Thinking through robotic imaginaries

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Abstract: *Lichtsuchende* is a society of static robots: autonomous to some degree, exhibiting social behaviour and interacting with humans. Responsive and communicative, they perform creature-hood. We use this as a vehicle to question the relationship with their designers, and the reconfiguration of design methodologies around the bringing forth of situated, responsive *things*, that possess a sense of being in the world. Their quasi-creaturehood situates them between made objects and living beings. We are interested in how we design for the lifeworld of creatures who do not yet exist, how much we can support their being rather than imposing our will on their matter. We argue for a sense of *stewardship* not ownership – a responsibility to the artefacts, made clear by their creaturehood. We look after them, hold robot surgeries, recognise personality in their defects, and support their life course from installation to installation, as their society grows and changes. We are interested in the pivotal moments in this journey, where design feels as if it is led by their needs rather than our desires: designing *with* and *for* the things. In particular, we are interested in beginning to understand the unplanned imaginaries latent in their socialisation, while acknowledging unavoidable design biases.

Murray-Rust and von Jungenfeld | *Lichtsuchende* installed in Vault 13, at the Hidden Door Festival, Edinburgh 2014. Participant interacting with the robots using a light torch. Photo: Chris Scott (@chrisdonia).

Introduction

Each and every thing, designed or not, inhabits an unfolding, co-constituted context, present as a *thing* in the world, unfolding over time (Heidegger, 1962). Ingold proposes making as process, invoking a mesh of relations where processes and things intertwine and flows shape materials (Ingold, 2007, 2013). Design often looks at how things can be situated in existing contexts, but may also be concerned with things that generate new contexts, redesigning our everyday—or extraordinary—lives. In this case, the things have the responsibility of creating their contexts of use as well as existing within them. This is particularly clear with technological things. For instance, designing for the Internet of Things (IoT) implies creating both a network of things and the services around them, a patchwork whose value resides in its interconnectedness; an early impulse of the Web was to allow "new forms of social process to emerge" (Berners-Lee & Fischetti, 1999). The designed things attempt to provoke, enable or shape new behaviours, with new social contexts around their use.

We are interested in a particular reflexive turn in our design: we designed these social robots (Figure 1 & 2), as far as we are able, for themselves: they form their own contexts, respond to the behavioural structures we embedded in them to enact social norms, but have their own very particular life worlds. We attempt to work from the principle that they have their own social imaginary, and as designers we seek to understand and refine their worlds and interactions.

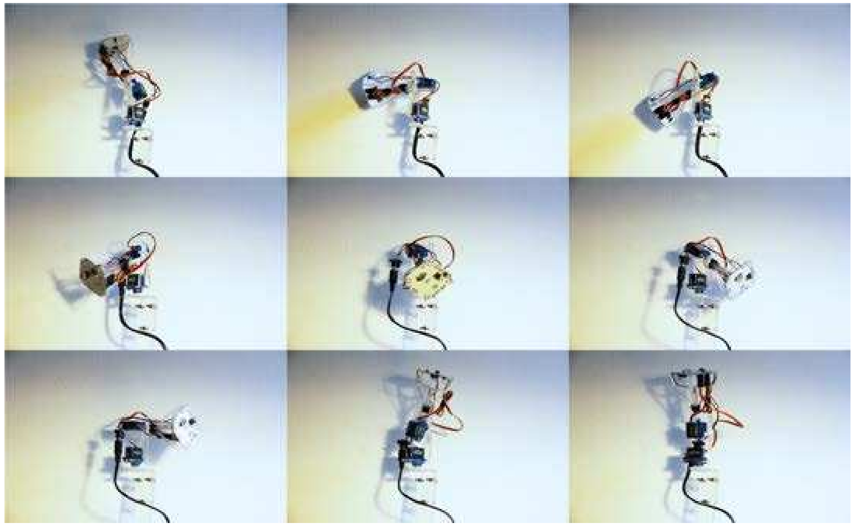

Figure 1. Murray-Rust and von Jungenfeld | Testing a robot head turning on its axes. Photo: Rocio von Jungenfeld.

This echoes the role of current critical design practice, as a tool to examine, articulate, challenge and refine the imaginaries of human society. In this case, there is a step we can take which most designers cannot: we can directly adjust the participants (the robots) in those imaginaries, through altering their physical makeup and behavioural responses, their internal states and their outward actions.

