

Fabulating Biodata Futures for Living and Knowing Together

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Abstract

A growing number of design researchers explore engagement with and through biodata. To help make sense of this growing space, we synthesize three emergent themes: (1) expanding notions of biodata and bodies, (2) attending to a greater diversity of human bodies and experiences with biodata, and (3) biodata collaborations between human and non-human bodies. We illustrate these themes with selected design examples. From this synthesis, we develop three interconnected fabulations reimagining alternative engagements with biodata: *Weaving Alongside*, *Diffracting Selves*, and *Collective Affect*. Our discussion unpacks conceptual work of the fabulations, offering invitations for design research to explore alternative ways of living and knowing together with biodata.

Authors Keywords

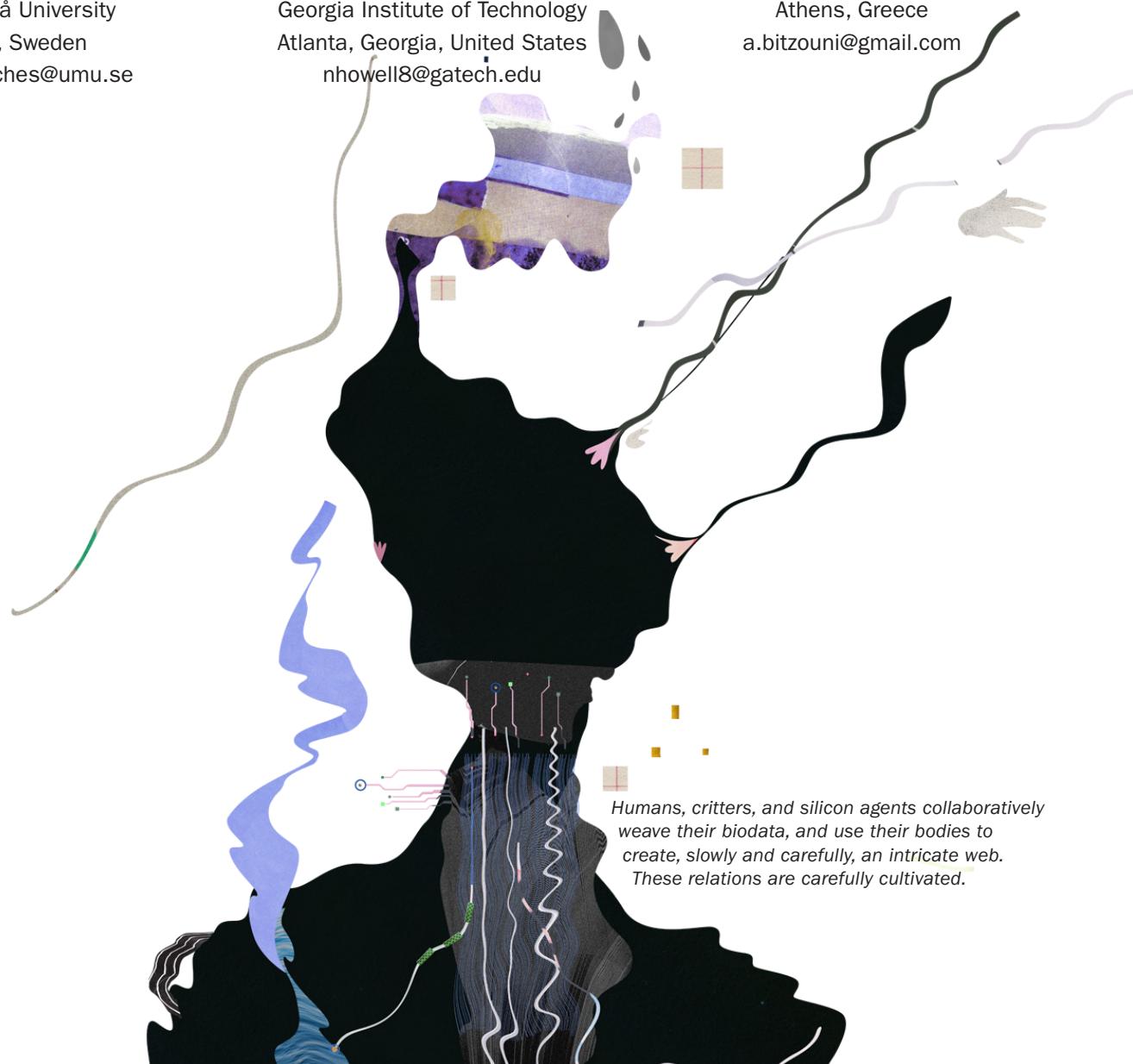
Biodata, fabulation, more-than-human, bodies, design research, futuring, diffraction

CCS Concepts

• Human-centered computing~Interaction design

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Introduction

Biodata—data about people's bodies and behaviours—is increasingly pervasive, from wearable sensors such as Fitbit [23] to smart environments sensing breathing and heart rate through walls [1]. Amidst consumer products and HCI research enrolling biodata to support fitness [60, 75], mindfulness [25, 59], or other aspects of health [64, 68], design research has been engaging biodata from an exploratory perspective, including critiquing and reflecting on bodily experiences surrounding biodata tracking [2, 43, 78]. Along similar lines, other works explore expressive engagements with biodata visualisations or materialisations that can provoke new understandings surrounding bodies and experiences of being tracked [11, 22, 70]. As biodata design research continues to grow and expand, we asked: *What are emergent directions within biodata design research? What biodata design futures can we imagine and like?*

With these questions as a starting point, we held a workshop that consisted of three sessions, detailed on page 3, convening biodata researchers and practitioners to discuss emergent possibilities for biodata design research. Through further analysis after the workshops, we as authors synthesised three themes for biodata design research:

Theme 1: Expanding notions of biodata and bodies, expanding what counts as biodata, and what counts as a body to measure.

Theme 2: Attending to a greater diversity of human bodies and experiences with biodata, especially in ways that challenge existing regimes of measurement of meaning-making.

Theme 3: Fostering biodata collaborations between human and other (non-human) bodies.

On page 4 we present each theme, and on page 5 we illustrate them through carefully selected design examples. We contribute this collection to articulate connections between design and theory [26]. We intentionally draw from wide-ranging design sources to invite others to synthesise broader collections and make sense of growing, shifting design spaces.

