

Between breakfast and bed: Towards fluid modes of designing and cohabiting with living organisms

S. Keune

Swedish School of Textiles, University of Borås, Borås, Sweden

A. Mody

Design School Kolding, Kolding, Denmark

M. Westerlaken

The University of Cambridge, Cambridge, UK

ABSTRACT: Biodesign is considered as a new industrial paradigm holding the potential to fundamentally change the way we produce and impact the environment through e.g., the building practice. Within biodesign the living is predominantly described as providing resources that can be used and programmed. The livingness is reduced to being a material quality in design that is compelling due to its dynamic, performative, and temporal dimensions. Thereby, the methods of specification and representation are often fundamentally anthropocentric and create hierarchical relationships. At the same time, biodesign holds the potential to re-think nature culture relationships and challenge these hierarchies, especially when it comes to envisioning and designing living environments that are shared with others e.g., insects and plants. Therefore, we need to expand conceptions of biodesign beyond how we currently work with living matter, materials, and organisms. This research aims to investigate emerging practices, environments, and mindsets that reach a more inclusive approach to biodesign. Therefore, we conducted interviews with selected practitioners who developed an experimental practice or mindset as a result of their “reflective conversation with the materials of a situation” and their species-specific demands. This paper contributes to the biodesign discourse and provides incentives about how the built environment can respond to, and develop together with other living organisms. We want to challenge biodesign as merely a new industrial variety and material practice towards an activity that includes and gives space to the agency of living organisms and their creative potential to design our lives as much as we design theirs. Building on the interview data, we argue for a “fluid design landscape”, as a more responsive methodological framework that encourages biodesigners to integrate a larger array of methods and environments into their practices, while remaining open to exploring ways of co-creating and co-evolving with the living world.

1 INTRODUCTION

Dealing and designing with living organisms increasingly becomes part of education, research, and practice across various disciplines such as design, architecture, material science, philosophy, and human-computer interaction. This shift is driven by the socio-environmental challenges we are facing and is accompanied by concepts of their mitigation, e.g., growing instead of exploiting resources, addressing or including multi-species entities to counter extinction and biodiversity- and habitat loss. Biodesign, the cross-pollination of biology with art, architecture and design is described as “the emerging and often radical approach to design that draws on biological tenets and even incorporates the use of living materials into structures, objects and tools” (Myers 2012, p.8).

The variety of approaches that merge biology and design have been grouped into taxonomies by several scholars. Collet (2017) defined the three strategies ‘Nature as a Model’, ‘Nature as a Co-worker’, and

‘Nature as a Hackable system’ which was further developed by Camere & Karana (2018) who identified four main material design practices: ‘Growing Design’; ‘Augmented Biology’; ‘Digital Biofabrication’; and ‘Biodesign fiction’.

The idea of co-creating with the living world to achieve diverse expressions and the opportunity to rethink and reimagine long-held assumptions in anthropocentric design and production are major driving forces for designers (Antonelli 2012). However, most of the design work starts with the designers’ intention and the living organisms are merely used to carry out a specific task, e.g., growing bacterial cellulose. After the task has been completed successfully, the “material” is treated to preserve and further process it, thereby achieving a rather stable and predictable outcome. This usually means that the “collaborators” are killed. Hence, anthropocentric perspectives remain an integral part of the design process. The livingness is reduced to being a material quality in design that is interesting due to its dynamic, performative, and temporal characteristics (Camere & Karana 2018; Collet 2017; Karana 2020; Karana et al. 2020; Myers 2012). The methods of specification and representation are fundamentally anthropocentric and reinforce hierarchical relationships. While a move towards less anthropocentric design is now turning towards other species, these tend to involve a focus on designing with mammals and birds, rather than smaller organisms, thus continuing to reinforce existing species-hierarchies.