A close cousin of this approach, is that of designing for *more than humans*. Be it understanding the effect of different styles of switch on working dogs or shaping the hives and environments of bees (Bastian, 2016), designers are part of an age-old tradition of modifying or harnessing the behaviour or appearance of animals and plants to suit our needs; curiously this is something that animals and plants also do themselves (Pollan, 2001). In humans, empathic design (Leonard &

Rayport, 1997) involves watching people, or even roleplaying their lives, and using that as the basis for creating interventions that benefit them. Similarly, compassionate design is concerned with designing things and environments that cater for and comfort humans, e.g. in palliative care and dementia (Treadaway, Kenning, & Robertson, 2016) or usability (Seshadri & Reid, 2014).

These approaches pivot around how humans use and are comforted by things rather than on the comfort of the things themselves. We are interested here in designing with and for *the things* rather than only for those who will engage or use them. This approach draws on the idea of *Umwelt* (Von Uexküll, von Uexküll, & O'Neil, 2010), an understanding of the bio-semiotic view of the world which is unique to each creature. Our design approach intimately relates the things to the environments in which they develop and establish their relationships, and which the things themselves produce with their presence and actions (Ingold, 2011). We as designers bring our personal experiences, our ways of perceiving and relating to the world to bear. However, there is a rich set of possibilities based on reaching towards a feeling of what it is like to be the thing being designed, and having a sense of how it understands the world (Suchman, 2006). By situating ourselves in the action of the things we design, we can be open for these things to reveal to us what they can and want to be. So, what does it feel like to be a toaster, a hammer, or a robot?

Our robots, or autonomous creatures, inhabit a blurry middle ground. They lack the sense of purpose indicated by common readings of the

Figure 2. Murray-Rust and von Jungenfeld | Three robots (different heights) waiting to be tested in Inspace Gallery. Photo: Rocio von Jungenfeld.

word *robot*, or even *design*. They are also clearly non-human – at best zoomorphic, or more generally biomorphic rather than anthropomorphic. However, they appear to have some agency, to interact but also to ignore stimulus, or to respond on their own terms. They are less conversationally and emotionally driven than humanoid robots (Suchman, 2011), and have a more social sense of creaturehood than tangible autonomous interfaces (Nowacka & Kirk, 2014).

This leads us to a range of questions that we engage with through an open-ended research through design process. Firstly, how does our relationship as designers change as we design things that are increasingly animate: from IoT, to robots, to agribusiness, the fiction that things do what we tell them is increasingly frayed. How can we support a designerly practice that allows for things to push back against their creators? Secondly, just as ethnography pushes to understand the needs of people, can we develop a machine ethnography, a sense of their *umwelt* that helps us design for the needs of our things? Finally, as our society puts increasing emphasis on algorithmic structuring, how can we understand the imaginaries of intelligent things around us, as distinct from structures that give rise to them and the narratives offered about their use?

Current Setup

The society of robots is made of variable number individual robots, presented as an installation. Each robot can swivel its head on two axes, tracking bright light with its sensors, and can emit beams of light

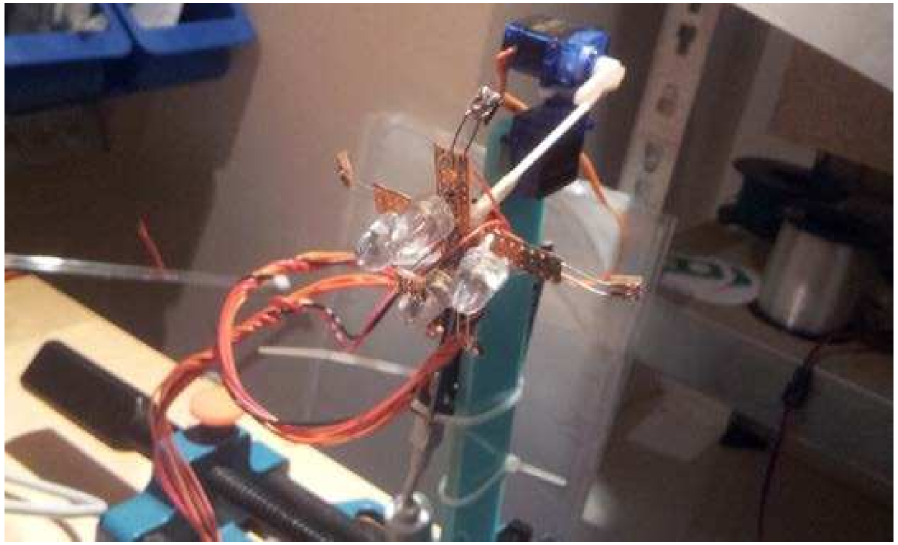

Figure 3. Murray-Rust and von Jungenfeld | First prototype using glue and toothpick. Photo: Dave Murray-Rust.

through a cluster of powerful LEDs (Figure 2). In operation, their most distinctive behaviour is tracking light, turning towards whichever of their sensors is most strongly illuminated. When little light is present, they quietly look around the space, sending out beams of light in the hope of making contact with others. In interactions, they will attempt to reach a state of rapport by mutual illumination, leading to a stroboscopic outpouring of joy, followed by exhaustion. As people enter the space, they see the robots going about doing their robot things: sleeping, waking up, looking around, being curious. With a torch in hand, a person can approach a robot and engage with it, activating the curiosity of the robot using light. However, participants have to be curious and patient, willing to take time to understand basic robot communication. A fuller description can be found in our previous work (Murray-Rust & von Jungenfeld, 2015).