Taking these themes are invitations, we embarked on a creative process to move from themes to fabulations. Drawing from Haraway, fabulation attempts to “refigure—how to trope and how to knot together—key discourses about technoscience”

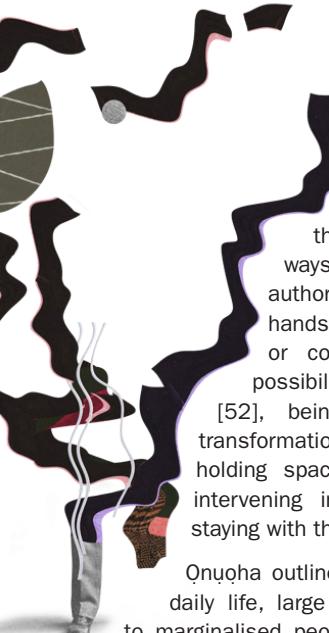
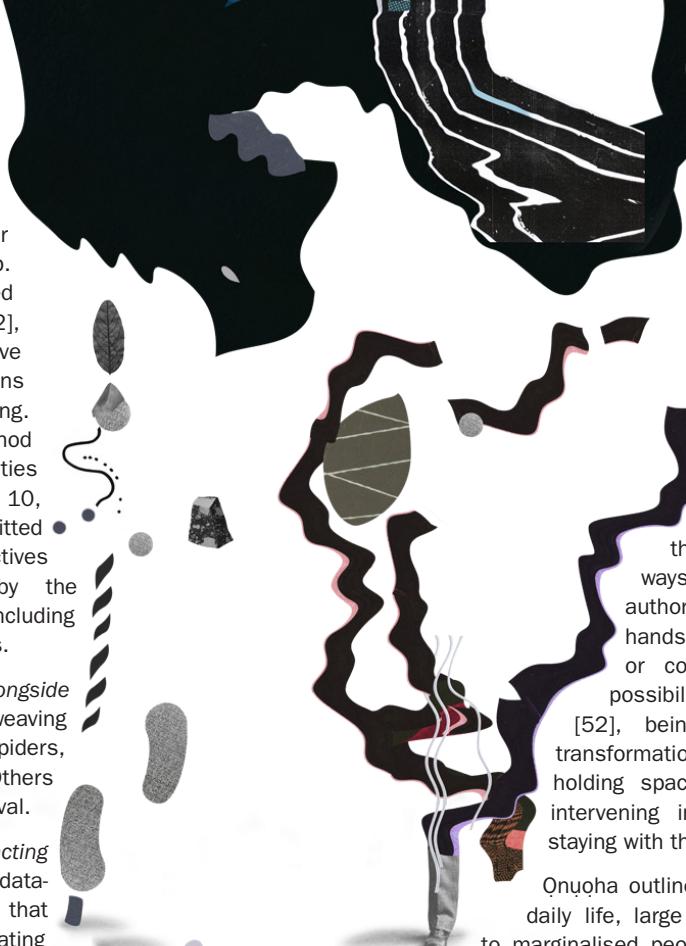
toward “the hope for livable worlds” [31] (p. 60). Rosner has proposed critical fabulations [62], while Helms et al. have adapted utopian fabulations [34] for design futuring. Fabulation as a method shares some similarities with design fiction [9, 10, 67], while being committed to accounting for perspectives from all implicated by the practice of worlding, including multispecies perspectives.

Fabulation 1: Weaving Alongside explores interspecies weaving between humans and spiders, moving beyond fear of Others toward collaborative survival.

Fabulation 2: Diffracting Selves explores biodata-responsive implants that sense and modulate radiating waves of human experience, moving from representational or reductive biodata epistemologies toward diffractive ongoing transformations of meaning with biodata.

Fabulation 3: Collective Affect explores how biodata publics might better hold space for the highly varied emotions of community members, including grief, rage, resilience, and collective joy.

The final author, a professional illustrator, developed the imagery in close collaboration with the other authors. This collaboration emphasized phrases and terms that were reinterpreted as illustrations. These should be read in combination with the fabulation text as an integral part of the fabulations, demonstrating how the elements living in those worlds are entangled together.



Finally, our discussion unpacks conceptual work done by the fabulations and offers generative possibilities for design research with biodata. We reflect on how the three themes served as expansive moves inviting the creative embargos of the fabulations. We trace how each theme and fabulation explores ways of investing meaning-making authority (in a biopolitical sense) in hands or bodies other than medical or computing experts. We explore possibilities for collaborative survival [52], being alongside [49], diffractive transformations of meaning [5, 27, 30], holding space and witnessing rather than intervening in interconnected publics, and staying with the trouble [32].

Onuoha outlines how, even as data pervades daily life, large swaths of missing data point to marginalised people and concepts that deserve attention [56, 57]. Gaps and limitations in existing biodata design research point to needful opportunities for future work: Beyond moments of being-with, how can biodata design research support longer term collaborative partnerships of being-with that work toward justice [4, 6, 29, 49, 50]? Beyond DIS, biodata is enrolled in agendas of oppressive surveillance (e.g., [8, 35, 53]), and design researchers have a toolkit of methods that open ways to engage difficult issues to spark public debate and imagination. Motivated by these broader ethical concerns around biodata, we aim to provoke critical discussion and reimaging around biodata's social and societal purposes. In this pictorial we offer very small, partial, and incomplete, yet radically hopeful reimaginings of biodata futures.

Workshop Session 1

Projects and Provocations

1

Each participant presented a recent biodata design artifact and its relation to the workshop topic. We collected text, image, and video of these artifacts on Miro, an online whiteboard platform. Collaboratively annotating the projects on Miro, we began extracting ways in which each project addresses the body, ways of measuring and aggregating biodata, and the goals of doing so.

Annotating Projects

2

We then split participants in three groups that emerged: feminist perspectives, health and affective contexts, and post-anthropocentrism. Each group discussed current and future issues for biodata, challenges and opportunities in those areas, and ended by extracting and documenting common threads and questions that emerged.

Workshop Session 2

Themes across Projects

3

The second session grouped participants in new constellations to cross-pollinate ideas. Working in the same Miro board, each session continued the discussion thread of the prior one, building on earlier strands of thought and documentation by reviewing and appending to the shared document. Initial themes across projects emerged.

Workshop Session 3

Statements of Meaning

4

In the third session, we developed and articulated findings, and summarised our experiences. One main finding was that existing work on biodata already starts pushing the boundaries of what counts as biodata materials, troubling in different ways what counts as "bio", what counts as "body" and what counts as "data."

TOWARDS BIODATA RESEARCH THEMES

The workshop consisted of three 2-hour sessions held over three weeks, bringing together 20 researchers and practitioners working with biodata from diverse perspectives, including interaction design, computer science, affective interaction, designing for movement, and digital health. These were gathered based on a call for participation via prevalent subject-area e-mail lists, social media, and research networks. The workshop offered a space for the participants to share how we do biodata research, what challenges and opportunities we see emerging in this domain, and how we imagine futures of biodata design research. The weekly rhythm supported deeper discussion, as we all took some distance from the topic to think about it and come back to it a week later.