Biodesign, as a focus, allows designers to engage with biology, different levels of temporality, different scales of organisms to collaborate with, and different materials, environments and epistemologies. It consequently lets us think about hierarchies beyond immediate design practices and reflect on our ethical commitments. Biodesign holds the potential to re-think nature-culture relationships, especially when it comes to envisioning and designing living environments that are shared with smaller living organisms. Therefore, there is a need to reflect on and expand on how we currently work with living matter, materials, and organisms. By reporting on an interview study and questionnaire with 14 practitioners, this paper investigates how designers and researchers engage with other living entities in their own design practices. Section 2 outlines the methodology of this study. Section 3 highlights our findings from this study while reflecting on the complexities and challenges that were addressed by our interviewees in relation to using, designing for, designing together with, and living with other species. Our discussion in section 4 suggests to expand the bio-design landscape into a more fluid methodological framework that allows designers to move into different design spaces while remaining open to exploring ways of co-creating and co-evolving with the living world.

2 METHOD

2.1 *Participants*

For our interviews, we selected and invited 14 practitioners within the biodesign field who are known to engage with design and living organisms in ways that move beyond extractivism or industrial usage, towards experimenting with less anthropocentric practices. Other criteria were to include different disciplines and levels of expertise, including MA students, young practitioners and PhD students, as well as professionals and senior researchers. However, it must be noted that their level of academic or professional expertise does not necessarily correlate with the level of expertise in relation to designing and reflecting on living with other species. In our case the MA-students worked with living organisms in design practice for the first time, but reportedly had a more intense relationship with them, since they worked from home during this activity and therefore lived together with their experiments. Since the participants’ backgrounds and experiences are quite different, we find it hard to argue for formally distinguishable levels of expertise. However, to understand the differences in working environments to some extent, we marked the participants at beginner level with the letter B, the ones at intermediate level with the letter I, and the experts with the letter E.

Besides, letter coding their level expertise in designing with living organisms, the model in Figure 1 maps in which environments our participants have worked with living organisms and what kind of living organisms they have worked with. The purpose of the model is to provide an overview of how the participants negotiate different environments when they are designing with living organisms and how different design experiments with living organisms link to different contexts, procedures, and methods.

The participant I.5, for example, learned about bacteria cultivation in a professional lab and carried out textile dyeing in the design workshop. Due to the pandemic, she moved the bacteria cultivation into her private home.

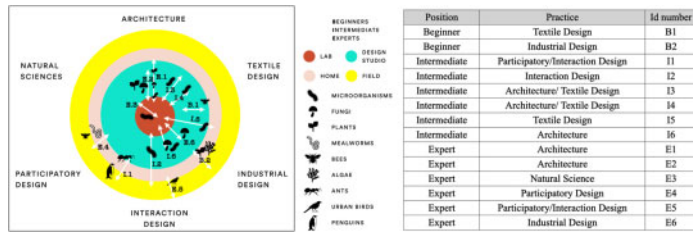


Figure 1. (left): Representation of the participants, their background and expertise, the organisms they worked with and the environment. Lab here is understood as a professional science laboratory (wetlab). Figure 2 (right): Table specifying the participants' position, practice and identification (Id) number.

As also shown in Figures 1 and 2, four of the participants were architects: E.1 is a researcher working at the intersection of biomimicry and architecture, E.2 is a researcher between architecture, computation, and biology, and I.3 is working as a practitioner and educator in biodesign, fashion and textiles. I.6 has a background in engineering with specialization in computational design and biodesign, now working at the intersections with architecture. Four of the professionals have a background in textiles: B.1 was a MA-student working with sustainability, I.5 is a recent MA graduate in textile design. I.4 is a designer, senior researcher and teacher working at the cross of textile design, architecture, new technologies and biodesign and I.3 is a practitioner and educator in biodesign, fashion and textiles. Two of them are industrial designers: B.2 is a student and E.6 has a background in industrial design and research and is now working in the biofabrication industry. Two participants can be identified with the field of interaction design, I.2 is a young professional, I.1 recently completed the doctoral studies and E.5 is a researcher in the field of STS, participatory and posthuman design. Finally, we interviewed E.4, an expert in participatory, democratic design and processes and publics-in-the-making and E.3, a professor in biophysics. Both are interested and engaged in how art and design can expand their practices. Since biodesign is considered to be a cross disciplinary practice, we found it important to also include the perspectives of a researcher from the natural sciences.

