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Algorithmic Food Justice

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Abstract

Under what technoscientific conditions might the scarcity of food be understood as contingent on heterogeneous actors? And the possibilities of food abundance be approached as a reparative project of valuing their manifold relations? Blockchain promises to be an infrastructure that presents both productive imaginaries and also challenges to such restorative and sustainable work (Seidler et al 2017; Rozas et al, 2018).

In a series of workshops, we critically experimented with these possibilities and challenges. Working with diverse participants including community growers, organisers, artists, and technologists we used a variety of playful methods to act out fictional scenarios set in 2025, when all of London had been transformed into a city farm. For organisations and participants, reparation meant working in the aftermath of social and environmental collapse to bring into being more-than-human-value systems that radically decentred human knowledge and experience.

Ecological reparation

In recent years, practices of reparation (broadly including maintenance, repair, remediation and regeneration) have become lively sites of scholarly interest in the social sciences, particularly in relation to environmental concerns. Some scholars have critiqued the idea of repair as a framing for ecological reparation, seeing repair as too invested in a return to normative relations that are already broken (Middleton, 2018). Indeed, some have argued that repair and maintenance work can keep orders running long past their end dates, masking and displacing the opportunity for system change and alternative approaches (Ribes, 2017).

For others, the idea of repair still has something to offer. Jackson writes about repair as the kind of hope that we need, as we think from—and respond to—'broken worlds' (Jackson 2014; 2019). Henke and Sims disambiguate between forms of repair action: 'repair as maintenance' works within existing orders whereas 'repair as transformation' brings new configurations into being (2020). Henke and Sims suggest that both are required for repair within the context of the Anthropocene, a recursive idea of 'repairing repair' (2020: 122).

What is clear to all interested in reparation, is that when moments of breakdown come under study, they are often revealing: decentring subjects and showing up relations in their complexity, in their fragility and in their ever-changing temporality (Houston, 2017). To study repair is to think about the possibility of action in this moment; to examine decisions that are taken about what endures and what is let go. On the one hand, that might mean thinking about building new orders in the world's aftermaths: working with the conditions at hand and without the expectation of solutions (Tsing, 2017). On the other, reparation might also mean un-making damaging systems through design for decline (Tonkinwise, 2019; Lindström and Ståhl, 2020).

Algorithmic Food Justice

The politics of ecological reparation is increasingly played out in spaces of anticipatory governance. Here, repairing problems involves the conceptualisation of new visions of future

systems, in which algorithms increasingly loom large as reparative agents. In the case of smart cities, for example, the responsibility for emissions reduction is delegated to networked infrastructures and big data, which are intended to produce carbon efficiencies through real-time data gathering, analysis and control (Gabrys, 2014). This is a 'repair as maintenance' vision (Henke and Sims, 2020), where computational efficiency is given priority so that existing logics of valuing and exchange can go on (relatively) uninterrupted.

In the last decade, 'smart' algorithmic technologies have also taken on a much larger role in agricultural production. For example, the measurement, mapping and sensing of soil and crops has been used to maintain and maximise yields, and algorithms have become central to logistics, helping to reduce crop losses and optimise the supply chains that distribute food. Computational systems have also become central figures in future visions for urban food, where automated vertical farms have attracted considerable hype.

In the *Algorithmic Food Justice* project we have investigated the ways that algorithmic imaginations are being developed within urban food ecologies. In prior work, we observed shortcomings in 'ecocidal' and 'broken' smart city visions (Heitlinger et al 2018; Houston et al 2019). In this chapter, we work with urban agricultural communities, technologists, artists and researchers to propose our own, reparative future visions. We critically explore the potential that blockchain might have for creating algorithmic networks that enact transformative repair. We build on existing work that uses blockchain to reconfigure relations between human and more-than-human life forms, using alternative systems of valuing and exchange such as commoning (Teli et al, 2018).