POST-WORKSHOP ANALYSIS

By annotating specific design examples, we drew connections between theory and practice [26] that open possibilities for future design directions.

After the workshops, we further analyzed and synthesized findings, inductively and iteratively [13], drawing inspiration from other HCI syntheses [14, 39, 54] that provide lenses to analyse past work and generate new directions for design research.

This resulted in three themes (described on the next page), each offering a conceptual shift transitioning from current to future research. Although these themes connect to feminist theories [5–7, 29, 49], as designers we recognize how "design choices were underdetermined by theory" and it is "by looking at specific examples of practice that we found guidance for our work" [26].

Three Biodata Design Research Themes

Theme 1: Expanding Notions of Biodata and Bodies

Our first theme moves beyond existing practises of biodata measurement, calculation and representation in HCI which are indebted to particular and historical ways of inscribing the human body through affective computing and scientific frameworks. These frameworks can be powerful and useful in particular contexts, such as health settings, since examining the human body through a medical gaze makes it available for being acted on and improved. For example, displaying weight over time for weight management [18, 63, 77], or biofeedback to help cope with affective disorders [64, 65].

This theme recognizes how emergent biodata design research is starting to push boundaries of what counts as biodata through expanding notions of the body and how bodies are approached and understood. These data-driven ways of engaging the body explore deeper reflections and critiques on what they amplify or hide. They question and rework assumptions on what constitutes “a body” and what “bio” is, and challenge notions that the body can be reduced to biosignals. For example, some work questions boundaries of inside / outside of the body [70], or foregrounds collaboration and social meaning-making [44, 51, 66]. Additionally, somaesthetic design [2, 40] emphasises our ability to engage with bodies from a holistic perspective including mind, fleshy body, emotions and values.

Building on these alternative conceptualisations of the human body, Theme 1 highlights design research pushing boundaries of biodata and how it can be represented and experienced, suggesting a move from abstract representation of biodata to turning it into a material form that can be experienced with multiple senses. This theme asks, *how can biodata captured and aggregated through human bodies be leveraged as a material that can be designed, focusing on the body, as a way of creating new meanings and supporting embodied understandings of biodata?*

Theme 2: Attending to a Greater Diversity of Human Bodies and Experiences

The second theme highlights biodata design research approaches beyond empathy, where biodata is enrolled for sharing or communicating experiences beyond an individual. Data feminist principles consider multiple forms of interpretation and knowledge as valid [21, 34], and design research is starting to attend to a greater diversity of human bodies and ways of knowing when designing with biodata. Yet, designing for diversity can be rife with pitfalls and problematic power dynamics. Biodata-driven categorizations of human characteristics across risk embedding hegemonic norms that entrench axes of systemic oppression, such as what counts as ab/normal, un/healthy, un/civilised, etc. [12, 15, 43]. Categories also risk flattening the richness and variety of lived experiences [21].

This theme grapples with these issues by exploring biodata in social contexts. It envisions biodata without categorization, attending to greater diversity of bodies and experiences, and convening multiple bodies in respectful collaboration for sensemaking. Empathy is often considered beneficial, and as designers we are trained to understand and empathise with others’ experiences in order to design for them. However, ways of relating to and knowing others still carry ethical pitfalls. Bennett and Rosner explain how our interpretation of the Other is always an exercise of power, and how empathy risks erasing another’s experience with one’s own ‘empathic’ experience [6]. They critique the role of empathy in design and propose being-with instead [6]. Considering “being-with” for biodata design research, this theme emphasises how biodata designs can invite more respectful encounters with a plurality of other human bodies, holding space for difference, while caring for and attending to others’ feelings. Engaging issues of power, inclusiveness and privilege, this theme asks: *How can biodata be enrolled for ways of knowing that invite more ethical, respectful encounters with Others, holding space for the irreducible complexity of human experiences?*

Theme 3: Biodata Collaborations between Human and Other (non-human) Bodies

The third theme takes into account human and more-than-human collaborations and draws wide-ranging inspiration from sympoiesis or making-with [32], companion species [29], being alongside [49], and vital materialism [7]. Taken together, these concepts explore more-than-human agencies living, knowing, and collaborating with humans. Acknowledging these strands of thought do not all knit together perfectly, this theme invites expansive ideation on how relations and collaborations between human and non-human bodies. Instead of foregrounding the authority of exclusively human bodies and biodata, this theme seeks to also account for other companion species [29] in or outside our bodies, ranging from microorganisms to animals, to materials as vibrant bodies [72], to technologies.

Engaging with this “anxious alliance of knowledge, bodies, devices, and data” and its potential opening to the world [77] this theme signposts paths to cultivating ways of caring for Other multispecies bodies via the work of tending to biodata. This theme builds on the prior themes by continuing to push boundaries of what counts as biodata and bodies and by engaging encounters with Otherness, questioning what is “the body” being sensed. This theme also engages the alterity of data, re-configuring data as an Other with agency. Data becomes less of a referent, and more of a collaborator between multiple agents or bodies co-existing and helping one-another. This extends our second theme’s concern with risks of categorization. As Latimer argues [49], “the relations between the human and the animal have, like gender relations, been largely caught in what Strathern [69] identifies as the Euro-American ‘mode of comparison’,” where comparison can risk denigrating or even effacing the ‘lesser’ category. This theme asks, *what might it mean for biodata design research to move away from comparison as an analytic mode, to collaboration as a mode of doing biodata design research? When is the individual valued and when the collective?*

Biodata Design Research Projects Exemplifying the Themes

Theme 1: Expanding Notions of Biodata and Bodies



Homewood et al.'s *Ovum* [37, 38], an ovulation-tracking device based on the saliva-tracking method of detecting fertility, pushes the boundaries of what counts as biodata by not engaging with a representation of a biological process, but rather by engaging directly with the material itself (saliva).

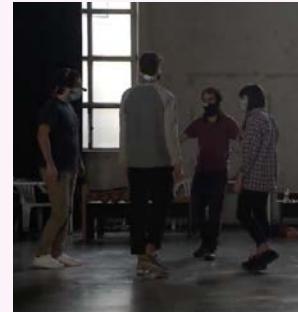
Tsaknaki et al.'s *Breathing Shell* [71] pushes the boundaries of biodata by materializing breathing patterns haptically, felt by the wearer as shape-change actuation. This evokes an experience of being inside another body that breathes with your own.



Helms' *Fiddling Necklaces* [33] offers an example of how bodily fluids, such as breastmilk, can be considered as a form of biodata to design with, and engage with 'other' bodies (the mothers', the childs' and the necklaces' materials).