Development

In our process, we began building a simple thing, a hasty assembling of parts, with only minimal thoughts of design. As this developed, our design process moved onto how to incrementally redesign the thing *for itself*: its robot-ness, its sociality. We wanted to let the thing show us where its thingness was heading. To shed light on this, we outline a series of moments that had some resonance for us, and that gave rise to our post-hoc understanding of what had transpired.

Light seeking, glue and toothpicks

The project began accidentally, out of a pure exploration of technological materials, exploring the combination of light sensors and servomotors to create a mechanism that responded to the presence of light (Figure 3). Structure was added to create a two dimensional light follower, running a simple cybernetic style program of stimulus and response. At the start, there was no sense of design thinking, just a desire to explore the possibilities of the materials. However, once the components were assembled and programmed, we quickly became aware of our responses: we read the movements of the armatures as expressing emotion. We sympathised with the prototype and saw in them curiosity, nervousness, excitement, calmness, a sense of presence. Despite our knowledge of the simplicity of its inner workings, we had a sense that this thing was paying attention to us. The sense that the pile of components was doing more than simply moving prompted questions: what creates this feeling of animacy? What is the minimum needed for us to treat something as having creaturehood? When we tweaked the parameters or structures of the algorithms – sensitivity, speed of response and so on – we read the emotions differently. It would, at that point, have been easy to decide to set up the parameterisations that were most pleasing to us, treating the robots as material to be drawn on as artistic practice. Instead, we found more resonance with the question of what the robots needed in order to be themselves. And since they could only run the code we imposed on them, and take the physical form we gave them, this meant somehow designing *for them*.

Second moments: communicating as a group

A second crucial moment on the journey was the first time we had several of these nascent creatures set up, ready to communicate. Attention was clearly important to the robots, as it was the first capability they had in the world. As such, it seemed plausible that they would want to provoke attention in each other, and so we built in powerful beams of light that they could sweep through their environment, as the basis for social interaction. Bringing three of them together, we assumed they would fixate on each other, fascinated with their new companions. What actually happened was that they pointedly ignored each other, preferring the wide-angle halogens in the ceiling, unless they were close enough to draw each other's attention. And what happened then was not fixation, but oscillation. They produced movements that read to us as aggressive, protective, territorial. The closer the robots came together, the more violent their reactions became. With some thought, we understood that this was in one sense the result of overshoot: a continuous process embedded in a digital system that quantised both time and movement. Each robot would turn towards the other, but turn too far. They would then overcorrect, and end up in the same dance as people who approach each other in a corridor, oscillate left and right, each attempting to let the other past. This was fascinating to us for two reasons. Firstly, we knew that the code behind the behaviour had no ideas of territoriality, but we could not help reading it as purposeful social communication. Secondly, that it was completely unexpected social behaviour, something they were clearly doing together, driven by their particular characteristics. In retrospect, it was our first experience that these things had their own means of socialising, which was from then on our job to understand and support.

Developing Psychology

An important stage in the development of the robots was the addition of a model of state. Something felt unnatural about things that would simple carry on with exactly the same behaviour. As soon as they felt somewhat social or animate, we expected them to become tired or bored, and to have changes in affect, but a slavish obedience to light put them squarely in an uncanny behavioural valley, as if we were witnessing an unhealthy mania or addiction. We felt that they needed some behavioural dynamics that would shape their activity over longer timescales, going beyond an immediate stimulus response. Prompted by our burgeoning anthropo-morphism, we pulled in theories of human