We take up these ideas around more-than-human algorithmic agency and entanglement using justice as a framing. As a form of reparation, we take justice to mean grappling with complex accountabilities towards some sort of recuperative action, even where this may be difficult, or even impossible. Indeed, given that the idea of justice is a foundationally human concept of governance, our idea of extending this to include more-than-human actors is ultimately destined to fail. However, this chapter will demonstrate how trying and failing at more-than-human design for digital infrastructures, foregrounds alternative value systems and modes of exchange that create playful and difficult dissonances. Designing future systems with food justice in mind helps us to encounter the many trade-offs and synergies in the (co)production and sharing of food, towards the aim of multispecies flourishing.

In this chapter, we will describe two (out of a series of three) workshops that took place in late 2019, where we co-designed algorithmic futures for a thriving multispecies urban food commons along with urban growers, community organisers, technologists, artists and researchers. We will reflect on the way they created conditions of possibility for more-than-human relations, including how they surfaced speculative futures in which the algorithmic afforded imagining alternative, more-than-human value systems. Through partial and improvised efforts to mimic and speak for the more-than-human, workshop participants attuned themselves to reparative relations.

Understanding blockchain

In order to contextualise the workshop descriptions that follow, we briefly summarise several important aspects of blockchain technology. In short, blockchain is a distributed ledger technology: rather than having a centralised ledger that records and stores the transaction of assets, blockchain ledgers are maintained in multiple places at the same time. Therefore, blockchains offer significant tools for decentralised organising. Experimental blockchain communities have formed decentralised autonomous organisations (DAOs). A key idea is that these social-digital architectures can open up different types and granularities of exchange, helping to facilitate distributed and self-governing networks that are able to

recognise and reward often excluded forms of labour—for example the work of care (DisCO.coop et al 2019).

Two affordances of DAOs are particularly significant: firstly, the ability to issue tokens to each member and secondly, the ability to automate organisational rules through the use of 'smart contracts'—software-based protocols that can execute contract-like forms without human intermediaries when certain conditions are met (Nissen et al, 2018). The issuing of tokens and the creation of smart contracts can partly automate the processes of distributed rule-making (e.g. relating to sharing and voting), and, depending on the design of the system, they may register the contributions made by actors. For example, the blockchain-based co-operation platforms Backfeed (Pazaitis et al, 2017) and Commonfare (Teli et al, 2018) use the 'reputation' token as a way for community members to collectively address issues of contribution and reward for participation in an emergent, consensus-based fashion. Our work attempts to add to these discussions, albeit through the production of conceptual prototypes rather than computational platforms.

More-than-human blockchains

For many scholars, the possibility of ecological reparation lies in crafting alternative relations with more-than-human others, which is as much an ontological as a practical project. In her work on the Planthropocene, Myers calls for 'art, experiment and radical disruption to learn other ways to see, feel and know' (2020, np) that can form the basis for different modes of relating. Our work has been inspired by two critical art projects that use blockchain to prototype new modes of algorithmic interrelation with other species: terra0 and Zoöp. In a 2016 white paper, the artists Paul Seidler, Paul Kolling, and Max Hampshire speculate on how to create a DAC from a forest—by buying a piece of forest, mapping its ecosystem relations using networked sensors, and encoding a corresponding model on a blockchain using smart contracts. When sensors report that trees are grown, the terra0 DAC can then sell its own logging rights for cryptocurrency which it spends on managing itself, eventually buying itself back from the artists.

A Zoöp is a piece of land that is managed for the benefit of its more-than-human inhabitants. In this co-operative legal structure, they are represented by a Zoöconomic Foundation of humans who use analog and digital sensors to understand their needs. This project emerged from a speculative arts-led workshop and the initial vision includes a role for blockchain in mapping and managing exchanges (Kuitenbrouwer K. and Rui, A. 2019). In these projects blockchain technologies become a test site for different forms of algorithmic relations, where a turn to automation is not about creating efficiencies, but about crafting some form of autonomy for land and forests. In both cases the moral and ethical questions are not simply delegated to blockchain as an agent of repair, but are set into wider social, legal and economic infrastructures that aim to free more-than-humans from (at least some) aspects of human-centred value extraction.