Theme 2: Attending to a Greater Diversity of Human Bodies and Experiences

Primett's *Anti-Social Distancing Ensemble* [58] engages proximity biodata for co-creation of relational and performative meaning through abstract sonic and visual communication in public space. In this case, proximity biodata foregrounds shared presence among many.



In Rosenthal and Benabdallah's *IBPoet* [61], one person reads a poem, while a listener's EEG and EMG signals change keywords in the poem and send vibration and heat feedback to the reader. Biodata becomes a mediator for co-experiencing and co-shaping a poem.



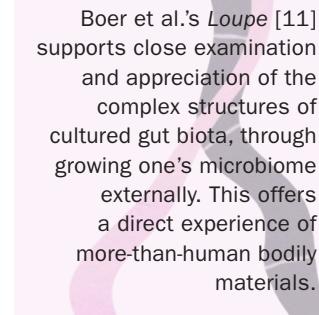
Howell et al.'s *Heart Sounds Bench* [41], amplifies live, unfiltered heart sounds of bench-sitters. Listening to the shifting polyrhythm of two bodies' heartbeat invites a quiet moment of co-experiencing entanglements of living human bodies in a public space.

Theme 3: Biodata Collaborations between Human and Other (non-human) Bodies

Tsaknaki's *Breathing Wings* [70] imposes its own alien rhythm of pneumatic inflating/deflating breathing to the wearer. Through co-experiencing breathing as a form of biodata, the agency shifts from the human body to a co-living experience between human and wearable.



Fox's *Biolesce* [24], a synced multispecies light display, translates human heartbeat data into physical pulses in the algae's water, resulting in a bioluminescent response—an embodied, autonomic process of the algae, connecting human and algae.



Boer et al.'s *Loupe* [11] supports close examination and appreciation of the complex structures of cultured gut biota, through growing one's microbiome externally. This offers a direct experience of more-than-human bodily materials.

1 Collecting Inspiration

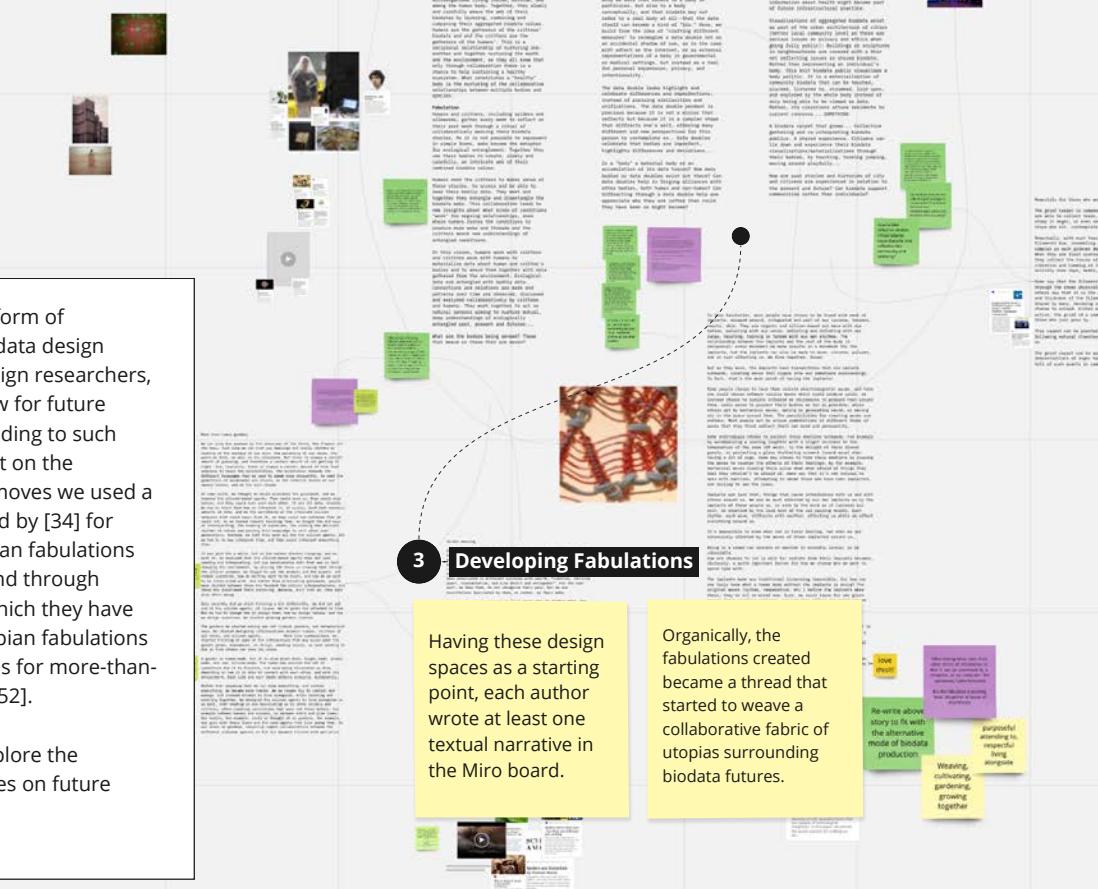
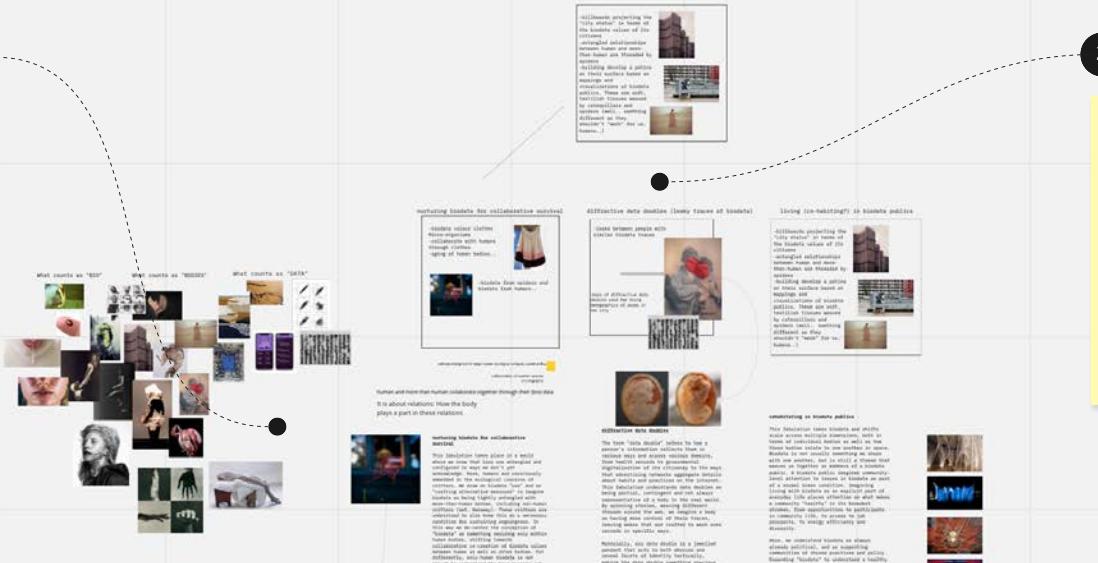
We began by collecting aesthetic inspiration from artistic and other projects by searching online resources.