2.2 Interview study

The interview study was inspired by and built on an interview study carried out by Camere & Karana in 2018 in which they provided a questionnaire and had a follow up discussion with each participant. In our study, four of total fourteen cases we discussed the questionnaire verbally without having it filled out, as the participants preferred this process to save time. All conversations took place in English via video conference, lasted approximately 50 minutes and have been recorded.

Camere & Karana concluded that 'Growing Design', or biodesign, challenges the interpretation of sustainability, redefines the role of the designer, demands the development of new design sensibilities, and reveals new principles of ecological production (2018). To build on these findings, we were curious about the experiences of biodesign practitioners regarding different design strategies as proposed by Collet (2013). We defined four phases and structured the questionnaire, accordingly, starting with how biodesign is commonly perceived (using living organisms in design processes) and finishing with where we think biodesign will take us (multispecies cohabitation). The purpose of the four phases was to encourage the designers to report on their practices, while also challenging them to reflect upon them, and to open up their imagination. Furthermore, we specifically wanted to investigate autobiographic experiences of living together with biodesign experiments in the home due to the pandemic.

The questions of the first phase evolved around using living organisms in a design process (in the context of this work described as *designing with*). More specifically about the kinds of organisms

and environments the participants experienced, how they refer to the materials/organisms, and ethical implications they see.

The second phase moved to *designing for* living organisms with the aim to elaborate on how the design process unfolds. We asked questions that related to the “success/unsuccess” of the experiment and how information/skills/materials/tools/participants would have improved it. Besides, we interrogated how designers thought the living organism/s experienced their work.

The third phase of the questionnaire focused on *designing together with* living organisms. In this phase we asked similar questions as in the first phase, adding questions that address the perspective of the organisms and future objectives.

In the fourth phase we addressed *multispecies cohabitation* and included a drawing exercise about a fictive scenario of moving in together with a bunch of living beings.

We assumed that not all our conversational partners have worked with all four phases and used the questionnaire also to allow them to reflect on their own practice by classifying themselves and their work to one or between certain categories.

2.3 Analysis

To analyse and compare the questionnaire and drawing activity, we collected all of them in one document. We transcribed the recordings and organised them according to different emerging themes of interests, such as “cohabitation”, “failures”, and “ethics”. Since we gained far more data as we can address in this paper, we used Moisy & Pschetz (2017) prediction of biodesign advancing towards programming or collaboration as an analytical lens. We combined this with other theoretical references that help to contextualize our analysis in the next section. Lastly, we analysed the workflows of the participants to reflect on the nature of their biodesign processes and how they unfold over time. This largely inspired the “fluid design landscape” we will expand upon in the fourth section of this paper.

3 INTERVIEW STUDY

3.1 Using living organisms

Moisy & Pschetz could see two ways in which biodesign practices advance (Ibid.). One way follows the promises of synthetic biology to develop straightforward outcomes by programming living materials (Barrett 2006). The other way connects to design and its traditions as a “reflective conversation with the materials of a situation” (Schön 1983) where both researchers/designers and artefacts (living or non-living) can influence directions and decisions (Savic & Huang 2014). The interviews can be aligned to these insights as participants reflected on the tensions between the usage of living organisms and co-design or co-habitation. Many designers who work with living organisms reported on the challenges that come with it. Certain tools, protocols and environments are needed and on top of that a lot of commitment, care and attention is required from designers engaging with biodesign. Moisy & Pschetz report that living materials can therefore not be seen as mere materials. However, they also admit, that they themselves could not help treating them as such when they were looking for specific design qualities (2017). In our questionnaire we deliberately asked the participants how they refer to the organisms or materials they are working with and what they consider as “living organisms” and “living materials”. When discussing this during the interviews we usually ended up touching upon “what is life” and the different viewpoints to this fundamental question, which are still constantly evolving and informed by new findings. Here, E.1 argued that there are a variety of definitions and new findings about the signs and qualities of life that cannot possibly apply to all living organisms. E.1 discussed that we tend to categorize and consider ethics according to what we consider simple or more complex forms of life, and this approach should be questioned.