These projects also grapple with the vexed question of how more-than-human interests are represented in human-led governance processes—a site of interest for many scholars in the social sciences more broadly (Bastian et al 2017). Despite scaffolding more-than-human autonomy through algorithmic automation, all of this inevitably takes place within a human frame, created by human designers and developers. These projects demonstrate that the project of designing for more-than-humans will always be partial and incomplete. However, even attempting to do so prompts us to reach beyond the value systems that underpin many of our societies' extractivist imaginations. In the next section we will build on our previous work about the project (Heitlinger et al, 2021) to explore where we succeeded and failed at more-than-human or 'posthuman' design (Forlano, 2017; Clarke et al, 2019).

Algorithmic Food Justice workshops

The Algorithmic Food Justice project involved three workshops that took place in the autumn and winter of 2019. They were held at Spitalfields City Farm—a 1.3 acre urban farm housed on the site of a former railway goods depot near London's financial centre, which has been running since the late 1970s. The site hosts growing areas and community facilities such as a shared outdoor kitchen, and is home to farm animals such as donkeys, pigs and ducks. One of the authors has undertaken participatory research there for the last decade. For brevity, the following sections will expand on the second workshop and show how these strands of thinking carried on into the third workshop.

Workshop Two, entitled 'Now London is a City Farm' was attended by approximately 20 participants, including community growers, artists, researchers and technologists. The workshop used an arts-based research approach developed by one of the authors, known as LAARRPing (Live Art Action Research Role Playing) (Catlow, 2017). In essence, LAARRPs are expansive exercises in collaborative world-building, where each participant roleplays a character, and the group collectively adds detail and complexity around scaffolded scenarios. They differ from other forms of roleplaying in that they have been adapted to address a research question. Scholar Natasha Myers argues 'if you had to consult the plants to ask permission to use them, industrial agriculture, strip mining, clear-cutting and the expanding concrete of urban sprawl would be inconceivable' (2020, n.p.) she writes: 'just ask, they will tell you'. We designed our LAARRP as an imaginative method to do this 'asking'.

Following existing trajectories in design and futures research, our aim was to use this highly embodied technique to create provocative and critical prototypes that could start discussions about both the development of blockchain and the ethics of more-than-human relations, design and futures research (Muidermann et al, 2020: 3; Dunne and Raby, 2013). Rather than playing with probable or plausible futures, we chose a speculative approach in which participants were transported to the year 2025, five years after the fictional Great Food Emergency of 2020, when all available land in London was being reclaimed for food production. We LAARRPed for just under two hours and afterwards held a debriefing discussion. Later, we transcribed the recorded audio. When analysing these we looked for three specific themes: how participants had figured future modes of algorithmic governance; how they had constructed more-than-human relations; and how they had conceptualised justice within their improvisations (the latter two were often deeply intertwined).

On the morning of the workshop, we reminded participants of the outline scenario of the LAARRP and split them into two groups: 1) the Greater London City Farm Assembly (GLCFA), the governing body of the whole of London; and, 2) the E1 City Farm Assembly (E1CFA), the governing body of the local City Farm. Participants were invited to choose a governance portfolio to represent during the upcoming Assembly meeting (which formed the setting of the roleplay game). Participants could choose to represent the following portfolios: Coordination, Health, Agriculture, Security, Culture, Justice, Resources and Waste Management, Education, Energy, Infrastructure, and Assembly Liaison. In order to represent more-than-human entities, we asked participants to formally adopt a 'companion species,' (Haraway, 2003) by choosing a badge showing birds, insects, farm animals, honeybees, soil, plants, trees, sensors, water, air, or weather. Participants wore this throughout, to signal their connection.

Participants then fleshed out their own character, by filling in an official-looking Identity Certificate, that we had designed. We scattered character traits and potential plot points across these materials: possible roles included Land Conversion Co-ordinator, Extinction Rebel, Live-in Guardian Community Police Officer, Human Hand Pollinator, Single Parent and Mental Health Service User. Each was accompanied by a short description, for example Human Hand Pollinators 'pollinate crops by hand, a job that used to be performed by insects

before their demise. We use our craft to build crop diversity in the hope that pollinators will return. Our job is under threat by robots’.

