *Pigeon*, and *Seahorse*. In a typical commercial studio, there are several specialised artists involved in creating a single digital creature. In the projects discussed below, the author performed all aspects of production

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1   *Possum* - Created between June 2020 and January 2021 for Dwyer's public artwork, *Apparition* which features two larger than life Brushtail possums projected onto hologauze screens suspended in trees (Fig. 6 shows the final installation). One of Australia's native marsupials, the Brushtail possum is found in many suburban and urban parklands including University Square (Melbourne, Australia) the location for *Apparition*.
Koala - Koala was created between October 2020 and March 2021 for Dwyer's installation *Phantom*, exhibited at the Ian Potter Sculpture Court, Muma Gallery, Melbourne, Australia. April to October 2021. Like *Apparition*, *Phantom* is designed to be encountered at night. It shows a photoreal animated koala projected onto a hologauze screen suspended between trees.
Pigeon - Created between March and July 2021, Pigeon is a 4-minute looped animation made for Mikala's exhibition *Bird* at Roslyn Oxley9 Gallery, Sydney, Australia. Pigeon features a Spotted Dove (Spilopelia chinensis). Native to the Indian subcontinent and southeast Asia and introduced to Melbourne in the 1860s, this bird is commonly found in urban and suburban areas.
Seahorse - Created between August 2022 - January 2023 for Dwyer's exhibition *Penelope and the Seahorse,* Chau Chuk Wing Museum, Sydney, Australia. Seahorse is a 5-minute loop projected onto a hologauze screen suspended from the ceiling of the gallery.

including modelling, texturing, rigging, animation, grooming, simulation, lighting, rendering, and compositing.

The paper is presented in four sections, with each section focused on a subset of creature FX practices and the umwelt they elicit. *Section 1, Animal objects*, is focused on modelling, grooming, and rigging; processes that elicit the umwelt of a naturalist illustrator, i.e., someone aiming to analyse and record a new species. Here, I'm studying the animal as an object isolated from its environment and I see the animal as a complex machine built of component parts. *Section 2, Animal worlds*, describes processes where my umwelt is like that of a tracker attuned to the animal's umwelt. Here I am wondering what the animal sees, smells, and hears and how it responds to what it senses. For a tracker, attunement to the animal's umwelt helps them find an animal; for an animator, it helps them create a believable performance. In *Section 3, Mathematical relations*, I'm thinking and seeing like a mathematician. My goal is to replicate an organic lifeform but I'm working on a computer so ultimately my medium is data, numbers, and maths. Everywhere I see properties that vary or change. There are static properties that change across a form and dynamic properties that change across time. In *Section 4, Revealing process*, I am like a painter who wants viewers to notice brushstrokes in their finished artwork. Creature FX (and visual FX more broadly) usually seeks media transparency, which means that it attempts to erase its own presence, so the viewer feels they are directly perceiving reality without mediation (Bolter & Grusin, 1996). Against the grain of transparency, this section describes how and why CFX might explore and expose the material facts behind its creation. In addition to summary comments, the conclusion of this paper briefly speculates about the future of CFX and AI-based methods.

Section 1 - Animal objects

A naturalist illustrator's task is to accurately represent an animal species through careful observation, a skill which was particularly important before photography. Naturalist illustration is associated with European expansion and the quest to document and classify the entire natural world (Olsen & Russell, 2019). When Europeans colonised Australia in the early 19th century, naturalists set about finding and documenting the continent's unusual animals (Olsen & Russell, 2019, p.33). As the colonies expanded, naturalist illustrators often accompanied exploration and survey expeditions. Using pencils, ink, and paints, they carefully observed animals, sketching them from life and from preserved specimens.

Creature FX reminds me of naturalist illustration because both practices involve studying the animal as an object isolated from its environment, and both strive to create an accurate portrait of a whole species by studying specificities of many individual animals. Before photography, naturalists worked from life; today CFX artists mostly study digital photos and video. In both cases, the artist hones their observational skills and becomes alert to subtle variations in form, colour, and myriad other attributes. They study the way attributes change across individual animals and discern patterns that are common across a species. Seventeenth century philosopher and mathematician Renne Descartes famously thought of animals as unthinking automata (Harrison, 1992). Naturalist illustration and CFX seem to follow this tradition because, in both cases, the artist sees the animal as a complex machine. In CFX, the sensibilities of the naturalist illustrator are particularly evident in modelling, grooming, and rigging. Describing these processes below, I use *Possum* and *Pigeon* as examples, but most statements also hold true for *Koala*, *Seahorse* and for CFX more generally.
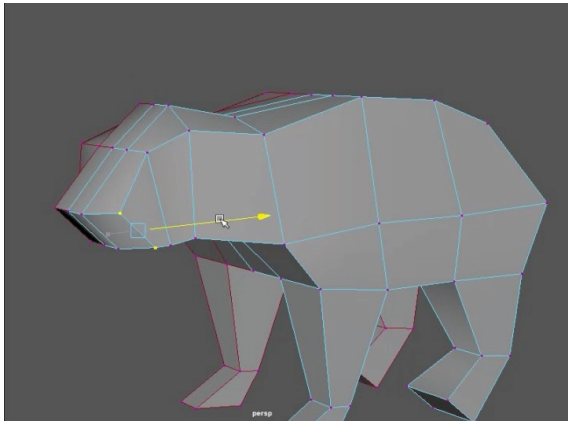
Fig. 2 Screen recording of box modelling process, Gina Moore, 2020. https://vimeo.com/1072062253/2c4e6f4d04

Fig. 3 Grooming process image, Gina Moore, 2021

Modelling means making the animal's outer form or skin and it's the first step in most creature FX projects. To model *Possum,* I study hundreds of photos from the internet, all featuring individuals in different poses including crouching, sitting, or climbing. With this diverse set of images as my guide, I sketch a possum hovering midair with limbs outstretched staring into space. Extrapolated from many characteristic poses, this stiff, unnatural pose is called the "default pose" and it's a necessary step because my possum model must be created symmetrical and aligned to the Cartesian grid. *Possum* starts as a cube to which I add detail by manipulating points until organic form emerges from polygonal geometry (Figure 2). This is known as "box modelling". It's an absorbing process which takes hours or days. I focus first on the general shape, then zone in on details, the face, then the nose, the hands, then the claws. I study photos of whole possums and possum parts including eyes and teeth, which I build as separate models. Like the naturalist, I have extracted the animal from its environment, I'm studying its component parts and trying to achieve as much detail as possible. When the skin is finished, I can move on to the fur.

