Umwelt Hacking: Can we sense like a forest, a mycelium network or an octopus?

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Can we sense like a forest, a mycelium network or an octopus? Each of these is their own 'kingdom' so how do we build sensory bridges between these kingdoms? This paper explores expanding the definition of intelligence, seeking to find a bridge between what humans can sense, and what a forest, mycelium network or octopus can. The project came out of the observation that our human metric of intelligence is flawed, there seems to be a hierarchical and binary approach, alongside a predominant belief that what we consider is quite narrow and fixed, aligning with what computers can do, favouring speed, efficiency, and memory. This excludes the richness of neurodiversity and people with radically different abilities. Building on previous projects and experiments we have conducted several experiments exploring the transfer process involved in sensing like a forest, a mycelium network or an octopus.

Umwelt hacking. Neurodiversity. Prosthetics. Immersive. Biohacking.

1. INTRODUCTION

An Umwelt is the world as it is experienced by a particular organism, it is a "closed unit" consisting of all an organism can sense and act on. Our research asks if that private world is the only world, it can know and experience.

Umwelt Hacking is not new, in 1974 a paper by Thomas Nagel, asked “What is it like to be a bat?” (Nagel 1974) and in 1934 a theoretical biologist, Jakob von Uexküll asked what it is like to be a tick (von Uexkull 1934).

von Uexküll even did early Umwelt hacking experiments using a variety of media:

Von Uexküll does not just tell us what these umwelts are like. He shows us — or tries, anyway, using inventive illustrations and sometimes photographic gimmicks. In one series of his figures, a first photograph shows a village scene as we might experience it ourselves; the next shows the same scene photographed through a screen, to simulate the
cruder visual resolution that others species experience. He then goes another step, photographing the photograph through a screen, rendering the village that much as coarser. As a fly might see it, or a mollusk (Cooperrider 2020).

Humans have a habit of believing that they are separate and above nature. There is a prevalent culture based on an assumption that humans have the ultimate intelligence and that anything other than human intelligence is less than. These two factors have a major impact on how humans mistreat their environment. This also impacts upon the neurodiverse community, creating a feeling of being inadequate. We have a hypothesis that more empathy (and compassion) between people and nature could help close this gap. We have chosen to explore 3 entities from 3 kingdoms: Forest / Mycelium network / Octopus.

The goal is to make playful physical prosthetics that could create a bridge between what these entities experience and what humans experience.
For each kingdom we ask:

- Can we sense like a forest?
- Can we sense like a mycelium network?
- Can we sense like an octopus?

All three have a unique way of being in the world and experience life very differently.

2. NEURODIVERSITY

How do we recognise what is forest, when we don’t even recognise what is human? We clear the understory in the same way we scrub our outer biome – removing essential elements and leaving areas barren and vulnerable.

– Jay Cousins.

We think there is a connection between radically different sensing systems and intelligence within our own species. We see a value in neurodiversity, in brains working slightly differently. We are trying to explore understanding radically different sensing systems in the hopes that it will uncover a new understanding of different forms of intelligence.

One problem with our definition of intelligence is that we compare it narrowly to human abilities. We are very limited in understanding a very different sort of intelligence. Which is why we are trying to create embodied wearable prosthetics, to allow people to fully comprehend the different intelligence in a more visceral way.

First, we sense, then we respond to those senses. The combination of that builds intelligence. There is actually one theory for how we built the ability to speak and think. That we made sounds, then heard them, then compared what we heard with what we had planned to sound like. And this circular series of events of sensing and acting led to the ability to speak and think.

In considering how differently a human senses from an octopus, it’s important to consider how differently we sense from each other. To celebrate and value neurodiversity we sent a tool kit of hackable whisker packs to several groups of people, including visually impaired performers, dyspraxics and makers, believing they would have a unique perspective on tactility. We left out how they should use or modify the whiskers open ended as we wanted to encourage user led ambiguous play and co-design.

3. DESIGN PROCESS

The design process is built from gathering insights from Umwelt experts. This includes scientists and researchers who are looking at mycelium networks, octopus and forests. As well as people who spend a lot of time caring for or around these beings and believe that they have got to ‘know’ the lived experience through observing them.

We have also gathered insights from our own observations and secondary research. We then perform a design synthesis phase where we collect together these insights in order to create prosthetics that can potentially map onto the human body.

We then build prosthetics in order to pinpoint key aspects of each kingdom, questioning what is the central aspect of how this kingdom exchanges or communicates or senses? Choosing one aspect, we explore how that can be experienced on the human body.

We then test these prosthetics. From the testing phase, we then reflect and iterate the prototypes. Finally, we discuss our findings back with the experts in order to maximise the benefits of the iteration process.

The purpose of the prototypes is to produce a physical manifestation of the research. Some prosthetics become science communication tools or at least manifestations of a philosophical idea, when we can only make something that allows us to imagine the other world of the creature. Part of our research is playing with this line between science and philosophy. This is a way to tangibly explore what more we can know about these worlds through prosthetics and our limited senses.

