

with” (Szaniecki, 2019, p. 3). She invokes Haraway’s term ‘response-hability’ (2016) to highlight the relevance of sympoiesis in the field of design: “It is the resurgences arising from response-hability as the capacity to respond to the challenges of the moment that particularly interest us” (Szaniecki, 2019, p. 4). Additionally, she adds:

Thinking about more sensitive ways to capture and make world in the complexity of the fabric of relationships between humans, non-humans, and things is a challenge for those who intend to make design a tool for transformation towards sustainability (Szaniecki, 2019, p. 8).

Reune Frankjaer (2019) leans on the concept of sympoiesis for her research and design processes. She says:

sympoietic processes are unpredictable as they find their form in response to encounters with the various elements in a given environment, i.e. they may meander and move in unanticipated directions. [...] In sympoiesis, all parts are considered active partners in the creative process. Humans, nonhumans – whether organic or inorganic, physical or virtual - the dead and the living, all come together in multifaceted arrays of complex interactions out of which something new can emerge (Frankjaer, 2019, p. 4).

Considering what has been highlighted from the presented texts, by Haraway and designers who are thinking of sympoiesis as a projectual practice, we understand that sympoiesis is inevitable, it happens whether one wants it or not. A sympoietic design attitude, however, chooses the making-with, involves the others –living, non-living, human or non-human–, and considers interferences as welcome, or at least, accepts them as part of the journey. This attitude adds life and complexity to processes and projects, teaching us about response-hability – the dynamic capacity to question and respond with/in a world of simultaneous global and microscopic transformations.

A project/act of living that might help us understand sympoiesis in a projectual way is the living bridges in Meghalaya, India. These bridges are part of the culture of villages interconnected above and across rivers (See *Figure 7*). Made from the roots of the rubber tree (*Ficus elastica*), some bridges are centuries old, with the oldest estimated to be 700 years. They are planted by the riverside with the intention of facilitating the transit of people between villages, farmlands, and market centers (ARTE.tv Documentary, 2022).



Figure 7.
Living Brigde in
Meghalaya, India,
photographed
by Aliaksandr
Mazurkevich (Source:
[https://shorturl.at/
jqUV1](https://shorturl.at/jqUV1)).

It takes forty to seventy years for a bridge to develop roots strong enough to be crossed, depending on environmental conditions, soil health, tree health, and the humans who intertwine and tie them. Thus, it is common for bridges to be built for future generations, reflecting a community's solidarity and visionary thinking about continuity (ARTE.tv Documentary, 2022). It is also expected that care and maintenance will be passed down through generations. The process of making, or perhaps, co-creating with the tree, occurs annually during the rainy seasons when the roots are more pliable. The elder's nurturing of care and attention for the trees instills knowledge and interest in the younger generations (ARTE.tv Documentary, 2022).

The example and descriptions provided help form the beginning of a definition and understanding of the term. However, like Szaniecki (2019), we believe that experimental practice in the field is crucial for a comprehensive and tacit understanding of sympoiesis as a pathway in design. Therefore, beyond theoretical explanations and the projectual example, we propose some experiments with mycelium composite, considering a sympoietic attitude.

Mycelial Experiments

We then introduce an experiment that seeks to perceive and accompany the creative and dialogical capacity of mycelium, as well as the sensitivity and respons-hability of the designer throughout the processes of experimenting and crafting with fungi as an active material (mycelium composite). Mycelium also serves as inspiration and metaphor for sympoietic attitudes, due to its networking behavior, interconnecting different species, and its role as a decomposer of organic matter, enriching the soil and allowing the continuation of cycles.

Although mycelium presents itself as a vast enterprise promising to solving lots of challenges from our times, this experiment is rather simple. It aims to align the work of the de-

signer with mycelium closer to sympoietic concepts. For the practical experience, beyond seeking attitudes aligned with the concept of sympoiesis (making-with), we utilized the method of Research Through Design (RTD) and Material Driven Design (MDD).