Camere & Karana (2018) argue that designers when designing with living materials rather than having a “skilful hand and sensitive mind (...), they need an informed eye and scientific mind” (p. 589). However, designers we interviewed deliberately continued to reflect on the organism’s aliveness. This duality between care and maintenance is described as indivisible by I.6 as “... *this aliveness quality*

cannot be maintained by itself. There has to be a closer relationship...” However, another duality is opening here, as E.1 states: *“The biggest problem in growing organisms is to prevent the growth of other organisms. With the environment you create, you have to create an advantage for the specific species you want to have.”* I.6 works with design and bio-fabrication in an industrial context and shared: *“It is really a matter of daily struggle. Constantly daily struggle with incredible care and with incredible motivation. From all of us ... [and] it really involves a lot of failures.”* However, the challenges that designing with living organisms entail are much more fundamental, as E.2 reflects: *“We were taught that as architects we design endpoints and we design an image. The moment you start incorporating living organisms and work with biohybrids you realize that there is no endpoint. We might be better off conceptualizing the idea of grow careers: Architectures that are continually changing and which image is not fixed but might be moving or meandering.”*

We asked our participants to reflect on the different environments they worked in. The lab with its sterile setting and established protocols seems helpful when it comes to research and preventing contamination. At the same time an improvised or semi-professional lab set up allows for a cross-fertilization of scientific methods and protocols with experimental approaches. Having learned the standard procedures and safety guidelines in a professional lab, I.5 discusses a deeper learning process at home, reflecting more intensely about failures and understanding how they might have been caused. Working from home, is therefore not only an advantage for maintenance, but also provides a landscape of designing that both manifests itself in time and space (Telier et al. 2011) and supports creative processes, intuitive moves, and intimacy.

Generally, we observed that the act of engaging generates sympathy and sensitivity towards living organisms and therefore triggers thinking and acting with care. The different agendas and relationships that can unfold within what can be understood as matters of care are very well summarised by E.4: *“Sometimes there is a “pet relationship”, sometimes there is a “pest relationship”, humans want to get rid of something. Sometimes there is a “pesto-relationship”, where you eat each other. And sometimes it is more about a multi-species labor force, asking for help. Humans asking other species for help.”*

3.2 Designing for living organisms

Puig de la Bellacasa describes care as a value or concern that is added to factual matters and that reaches beyond just having respect while being involved in the becoming of something or someone. She coins that care is required in processes in which humans and non-humans co-train each other to live, work, and play together to construct relationships of “significant otherness” (Puig de la Bellacasa 2017, p. 66). Hence, we asked our participants if stepping into the perspective of the living organisms they are working with is something they do as a creative or reflective practice. E.5 brings up a project in which they imagined being pollinators for e.g., red clover and that this work is very specific to the respective plant which leads to pollinators needing specific tools such as long tongues. I.1 commented on a project with ants and their very different cognitive structures and perceptions compare to ours, which makes it difficult to think from their perspective. Hence, I.1 made use of design speculations as a way to generate parameters for prototyping and reflecting and states that involving oneself is still better than withdrawal. I.1 further reflects on a design process for larger animals: *“This was a super complicated situation. (...) There was a colony of 22 penguins: Some of the penguins could not care less that I was there, while others were interested, but in their own particular ways. They used the situation to also propose things, they wanted to do during those days I was there.”*

3.3 Designing together with living organisms

Designing with living organisms, challenges established design activities, such as making, prototyping and form-giving. Camere & Karana describe how making becomes “co-performed with nature” with the process becoming “intimate, button-up, structured, yet intuitive” (2018, p. 576). At this point during the interview, we observed that the distinctions between using organisms, designing for, or designing with were not easy to separate. It was furthermore not always possible or desirable to develop intimate relationships with the organisms involved. Taking on the organisms’ perspective was sometimes avoided

as B.2 reflects *“The algae died a slow death and were used as a material. I am not quite sure if I want to imagine their emotional connection to this project.”*, or found challenging, as stated by B.1 *“I am not sure what the other species members thought of my projects, I do not fully understand their way of communicating and I probably never will. (...) I have to say that the lichen might not be so fond of a collaboration with humans.”*. It became clear to us that even if the practitioners did not intend to design together with the living organisms, they were changed by them during the process, and this influenced their design processes in turn. Intuitive changes, intimate relationships, and surprising moments characterized their projects. How unpredictability is an integrative part of this reflective conversation in between the designer and the living organism was mentioned by many of the participants with one example being: *“... Sometimes, the recipe is the same, the conditions are the same, but then it does not grow (...)”* – I.3. This unpredictability was mentioned by many of the participants, and it can be seen as a failure or as a necessary and long process of learning, adjusting, and evolving together, which connects to Puig de la Bellacasa’s understanding of care: *“If care is to move a situation, those who care will also be moved by it”* (Puig de la Bellacasa 2012, p.206).