In CFX, styling the fur of a digital animal is called **grooming**. It is a painstaking process that involves defining hair attributes

including direction, length, density, frizziness, clumping, and colour. In his book about observational sketching Frederick Franck says, "what I have not drawn I have never really seen, and … when I start drawing an ordinary thing I realise how extraordinary it is" (Franck, 1973, p.6). *Possum* was my first experience of grooming and, following Franck, I could say that a furry animal I have not groomed, I have never "really seen". Possums are native Australian marsupials and there are many living in parks and trees near my home. They are nocturnal, but I occasionally see them in the day when walking my dog. So, I have seen possums many times but adding digital fur to a creature requires seeing the animal in a way I never have before. To groom *Possum,* I study photos and video, noting how hair attributes change across the animal's body. Every animal is different but there are common features. For example, the hair colour tends to be yellower underneath the body and darker where the body thickens (Figure 3). Like the naturalist, I study multiple individuals and discern common patterns that make a possum what it is. The world of the naturalist illustrator is full of variations overlooked by other people and the same is true for the CFX artist. In both cases, the artist's umwelt emerges by repeatedly noticing subtle variations in the attributes of animal objects.

Rigging is a technical process in which we approach the animal as a complex machine. Like muscle, fat, and skin simulation, rigging involves analysing the inner workings of the animal by studying anatomy diagrams and photos of re-al-life skeletons. Based on this research, we build a hierarchy of joints that acts as an internal armature. Like wire inside a plastic toy, joints are rotated to deform the creature's skin. To easily manipulate the joints, we create control objects with various coded relations and constraints. These objects are manipulated to test the rig and will be keyframed by the ani-mator (Figure 4).

One of the most difficult animals to rig is a bird. Rigging *Pigeon* required an understanding of the inner workings of birds with a particular focus on wing joints and feather distribution. The wings of a real bird tuck neatly into the body forming a dis-tinctive silhouette and plumage pattern. Outstretched, the wing shape and pattern is entirely different but equally rec-ognisable. Achieving something resembling this complex be-haviour requires many hours studying wing architecture and testing joint placement.

Like all digital creatures, a 3D bird can never achieve the range of movement enjoyed by a real animal. Like grooming, rigging makes us realise the complexity of real animals and the fact that we could never achieve a fully accurate representation in 3D software. The digital version is an abstract diagram that
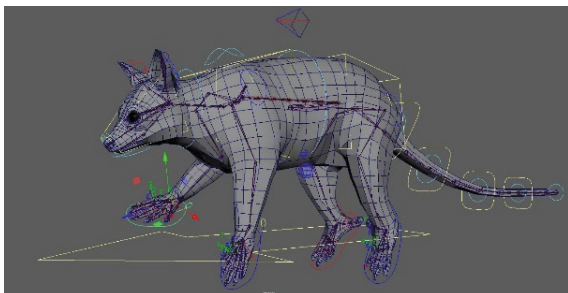

Fig. 4 Rigging process image, Gina Moore, 2021

only approximates the real thing. For the CFX artist and the naturalist illustrator, the animal is a complex machine object which they represent as accurately as their medium allows. Using the language of Uexkull, we could say that animals take on an "object tone" in the naturalist's umwelt. This means that we don't appreciate the animal's subjectivity and unique per-spective, but we might appreciate that every animal object is more beautiful and complex than we can comprehend.

Section 2 - Animal worlds

If modelling, grooming, and rigging elicit the umwelt of the naturalist illustrator, then **animating** is like being a tracker at-tuned to the animal's world. In this umwelt, the animal takes on a "subject tone", which means it is appreciated as a think-ing, acting being, with its own unique lifeworld. To elucidate the difference between the naturalist illustrator's umwelt and the tracker's (i.e., between attending to animal objects vs an-imal worlds) let's turn again to 19th century Australia. When Europeans colonised Australia, they depended on the envi-ronmental knowledge of the continent's indigenous people for their naturalist project because, before an animal can be collected and classified, it must be found (Olsen & Russell, 2019, p.32). Skilled indigenous trackers can find animals be-cause, like Uexkull, they understand animal behaviour. They can read animal activity from footprints, dung, broken twigs, etc., and they are attuned to an animal's perspective. They know the environmental signs or affordances that are rele-vant to the animal; in other words, they know how the ani-mal perceives its physical surroundings and how it responds. Broadly speaking, European naturalists focus on the animal as autonomous object while indigenous trackers understand connections between an animal and its environment.

Animating an animal, or any character, means making it move in a lifelike or convincing way, and much has been writ-ten about what this art involves. Many theorists emphasise

the importance of conveying the goal or intention behind a character's actions. In his book, "Acting for Animators", Ed Hooks insists that "Walt Disney's greatest contribution to animation was giving Mickey Mouse a brain. With a brain, he could think, develop values and feel emotions. 'An illusion of life' is another way of saying, 'An illusion of thinking'" (Hooks, 2017, p.5). We can detect an underlying anthropocentrism in Hooks' advice because it seems to equate the illusion of life with human brains, goals, and values.