RTD emphasizes the design process as a means of investigation and discovery to refine ideas and generate knowledge, allowing the designer to explore various possibilities and discover new perspectives (Frayling, 1993; Godin, 2014). MDD focuses on materials as the starting point for the creative process, where materials are seen as active agents in design development, influencing its form, function, and aesthetic expression (Karana, 2015).

The experiments were guided and conducted with fungi. Handling mycelium, finding it in the woods or the supermarket, observing its growth, offering nutrients, witnessing the decomposition of matter and the fruiting of mushrooms –each in its own way– brings us closer to a previously unseen universe, opening us up to the understanding of multispecies life, care, and the continuous transformations of cycles and their ends.

Fungi are multicellular organisms with filamentous growth; these filaments are called hyphae, and a mass of hyphae is what we refer to as mycelium. It is the living, metabolically active part of fungi that grows and absorbs nutrients. For Sheldrake, “Mycelium describes the most common of fungal habits, better thought of not as a thing but as a process: an exploratory, irregular tendency” (Sheldrake, 2020, p. 12).

If fungi are placed within a mold with nutrients (substrate), at the right temperature and environmental conditions, they grow and conform to the shape delineated by the mold. The aim of the experiment, then, is to produce figures with initially defined outlines, which gradually become altered by the growth of the fungi.

The chosen fungus was *Pleurotus* sp., commonly known as Shimeji (See Figure 8). The specimen used was purchased from a supermarket and cloned in an adapted laboratory I’ve set up in my living room – a DIY laminar flow and a DIY incubator. These equipment help with some of the steps in working with fungi, maintaining favorable temperature conditions and hygiene to avoid unwanted contaminations. However, you still need to touch the fungi and the substrate during the process, maintaining a physical closeness with these beings.

Having the lab at home allows for closer proximity to these beings and a routine of care that would be difficult to replicate in a workplace. Often, constant monitoring allows us to notice subtle changes in smell or appearance that can signal needs or contaminations, communications perceived through the sensitivity of daily life.

The substrate acts as both the nutrient source for the fungi and their corporeal extension. Mycelium expands by incorporating and unifying the matter to form a solid structure. Our substrate composition includes cellulose waste (paper, cardboard), rice flour, yerba mate residue, and water (See Figure 8).



Figure 8. Pleurotus sp. and paper substrate (Author's archive).

We crafted molds in specific shapes, named as cube, semisphere, perforated cylinder, stair, ameba1, and ameba2 (See Figure 9). The selected shapes were to ascertain if fungi shows preferences for certain spatial qualities for their healthy growth—whether they favor sharp or rounded edges, flat or convex surfaces, thicker or thinner pieces. The molds are used to contain the fungi and their nutrients during growth; this is a moment where the form is imposed by the designer, and the mycelium can grow only within the confines of the material.

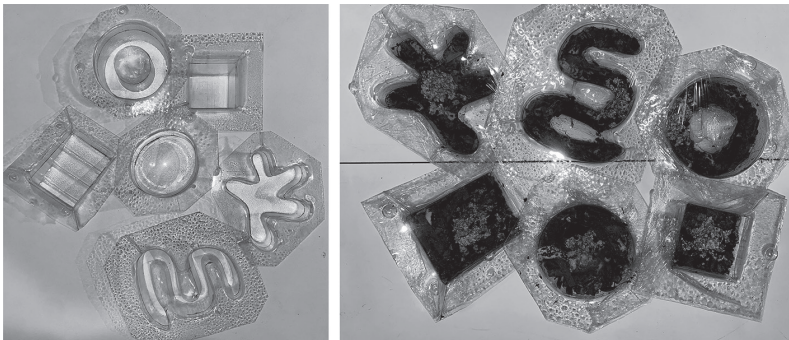


Figure 9. PETG molds (Polyethylene Terephthalate Glicol) (Author's archive).

