THE BREAD WITHOUT FORM: ATTUNING TO RELATIONAL WAYS OF MAKING THROUGH CONVIVIAL BAKING PRACTICE

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ABSTRACT

This paper investigates the notion of form as a relational process rather than a fixed attribute of things. Through the lenses of contemporary design theory and symbiotic conviviality, we present a snapshot of the first author's bakery practice, where the ever-emerging form of sourdough bread is used to discuss ways of attuning differently to dominant understandings of design, making, and materiality. The case presented here follows a practice-led research approach, with different sources of data captured through documentation and reflection. Our findings illustrate the methodological potential of baking to explore form-making as a convivial and symbiotic process. We conclude by laying out a few implications of employing practices of 'making-with' as a guiding principle to anchor design activity in an ethos of regenerative, evolutionary, and co-existence-based survival, thus prioritising care and signaling a shift away from the domesticating role of the designer.

FORM AS A RELATIONAL PROCESS

The prevailing discourse on form-making within design has traditionally been structured around a hylomorphic paradigm, where form is understood as a preconceived, desired result imposed upon matter by a designer. This model reinforces a hierarchical dynamic between maker and material, privileging human intentionality over material and other-than-human agencies. Contemporary perspectives in design research problematise this deterministic mode of relationality, advocating instead for a *morphogenetic* understanding that situates form as an emergent phenomenon that acknowledges complex, multiple forms of relationality that encompass both human, non-human, material, and immaterial actors (Ingold, 2013; Gürsoy, 2016; Redström, 2017).

Anthropologist Tim Ingold (2013) offers a critique of the hylomorphic model, asserting that making is not a unilateral act of imposition of form but an ongoing engagement with materials in flux. He contends that materials are not passive substrates but active participants in a continual process of becoming. Within this framework, the maker does not have control but instead negotiates material form through a dialogical approach (Aktas & Mäkelä, 2019). Ingold (2005; 2007) uses two paradigms of making to compare the hylomorphic model and the morphogenetic one: the *transport*, which is goal-driven and prescriptive, and the *wayfaring*, which is exploratory and emergent. In the latter, form is dynamically enacted through the interplay of material properties, environmental conditions and the attentive responsiveness of the maker.

Within the morphogenetic paradigm, making is increasingly understood as an epistemic practice rather than the sole actualisation of designed outcomes, meaning that the act of bringing something into being

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can be understood as a way of knowing in its own right (Vega, 2021, p. 271). Design scholar Johan Redström (2017) reiterates this idea, proposing that making constitutes a legitimate mode of inquiry rather than a mere mode of production. In doing this, he critiques dualistic design theory that categorically separates conceptualisation from materialisation, proposing instead that concepts are emergent within the act of making itself. Similarly, architect and researcher Benay Gürsoy (2016) proposes the notion of *making for*, referring to the activity whereby "uncertainty in the processing of the matter is valued over the control and accuracy" (p. 855, see also Gürsoy & Özkar, 2015). These perspectives create a rupture with the conception of design as an imposition of structure, form, and meaning onto passive matter, supporting instead an understanding of making as a continuous, flowing engagement with the multifaceted agency of materials.

Cognitive archaeologist Lambros Malafouris (2023) explores the role of chance and material agency in his discussion of seizing uncertainty in material engagement, emphasising that form-making involves non-deterministic events that happen through the entanglement of human desires and material responses. He suggests that accidental occurrences are not failures of control but rather constitutive elements of practice. The practitioner does not impose a design but negotiates with the material's affordances, resistances, and transformations.

For design practice, this foregrounds the need to embrace other-than-human entities as active participants in the process of form-giving rather than passive recipients of material form. This perspective has profound implications for how we think about knowledge production in design, translating focus from control to collaboration and attunement, or what Ingold refers to as the education of attention (Ingold, 2000). These ideas allow us to expand current theoretical frameworks in design and lay the ground to discuss more convivial, symbiotic, and multi-actor perspectives. To summarise, we contend that form is not shaped only by (human) intentions but by an extended agency that includes social, material, and environmental forces.

CONVIVIAL, SYMBIOTIC, AND MULTI-ACTOR PERSPECTIVES OF FORM-MAKING IN DESIGN

This paper presents a case of form-making extracted from the first author's bakery practice, where form is explored as a relational process based on the theoretical framing introduced above. Building on the idea that form emerges through relational interactions—and most particularly because our case deals especially with non-inert/alive and lively material configurations—we find it relevant to expand our positioning to conviviality, symbiogenesis, and multi-actor participation in making. Each of these concepts offers valuable perspectives on its own. When brought together, however, they emphasise that creative processes need multiple agents (human and non-human) working in interdependent negotiations and correspondences over time (Ingold, 2013).