My animations imbue characters with an inner world, but I'm more interested in the animal's capacity for sensation and response than its mental capacity for goal-based action. I'm also focused on my own capacity for sensation and response, i.e., my capacity to sense and respond to real animals, to animation technology, and to animated characters as they evolve or emerge. I take the emphasis away from goal-oriented action and rational decision-making because these traits are used in anthropocentric, humanist discourse to divide humans and animals on the grounds of agency, i.e., rational decision-making and abstract thought are supposedly unique to human agents and are lacking in animals who merely operate on instinct. By focusing on capacities for sensation and response, I want to emphasise that humans and animals are embodied subjects whose lifeworlds are

Fig. 5 *Possum* animation test, Gina Moore, 2021 https://vimeo.com/495687456/6cc2e58eae

shaped by relationships and activities. This shift in emphasis, from control to response, is a key part of creature FX as posthuman practice. In previous publications I've called this "a conversational approach to 3D animation" (Moore, 2016). Emphasising response means adopting an actively receptive comportment which is a type of empathic engagement that can disrupt perceptual habits and give us a glimpse into the worlds of others.

My projects use orthodox keyframe animation techniques, but my general approach to animation is not entirely orthodox because I shift the focus from animator as masterful controller to animator as empathic responder. Hooks says the animator is like a "puppet master" and refers to the relationship between animator and character as "empathetic direction" (Hooks, 2017, p.3). This is a useful description as long as we realise that the animator is puppet as much as puppeteer, directing works both ways. The animator directs the character, while the character (together with real animals and animation tools) directs the performance of the animator.

While creating each work described in this paper, my attention is continually drawn to animals in my local environment. I notice subtleties in the way they look and the way they move. I observe them observing me and I imagine how I feature in their lifeworld. This empathic mode of attention changes my own world for the duration of the project and beyond.

Creature animators need to study real animals to create a believable performance, but often the basic performance is predefined by a script and animal antics are added on top, like icing on a cake. In contrast, my animations are non-narrative animal portraits, and the performance emerges through an improvisational process with observation as the starting point. *Possum* leaps from branch to branch and pauses to smell and listen (Figure 5); *Koala* runs with her baby on her back and sits down to rest; *Pigeon* lands on an invisible branch before taking off again, *Seahorse* changes form and swims
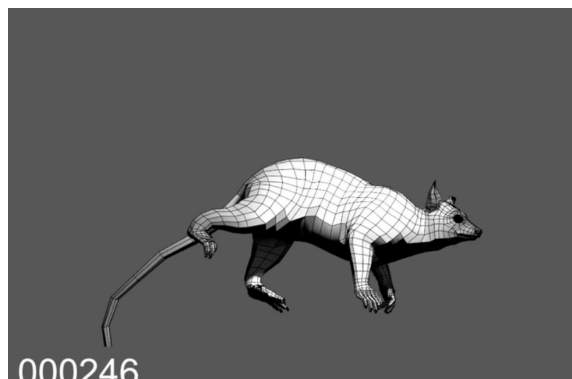
Fig. 6 *Apparition*, installation by Mikala Dwyer featuring animated brushtail possums by Gina Moore, 2021.

in graceful figures of eights. Comprised of short, animated loops, each work is a portrait of a species and a portrait of myself in animal form. I liken it to a self-portrait because each performance is created intuitively after watching animals and empathising with their ways of being. Unlike much CFX, the performances of my animated animals are not spectacular or threatening. They are more naturalistic than the anthropo-morphised, talking animals described above.

Possum, *Koala*, *Pigeon* and *Seahorse* are all rendered in detail with dramatic lighting on a black background. With no vir-tual environment shown in the finished videos, the physical objects surrounding each video installation are part of each creature's surrounding world. Projected onto hologauze[2] screens suspended between trees, *Possum* and *Koala* exist in an outdoor setting surrounded by parkland (Figure 6 and Figure 1). *Pigeon* is projected onto a black gallery wall and *Seahorse* is projected onto hologauze hanging loosely from a

gallery ceiling; these animals exist in an indoor architectural space surrounded by Dwyer's other artwork including sculp-tures and paintings. As well as being designed for a particular physical context, i.e., outdoor landscape or indoor architec-ture, each animated performance acknowledges the pres-ence of the viewer by making eye contact and returning the viewer's gaze (Figure 7). Seeing the animal seeing us gives the work a certain symmetry. It's like looking in a mirror and seeing something of ourselves.

Each animal is projected much larger than life and dramat-ic lighting makes it stand out against the black background. This large scale and high contrast help focus the viewer's at-tention on subtle movements including breath, ear and mus-cle twitches, blinking, and eye saccades. These "micromove-ments" indicate that the animal is processing its meaningful world, i.e., it is hearing, seeing, and smelling things which are mostly imperceptible to us.

2   Hologauze is a gauze-like material woven with silver thread which enables it to capture a crisp projected image while remaining semi-trans-parent. If the screen edges are well hidden, the projected image seems to be suspended in mid-air, almost like a hologram.

In their contribution to "Justice Through a Multispecies Lens", Sria Chatterjee and Astrida Neimanis note that "artworks can bring us into intimacy with incommensurable worlds of other species … [while] simultaneously keep[ing] these worlds strange – never fully known, impossible to assimilate" (Celermajer et al., 2020, p.22). As well as activating the installation's physical context and focusing the viewers' attention on micromovements, the black backgrounds in my animations symbolise the fact that we can never really know an animal's world. Despite (or because of) his careful experimentation and exhaustive descriptions, Uexkull's work underscores this fact because it shows that all worlds are partial and there is no all-inclusive, objective world of science. We can never fully know the world of another being but trying to understand the animal's perspective shifts our own umwelt at least a little.

Section 3 - Mathematical relations

 As well as the umwelt of the naturalist and the tracker, each of the processes described above can evoke the lifeworld of a mathematician. In this umwelt, animals take on a "relation tone", which means that we see the animal as a web of interrelated attributes which change across space and time.