We focused on visual material that extends notions of body, bio and data in relation to the three themes, gathering all the material on a Miro board to create a visual collage.

We annotated the material with virtual post-it notes and discussed how biodata futures can extend notions of bio, bodies and data through scale, collaboration and through crafting different measures.

How can these themes in the form of conceptual moves around biodata design research be generative for design researchers, and which paths can they show for future research in this domain? Attending to such questions and aiming to reflect on the generativity of these themes/moves we used a method similar to the one used by [34] for reimagining and crafting utopian fabulations through scale, collaboration and through crafting different measures, which they have found generative for their utopian fabulations focused on human bodily fluids for more-than-human collaborative survival [52].

We followed three steps to explore the generativity of the three themes on future biodata design research.



2 Developing Design Spaces

We then combined the images and brainstormed on our initial workshop themes through the lenses of scale, collaboration and through crafting different measures, which led us to constructing three design spaces:

- 1) Nurturing biodata for collaborative survival
- 2) diffractive data doubles
- 3) Cohabitating in biodata publics

These titles started to suggest rich narratives and formed the ground for our fabulations.

The generated fabulations draw on biodata use and on *crafting alternative measures* to imagine biodata as being tightly entangled with more-than-human bodies, including computers which are imagined as embodied actors and referred to generically as silicon-based agents, as well as non-human critters [29]. These critters are understood to also know that this collaboration is a necessary condition for sustaining ongoing life. In this way, we de-center the conception of "biodata" as something calculated only from human bodies, shifting towards collaborative co-creation of biodata values between humans and other bodies. Put differently, only-human biodata is not enough to understand the true meaning and diversity of *bio*.

We describe the genesis of the world where the fabulations take place, setting the stage for re-imagining communication and knowledge relations as ongoing and entangled practices of care between humans and non-humans. We then present three stories to illustrate how biodata takes on roles in this new mode of knowing, specifically: 1) As part of nurturing inter-species collaboration, 2) as part of troubling the border between self and the world, 3) as part of building communities with others.



An Entangled Biodata World

We use data for recording, remembering, knowing. But sometimes we forget that we can know without data. We can know the seasons by the behaviour of the trees, flowers, and insects. Just like we can know our feelings and bodily rhythms by examining the surface of our skin, the pulsing of our veins, the pain we feel, as well as the pleasures. But there is always a certain amount of guessing, and therefore a certain amount of not getting it right. And, crucially, there is always a certain amount of time required to train the sensibilities, the orientation towards the different langues that we used to speak more eloquently, to read the geometries of spiderwebs and leaves, or the chemical dances of our sweaty bodies, and of the rain clouds.

At some point, we thought we would eliminate the guesswork, and we created the silicon-based agents. They could read us, they could read nature, and they could even read each other, reliably, and methodically. Their readings, we called them biodata. We had to teach them how to interpret the world, of course, feed them enormous amounts of data, and be the architects of the intricate silicon networks that could learn from it, so they could see patterns that we could not. As we turned towards teaching them, we forgot the old ways of introspecting, knowing ourselves, knowing of the delicate rhythms of nature [47], and passing this knowledge to each other over generations. Instead, we left this work all for the silicon agents. All we had to do was interpret them, and they would interpret everything else.

It was good for a while. But, as nature started changing, and us with it, we realised that the silicon-based agents were not just reading and interpreting. Our relationship with them was in fact changing the environment. By placing the focus on knowing them through the silicon sensors, we forgot to ask the animals and the plants, and indeed ourselves, how do we/they want to be known, and how do we want to be intra-acted [5] with. And

rather than eliminating guesswork, people were divided between those who trusted the silicon interpretations, and those who questioned their reasoning. Because, much like us, they were also often wrong.

Only recently did we start thinking a bit differently. We did not get rid of the silicon agents, of course. We've grown too attached to them. But we had to change how to design them, how we get to know and design with nature, and how we know and design ourselves. We started by acknowledging that bios are entangled and configured in ways we don't fully understand, but we took steps to consciously embed ourselves in the ecological concerns of other forms of life.

We started growing gardens instead. Not literal gardens, but metaphorical ones. We started designing collaborations between humans, critters of all kinds, and silicon agents. Like permaculture, we started thinking of interactions that occur when the garden grows, reproduces, or decays, needs repair, or needs to die so that others can take its place. A garden is not something that is designed, deployed, and finished. It is an ongoing process of designing, where all parts move. As they move, they need to perceive each other, attempt to understand each other, albeit necessarily imperfectly. Biodata is the glue between all garden elements, how we attempt to translate our bodies to one another. Rather than the product of a finished calculation of a silicon-agent, biodata becomes the product of an active co-orientation, a joint effort to understand and be-with one another. Humans, critters, and silicon-agents collaboratively weave their biodata, use their bodies to create, slowly and carefully, an intricate web. These relations are carefully cultivated. As it is not possible to represent in simple forms, webs become the metaphor for ecological entanglement.

Fabulation 1: Weaving Alongside

Spiders and humans have always **cautiously lived alongside** one another. Human houses provide warmth and food to attract insects for spiders to eat, and spiders protect humans from disease carrying mosquitoes. Spiders and webs are intimately connected, yet most of us only think of the webs as fascinating. As it turns out, spiders are very sensitive creatures: they can hear through their legs and through their web and seem to like a certain amount of noise, but not too much. Particularly, they do not like how noisy humans usually are. Few people ever stopped to think about what spiders want, maybe because they fear them and do not recognize their pain.

Humans living alongside spiders needed to learn how to be quieter, calmer. Spiders alongside humans learned not crawl on their necks, or hide in shoes. We had to learn to stop fearing each other. **What if we could transform our fears into care?** What if we learned to recognize their webs as integral parts of our lives? What if we could weave webs together for mutual benefit? How could biodata help us do that?

When spiders weave webs, their whole bodies move through the weaving, leaving a thread in their wake. **The webs are traces of a dance continuing their entire lives.** The silicon-agents we first made were able to interpret the dance of the spiders and recommended places that, from the perspective of the spider, would be mostly beneficial to be in. Enough food, less noise, more peace. In the end, spiders and humans are not-so-different, compatible.