Conviviality, as proposed by philosopher Ivan Illich (1973), refers to a situation whereby individuals, tools, and systems enable cooperation and self-organisation rather than hierarchical, centralised control. Anthropologist Anna Tsing (2015) expands on these ideas and offers alternative readings to understanding modes of collaborative survival embedded in precarious but interdependent lifeworlds. These ideas are interconnected and nourish each other with feminist theorist Donna Haraway's (2016) conceptualisation of *sympoiesis*, which amounts to a process of 'making-with.' Here, they extend these perspectives by questioning human-centredness and the idea of authorship while bringing forward a canvas where making is an entangled process that expands to operate at eco-systemic scales. Another theoretical perspective that can contribute to this understanding is the *symbiogenesis theory* developed by biologist Lynn Margulis (1991). It proposes that biological evolution is driven by cooperation rather than competition, an idea that challenges the dominant and widespread Darwinian understanding of evolutionary dynamics.

We embrace these concepts in the framing of the practice investigated in this paper, discussing how making and form emerge from interdependence, co-existence, and co-evolutionary forces that decenter the domesticating role of the human (and, in this case, the designer). In this view, making is also a relational and political commitment that necessitates careful attention and resists extractive, purely instrumental modes of production (Puig de la Bellacasa, 2017). Bringing forth care and time as integral to making, the perspective we present here foregrounds how designing and form-making are deeply embedded, ethical, and political practices. The convivial, symbiotic, and multi-actor perspectives we highlight here situate the central inquiry of this study: *How and why does form emerge in contexts where making is not based on a designer's intention but a convivial, symbiotic, and multi-actor process?*

Against this backdrop, sourdough bread-baking enables a multi-layered means to approach the question posed above, as it embodies and embeds different modes of material engagement that are relevant to designing at large. Baking, for instance, implies being-with and becoming attentive to living cultures, understanding ingredient properties and qualities, and responding to changing environmental conditions. In the same vein, designing demands coupling with dynamic socio-technical contexts, harnessing material affordances, and adapting to evolving circumstances (Vega et al., 2023, p.

3). By studying how form emerges through a negotiation with sourdough bread, bakers, and climate conditions, we are looking at the broader dynamics of form-giving through attunement and engagement with multiple actors that concur in this generative process. Baking is thus a case that amplifies the relational character of design activity as understood from a morphogenetic perspective.

MATERIALS AND METHODS

The research setting presented in this paper consists of a snapshot (Flick, 2014) of the activities of *Panicuocoli*, a commercial sourdough bakery established by Author 1 in Helsinki, Finland. The bakery grew from a personal project which was active from 2020 to 2023 to a full-time commercial project operating between 2023 and 2024 with the number of employees oscillating from one to four. Two sales points were active during the day, and the bakery had presence in at least one local market per week during the evenings.

The bakery originated from the author's personal passion paired with his academic interests. Yet, when transitioning from being a home-based activity to a bakery with a dedicated kitchen and later to a bakery with a point of sale in the city's main market hall (Figure 1), the desire was for the place to be open and plural, countering a common narrative in the industry that sees a master with its workers to a place where alternative ways of baking bread are possible.

Figure 1. Bread counter at the Helsinki Market hall. Image: Gianluca Giabardo.

This approach mirrors an ongoing effort in design practice and research, which challenges the view of the designer as the primary agent who imposes form and meaning over intended or preconceived material outcomes (see Gürsoy & Özkar, 2015). Instead, it opens up an understanding of designing as an inherently relational endeavor, where form emerges through the collective engagement and attunement to multiple actors, be they human or non-human.

Author 1 envisioned a scenario where bread baking was all and whole: bread would function as the subject matter being researched while also being the raw material that would sustain and finance the commercial project. He worked as a baker alongside others, meaning that the practice that served as a case for this study was a collective effort that attended to the ongoing needs of the bakery.

Figure 2. Aliisa dough ready to go into the oven. Image: Gianluca Giabardo.

The bakery produced only organic bread and had obtained a certification for it. The bakers only used local ingredients when baking sourdough bread; flours were sourced directly from farmers who had grown and milled them directly or through third-party mills. This exposed the bakers and the operations to variations in quality, variety, origin, and characteristics of the raw ingredients as the ordering cycle of the bakery was weekly or twice a month. The bakers observed and recorded variations related to two subsequent harvests and noted different availability of the cereal varieties they had gotten used to mixing in their dough. They also noticed differences induced by having flour delivered with non-consistent milling or milled by different machines or mills.

The bakery initially tried to search for substitute producers of the same kind of varieties it initially used and developed its own recipes around, but the bakers soon decided to adapt (the bread) to what was available and to sustain the activities of the local farms.