Possum, *Koala*, *Pigeon,* and *Seahorse* were all created using industry standard 3D animation and visual FX software,

Fig. 7 Koala returns the viewer's gaze; still from *Koala* Breakdown video, Gina Moore, 2021. https://vimeo.com/554088837

specifically Maya (by Autodesk) and Houdini (by Sidefx software). Typical of 3D computer graphics (CG) software, these applications are comprised of various coordinate systems, coded functions, and dynamic solvers based on real world physics. We can think of this software as an incredibly sophisticated calculator; a complex collection of mathematical knowledge acquired by humans over many hundreds of years. Like most users, I don't fully understand the mathematics behind the user interface but, after 20 years using this software, it plays a part in the world that I see.
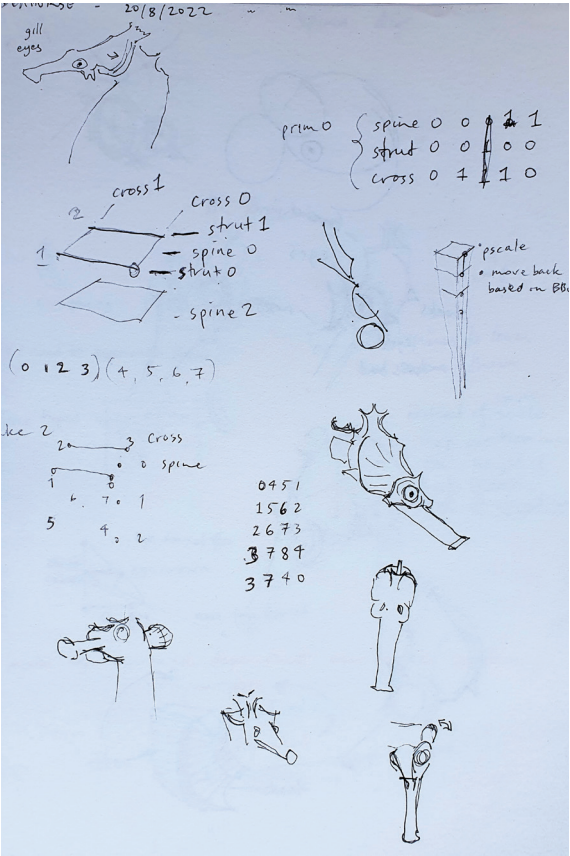
Working in 3D animation and visual FX, I see all objects (including animals) as collections of attributes that vary and change. I see static attributes that vary across a form and dynamic attributes that change across time. Examples of static attributes include hair length, colour, and density, which change across an animal's body and are usually stable for the duration of the animation. Example dynamic attributes include the position and rotation of an animal's internal joints. As is common practice in CFX, I often set the length of an animal's fur using a greyscale image (Figure 9) and I manipulate joints using keyframes and curves (Figure 10). Images and curves are two ways to represent and manipulate amounts or magnitudes and there are many other ways to modulate magnitudes, including adjusting sliders, entering numerical values, and writing code.

Attribute changes that are very simple can be represented as straight lines or linear gradients, while more complex attribute changes are represented as curves, vector fields, or patterns. It's important to note that curves and patterns never exist in isolation; each object is made of many curves or patterns which represent changing magnitudes that are interdependent. In other words, each object is a collection of attributes that change in relation to each other and there is always a logic to the way that changing attributes overlap. For example, an

Fig. 8 Sketch for *Seahorse* procedural model, Gina Moore, 2022.

Fig. 9 Greyscale image driving *Possum* hair length, Gina Moore, 2020.
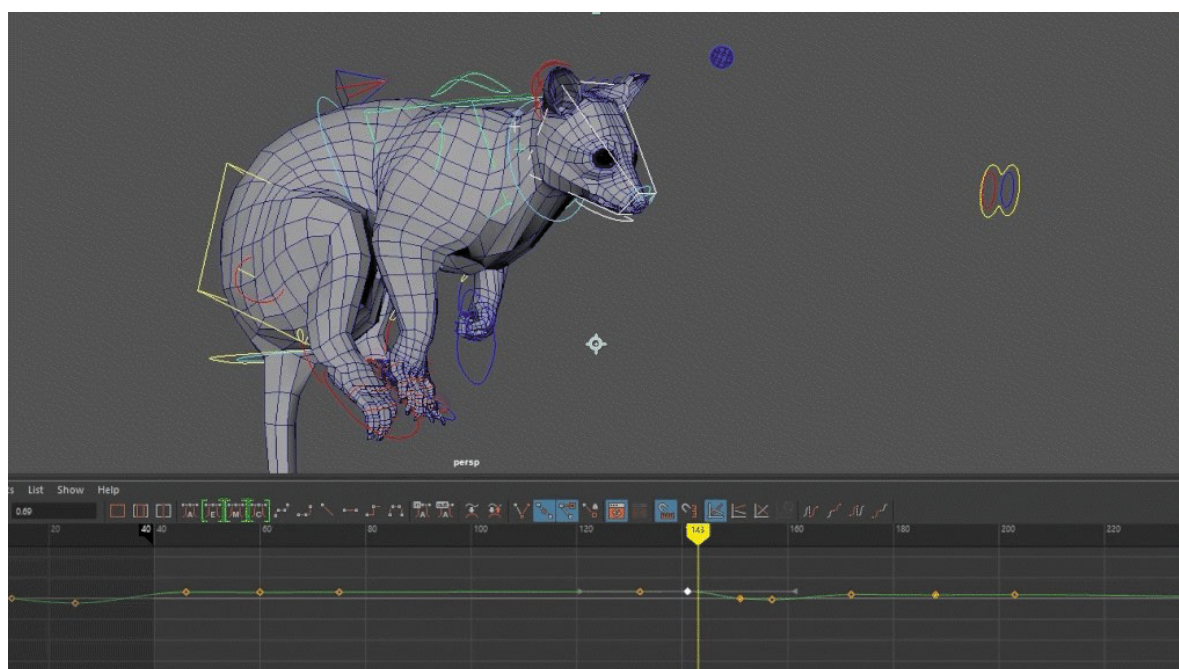
Fig. 10 Curve driving *Possum* chest height, Gina Moore, 2020. https://vimeo.com/1072065493/0a7cb37a07

animal's fur is often shorter where the mesh is thin (e.g., fingers) and longer where the body thickens (e.g., belly)[3].