4. METHODOLOGY

Our methodology consists of the following component parts:

(i) Interviews: We gathered a group of umwelt experts including: Jay Cousins, Sue Thomas and David Satori

(ii) Literature Review: A literature review of existing Umwelt Hacking attempts was conducted including David Abrams Becoming Animal (Abram 2011), Charles Foster, Being a Beast, where he lives as a badger, a deer, an otter, an urban fox and attempts even a swift. (Foster 2016) and Marshmallow laser feast, in the eyes of the animal.

(iii) Design synthesis: Bringing together insights gathered from research and
observations of Forests, mycelium and octopus to design prototypes

(iv) **Design matrix’s:** Mapping out insights together to find similarities and differences.

(v) **Kingdom centred design:** Considering our designs from that kingdom’s perspective: What is important to that kingdom, what are the kingdom’s struggles and joys. Mapping out the wider reality of the Create prototype prosthetics to experiment with finding ways of sensing more like the Forest / mycelium or octopus

(vi) **Testing:** Test prosthetics with a variety of users (including the neurodiverse)

(vii) **Iterative design:** Iterative cycle of user testing, reflecting on experience and creating new prototypes.

4.1 Play and ambiguous goals

During our sessions we take into consideration the core insights gathered and use them as a theme (e.g. = octopus are very tactile, so tactility becomes a theme of exploration) but we allow play to be the method in which that theme is explored. By having ambiguous goals, we can be open to more radical outcomes.

4.2 Design provocation

Design provocation involves using prototypes, visuals and concepts to stimulate discussion. This is not about validating final concepts but about provoking new insights and sparking new conversations. In a workshop context it also allows for different thinking styles to engage with content in a new way which can open up new ideas and discussions.

4.3 Sample questions for guiding our discussions with the Umwelt experts

- When a slime mould does a maze, how does it make those decisions?
- What can trees sense? (we assume they know where water is, and where light is, is there something else?)
- Do trees sense each other?
- Do trees sense through their roots?
- Do trees have other senses?
- Is it always an individual tree, or can a group of trees sense as one?
- Can trees communicate? (this can be in an abstract way, separate from how we consider communication)
- Are trees intelligent? (can be in an alternative way from what we consider human intelligence)
- Mycelium and Octopus’ – Same questions but we are also interested in when is it one organism or a group? Or is the individual and a group the same thing?

5. THE OCTOPUS

One of the most interesting things we discovered is that they are the only creatures to develop a radically different brain from our own. Octopus have a central brain, and a brain in each tentacle. This means they have top down and localised control. So, they tell each tentacle to do something, but also watch it go. Each tentacle also has chemical control; it emits a chemical that repels their other tentacles to avoid tangling. Their skin can also feel, taste, sense light and change colour (Figure 1). This research made us realise that sensation and tactility is paramount to an octopus which led to the design of the whisker’s prosthetic.

The octopus’s brain and nervous system is a very unique expression of evolution. All other creatures who we consider intelligent, and have a complex brain are very close on the evolutionary tree, where our closest ancestors to an octopus are a tiny flat worm.

Camouflage is also a big theme. They are so aware of the colours and textures in their environment that they can, for example, easily become a piece of seaweed. Mischief and craft are another big theme. There are tons of examples of octopus mischief. Also creating their own tools for hiding.

Another thing that is interesting to consider is why they are not more intelligent. One thing to take into account is that the octopus cannot exactly reflect on how they change. Humans improve their speech by hearing what they say and reflecting on what their plan was. We believe that an octopus doesn’t have the ability to do this. They do not grow very old which also stops them from developing more. They do learn from others, but they are often solo creatures with no parents.

![Figure 1: Parameters of Octopus intelligence](image)
6. INTERVIEWS WITH UMWELT EXPERTS

David Satori: I think that feeling what it’s like to be a tree or a fungus actually requires us to first learn to feel more human by conscientiously putting ourselves in our natural evolutionary context (nature). When we learn about cultures across the world that live a lot closer to nature, we see an extraordinary capacity to empathise and “know” what it means to be other creatures, and that’s especially true of people who hunt for a living.

That’s why the art of tracking is now starting to become a popular practice in bushcraft and mindfulness courses. When you can read nature and decipher the stories of why things look the way they do, you can slip into the memory trace of the animals that left the tracks. The same is true for intuitive herbalists, and probably true for indigenous mycologists (but I’ve never heard of such a person!).

It’s like becoming familiar with a friend – you have to spend a lot of time with them to “really” know who they are, and it could take years before you know the developmental situations that shaped them to be who they are, and only then can you put yourself in their shoes.

I think we really need to spend more time with organisms that aren’t just humans, and more time in the woods just thinking about the lives of all the plants and fungi around you. I spent some time in the Yorkshire Moors when I came across a St George’s mushroom growing from the root system of an old oak. At once it reminded me of my childhood when I’d go searching for mushrooms and the feelings that brought up in me when I found them. So I sat next to it and just observed it and imagined all the complex nutrient exchange that are happening between the mushroom’s mycelium and the root tips of the tree, what it feels like to have a thirst for glucose, nitrogen, phosphorus, water, and after a few minutes I was like “ah, I get it”.