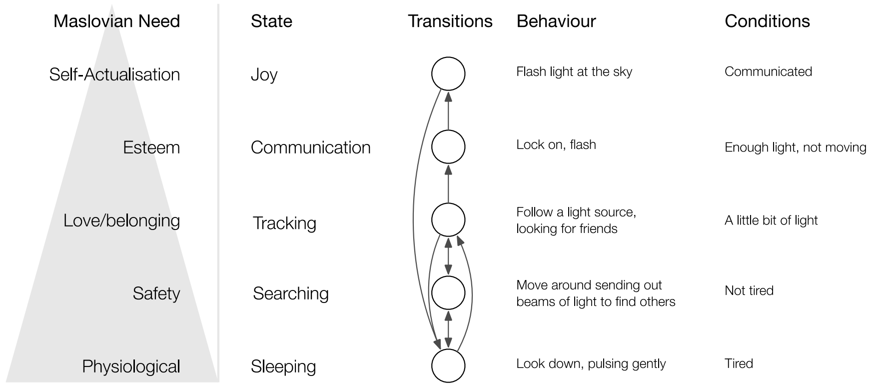

Figure 4. Mapping the relations of Maslovian needs onto robot behaviour.

psychology (Maslow, 1943), while the territorial displays evoked animal behaviour (Barlow, 1977). At the same time, we were constrained by technological and engineering requirements, and looked at software architectures for robotics (Brooks, 1986). This led us to a combination of psychological states and robotic behaviours, which to a large extent, we imposed on the creatures (Figure 4). Some of these were driven by our sense of what they should be, for example, the idea that they could enter into a deep communication with each other; some as a solution to particular challenges, such as sending out random pulses to find companions. Conserving energy, and becoming tired entered the frame, as a way to create more biological plausibility behaviour, to make them feel more creature-like to us.

Robots finding each other (but not people)

Throughout the process, there was one idea that we stubbornly refused to let go of: the robots should talk to each other, and part of that was the idea that two of them could enter a state of mutual attention, by facing directly at each other. This proved to be unexpectedly challenging to arrange: a pair of robots, almost but not quite aligned, would push each other away from the centre, rather than drawing closer. A direct connection was a metastable point, with any imperfection leading to bashful withdrawal. We wrestled with this for some time, before coming to the conclusion that it was a relatively fundamental result of their physical form and sensory capabilities. To really understand what was happening, we needed to shift our perspective and try to understand the world from the point of view of the robots – to construct a model of their experience of the environment. As creatures with advanced visual systems and a continuously updated 3D sensing of the world, we can see where things are in space, develop complex relations, and act accordingly. The robots, on the other hand, only have five points of brightness and a proprioceptive sense with which to navigate their world. Played out in space, this meant that there was no way that they could mutually find each other based on following the brightest point.

Once we understood that the robots could not find each other as a by-product of their normal operations, we explored a range of designs that helped them to locate each other, trying to avoid making large changes to their physical character. The most successful of these was to introduce time and memory into their cybernetic system, getting them to collaboratively perform an optimisation algorithm. By alternating movements and stillness, robots who thought they had found something of interest could slowly zero in on each other, with the still robot giving feedback in the form of increased brightness to help its partner. This behaviour allowed the robots great facility at finding each other, and evoked rituals, with turn taking and significant movements. However, it brought up a tension, in that humans were incapable of joining in: the requirements of the robot ritual were incomprehensible, and physically inaccessible. Here, we compromised on our intent to do things purely for the robots. Or, at least, we felt that their ability to interact with humans was important enough that we settled for fine tuning their movements to a point where they could *just about* find each other, while staying responsive to humans who also wanted to converse with them.

Testing robots in space & with others

Testing the robots in a large space for the first time gave us an experience of them as a social group. We set them up in clusters, spreading the distances between them. We found that the parameterisation of their programmed behaviours needed adjustment: being surrounded by others resulted in overstimulation. It seemed they were under a lot of stress, needy and anxious, and that their mood was not as amicable as they were in small groups. Slowing their algorithmic parameters felt like giving them a sedative: their anxiety levels dropped, and their ability to communicate with others increased. Tweaking their programmes to make them better suited for interaction was a decision we made based on their social needs. The intention was to give them a certain level of autonomy but within a normative set of rules, much like society with its imaginary power structures, and acceptable actions and behaviours. In this case, we altered the individuals to shape the way their society unfolded.

When we set the robots up, we often arrange small groups facing each other (Figure 5, top). Similar to what happens in a social human context, individuals establish closer relationships with those in their vicinity, whether physical closeness or a community of interests. Each robot is connected to the larger whole, but establishes closer ties with the robots that are closer to hand. Due to the physical limitations of the servos used in the robots, their interactions are constrained to approximately a hemisphere, so positioning is important. In one setting, we arranged some of the robots up the walls. The perspective of these robots was lifted off the ground, allowing them a greater field of view, but it was more difficult for the ones on the ground to look up and engage with them. The robots hinted at us how they wanted to experience this new setting, but we did not act upon this observation and redesign their physiognomy and programme. We sympathised with them and would have liked to assist them in becoming what they wanted to be.