As well as overlapping interdependent patterns, there are patterns within patterns (or curves within curves). In other words, there are hierarchies of patterns representing hierarchies of change. For example, attributes used to model *Pigeon's* flight feathers (including bend, length, and colour) gradually change along each wing, along each feather, and along each barb (Figure 11). Likewise, hierarchies of change (curves within curves) bring the bird to life, e.g., rotation within rotation produces flapping wings.

The general approach I have described so far in this section embraces the *procedural* qualities of 3D workflows, which means building flexible systems, or "live" data networks, that can be manipulated to create variations of form (model), image (texture), and movement (animation). In 3D animation, procedural workflows are often contrasted with linear, destructive workflows (Katara, 2020). Box modelling (described above) and painting bitmap textures are both "linear" and "destructive" because their aim is to create one-off items rather than flexible systems. For *Possum* and *Koala* I created one-off animal forms using box modelling (a linear and destructive technique), but for *Seahorse* I used node-based coding to create a flexible system that makes seahorses of various shapes and sizes. This is known as a *procedural model*.

Figure 8 is one of many sketches I made while creating *Seahorse*, and it indicates how procedural modelling is more

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3   This common relationship, between fur length and body thickness, is illustrated in Figure 9 which shows a greyscale image (mapped onto the possum skin) that I created by first measuring the thickness of the mesh.
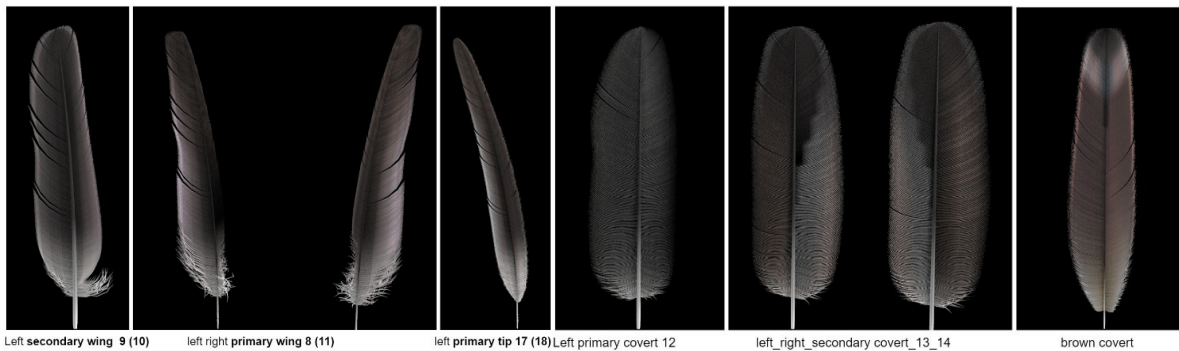
| Left **secondary wing 9 (10)** | left right **primary wing 8 (11)** | left **primary tip 17 (18)** | Left primary covert 12 | left_right_secondary covert_13_14 | brown covert |

Fig. 11 Some of the feathers modelled for *Pigeon*, Gina Moore, 2021.

overtly mathematical than other methods. My "finished" pro-cedural seahorse is flexible in the sense that it has attributes (or parameters) that can be altered to create many seahorse variations. Easy changes include the number of segments, size of the eyes, length of the tail, nose, and spines, as well as colour and other surface properties (Figure 12).

In his book "How to Speak Machine: Computational Thinking for the Rest of Us", John Maeda marvels at the way algo-rithms can emulate living systems and describe patterns found in nature (Maeda, 2019). Utilising algorithmic functions embedded in 3D software, I created procedural textures that

Fig. 12 Demonstration video showing procedural seahorse model, Gina Moore, 2023. https://vimeo.com/1030430006/8ef52207b2

approximate the Pot-Bellied seahorse (Figure 13 left) and the White's seahorse (Figure 13 right). One advantage of creating patterns procedurally rather than painting one-off images or texture maps is that they can be easily changed by altering algorithm parameters and they can also be animated, as shown in Figure 14.

Linear workflows involve defining objects in terms of static, essential, qualities, while proceduralism, on the other hand, encourages us to see all objects in terms of change and rela-tion. For this reason, I suggest that linear processes (includ-ing box modelling) align with the rigid categories of humanist thought, while proceduralism aligns with posthuman thought because of its focus on gradual transitions and emergent properties. When box modelling, as shown above (Figure 2), I am moving points on the mesh using an x, y, z manipula-tor. I'm not entering numerical coordinates but I'm aware of the three-dimensional Cartesian grid as a "container" for my static, one-off model. Maths is behind all CG workflows but there are many branches of mathematics. If box modelling and bitmap texturing recall Cartesian coordinate systems, procedural modelling reminds us of calculus.

Differential calculus models rates of change and is often used to analyse moving objects, for example, to find the instanta-neous velocity of a ball thrown in the air. But static geometry,

including curves and surfaces, can also be characterised by rates of change.

In his book "Intensive Science and Virtual Philosophy", artist and philosopher Manuel Delanda explains that this differential way of describing static objects can be contrasted with the older Cartesian method of plotting static points (DeLanda, 2013, p.12). Delanda's book explores the relationship between science (and maths) and the work of French philosopher Gilles Deleuze. In the book's opening chapter, Delanda explains how Deleuze's philosophy uses mathematical concepts including differential calculus to move beyond the concept of essence.