But that was just the first generation: **first, we learned how to dance, and then we asked to join them.** To do so, we started thinking of spider webs the way we think of **gardens**, as collaborative multispecies spaces of life and beauty,

able to **grow in unexpected ways**. In other words, the second generation of silicon-agents included ways of **weaving with the spiders**. For some humans, generations of learned fears deep in their bodies required ways of letting those fears out in regenerative ways. Small weaving agents embedded sensors that responded to human fear by transforming



fear into threads made of noise dampening materials, helping spiders attain the peace that they crave. These weaving agents helped scaffold webs by following the spider as she moves or inviting her to weave in certain ways and patterns in the shape of objects and other structures. As no partner was really in control, and every step of **this dance was**

improvised, each resulting collaborative web was different, strange, and unique. For the humans, this multispecies collaboration allowed for the making of homes together, transforming fear into mutual care. Once the fear is gone, the sensors go silent, the silicon agents go to sleep, retracting into the web, and there is no more material to make thread. The shared dwelling is then complete.

Humans, spiders, and silicon agents collaborated to weave webs where humans find them less creepy, more beautiful, in areas good for catching insects. **Windows** became appealing spots because they offer spider food flying in, and the **webs filter sunlight** for a natural sepia mood lighting. Others found intrinsic beauty in the silky dangling webs, and found them to be perfect materials to grow into chandeliers, dream catchers, and decor. These webs became long-lasting parts of each home, as **it would be unthinkable to detach the spider** from the home she helped build. Like cobwebs around aged wine bottles, denoting a long, slow process of maturation and appreciated by any discerning wine connoisseur, collaborative webs became signs of mature homes, where nature and people have learned to co-exist.

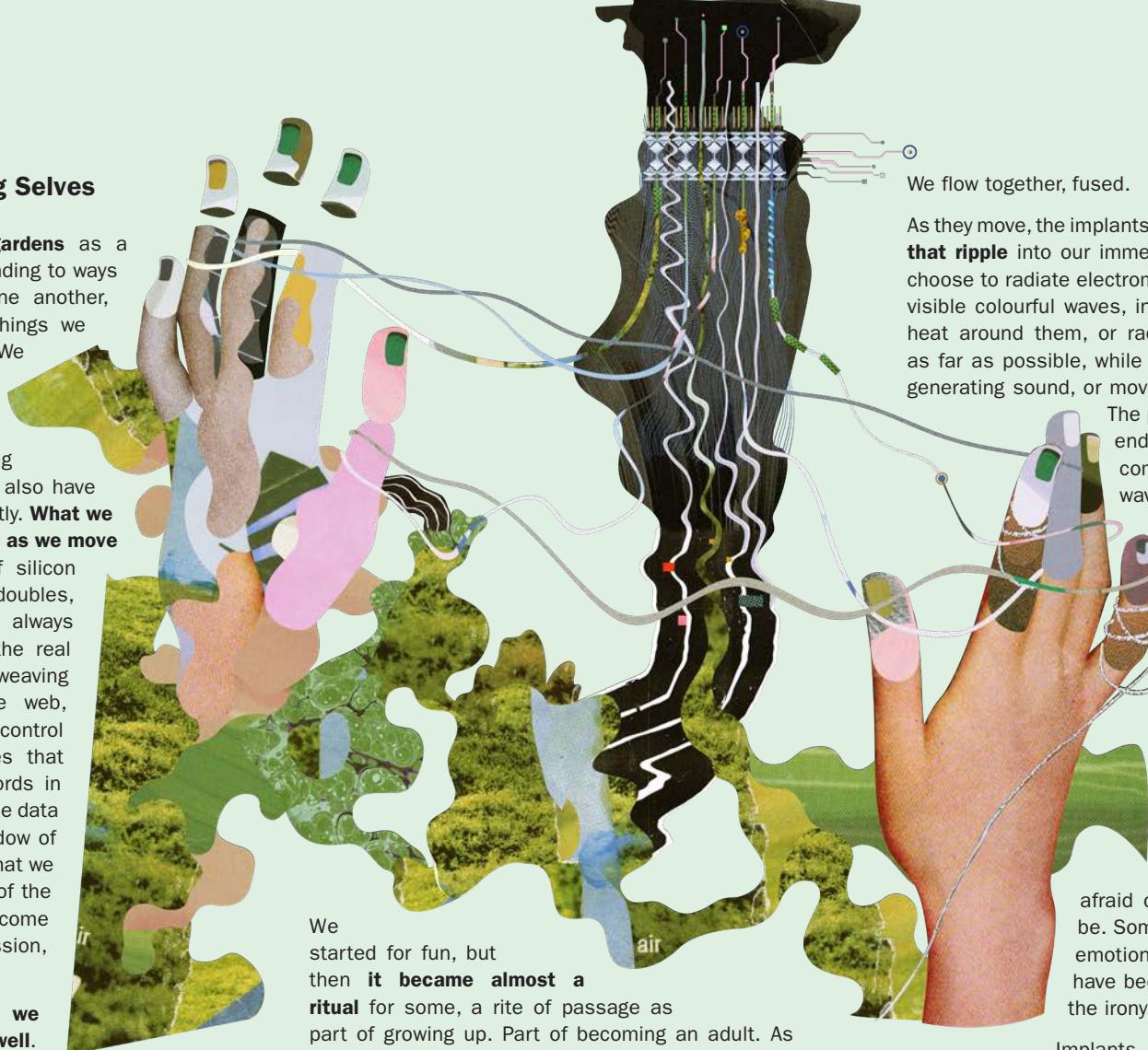
It is this mutual orientation, this work towards each other, this incomplete, but productive comprehension that we are still learning how to foster.

Fabulation 2: Diffracting Selves

When we started **growing gardens** as a metaphor for design, and attending to ways we are all entangled with one another, we started by manipulating things we could see with our naked eye. We started by designing different, kinder, relationships with the critters around us, such as spiders. But by building collaborations with others, we also have had to know ourselves differently. **What we leave of ourselves in the world as we move through it**—a combination of silicon and carbon space—are data doubles, partial, contingent and not always representative of a body in the real world. By spinning stories, weaving different threads around the web, we imagine bodies as having control of their traces, leaving wakes that are crafted to wash over records in specific ways. In earlier eras, the data double was an accidental shadow of being in the world. By taking what we project in the world as a part of the self, our data emanations become tools for personal expression, privacy, and intentionality.