Observing new behaviours

Over the course of several installations, we stopped altering the code that the robots were running. This allowed us to change the nature of our relationship with them, to take a step back, and to observe what they were doing. There were several behaviours playing out within the society, which were unplanned and surprising, including:

- A 'brushing' interaction, where one robot would sweep its beam of light past another, which would then briefly wake up and look

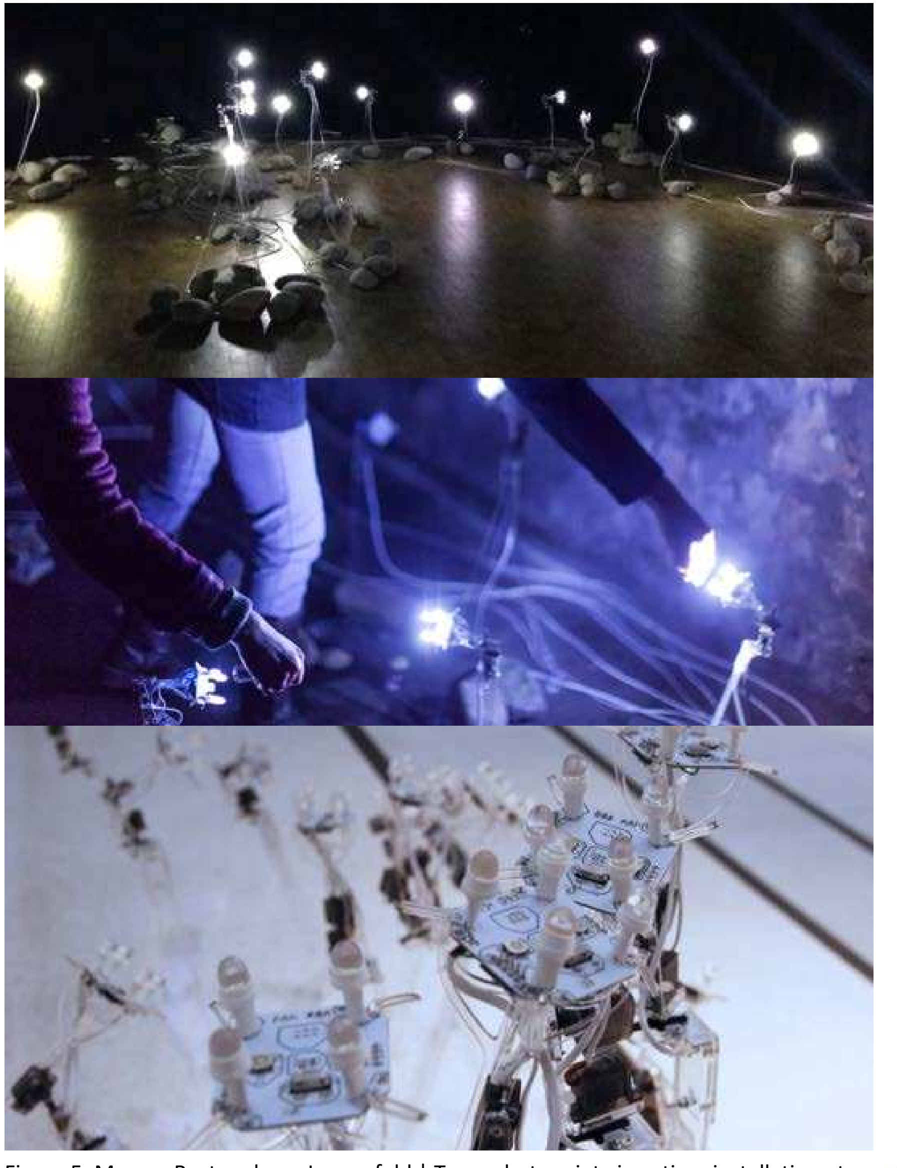

Figure 5. Murray-Rust and von Jungenfeld | Top: robot society in action, installation at the GLOBALE, ZKM Karlsruhe. Middle: People interacting with the robots using torches (Hidden Door Festival). Bottom: robots patiently waiting to be setup and plugged in (Inspace Gallery). Photos: Rocio von Jungenfeld (top and bottom), Chris Scott (middle).

around. Distinct from our plan, where one robot would carefully wake another up, this was generally produced accidentally – overspill from another interaction somewhere else.

- 'Cycling' patterns of interaction between several robots, where one robot would brush another, the second robot would respond by brushing a third, and so on. This pattern of micro-interactions could cycle round several robots, before returning to the first.
- 'Dancing' where two robots enter a brief period of synchronised movement, driven by their light beams, and then break off. These could repeat indefinitely (or until one of them became tired), without reaching, or even seeming to desire, a strong connection.