But that aha moment quickly disappears once you’re back at home. Our nature-disconnected society makes us feel like we’re unable to understand trees or fungi, but just like an unused muscle withers away, our senses do too if we don’t train them. Technologies can be really useful for bringing us closer to nature (like, a thermos is an amazing tool for helping me to stay outside for longer in the winter), but we can only use it if we have a good foundational nature connection, otherwise prosthetics can risk alienating us even more.

Sue Thomas: David Abrams wrote “A genuinely ecological approach does not work to attain a mentally envisioned future, but strives to enter, ever more deeply, into the sensorial present”. (Abram 2011).

I’m not sure how far I agree with the first part, but the second part certainly strikes a chord because, sadly, this is often what I do not do when I’m in nature. I still find it hard just to ‘be’ without slipping into intellectualising, and in terms of the question of this paper, I wonder whether any deliberate attempt to sense like a Forest or Mycelium network is doomed to failure simply because it is deliberate and therefore the antithesis of the purpose?

Of course, we don’t know how ‘deliberate’ a tree’s life might be, if at all. I live near the New Forest and often go there, but David Abram’s observation has made me realise that I spend too much time being active there and not enough time simply standing or sitting still quietly while what is above and below me goes about its business.

7. UMWELT PROSTHETICS

We explored ways of amplifying the sensation of the skin. We imagined that by giving our human body parts amplified tactility and more sensation through whiskers each arm becomes more kinaesthetically intelligent, sentient, and curious and can experience the world more like an octopus.

7.1 Wind whiskers

These leaf-like whiskers augment the body with whiskers that move and pull at the skin with the movement of the wind. This allows the wearer to have a new experience of sensing the wind and allows observers to see the flow of wind around them.

7.2 Whisker whiskers

This suit gives the body amplified tactility and sensation through whiskers. This experiment is about becoming more somatic and valuing the kinaesthetic understanding of the forest. By giving our human body parts amplified tactility and more sensation through whiskers it suggests ways that humans may become more kinaesthetically intelligent, sentient, and curious. It considers ways we can manipulate and rewire our sense of spatial navigation by amplifying what our skin feels.
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Figure 2: Whisker whiskers

Figure 3: Whisker whiskers

Figure 4: Wind whiskers

Figure 5: Wind whiskers toolkit

Figure 6: Wind whiskers
My favourite hack was this person who connected all the whiskers together to make the sensation travel up her body; as she played with a whisker on her hand, she would feel it up her arm.

I had to really focus, creating quite a mindful experience. I found myself rediscovering common objects in a new way. Felt like a whole new sensation.

I noticed textures on things I had never noticed before, the whiskers heighten my sense of when something was near.

The whiskers could illustrate to an audience what I’m sensing and feeling, and how I am perceiving my space.

It forced me to make time for exploring how my body felt. A mindful time where I felt new sensations.

Another part of the research is to create an Umwelt Hacking Framework where we generate guidelines for other Umwelt hackers which they can then apply to their own investigations. A sample of these guidelines include:

- Observe what are the forests paying attention to, what are the fungi paying attention to?
- Sit and observe and imagine all the complex nutrient exchanges (Engage the imagination – like an unused muscle it withers away, our senses do too if we don’t train and activate them)
- Mushrooms can’t move and neither can trees – maybe we need to bury ourselves?
- Use prosthetics to disable the human (so you can’t pick up your phone, disable time)

We can only achieve umwelt hacking if we have a good foundational nature connection, otherwise prosthetics can risk alienating us even more. I try and use my hands before the spade. We have a different awareness of fibre when we have to rip, tear, chomp and chew. So, perhaps it’s about tool reduction before augmentation.

– Jay Cousins.

When you can read nature and decipher the stories of why things look the way they do, you can slip into the memory trace of the animals that left the tracks. The same is true for intuitive herbalists, and probably true for indigenous mycologists.

– David Satori.

We understand that we cannot claim through our prosthetics that we are sensing “like them” but we hope we are one step closer to sensing a new form of intelligence.
10. FUTURE WORK

We are designing our next round of prosthetics. First, we are considering mapping onto the body the response plants have to being nibbled. Some plants will actually send a chemical signal through their leaves to make themselves toxic, this signal can also be passed on to other plants. This prosthetic (Figure 9) will see two to eight people wearing gloves with long extended fingers which will connect to the next person. Signals will be passed from person to person along the gloves by light, sound or vibration.

Another prosthetic (Figure 10) considers what it would be like to be a tree within the mycelium network. In this design each person would put their hand into a ground embedded prosthetic. When both people have their hand inside the prosthetic it will simulate a mycelium network by sending and receiving signals potentially in the form of vibrations. We will experiment sending different sorts of signals through the prosthetic to represent different nutrients. The research and testing will reveal what signals we end up using.

In future iterations we will focus on considering the human at different scales. e.g. one human being, one fungus, or another human being a whole mycelium network. We would like to consider what it would be like to be one cell in the human body.

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