3.4 Multi-species cohabitation

Puig de la Bellacasa proposes *“Thinking-with nonhumans should always be a living-with, aware of troubling relations and seeking otherness that transforms those involved in the relation and the worlds we live in”* (2017, p. 83). Indeed, the participants with experiences of *“living together with”* their living experiments, motivated or required by a missing set up at the University or the lock-down during the pandemic, report of closer relationships and an increased awareness towards the behaviour of the living organisms and their effect on everyday life situations. I.2 lived with 55 petri dishes in a box under the bed and with batches of kombucha under the desk. I.3 mentions a growing aversion against the smell of vinegar that still has a personal impact today. Additionally, B.1 describes the process of killing the living organisms in order to harvest and treat the material that they produced as an emotional act.

The challenges around the killing and disposal of living organisms were an often-referred topic. In contrast to professional laboratories, protocols and facilities for disposal of experiments do not exist in design workshops or private homes and therefore create interesting pragmatic and ethical challenges about *“having to make the kill”* (E.5) and how to dispose of living organisms in a way that reflects possible emotional attachments and without impacting the environment. Such a challenge is described by E.1 as follows: *“What do you do with your overflow of organism. Do you just put it into the toilet? You cannot just dump it into the next lake, because you might infect it with something that was not there before. Whatever you are doing, has an impact on your environment. Whenever you grow an organism, you also have to dispose this organism in an ethical way.”* I.1 reflected in response to this question: *“I think that is interesting, that we can have ethical discussions, without having final answers. Or without really knowing if what we are doing is the right thing or whether it is a temporary decision. Whether that is what we can do or know now and how we can live.”*

Working at home thus opens up for new spaces in design and to rethink practices and relationships. In relation to this E.4 highlights the potential of the home as a driver for change: *“Change might as well start in your home as somewhere else. If we want to have an ongoing relationship, then I think the home is the easiest, as that is where we are at.”*

The home as a driver for change opens a large space for design experiments. However, it is a space that is designed to accommodate human bodies and activities. Therefore, some of our participants did not want to answer our last exercise in the questionnaire about speculatively inviting several different organisms and animals into their homes. In one of the conversations, we discussed moving in together, and that it is much easier to move into a new place together instead of making space for someone else. Multispecies cohabitation is also far more complex than just inviting other species to live with us, as pointed out by I.1: *“I think in the case of animals we need to become better aware of the notion and practices of speciesism and formulate a more informed approach about cohabitations and consumption of other animals. Many of our cohabitations are deeply speciesist and I think it would be cruel to claim any kind of non-anthropocentric cohabitations if we do not break with these norms.”*

4 EXPANDING THE DESIGN LANDSCAPE

4.1 *Directions*

Our conversations with participants show that there is an increase in complexity of biodesign processes and projects in general due to the cross-fertilisation between design studio, conventional lab, home, and the field, in terms of environments and research methodologies. Our research demonstrates that the home is increasingly becoming a part of the biodesign landscape; it is a place where biodesign work is carried out, cared for, lived-with, and reflected upon. This complexity is also increased by the needs of respective living organisms and the participants' search for a reflective conversation/practice with them, which leads to both, designer and living organisms influencing the design work. Here we see a possible extension on design events (Jönsson 2014) as an approach towards increasing post-anthropocentric perspectives in participatory design approaches with living organisms. We argue that these perspectives become more important in biodesign as well. Thus, biodesign borrows from efforts in fields such as, Participatory Design and Interaction Design towards post-anthropocentric approaches. Furthermore, a focus on "care" as emphasized by various participants leads to expanded sensibilities towards living organisms. This more responsive approach deliberately instils ethical reflections, awareness of different aspects of care, and an increased capacity to envision perspectives of multispecies cohabitation. We further discuss the implications of this "fluid design landscape" below.