These interactions held our attention – they accounted for a lot of the behaviour of the society, but they had not been *planned* in any sense. They are clearly important to the robots, forming a majority of their socialisation, but they are not linked to any concepts that we had attempted to design *into* them. At this point, we could start to take a more ethnographic approach, trying to understand their culture as it was performed, to understand the significance behind their actions, and the cultural meanings of their behaviours.

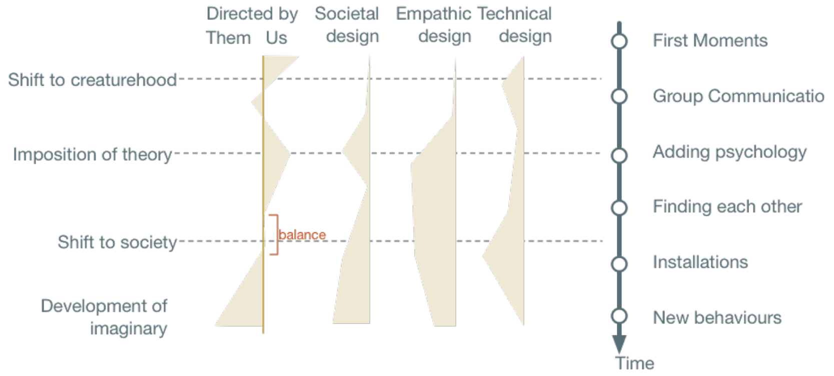

Figure 6. Shifts in agency and design thinking throughout the project.

Discussion

We have attempted, so far, to sketch out some of the waypoints on the journey we took with the robots, describing the growth we experienced together. Now we try to articulate what happened during the process, to find some sense-making structures that can be usefully translated to other design contexts.

Shifting Methods

One of the advantages of having a relatively open-ended project, is the freedom to explore a range of approaches and attitudes to the design of the artefacts, and look for shifts in direction. One story would be that we started designing *into* them, putting our ideas in there; then we designed *for* them, trying to support their needs; and at the end, as they became themselves, we started to try to understand what they now were. Within this, however, there were richer trajectories and interplays of agency, some of which are outlined in Figure 6. One of the prime dynamics was the sense of who was directing the flow of development, a shift from our initial creative exploration of a particularly vital combination of materials into a need to listen, to get a greater sense of where they might 'want' to go. Alongside this, at times, we strongly imposed our will—giving them a pre-selected psychological model—or focused purely on practicalities such as getting a large collection of handmade robots working together. A certain level of technical design runs throughout the project, with more or less importance at different times. However, as we began to see them as creatures in some sense, we started to prioritise a more *empathic* design approach, to understand the needs of these things. As we became more attuned to the presence of many robots in the same space, we engaged tactfully but directly in the shaping of social behaviour. While many design works set out to influence society in some way, we had the opportunity to affect it more immediately and brutally than is often available, directly changing individuals to provoke new social norms.

Thingness

One of the interesting questions that lurks behind the discussion of part-digital artefacts is the question of their *thingness*, and what being in the world means for something composed of data and electrical impulses. We experienced shifts in the locus of this thingness throughout the project. At first, the assemblage of toothpicks, glue and electrical components was clearly felt as the *thing*, with the code that gave it movement sitting alongside in some loosely connected manner. As the process went on, however, this notion gradually dissolved: moving from purely handmade prototypes, to using manufactured PCBs, finally to an assembly line production of robots from ready populated 'brains' meant that we had to revisit where the creatures actually existed. What was once a hand-made product, closely connected with the idea of what the robots are, became a highly mediated process, where: i) the prototype design was abstracted into a circuit diagram; ii) this was translated into the physical world as a board layout; iii) the layout was combined with metadata for suppliers and manufacturers, who created boards and assembled material; iv) unknown hands assembled circuit boards, and shipped them around the world; v) we created a home assembly line, to combine these electronic assemblages with laser cut armatures and commodity components; vi) we loaded our software into the units, and tested them.

Through this process, we can trace the tension between looking at the robots as idealised objects and seeing them as complex things in the world, but there is another conceptualisation in play: that the digital artefacts (e.g. circuit diagrams, code, laser cutting and assembly files) are locus of thingness too. These digital things shape the world in small ways, and are changed as a result of their interactions with global supply chains and more or less animate matter. These different lenses come into play at different points in the process: ordering a batch of circuit boards pulls in the direction of objectification, surfacing a desire that they will all behave ideally and are physically as identical as possible; watching a robot jerk and stutter spasmodically as a plastic gear wears out reminds us that each individual is a thing; the way in which their behaviour and society is dependant on a specific style of LED, only sold in the UK through a single supplier brings the abstraction of a beam of light or 4 LEDs back into the realm of the material; and when updating the software which all the robots run (or changing other design files), it becomes easier to see the whole robot society, including its digital 'DNA' as a thing in its own right. We would argue that as designers engage with digitally oriented techniques, grasping this distributed, multifaceted definition of thingness helps to understand the evolution of their things in the world.