Once each group had taken their seats at the two separate Assembly meeting tables, we performed a ritual of communion, imagining our fictional characters in our left hands and our companion species in our right hands, rubbing them together until we felt a bonding heat. From that moment on we had to speak as our new characters, making no reference to the artifice of the game. The gameplay involved two of the authors acting as chairpersons—leading each of the groups through a pre-designed Meeting Agenda which presented a series of propositions that participants had to improvise around. We worked with questions around membership, fair shares and conflict resolution that are also being experimentally negotiated in blockchain initiatives (Pazaitis et al, 2018; Teli et al, 2018; DisCO.coop et al 2019).

The Chair used a technique called ‘hot seating’ to kick off discussion. The first Agenda item, for example concerned a false claim on some bags of salad:

“Someone had claimed that they were entitled to five bags of salad...luckily, there was someone from the Coordination Committee who discovered that they weren't a member of this city farm...could you just remind us what happened?” (EC1FA Chair)

Here, the Chair invited the representative from the Coordination portfolio to invent something about the governance of group membership in the EC1 Assembly (hereafter referred to as the Coordination Rep). Subsequent participants had to build on, or gently modify this contribution—in the process collaboratively creating a semi-coherent scenario.

Algorithmic imaginaries and the more-than-human

The local E1CFA and London-wide GLCFA differed significantly in the algorithmic imaginaries that they put forward. In response to the bags of salad problem outlined above, the E1CFA group improvised an extensive digital infrastructure of control. According to the E1CFA Coordination Rep, the person who had claimed the salad had been “tending a lot of the sensors that are in the park outside Bethnal Green, so they built up a lot of credits within their own farm membership—and they assumed that our farm was part of their network”. In the following five minutes, other players expanded on this to include: an automated digital credits system, a food tracking app linked to a distribution centre, identity scanning on the farm gates and some (contentious) proposals to build profiles of farm members using personal data and aggregations of their social media feeds. This sequence of play represents a wholesale intensification of today’s algorithmic logics and interestingly, it was derailed by the EC1FA Culture Rep raising the question of how these systems would apply to more-than-humans. The infrastructure failed at this point because no accommodation had been made for the materiality or meaning of more-than-human others.

Conversely, for the London-wide GLCFA in the post-Emergency period, digital infrastructures were “starting to disaggregate...the problem [is] that we’re now running different systems that aren’t entirely compatible...people have gone from sort of grids and much more independent systems that don’t quite overlap” (GLCFA Infrastructure Rep). The GLCFA helps communities to set up energy and water microgrids in London localities using scrap materials, as the GLCFA Energy Rep outlines: “we can... give microgrid options to local communities and then they can rely on each other for energy so that that community, if they can define what that community is we can supply them with enough energy from anything around them”. This is a vision of community-led and managed infrastructures that

(unlike their neighbours in EC1FA) don't use digital technologies to monitor and track human and more-than-human entities.

Both groups proposed using algorithms to facilitate multispecies communication, with varying levels of detail. In the E1CFA group algorithmic relations were later proposed as a way to facilitate interspecies communication across an "urban biome", as the EC1FA Culture Rep explained: "one of the ideas...was to set up a whole very dense network of sensors across the city, which measure the health of the sort of urban biome...through that, we could sort of gauge the happiness of the various species...you know [the] relationship with our species". Here, tracking is not about the maximisation of productivity and the awarding of fair shares, but about understanding the wellness of other species.

Interestingly, when the problem of interspecies communication got too great both groups turned to the seemingly all-encompassing possibilities of AI. In the E1CFA, the Culture Rep quips "we need an AI, I like to mediate between all the species—that's a solution". In a conversation about interspecies sharing, the GLCFA the Energy Rep also turns to an all-knowing AI: "This is where the algorithms will be coming in, logging and running these processes would be much safer to leave to an algorithm, or an AI possibly—that speaks both insects and microbial languages and human". This turn to technological solutions is heard, but not taken further by either of the groups.