The concept of essence relies on defining the fundamental traits that make an object what it is. For example, defining humans as a "rational animal" assumes rationality is a defining characteristic. Essentialism tends to assume fixed categories (such as human and animal) and it's a characteristic of much

humanist thought. In contrast, for Deleuze "a species is not defined by its essential traits but rather by the morphogenetic process that gave rise to it. Rather than representing timeless categories, species are historically constituted entities" (DeLanda, 2013, p.9). Delanda explains that Deleuze replaces the concept of *essence* with *multiplicity,* which specifies the structure of a *space of possibility*. A multiplicity explains the variations and the regularities in a morphogenetic process such as the development of an organism (DeLanda, 2013, p.10). Like procedural CG workflows, Deleuze's work encourages us to think in terms of gradual transitions and emergent properties and, for this reason, posthuman scholars and artists are drawn to his work.

It takes longer to create a procedural model than a one-off item but, once created, the procedural model can generate countless variations including some that are surprising. In an experimental project, building a procedural model or system is like designing a space to play. Of the four CFX projects presented

Fig. 13 Stills from *Seahorse* showing procedural patterns. Gina Moore, 2022.

Fig. 14 Cropped excerpt from *Seahorse* video showing animated procedural pattern. Gina Moore, 2022. https://vimeo.com/1072062624/3238692db5

here, *Seahorse* is the most playful and improvised. To create the video, I manipulated some attributes manually and animated them using keyframes. Other changes are generated by driving one attribute with another, for example, I used speed (calculated for each point on the seahorse skin) to drive the colour and random location of each point (Figure 15).

Connecting speed, colour, and location gave surprising results (or glitches) which I embraced because *Seahorse* is an experimental project. It's worth noting that coding relations between magnitudes is also common practice in orthodox VFX practice, i.e., it doesn't always give surprising results[4]. More so than *Possum*, *Koala*, or *Pigeon*, the "finished" Seahorse movie feels like the tip of the iceberg; I'm aware of the *possibility space* below the rendered surface because *Seahorse* is a "live" system that can easily generate many varied results.

Procedural modelling and texturing can feel abstract and mathematical compared to other creature FX processes which feel organic and intuitive. Proceduralism generally requires an understanding of basic maths and core computer graphics concepts including data types and coordinate systems. It is therefore a great way to become familiar with the "stuff" of 3D, i.e., the mathematical recipes and calculations behind the interface. Likening the CFX artist to the painter, this is like becoming intimate with paint, brushes and palette knives and not using colours straight from the tube.

Section 4 - Revealing process

There are similarities between the umwelt of the painter and that of the naturalist illustrator because in both the animal has an "object tone". But, unlike the illustrator, the painter's attention continually moves between the animal object and the tools, materials, and gestures used to depict the animal form. For the illustrator, tools and materials are invisible or have a "use tone", but, for the painter, they have a "revealing tone" or a "layering tone". Playing with tools and materials can reveal appealing aesthetic details and provoke a visual interplay between painted surface and three-dimensional illusory form.

Based on my own experience, I suggest that a figurative painter tends to see the world as a field of abstract shapes, noticing shadows and shifts in colour that are invisible to most people. They also notice how their tools and media interact, i.e., the way pigments mix with fluids, and interact with brushes and canvas. Just as a woodcarver becomes attuned to the grain and texture of wood, a painter is attuned to the way paint behaves. Being attuned to the qualities of their medium allows the painter to coax an image from the canvas while "keeping the paint alive", i.e., allowing it to drip, smudge, etc. This means that a final painting can depict recognisable objects while retaining a painterly quality.

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4   Examples include the colour, size, or transparency of a particle being driven by its normalised age.

The viewer of a painterly figurative painting can see the represented object (e.g., a haystack or a bowl of fruit) and, looking closer, they can see daubs or splashes of paint. In other words, there is a visual interplay between the representational image and the materiality (or facts) of the medium. An astute viewer notices layers of paint and has a sense of how the painting was made with brushes, pigments, and human gestures. The desire to see how a work was made as well as what it represents is common in painting and other artforms such as sculpture, and animation. According to social anthropologist Alfred Gell, knowing how an object was made is an important ingredient for any artwork (Gell, 1992).

In his 1992 paper "The Technology of Enchantment and the Enchantment of Technology", Gell explains that an art object is enchanting to the extent that it displays technical virtuosity (Gell, 1992). For example, the spiritual resonance of a religious artwork is partly the result of it being an incredible human achievement; the viewer struggles to comprehend this achievement and so attributes it to divine forces. Likewise, the astonishing skill of a woodcarver, potter, or painter appears to be almost supernatural and so the work has a magical or enchanting quality. Important elements of Gell's theory are that a viewer believes the artwork to made by a human, while at the same time the object displays such a high level of skill that it seems to exceed human agency.

Gell's theory of art assumes viewers have some understanding of techniques used to create a work, but creature FX involves creative practices that are unfamiliar to most viewers and computational processes that are obscure to many makers. In CFX, and 3D animation more generally, agency is distributed between artist and machine (Wood, 2014). In addition to this intrinsically ambiguous agency, the goal of most CFX is to obscure its making, i.e., to hide the fact that it was made by either human or machine.

Following the tradition introduced by Renaissance painters, mainstream VFX (and creature FX by extension) aims for media transparency (Bolter & Grusin, 1996). It might draw attention to itself as spectacle, but good VFX directs the viewer towards the represented phenomena (or creature) and the story in which it plays a part, not towards the human labour and computational processes used to create it. In short, the measure of success for orthodox VFX is transparency or invisibility.