A second phase of growth occurs when we remove the mycelium from the mold, allowing it to expand beyond its previous containment – sometimes, the fungi themselves initiate this movement, pushing through crevices and finding new paths. At this stage, it is the designer's responsibility to maintain the appropriate environmental conditions (temperature, humidity, and light) for the growth of the fungus as well as to observe and let go of the originally proposed shape. This could be a moment of contemplation or agony, but their manifestation and disobedience to the 'perfect' geometries (See *Figure 10*) encourage us to nurture a dynamic of negotiation, care, and respect.

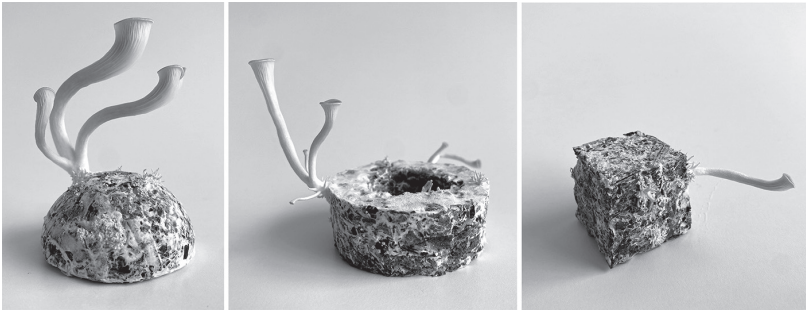


Figure 10. Experiments with *Pleurotus* sp. and paper leftovers (Author's archive).

Conclusions

In proposing to work alongside other species, we open ourselves to understanding diverse ways of living and world-making. This shift not only has the potential to transform the project and its impacts on the world but also the designer, who becomes attuned and sensitive to alternative possibilities of creating-with. Design, acting as a bridge-discipline, can help make visible the myriad ways of cohabitation.

As discussed in this paper, introducing sympoietic practices into the design field goes beyond merely incorporating other beings as functional components. 'Making-with' involves sharing responsibilities, learning together, experimenting, observing mutual and opposing needs, and maintaining an ongoing negotiation.

In this studies on sympoietic design, we discern a profound disparity between the functional mycelium composite projects depicted in *Figure 2*, and the soil grown chair in *Figure 4*, as compared to projects from *Figure 5* and *Figure 7* –the Yanomami's Përisi baskets and the Meghalaya's living bridges. The latter stand as testaments to a deep-seated symbiosis between human craft and natural ecosystems, showcasing an integration of life forms in

a continual symbiotic design process. These ancestral practices speak to an ingrained understanding of simpoiesis – not as a concept to be applied, but as an inherent way of life, manifest in the enduring resilience and adaptability of their creations.

In contrast, our contemporary design experiments are but nascent gestures, clumsy attempts to engage with the complex tapestry of life that our predecessors (not only the humans ones) have long since mastered. As we in the design field strive to establish sympoietic relationships, we must humbly acknowledge that we are only starting to understand how to collaborate with other forms of life, appreciate their intricacies, and integrate their perspectives into design practices.

By now, we have a good understanding of the whys and benefits of including other species in the design processes. We have introduced the concept of sympoiesis, examining the context in which it is situated and applied, particularly in dialogue with biodesign. A sympoietic design approach, as we comprehend at this point of our journey, revealed through theoretical studies and practical experiments, recognizes design as a living process. Begins with acknowledging interdependencies and engaging deeply with the entities we work with, understanding their lifeways, preferences, relationships, and roles in world-making. Control in this context is decentralized, embraces the flux of transformation, and welcomes unpredictability as a source of creativity and innovation. It requires ongoing negotiation and adaptation of desires, methods, and timelines, ensuring that the design process remains a responsive and inclusive dialogue.

The practices and principles we have outlined are preliminary, illuminating a path rather than a formal methodology; it is the beginning of an ongoing dialogue with complexity rather than a finalized set of instructions. Our hope is that continued practice will yield more precise directions, yet we recognize that the intrinsic nature of simpoiesis –open and nonlinear– will preclude a rigid methodology. Crafting sympoietic tactics requires us to leave room for the specificities of the involved beings, trusting them to also guide the process.