Many of the Agenda prompts included references to multispecies entanglements, and therefore it was no surprise that the roleplay prompted powerful testimonies from companion species. Speaking as a bee, GCLFA Agriculture Rep gave an emotional account of the ongoing bees' strike:

'[You're] expecting us to pollinate all your crops so that the humans can have their food. And yet [you] make it hard for us to have a decent life and to be able to have a diversity of different flowers that we make nice honey for baby bees. So we've had enough... We're only pollinating wildflowers. We're not pollinating any of your crops anymore until this is resolved.' (Bee, companion of GCLFA Agriculture Rep)

The bee's testimony holds the other human members to account for their part in the conflict. Moments like these produced an electric strand of irony that ran through the gameplay, where the participants are playing together in a fictional scenario that they know is a proxy for interspecies conflict unfolding in the world right now.

Overall, both groups came up with remarkably similar strategies for multispecies communication, most notably by continuing to hold spaces for cross-species empathy and appreciation. The E1CFA group set up "multispecies assemblies" and "one-to-one working groups" so that species would get to know each other's contributions better (this notably required a serious amount of "unlearning" for the humans). Both proposed "cultural pieces"—for the E1CFA this was "Bacteria Week," a festival that promoted and celebrated the valuable contributions of under-acknowledged bacterial agencies, while the GLCFA wanted to create a multispecies musical. Likewise, both groups developed new rituals to thank other species for their contributions. Finally, appreciation was shown by the giving of material rewards—the E1CFA group proposed moving bacterial communities to a new spot for a little holiday, plus giving them a little nutrient agar.

Many of these visions were humorous, but at the same time involved genuinely seeking new modes of multispecies understanding. The absurdity often arose in the recognition of human exceptionalism, as this exchange in the GLCFA aptly demonstrates:

Agriculture Rep: "Do all the species like musicals?"...
Infrastructure Rep: "I've heard that trees don't like a musical"...

Chair as Companion Species Tree: “The trees have their own great musicals that the humans just don't even hear”.

In fact, the breaching of the human-political frame of the Assembly meeting, turned out to be a significant dynamic of the game, where more-than-human members repeatedly pointed out that deliberative democracy was simply not sufficient to recognise the complexity of their exchanges. These sequences of play produced clear disputations of anthropocentrism, and also began to suggest other types of relation.

One of the richest examples took place in the GLCFA group, where the Liaison Rep was concerned by the security of the farm, and the stealing of pumpkins (a real-world problem for this Spitalfields Farm grower). After cycling through a discussion of how to educate, punish, or rehabilitate (human) offenders, the group moved on to consider the limits of the concepts of justice in a more-than-human world. The Resources Rep asks “Is justice an anthropocentric concept though? You couldn't expect a carnivorous animal to be just to its prey—how would you mediate between a cat which has to eat rodents and things, between its things it's feeding on?”.

For the Coordination Rep the ecosystem is more important than relations predicated on the actions of individual subjects, and they explore soil as a model for human and more-than-human relations:

‘It's more like building a system that's robust enough to be to hold tensions or people... taking more. Like if you look at soil as a model. Mostly if you create the right conditions and the structure is right then most organisms will exchange fairly and that usually works. And there are a few that will take and not give back, but still overall, the system works. So I think it's about thinking about how to create a wider system that creates the right conditions for things to work, but not always and that's ok.’ (GLCFA Coordination Rep)

Here we get to the relations of interdependence more commonly found in more-than-human ontologies, where processes rather than subjectivities are foregrounded. Though interestingly for the Energy Rep there are some hard limits: “Driving other species into extinction is a no-no”. What constitutes more-than-human *injustice* is easier to figure than a shared concept of justice.

The conversation also engaged an interesting discussion of the agencies entailed in ‘growing’ the pumpkins in the first place. The Infrastructure Rep argued that growing is “still being regarded in quite a possessive [way] like “we grew the pumpkins;” no, the pumpkins grew and lots of other things contributed...” Again, here the assumed agencies are being turned upside down. The pumpkins are not owned, because they were not grown, but grew themselves. For the Infrastructure Rep this shift to relations undermines the concept of justice entirely because “it's very difficult then to come down with the justice system to see exactly where does justice sit?” in a shift from entities to relations.