Fig. 15 Cropped stills from *Seahorse* showing speed attribute driving point colour and position (via random offset), Gina Moore, 2023.
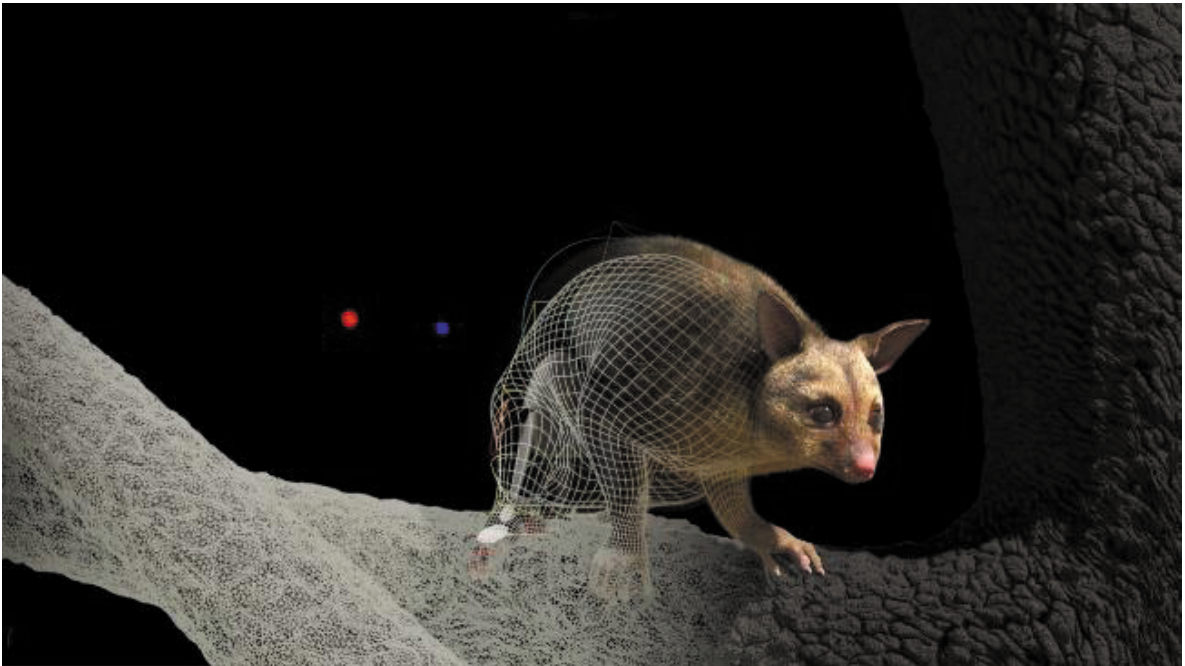
Fig. 16 Brushtail Possum Breakdown video, Gina Moore, 2020. https://vimeo.com/453454050

One way for VFX artists to reveal their process is to create a breakdown or making-of video. Like brushstrokes left by a painter, breakdown videos are VFX artists showing their hand. In accordance with Gell's theory of art, the quantity and popularity of these videos is evidence that visible process has a certain audience appeal. For *Possum* and *Koala*, I was compelled to reveal my making process to others by creating breakdown videos after completing the projects (Figure 16 shows a still from the Possum Breakdown video and Figure 7 shows a still from *Koala* Breakdown). Creating a breakdown on project completion is common practice; less common is the deliberate inclusion of process imagery in a final work. This is the unorthodox approach explored in *Pigeon* and *Seahorse*.

Like other works described above, *Pigeon* is rendered in a style approaching photorealism, but, in addition to these polished renders, *Pigeon* also incorporates viewport snapshots and various other data representations that I encountered during production. The final video includes the wireframe model, internal skeleton, and coloured planes used to simulate the flight feathers[5] (Figure 17). My hope is that incorporating process imagery gives viewers a sense of *how* the work was made, or at least *that* it was made by human and machine. More than *Possum* and *Koala*, *Pigeon* and *Seahorse* communicate the inherent fluidity of the digital medium by cycling through various data representations, i.e., they expose the inherent qualities of their medium in the same way that a painterly painting exposes the paint.

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5   This is a common workflow; it's not feasible to simulate forces on a complex model such as a feather, so we simulate a simple model (e.g., a plane) and use that to deform the complex model (e.g., a feather).

For Gell, an artwork's appeal stems from the enchantment or admiration associated with technical virtuosity. His essay includes descriptions of woodcarving and other analogue artforms where questions of agency and authorship are relatively straightforward. VFX is created with sophisticated software designed and owned by large companies, and the labour behind its production is often obscured (Sobchack, 2009). For contemporary VFX artists and viewers, questions of agency and authorship are unclear and sentiments towards VFX are often ambivalent. Scholar and artist Alan Warburton describes VFX, and CG more broadly, as an "ideological tool" which is ubiquitous and powerful and designed to obscure its origins. Warburton warns that, "anything powerful … designed to be invisible should be made visible" (Harris et al., 2019). Gell's theory of art suggests the possibility of creating

enchanting art objects by revealing processes behind the work. Following Warburton, we could say that, in the case of VFX, revealing the making process is inherently political.

As well as an ideological tool of advanced capitalism, computer graphics technology is often associated with climate change and environmental destruction (Cubitt, 2013; Formenti, 2024), hence there is an obvious paradox in using these tools to render natural subject matter. Like *Seahorse* and *Pigeon*, many contemporary CG artworks explore and embrace this paradox. *Country Diary* is a video essay by Warburton that highlights the paradox of building a virtual country scene using equipment that requires a high carbon footprint. This work shows lush, flowered fields as they are being rendered, revealing the "chugging pixellated realisation"

Fig. 17 *Pigeon* excerpt showing integration of coloured planes used to simulate feathers, Gina Moore, 2021. https://vimeo.com/1072062392/2d85b9ad94

Fig. 18 *Possum* video showing halo effect. Gina Moore, 2021. https://vimeo.com/502336464/49a84fb44a

of a simulated natural environment (Warburton, 2020). By exposing the mechanics of his "virtual nature", Warburton points to the contradictions and absurdities in his work. He created *Country Diary* in the UK during Covid-19 lockdowns and says that it was partly driven by his desire to be in nature at this time. *Possum*, *Koala*, *Pigeon*, and *Seahorse* were also made during intermittent Covid lockdowns. The many hours I spent creating digital animals partly satisfied my desire to be with real animals and I was aware of this contradiction.