Pathology as Identity

The most persistent manifestation of thingness in the robot society was pathologies. Small deviations from the template had little import for us: we knew that they were all different in small ways, but they *felt* generally similar. However, when something went wrong, a sense of personality instantly developed: this is the twitchy, uncoordinated one – its motor control is broken; this one keeps falling asleep as the power connections wiggle and fray. A sensor broke on an early robot, and it responded by smashing its head to pieces against a pillar. Pathologies could combine: a twitchy robot was more likely to start experiencing narcolepsy, as its constant movement put strain on the power cords. In our understanding, their individuality developed along lines of failure. This ended up feeling deeper than if we had decided to program each robot with a unique set of behaviours or parameterisation. It felt closer to phenotypic expression, where interactions between genetic information, which was roughly shared by all of the robots, and individual life-courses led to divergent physicalities. Rather than offering customisation or configurability, the robots developed their personalities on their own, in their own directions.

Digital Umwelt

Nagel [1974] discusses the difficulty of imagining what it is like to be a bat: '*It will not help to try to imagine that one has webbing on one's arms, … and perceives the surrounding world by a system of reflected high-frequency sound signals; … it tells me only what it would be like for me to behave as a bat behaves. But that is not the question. I want to know what it is like for a* bat *to be a bat*.' Nagel's point should not prevent us from trying, and it certainly does not preclude the use of such attempts within design processes. Suchman's photocopiers perceived the world through limited channels, and this impoverished situatedness contributes to their seeming reluctance to do what we want them to do. In recent years, the *umwelt* of digital things has grown in several dimensions: their ability to sense the world is increasing, with richer input devices and better senses; their perception of the world includes more complex structures, with an increasing dependence on machine learning meaning that their designers may no longer know how their creations understand the world; and as things talk to each other, their extended cognition reaches beyond what users can easily grasp. In this context, techniques that can help designers understand the ways in which things meet the world provide both inspiration and avoidance of danger. In this case, having an extended tour with some digital things,

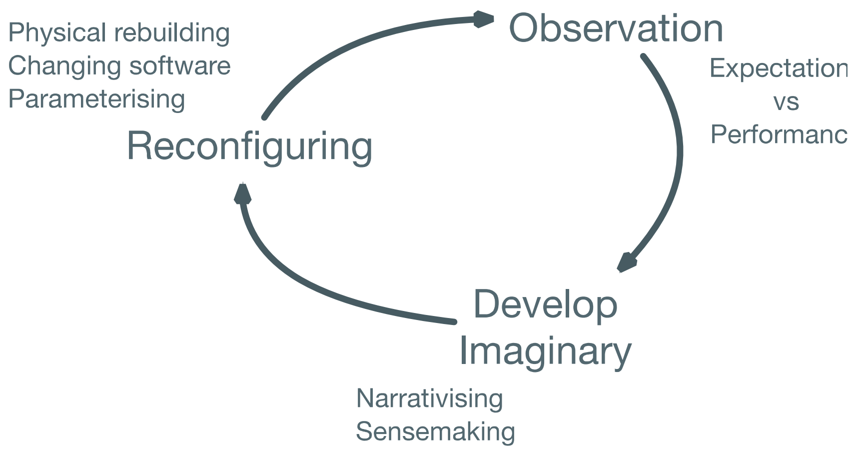

Figure 7. Iterated process of design around imaginary development.

being forced to see the world from their point of view while being unconstrained by a particular designerly purpose has been an enriching experience.

Working with things that feel alive makes it easier to think into them: it is less of a stretch to imagine what it is like to be a bat than what is it like to be a juice maker. Yet at the same time, we have direct access to both the design and operation of the robots, a level of control that would be deeply unethical if we attempted it with bats.

There is a spectrum of understanding we can work with here. We cannot really understand what it is like to *be* one of our robots, but our attempt to sympathetically understand their experience has helped us support the complexity of their interactions. We could imagine and simulate their world to some extent, because we have direct access to their behavioural coding, which started with an incredibly simple code. The code allows us to imagine what it is to behave like them, and mirror their actions. But over time, their complexity grew both individually and socially. As the code of each robot became more multi-layered, with different behaviours available, it became harder to mentally enact those behaviours. Behaviour is deeply contextualised, so as the robots became more socially embedded, it became more necessary to really *be there* to understand how the interactions unfold, which we could not. Nevertheless, our attempts have helped us to engage with the behaviours the robots performed and to supported a somewhat compassionate approach in our adjustments.