Trying and failing at posthuman design

The LAARRP concluded with group reflections. The scenario developed by the E1CFA group was very positive for humans: in 2025 food is being grown in homes, parks, rooftops, and all the abandoned buildings of the city. The allocation of food for humans is based on a needs assessment for those living in the local community. However, needs and contributions are tracked by an extensive algorithmic ID system with few privacy constraints across a network of Farm Nodes. Interspecies relations are primarily worked out in multispecies

assemblies and one-to-one working groups whilst the happiness of other species is also monitored through all kinds of sensing of the urban biome. There is enough food for the humans, though London's population have needed time to adapt to the new diet.

The GLCFA vision was less optimistic. In 2025, some humans are still going hungry, although the situation has improved in recent years. Water conflicts and animal rustling were once commonplace, but community relations have recently stabilised. There is a thriving circular economy, where organic waste materials are carefully recycled into food for other species and where obsolete technology is being reclaimed to set up localised infrastructures that are managed by communities to meet their own needs. Re-wilding is happening across human political borders which are becoming less and less important.

As part of this discussion participants raised the limitations of the committee format and the 'companion species' model that we had chosen in addressing interspecies relations, as outlined in the following exchange:

E1CFA Justice Rep: "I think at today's meeting it became clear that most of the time it's humans talking again still...there's strong concentration of the power there. Despite the fact that we all had non human representatives. Like air said, nothing".

Infrastructure Rep: "Yeah water was pretty minimal as well".

Energy Rep: "Yeah, it's all hot air".

Our decision to include more-than-humans as 'companion species' (Haraway, 2003) was intended to evoke a hybrid politics, however the act of improvising during the gameplay was cognitively taxing and therefore human participants only sporadically inhabited their more-than-human characters.

In our project, we took the established approach of inviting 'human intermediaries' (Bastian, 201: 21) such as urban growers practicing forms of regenerative agriculture, to speak about the more-than-human others that they had an intimate knowledge of, hoping that this would be less 'representation by human ventriloquists' (Pitt, 2018: 92) and more a generative facilitation. In retrospect, our decision to set up the gameplay using a format from representational politics (the committee) cemented the dynamics of one species speaking for another within a human-centric frame. We risked that even playing with humanist concepts like justice materialise more-than-humans as a knowledge object within an already given structure, and therefore collapse the transformative possibilities generated by new more-than-human ontologies as they are pulled into a familiar frame, that is oriented towards democratic, political, human subjects (a 'humanist posthumanism' Wolfe, 2009).

The LAARRP was ultimately an exercise in failing at more-than-human design, however the process of failing, opened up very lively spaces to creatively deconstruct human governance structures on behalf of the more-than-humans that they have come to know through community growing. An important quality of the LAARRP was its liveliness, in creating a collective world and a shared emotional experience connected to the improvisational qualities of the gameplay. The shared recognition of irony in playing anthropomorphic relations that were clearly impossible (for example, that bees could go on strike) yet were also clearly reasonable (most people supported the bees' demands). For Haraway:

Irony is about contradictions that do not resolve into larger wholes, even dialectically, about the tension of holding incompatible things together because both or all are necessary and true. Irony is about humour and serious play. It is also a rhetorical strategy and a political method. (Haraway, 1991: 149).

In this sense, if ontological transformation is the cornerstone of interdependent ways of thinking (Myers, 2020), then the LAARRP has demonstrated the potential of the movement between (human) ways of knowing the world as human subjects and algorithmic objects, and the always un-knowable ways of knowing brought to bear by more-than-humans.