4.2 *A fluid design landscape*

Many of the materials and living organisms that designers work with in biodesign involve liquids and organisms that cross boundaries between previously held concepts (living vs. non-living, lab vs. home, designing with vs. designing for, etc.). Reflecting on a more *fluid design landscape* helps to articulate forms of methodological cross-pollination without installing new boundaries. The practitioners we interviewed repeatedly reflected upon how their lives became deeply intertwined with the living entities they engaged with. From keeping kombucha under their bed, pesto-relationships, and instructing housemates on their waste-management, to figuring out how to get rid of organisms, and witnessing slow deaths, they shared their lives with living organisms beyond the structures of labs or studios. A more *fluid design landscape* helps to methodologically guide these processes, the movement between them, and can reflect on which design activities and forms of care take place in certain spaces and not others. We also noticed that there is a huge gap in knowledge and methodology about how to collaborate and live with living organisms that expand beyond anthropocentric perspectives. Here, acknowledging the not-knowing and turning towards speculation showed to be a productive approach that enables us to engage, learn, and experiment with new encounters. This *fluid design landscape* aligns with the concept of "correspondence" (Gatt & Ingold 2013) that argues that design is "not so much about innovation but improvisation" (p. 145) and the idea that designing for sustainability is not about designing for endpoints but rather for "keeping life going" (p.144). As also stated by Westerlaken (2020), instead of offering single solutions, adding unfinished and expansive openings in negotiations with other organisms can make worlds richer. Such an approach leaves space for the living organisms and the living environment to talk back to the designer's different design moves/proposals in different design environments which expands on reflective conversations with materials (Schön 1983). Here, the designer needs to become more sensitive to the suggestions of the living organisms or environments which adds a new – and much livelier – dimension to Schön's original framing.

5 DISCUSSION

This paper has expanded on the qualities of collaboration with living organisms in design processes and how they bring about new relationships, require alternative design sensibilities and practices, suggest new design spaces, and challenge ethical dimensions. Reflecting on the prediction by Moisy & Pschetz (2017) who envision an advancement of biodesign practices towards programming or collaboration, we see a more responsive approach to biodesign in the more fluid space between labs, studios, homes, and the living world where co-habitations guide different design methods. This is not to say that these

practices become truly collaborative, in which living organisms are part of decision-making processes, but our research suggests that they do increase reflections and conversations around personal “definitions” on working ethics, how one could collaborate, how one could balance the needs of humans and organisms. These reflections are often triggered by surprising situations, failures, and emotional experiences in relation to the physical presence of living organisms. The study shows that designing with living organisms is usually not limited to one environment and its related procedures, tools and methods, but rather evolves as a dialogue between them. The home, as an expanding environment for biodesign work and the reflective practices it fosters with regards to cohabitation, for many participants inspired shifting practices of maintenance and forms of care for the living organisms they engaged with. This environment created more experimental modes of designing inspired by emotional involvement and the practicalities of cohabitations. The characteristics of care however have varying scales of intensity and expression as we could learn from our conversations. Participants told stories of thousands of invisible bacteria bathing in sugary water and thereby altering the smell-scape of an entire room, the adventures of escaping ants, penguins that end up playing with human hair instead of design prototypes, and mealworms that are feeding on styrofoam. Such surprising experiences changed the practitioners, and thereby the living organisms affected their design processes.

By reflecting on these biodesign projects together with our participants, and questioning the environments in which they take place, we hope to contribute to design spaces becoming more open and fluid, to facilitate cross-pollination of methods, designs, and proposals made by other species.

In the context of biodesign as an emerging field, we also see the need for sharpening visions to less anthropocentric approaches and more focus on how design processes can be guided by, or inspire multispecies cohabitation, topics which we discussed extensively in our interview study beyond what we could cover in this paper. Here, biodesign poses an opportunity that, if taken on, expands the design landscape and the perspectives under which we design and live today.

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