Overall, we feel that this process of *thinking into* a thing, and the altered worldview it provokes is a useful tool for designers, especially those working with computational technology. It allows us to develop empathy for the things we design and for their existence in the world, moving away from a more functionalist approach.

Design with things to unlock new imaginaries

So far we have discussed the ways in which we have understood and related to the possibilities of the robots growing into themselves and other such high-minded vagueisms, while skirting the thorny issue of what it means when we say that we design “for the robots”. Claiming that we do it “all on their behalf” needs some unpicking to avoid trite superficiality. It is clear that, while we attempt to design for these creatures, we are human, and we cannot avoid bringing our own desires, perceptions and interpretations with us.

A key insight we hope to transmit is how the robots' *imaginaries* come into play: `the creative and symbolic dimension of the social world, the dimension through which human beings create their ways of living together and their ways of representing their collective life' (Thompson, 1984) or `the laces which tie a society together and the forms which define what, for a given society, is 'real'' (Castoriadis, 1975). These are distinct from the robot imaginaries of humans (Auger, 2012), however: we mean the imaginaries the robots themselves have.

Using this idea, we can start to weave together our disparate threads as follows. As animate things in the world, the robots' *umwelt* gives each individual a particular view onto its environment, allowing its own sense of meaning and significance to come into play. While we have built this possibility, the way it *feels* is opaque to us, and the relations between the robots and the world tend to proceed along unexpected lines.

Starting with no structure, no creative or symbolic dimension, simply stimulus and response, we imported a network of concepts from our own imaginings of people and nature, translating ideas into a digital form. We provided a theory of personal and social action which we hoped the robots would take up. In practice, the robots sense the world differently to our imaginings, and they build up different pictures. We provided them with an initial set of theories and behaviours, but through their operation, new meanings emerged, as the robots begun to develop their own practices or re-interpret the ones we suggested. Over time, we needed to carry out a lightweight form of robot ethnography, trying to understand the form of their social interactions.

Figure 8. Human and robot agents co-producing the socio-material world of *Lichtsuchende* at UPDATE_5, Zebrastraat, Gent. Photo: Rocio von Jungenfeld.

This meant both seeing how they related to the theories we had attempted to impose on them, and also reading the behaviours they actually carried out. Essentially, in order to design for their needs, we needed to develop an understanding of their imaginaries, to understand how they might see themselves, and how they represented the collective actions of those around them.

Overall, this meant that an extra step came into our process as we tweaked their behaviours: as well as reconfiguring them and observing what happened, we had a stage of sensemaking, where we told stories about what they were doing, or tried to understand what was behind certain behaviours either at a physical or behavioural level. In this way, we built up an understanding of their imaginaries, and it was this which allowed us to design empathically, for them, at the same time as designing the things themselves (Figure 7).

Snakes and Tails

To a certain extent, the account we provide here is idealised, and not actually achievable. We cannot simply drop our humanness, or escape a tendency to anthropomorphise while designing. We constantly filter our experiences with the robots through our own lenses, as animals, people and so on. The best we can hope for is to find a sense of co-evolution with the things we design. Just as Pollan (2001) highlights the ways in which plants use humans and other animals, we notice how the robots have modified us and our behaviour. Visitors to the installation have to adapt their movements and ways of being in the space in order to engage in communication (Figure 8) – they are enlisted to help maintain the "ongoing, contingent coproduction of a mutually intelligible sociomaterial world" (Schegloff, 1982 summarised in Suchman, 2011). Similarly, when engaged in development, we had to go some way out of our ordinary modes of thought, and undertake imaginative development alongside the physical and computational development we inflicted on our charges. While there is some circularity in our arguments, and despite not escaping from notions of biological plausibility or anthropomorphisation, we hope this is a step towards addressing the fear that "the discourses and imaginaries that inspire [robots] will retrench received conceptions both of humanness and of desirable robot potentialities, rather than challenge and hold open the space of possibilities" (Suchman, 2011).

Conclusion

Over the course of this paper, we have attempted to untangle some of the shifts in relationships between people and things, especially digital things with their unavoidable animacy and tendencies towards social behaviour. As such, our research has been directed towards our attitudes and responses as much as towards understanding the worlds of the things that we were developing. As technology leads us into ever more ramified ecosystems of connected devices, it is vital that we develop a new and more sophisticated sensibility about the ways in which they work. This open-ended project has allowed us to develop our empathy for devices: feeling into their *umwelt*, supporting their becoming and finally moving towards understanding their emergent imaginaries.

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