Workshop Three: Blockchain prototypes

In the third workshop we built on the LAARRP gameplay, by selecting eight ideas from the game to use as discussion prompts for participants about how blockchain could potentially be used as part of new infrastructure of more-than-human relating. To help participants think through their ideas we also produced a set of syntax cards with terms from conditional programming ('IF,' 'THEN,' and 'ELSE') plus other words such as TOKENS, ACTOR, ASSET, DURATION, LOCATION, and EVENT, drawing on Nissen et al's work on the GeoCoin project (2018). During the morning session, a smaller group of technologists, artists and community organisers were given the task of designing blockchain-based Decentralised autonomous organisations (DAOs) along with their governance rules, which were then discussed by a larger group (of previous participants) in the afternoon. We briefly describe each of the three conceptual prototypes here.

Group One: The Fellowshit of Dark Matter

The first group worked with the following scenario from the LAARRP:

Education Rep: "Can I speak as soil. With my soil hat on. The pile of waste that you're talking about. Is it just human excrement?"

Resources Rep: "It's a mix of farming manure like cattle and sheep."

Education Rep: "So everything organic. So for me, that's food. So I wouldn't call that waste, that's wonderful."

This group sought to capture the relational and emergent qualities of valuing in the design of socio-technical system that nurtured multispecies relations. The system utilised an app, where humans could post waste materials and make them freely available to others within the community, but there was also weekly ritual, "where storytellers would gather... to tell the story of how this waste is being transmuted into useful things from all sorts of perspectives...from cows' perspectives" (Participant KG).

Since multispecies entities would have trouble using the app directly, the ceremony provides a way for human dramatists to inhabit their perspectives; spotting opportunities for waste materials to be used for their own species' ends, and also celebrating the transformations of waste that had already been completed. During the ceremony, Transmute tokens would be awarded to those 'transmutations'. The DAO promotes a multispecies 'circular economy' with an expansive sense of value that is not only focussed on material utility but the meaning of unfolding interspecies relationships as they exchange materials within an ecosystem.

Group Two: DAO-n to Earth

The second group worked with the issue of the mis-claimed salad bags described previously:

"That individual...tends to a lot of the sensors in the park outside Bethnal Green. They built up a lot of credits within their own farm membership. And they incorrectly assumed that our farm was part of their network of food sharing....And because they weren't part of the same shared group or food node as we are - that was where the confusion came in." (E1CFA Coordination Rep)

The DAO-n to Earth group devised a DAO that helps to coordinate the exchange of tokens (currencies) between all the farms in the London Food Network. In short, the value of each farm's currency is tied to the soil health data that is acquired automatically from sensor arrays. The weight of each community's 'reputation' token changes according to whether its soil improves, stays the same or degrades over a given period of time. The system also includes "sensor sentinels"—sensor arrays connected to an Artificial Intelligence algorithm—that monitor soil health in real time. If a rapid decline is detected it tells all actors on the soil exchange, triggering a market crash of that farm's tokens, but also a social solidarity mechanism where other farmers are asked to step in and assist.

Group Three: The Corn Council

The third group worked on the lack of acknowledgement experienced by plants:

"There hasn't been overall enough acknowledgment of what sacrifices we [plants] make. Because principally we are generating most of the air and most of the food... we did originally discuss having rituals that actually thanked the plants and I don't know what's happened to that. I just know that the plants are carrying a load that no-one is acknowledging." (GLCFA Infrastructure Rep)

Participant ET suggests that alienation from the conditions of food production is a core condition for many humans, and proposes that "rituals, for example, or ceremonies can bring back the value and having a connection to what you consume". This idea forms the basis for the final proposal of the Corn Council, a system for repairing the disconnect between humans and other species. The group draw on the logics of the Brave browser's Basic Attention Token, which is a blockchain initiative intended to more visibly and fairly redistribute a proportion of the advertising monies received by website owners, directly to website users. However, in their prototype, the Corn Council DAO will reward humans with tokens simply for spending time with plants in a non-instrumental way (though tokens will also be available for care-taking work such as pruning and watering). Accruing more reputation tokens by spending more time with plants allows DAO members a greater say in votes about the DAO's management.