It did not take long before **we started looking inwards, as well.**

Our bodies, you see, are also metaphorical gardens, biomes that host many life forms, all continuously learning to live with one another. We are one but we are also many. From that realisation, from that decentering of ourselves, we dared to start changing ourselves, slowly. First, as with the tattoos of the past, some of us dared to wear the silicon agents on our skins. They were fun and allowed for new forms of expression, but they were just scratches on the surface. As we learned more about interactions with microbiomes, we were able to design organic-silicon based fibres knotted into our bodies.



We flow together, fused.

As they move, the implants transmit outwards, creating **waves that ripple** into our immediate surroundings. Some people choose to radiate electromagnetic waves, infrared, or microwaves to produce heat around them, or radio waves to project their wakes as far as possible, while others opt for mechanical waves, generating sound, or moving air in the space around them.

The possibilities for creating waves are endless. Most people opt for unique combinations of different forms of waves to express their own mood and personality. Some individuals choose to **project their emotions outwards**, such as accompanying roaring laughter with a slight increase in ambient temperature to delight dinner guests, or project a glass-shattering screech in a fit of rage. Some choose to hide their emotions by using waves to counter the effects of their feelings, e.g., using mechanical waves to slow their pulse when afraid of things they feel they shouldn't be. Some say it's not natural to mess with emotions, attempting to shame those who have been implanted, and they fail to see the irony.

Implants also **cause interference** with us and others around us. We are as much affected by our own implants as by the implants of those around us, by the wind as it caresses our skin, or the loud horn of a car passing nearby. Each rhythm, each wave, **diffracts** with one another, affecting us while we affect everything around us. It's **impossible to know** what anyone is "truly" feeling, not when we are constantly affected by the waves of those around us. Being in a crowd can elevate an emotion to ecstasy, or unbearable intensity. How one chooses to radiate becomes an important factor in choosing who to spend time with.

Fabulation 3: Collective Affect

This carpet is composed of **thousands of semi-alive filaments** that are able to collect tears, resonate with the excitement of new love or stomps of anger, and senses the disquieting, sombre reminiscence of those who sit, contemplate and struggle to let it all out. With every laugh, commemoration, or moment of sorrow, the multitudes of filaments hum, resembling a cat's purr that grows deeper and more complex. When they are first **planted**, the filaments are small and still, but as they collect the traces of grief of many, they respond to it through vibration and **humming, growing** in height and activity over days, weeks, years or however long the grief is felt.

Some say that the filaments may have a soothing effect on each person, through the **sheer physicality of the waves** of purring filaments, while others say that it is the growing intensity of the purr and the size and thickness of the filaments that acknowledges that the grief is shared by many, becoming an easier weight to bear, the more people choose to unload. In either case, as the carpet grows larger and more active, the grief of a community becomes impossible to ignore, even for those who just pass by.

This carpet can **become a living memorial** for collective pain and grief following natural disasters, wars, pandemic, shootings, police violence, and so on. It is a place to visit, tarry, and reminisce. In its thrum, there is **soothing for those who have lost**, and warmth for those who wish to use the carpeted space for their own ends. Just as cemeteries were once bucolic spaces for active living with legacy, these carpets provide a comforting shelter for students, dalliances, combining sorrow with social life. The carpet can be appropriated by activists, who stage public demonstrations of anger and grief to raise awareness for the emotional toll of such events in communities and calls for actions that things should be otherwise, even as the carpet itself remediates the **biological signals of pain and suffering** into something that focuses attention in a peaceful, meditative, and communal way.



Discussion

These fabulations chart ways of engaging ethical and biopolitical stakes of designing with biodata. Rather than operating as a complete set being directly representative of our concerns, we see the fabulations to be worthwhile as “things to think with” [74], serving as points of departure for reflecting on, posing questions and pointing to particular critical issues pertaining to ethics, biopolitics and justice in relation to biodata research. We feel that the strength of this pictorial lies not just in the textual contribution, but how these images and text combine to draw the reader into the fabulated world in intellectual, emotional, and aesthetic ways. We unpack some of the conceptual work explored in the fabulations, first by discussing each individually and then by reflecting on overarching themes found in all of them.

Unpacking the Fabulations

In the first fabulation, *Weaving Alongside*, humans work with spiders (or critters, as Haraway might call them) and critters work with humans to materialise data about human and critter bodies and to weave them together with data gathered from the environment. This fabulation explores more-than-human collaboration between humans and spiders at the relatively small scale of the everyday, refiguring the fear and killing humans have directed toward spiders into an ongoing collaboration of constructing webs and sharing space. Crafting a different measure with skin conductance and fear response, arachnophobia is transformed into co-constructing webs for collaborative survival [52]. Ecological data are entangled with bodily data. Connections and relations are made and patterns over time are observed, discussed and analysed collaboratively by critters and humans. They work together to act as natural sensors aiming to nurture mutual, deep understandings of ecologically entangled past, present and futures.

The second fabulation, *Diffracting Selves*, resists the prevalent push to ‘discover’ the ‘truth’, whether scientific or internal and subjective, of bodies through biodata. Rather than inner or outer truth, there is only interference and diffraction. Body, biosensor and data become one. Control becomes complex. We may be more free, or more prone to manipulation. This fabulation imagines expanding notions of biodata and bodies, and implants as designing for and

intentionally increasing diversity of human bodies and experiences. The very ability to craft a biodata measure in the traditional sense is complicated by the implants, which make it impossible to distinguish between the cyborg body and how one might have been prior to implantations. What are the bodies being sensed? Is a “body” a material body or an accumulation of its data traces? How many bodies or data doubles exist out there? Can data doubles help in forging alliances with other bodies, both human and non-human? Can diffracting through a data double help one appreciate who they are rather than could they have been or might become? Biodata moves from being something that is extracted from a body, as it becomes digitised, and re-assembled as a “data double” [28]; biodata becomes something that bodies do, an active ongoing phenomena of construction, and communication, in relation to others. In this fabulation, humans are active constructors of their biodata, which here has no resemblance to an objective truth, both by weaving the implants within, and by adjusting them to radiate outwards on their own. Of course, by doing that, they are affecting themselves, as they are always in the process of becoming.

The third fabulation, *Collective Affect*, shifts scales with biodata across multiple dimensions, both in terms of individual bodies as well as how those bodies relate to one another. Biodata is not usually something we share with one another, but is still a thread that weaves us together as members of a biodata public. A biodata public imagines enrolling biodata in attending to community-level issues. Imagining living with biodata as an explicit part of everyday life places attention on what makes a community “healthy” in its broadest strokes, from opportunities to participate in community life, to access to job prospects, to energy efficiency and diversity. Biodata is always political, and supports communities of shared practises and policy. Expanding “biodata” to understand a healthy community as a biome for living in lets us approach biodata as part of a fundamental condition for humans to thrive inside, and takes seriously how seemingly low-level information about health might become part of future infrastructures.