The Substitute is a video installation by artist Alexandra Daisy Ginsberg with CFX animation by production company, The Mill (Ginsberg, 2019). The installation features a life-sized projection of an animated northern white rhinoceros, a species that is now extinct. The visual style of the work moves between photorealism and pixelated boxes which allude to the animal's digital construction. By revealing processes behind the work, *The Substitute* points to our contradictory obsession with creating new life forms, while neglecting existing ones.

The installations in which *Possum*, *Koala*, *Pigeon*, and *Seahorse* feature are also about loss, created as a poetic response to deteriorating natural environments. *Pigeon* and *Seahorse* contain artefacts from the 3D animation process, and the final renders of *Possum* and *Koala* have a halo effect which gives the animals a ghostly quality (Figure 18). Like Gainsbourg's pixelated boxes, my digital artefacts and halos disturb the representational illusion of the animated animal and reveal its artificiality. None of the animals featured in Dwyer's installations are extinct, but koalas and White's seahorses are endangered; these animated animals act as ghosts from the future, prompting the question, Will you miss me when I'm gone?

In her book chapter, "Digital Experimentation: Extending animation's expressive vocabulary" Miriam Harris says, "Experimental animations that draw upon a photoreal aesthetic, while exercising reflexivity, have a particular kind of subversiveness – they adopt the tropes of commercial production, but also question its conventions" (Harris, 2019).

According to Harris, experimental digital animation (like its analogue counterparts) can reverberate with the viewer's body and senses because "the revelation of a work's digital guts ... can possess a raw honesty and vulnerability, in which digital materiality becomes palpable" (Harris, 2019, p.127). For many theorists and CGI artists, expression and subversion are associated with a glitch aesthetic (Menkman, 2011; Phipps, 2021; Russell, 2020). In *Seahorse* and *Pigeon,* I incorporate glitches but very selectively because I'm aiming for a style that communicates craft and care as much as glitchy disruption. Each of the four animated animals described in this paper took me 200-400 hours to create but it's difficult for viewers to appreciate this fact due to the myth of digital animation as effortless and automated (Sobchack, 2009). By revealing the process in finished works, I hope to give viewers' insight into the labour and care required by photoreal CGI projects and suggest that CFX can be a devotional practice characterised by deep attention and commitment to real animals.

Conclusion

Through a description of four recent animation projects, this paper has examined diverse lifeworlds emerging from contemporary creature FX practices and has revealed various humanist assumptions implicit in these practices. These include ideas such as animals are complex machines built of component parts, and humans are autonomous agents superior to other beings. Combined with assumptions implicit in animation discourse, the human mind (or brain) and its explicit intentions are given precedence while entangled, embodied relations are downplayed. Consistent with European humanism, the animator is positioned above, and separate from, animals and technology.

Examining CFX lifeworlds has also revealed the potential for posthuman approaches which embrace complexities of the human-animal-technology nexus. Central to these approaches is a re-evaluation of the animator's role, avoiding the notion of a masterful controller and emphasising a more empathic and responsive engagement with real animals, animated characters, and animation technology. By carefully observing real animals and recognising ourselves as part of an interconnected assemblage, animators can foster a deeper understanding of animals and CFX technology. An empathic posthuman approach to CFX means recognising how our tools and practices impact what we see, and how we think.

In the move towards a more equitable future, the stories we tell about animals are important but so too are the practices employed to create those stories. Through a posthuman approach to CFX we can notice things we usually overlook; we can learn to "really see" animals, and we can challenge our habitual understandings about ourselves. A posthuman approach to CFX closely interrogates common practices and explores new ones in order to challenge human exceptionalism and contribute to meaningful change in human-animal relations. This paper advocates for an approach to creature FX that acknowledges the complexities of the human-animal-technology nexus and aims to foster empathic and equitable relationships. As we confront unprecedented environmental and existential challenges, CFX as posthuman practice strives for a future where all life forms are respected.

The future of CFX: traditional CGI vs generative AI - The CFX processes described in this paper have existed in their nascent form since the first fully digital animals appeared in "Jurassic Park" in 1993 (Meila, 2023) but it's all about to change because machine learning and generative artificial intelligence (AI) will soon usher in a new paradigm for computer generated images. It's too early to say exactly how these changes will affect traditional CFX industries but, based on the historical trajectory of CG, we can speculate that it will make photoreal digital creatures easier and cheaper to produce. This will alter the human skills required

in CFX and might reduce employment opportunities. Most relevant to the theme of this paper is the question of how new CFX practices will change the way we see animals and the way we see ourselves.

In the context of this paper, one danger of the new AI rendering paradigm is that CFX artists turn away from real animals, *offloading the practice of close observation to the machine*, i.e., it is the computer which closely observes animals during the training process. Traditional CGI uses a bottom-up approach; for example, traditional CFX artists model an animal form, build an armature, create keyframes, add fur, etc. (as described above). By contrast, using generative AI is more top-down; it means using a computational model that has been trained on numerous finished artworks, photographs, animations, or film. Obviously, these approaches – bottom-up and top-down - are very different as are their inherent biases, blind spots and emergent creative opportunities.

There is another blind spot inherent in AI which is perhaps more obvious and more problematic; it hinges on the definition of "intelligence". As James Bridle points out in his book, "Ways of Being. Animals, Plants, Machines: The search for a Planetary Intelligence", AI embodies a kind of capitalist, corporate intelligence and *overlooks the various nonhuman intelligences* that constitute the natural world and have been with us all along (Bridle, 2022). In other words, the development of AI technologies and discourses around AI research routinely overlook the intelligences of plants, soils, ecosystems, and nonhuman animals.

CFX practitioners will inevitably embrace AI tools, and as we do so it's important to continue to closely observe and empathise with real animals, and important to question assumptions implicit in our definitions of "intelligence". A reflexive approach to new CFX practices, will help us discern workflows that encourage close observation of real animals and promote respect for animal intelligences and lifeworlds.

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