Carrying the LAARRP scenarios over into the blockchain prototyping workshop was a generative way to continue the discussion around multispecies justice and questions of algorithmic governance. Rather than working together to propose solutions for problems (as in a 'hackathon' style design event) the prototyping process began from speculative formations where the entanglements of humans and more-than-humans had already been made visible as relationships, processes and wider ecosystems. In addition, the LAARRP excerpts drew attention to interesting social formations such as ceremonies and rituals that might not have been explored otherwise in this type of co-design setting. At the same time, this short workshop only began to surface the complexity of the issues at stake, but the prototypes themselves remained highly partial and provisional.

Attuning to reparative relations

We want, in closing, to turn back to reparative relations. Both the LAARRP and prototyping did not give rise to an extended or coherent narrative in the ways we'd hoped for. Seen through a prism of ecological reparation, we might see this as a failure on the part of the workshops. Collectively, we failed to imagine fully-fledged futures, interweaving algorithmic systems and blockchains with multispecies relations, and distributing agencies across heterogeneous actors that might afford alternative value systems. The participants' repeated experimentation—from treating more-than-humans as subjects engaging in active communication and exchange (as in the bees dispute), to considering soil as a model for

future relations of justice—revealed, in a sense, the impossibility of speaking for or standing in for more than human species.

At the same time, however, we learned from the ways participants played up to and beyond the limits that the structures of the workshops imposed. Thus, what we found revealing was the larger groups' fluid movement between different ontological formations, for, if you will, momentary, just plausible and only partial ways of improvising more-than-human relations. We saw this, for example, with the GLCFA who went from seeing the pumpkin as stolen property, to an agent in its own right, who grew itself in relation to humans with the help of air and water. What we might say, then, is that transformation and the possibilities for change came not from wholesale visions, but from the chance for fleeting and partial co-minglings, for the right conditions to ask 'what if...?': 'what if we might speak for soil?'.

The chance to play, to tinker, and to mimic (no matter how partial and sometimes ludicrous) offered, then, the possibility of imagining more-than-human relations, the possibility for making reparations (e.g. increased soil health, fairer interchanges in multispecies accounting, transmutation of waste materials) in the aftermath of human exceptionalism. The LAARRPs and prototypes created "experimental propositions" (Hustak and Myers, 2012, p. 78), the chance to be moved by more-than-human relations in uneasy and unfamiliar ways, akin to Hustak and Myers' *involutionary momentum*, a bodily *leaning in* that "helps us to get a feel for [the] affective push and pull among bodies, including the affinities, ruptures, enmeshments, and repulsions among organisms constantly inventing new ways to live with and alongside one another." (ibid. p. 97). From Hustak and Myers, we discover such momentary improvisations become the basis for attunements with affectively charged ecologies; in other words, for building alliances, affinities and connections we might care for and nurture in new ways.

How can ideas of repair and reparation help us to think about the huge challenge of moving at least partially towards such new sets of relations that take the lives of more-than-humans seriously? The LAARRP certainly produced a new kind of experience and new challenges for creating a just multispecies food system. Empathising, improvising, laughing, experiencing irony and being moved by soliloquies about plant sacrifice provided new ways to understand the liveliness of the stakes at play here, beyond policy debates. The ability of species to call out other species was a moment where the politics of reparation came sharply into play: as the bees, for example, called out the damage that the humans were doing into starkest and most personal terms. The game brought problems down to local and individual scales: not addressing the conditions for *all* bees, but exploring conditions for *this* bee, sat across the table.

Rather than a return to normative relations, we have come to understand that even the most material of repairs (the replacement of one machine part with another) involves crafting a new set of relations: a new capacity and a new temporal unfolding (Houston, 2017). Repair, like care involves 'tinkering' (Mol, Moser and Pols 2010): altering relations to create new conditions and then understanding how practices or performances also transform; and treating the overall process as a tentative and iterative endeavour. If the ecologies on this damaged planet are to be recuperated then we will need tools like LAARRPing to think about systems and performances from a multispecies perspective (however partially)--bringing new registers of feeling to those encounters, which are rich with empathy and exchange. Repairing ecologies will mean transitioning from ontologies that enable extraction, destruction and extermination into something different--opening up a space for speculative futures that can enfold these kinds of transitions.

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