In presenting this article, we extend an offer to join us in the dynamic field of multispecies experimentations. Our initial endeavors in biodesign, set against the backdrop of ancestral practices, have highlighted the gaps in our current understanding and application of living design principles. The way we found to start then was playing, trying to connect-with and then to create-with the fungi. We encourage an embrace of the rich possibilities that arise from collaborating with the more-than-human world, initiating a shift from using to connecting and designing-with. As the landscape of design transforms under the weight of ecological urgencies, our article serves not as a conclusion or solution, but rather as a call to embrace other-than-human perspectives and creative possibilities.

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Resumen: Debido a las drásticas transformaciones en las condiciones para la vida que se están produciendo en el Antropoceno, se hace necesaria una reevaluación de las formas de ser y concebir el planeta. Por lo tanto, se vuelve crucial superar la supuesta dicotomía ser humano-naturaleza, comprendiendo y practicando su inseparabilidad e interdependencia. En el campo del diseño, el biodiseño ofrece una oportunidad en la dirección indicada (Myers, 2018; Langella, Fiume, 2023), abriéndose a actividades creativas que integran sistemas biológicos. Podría observarse que dicha integración puede darse con otros sistemas biológicos como objeto de la actividad humana de diseño, pero también como posibles socios. En este trabajo se pretende especular sobre nuevas relaciones de diseño abiertas a intimidades interespecíficas y guiadas por la simpoiesis (Haraway, 2016), por el “hacer-con” la naturaleza como socia en la convivencia y la creación, y no como recurso. Para ello, el artículo presenta una visión general de los campos del biodiseño y el diseño multiespecífico, algunas referencias basadas en proyectos y una experiencia de diseño elaborada siguiendo el método Research through Design (RtD) y adoptando un enfoque de diseño inspirado en el Material Driven Design (MDD) (Karana *et al.*, 2015; 2018). En esta experiencia ejercitamos las ideas de simpoiesis y convocamos a los hongos, ya que el trabajo creativo con hongos presenta un potencial de conexión y encantamiento con otras formas de vida.

Palabras clave: Biodiseño - Diseño multiespecie - Simpoiesis - Antropoceno - Interdependencia - Hongos - Compuesto de micelio - Proceso creativo - Investigación a través del diseño - Diseño basado en materiales

Resumo: Devido às drásticas transformações nas condições de vida que estão ocorrendo no Antropoceno, é necessária uma reavaliação das formas de ser e de projetar o planeta. Portanto, torna-se crucial superar a suposta dicotomia homem-natureza, compreendendo e praticando sua inseparabilidade e interdependência. No campo do design, o biodesign oferece uma oportunidade na direção indicada (Myers, 2018; Langella, Fiume, 2023), abrindo-se para atividades criativas que integram sistemas biológicos. Pode-se observar que essa integração pode ocorrer com outros sistemas biológicos como objeto da atividade de design humano, mas também como possíveis parceiros. Neste trabalho, pretende-se especular sobre novas relações de design abertas a intimidades interespecíficas e orientadas pela simpoiese (Haraway, 2016), pelo “fazer-com” a natureza como parceira na coexistência e na criação, e não como um recurso. Para isso, o artigo apresenta uma visão geral dos

campos do biodesign e do design multiespécie, algumas referências baseadas em projetos e uma experiência de design elaborada seguindo o método Research through Design (RtD) e adotando uma abordagem de design inspirada no Material Driven Design (MDD) (Karana *et al.*, 2015; 2018). Nessa experiência, exercitamos as ideias de sympoiesis e convocamos os fungos, uma vez que o trabalho criativo com fungos apresenta um potencial de conexão e encantamento com outras formas de vida.

Palavras-chave: Biodesign - Design multiespécies - Simpoiese - Antropoceno - Interdependência - Fungos - Micélio-composto - Processo criativo - Pesquisa por meio do design - Design orientado por materiais