Departing from metaphors of growing gardens and weaving as ongoing activities, we imagine the role of designers of biodata as makers of tools that allow active participation

of construction of biodata narratives by humans and non-humans. In these imagined futures, designers are not merely picking up a sensor to isolate and calculate a certain measurement, a particular way of isolating a signal from our bodies, but rather thinking about the different possible relationships they may want to foster, and how different bodies may be made intelligible to each other in novel and interesting ways. In this mode, designers merely plant the seeds for biodata co-production, and biodata-driven systems are always in the process of being designed. Some of the questions worth exploring in this new mode of biodata production are “how do we want our bodies to be understood and legible to other humans and critters around us? Who gets to choose how and where the system grows?” We suggest that the ethics of designing biodata should be related to how biodata co-production tools allow for or limit the range of expressions and ways of making our bodies understood to others. Additionally, since biodata futures can grow in unexpected ways, there should also be an ongoing monitoring of the evolution of the interactions to ensure that no party will take over and limit others’ agency.



Connecting Themes and Fabulations: Invitations for Design

The three themes’ expansive moves point to various ways biodata designs can invest meaning-making authority in those who lack medical, data, or scientific expertise, inviting people to trust their own experiences, bodies, and social relations as valid ways of knowing. As such the themes served as a ground for developing the fabulations while engaging ethical and biopolitical stakes of designing with biodata. All themes draw from feminist modes of knowing and relation. In addition, the second theme acknowledges the ethico-political concerns of encountering other humans, and theme three explores multispecies possibilities. Thus, the third theme moves from considering “the body” as exclusively human, building on the idea that “a body can be anything: it can be an animal, a body of sounds, a mind or an idea; it can be a

linguistic corpus, a social body, a collectivity” [19:172].

These fabulations build on the three themes to imagine how biodata could adopt roles beyond calculation and abstraction of “human bodies from their territorial settings and separating them into a series of discrete flows” [28], which are then amenable for scrutiny and targeting for intervention. Drawing from the first theme on expanding notions of biodata and bodies, in our fabulations we imagine materialising biodata in different non-symbolic forms (webs, waves, and growing filaments), which privilege experiential, felt, and aesthetic engagements with different human and non-human bodies. This approach allows us to approach data not only as something that is calculated and assembled for a human expert’s consumption (e.g., a trained data scientist), but rather as information to be shaped in a way that can be passed on between different species, and have an effect in the world. For example, in the second fabulation, the waves radiating outwards from the implants become the data themselves, a form of re-materialising the body and affecting our bodies and the bodies of those around us. Implications for design include questions such as “how to materialise biodata in ways that allow for meaningful communication with others”, which builds on current biodata design directions shifting biodata to ‘somadata’ [2].

The second theme, on attending to a greater diversity of human bodies and experiences, is explored in the fabulations as a re-imagining of how biodata could be produced. Rather than being solely the product of decisions made by biosensing experts and other data professionals, where the humans being sensed play largely a passive role, biodata becomes something that is actively constructed by those whose data refers to, produced in relation with others, and very thick with context. Humans weave webs with and for spiders (Fabulation 1), adjust how they radiate outwards while being conscious of how they affect and are affected by others (Fabulation 2), and both deposit and feel the grief of their community (Fabulation 3). This suggests ways design research can foreground lived experiences around data holding space for differences, allowing pluralistic interpretations of what data means and what roles it can take.

The third theme on more-than-human collaborations extends our concerns to non-human species. Also here, our

fabulations help imagine ways that biodata designers might include non-humans in the web of relationships they want to foster, but this in turn requires understanding how species want to be communicated with, and how to understand them in their own terms. And mostly, it requires that we are able to be in a relation with others without full understanding. We suggest that the ethics of biodata design research in this new mode of production extending to non-human collaboration should ask questions such as “How should we understand and ‘read’ other critters in order to foster our relationship with them?”

With our fabulations we are not only interested in imagining roles for biodata, but we also explore new ways of designing with biodata. Overall, the fabulations offer an imaginative perspective on existing trends in HCI and radically extrapolate toward alternative futures—not a totalizing view of progress toward the future, but rather a diversity of alternative futures [46, 48]. For instance, the preface draws in present tensions in HCI around algorithmic authority, bias, and contestability [3, 16, 36, 45, 55, 76], and ongoing debates between those who are more trusting or more critical of biodata insights. The first fabulation imagines one aspect of collaborative survival, an imaginative leap taken from Liu et al.’s work on designing for collaborative survival [52] and their inspiration from Tsing [73]. The second fabulation offers one imagined future of human-computer integration, an emergent agenda in HCI [54], extending HCI’s ongoing investigation of social factors of self-presentation in everyday life [20]. The third fabulation imagines a gentler, more nuanced alternative future for biodata publics; resisting dominant narratives of (bio)data-driven technocratic ‘smart cities’, this fabulation in a sense explores calls to reimagine ‘smart cities’ [17, 42] with biological, social, and emotional grassroots phenomena. Taken together, rather than producing more typical HCI contributions of an artefact, empirical investigation, or even design agenda, these fabulations offer speculations on potentially far-reaching implications for sociality, selfhood, and publics.

Conclusion

In this pictorial we offer small, partial, and incomplete—yet radically hopeful—reimaginings of biodata futures. With these, we aim to explore expansive and alternative design research directions with and through biodata. As biodata design

research continues to grow and expand, we asked: What are emergent directions of biodata design research? What biodata design futures might be possible and desirable? Starting from a series of workshops with invited researchers and practitioners, we unpacked emergent possibilities for biodata design research. The workshop outcomes were synthesised into three themes that show future perspectives for biodata design research: (1) expanding notions of biodata and bodies, (2) attending to a greater diversity of human bodies and experiences, (3) biodata collaborations between human and other (non-human) bodies. Starting from these three themes as a point of departure, we developed three fabulations that reimagine alternative engagements with biodata. The first one, *Weaving Alongside*, explores interspecies weaving between humans and spiders, moving beyond fear of Others toward collaborative survival and new forms of care. The second fabulation, *Diffracting Selves*, explores biodata-responsive implants that sense and modulate radiating waves of human experience, moving from representational biodata epistemologies toward diffractive ongoing transformations of meaning with biodata. The third and final—*Collective Affect*—explores how biodata publics might better hold space for the highly varied emotions of community members, including grief, rage, resilience, and collective joy. We reflect on how the three themes, intertwined in the three fabulations, served as expansive moves of attending to broader ethical concerns around biodata, provoking critical discussion and reimaginings of biodata’s social and societal purposes. We end by unpacking conceptual work done by the fabulations and offer generative possibilities for design research with biodata.

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