This practice of situated care and contextual adaptation is comparable with ways of doing design that embrace diverse environmental rhythms, material variations and

temporalities, and openness to uncertainty and experimentation (see e.g., Aktas & Mäkelä, 2019; Gürsoy & Özkar, 2015; Vega et al., 2023). Giving up dominance and control, when working with the living, bakers—and designers—can learn to be-with, attentively read, and respond to evolving conditions to enable the emergence of new forms and possibilities.

Among the types of bread produced by the bakery, this paper concentrates on two varieties: *Campagnolo* and *Aliisa* (Figure 2). The former is a country loaf, meaning a type of loaf that is traditionally baked from a blend of flours that are available from the local fields, and which historically would be the everyday bread baked by farmers in central and southern Europe; whereas the latter is a 100% wholegrain rye bread baked using a traditional Finnish process.

The practice performed as part of this study demanded fluidity and adaptability to various circumstances, requiring the bakers to respond, for example, to the ingredients' seasonal and qualitative variations. Typical of design research involving practice (see e.g., Dixon, 2020; Redström, 2017; Vaughan, 2017), this responsive approach extended beyond process-oriented adjustments to embrace local agricultural cycles and their inherent variabilities, which ultimately transferred this input into the final baked products. By trying to foster an open and plural environment, the practice challenged established hierarchical structures, letting the bakers to experiment with other ways of *being* and *making-with* others (Haraway, 2016). It is important to mention that the practice-led setup was not artificially bounded by a preformulated research question, but was instead run as a commercial operation that demanded the fulfilment of its own needs, conditions, and time scales. In this case, the practice itself became a prototype, originating organically through making rather than being synthetically designed as a site to conduct research (see Pawar & Redström, 2016, p. 74). This meant entering into a place and space where Author 1, along with the rest of the bakers, prototyped a practice, and practiced within the prototype (see Vega, 2024, pp. 38-39).

Unlike the more conventional, ‘design thinking’ way in which prototyping is conceived, where the aim is to explore, test, and refine predetermined ideas to obtain an envisioned or desired result, this practice emerged through its own doing (see Ingold, 2000; 2013). The bakery and its practice were an instance that was not pre-planned to verify an idea or iterate it, instead it materialised a need/desire that prototyped itself into being—a place and space that became available to the human practitioners in their own terms, and that was attentive to the correspondence between them and other agencies. This circumstance collapsed the space between our construals of prototyping *as* practice (i.e., an activity where a material outcome is being made and refined) and prototyping *a* practice (i.e., an activity where what is being made and refined is the activity itself) as both happened concurrently.

We define this complex, ongoing design situation as an *emergent prototype*, which emphasizes how material doings (practices) and material outcomes (prototypes) are intertwined and co-constitutive, with fluid, unstable, and undesigned boundaries (cf. Pawar & Redström, 2016, p. 82; Vega, 2024, p. 40). In contrast to more traditional modes of prototyping, which are operationalised by refining material outcomes (as in the methodological traditions of lab and showroom studies, see Koskinen et al., 2011), emergent prototyping emphasises processes and practices. The primary aim is not to extract insights from an intended material outcome but to explore and comprehend *practice* through the very act of practising. The material outcomes generated by this process (e.g., bread) serve as catalysts for generating new insights and facilitating alternative ways of thinking in action. In this particular case, the bakery functions as a place for experimentation but also as a living example of our object of inquiry: it embodies the complexities and dynamics of form-making through convivial practice, where form-making is both our phenomenon of interest and the process that shapes the research setting that allow us to explore this phenomenon.

On this note, it is important to acknowledge that although we bound this paper to a specific timeframe, we are, in fact, taking a snapshot of a continual process of becoming. The bakery operation was more than a site of production; it was a space where the practice itself generated new relational understandings that outlived the specific spatio-temporal process of making we are considering in this paper.

DATA COLLECTION

This paper uses a practice-led design research approach (see Mäkelä & Nimkulrat, 2018; Redström, 2017; Vaughan, 2017). We gathered data using different methods that included production logs, written documentation, retrospective observation, and self-reflection (Mäkelä & Nimkulrat, 2018). All data were collected by Author 1.The methods presented here were adapted to fit the intense everyday rhythm of the work and not interfere with the ongoing operations of the bakery. A summary is presented in Table 1.

Data collection was conducted over a four-year period from 2020 to 2024 to span the initial home-baking project through the end of the bakery operations using multiple documentation methods. Author 1 maintained a systematic production log on its recipe calculator and on paper during 2023-24, recording the amount of bread produced each day, its type, as well as the ingredients’ proportions and variations. Raw ingredients procurement and specifications were tracked through email correspondence and invoices as well as in the

Table 1. Data collection overview

Time frame	Method of data collection	Type of data	Data capturing tool
2023-2024	documentation	Production log	Digital recipe calculator and paper log
2023-2024	documentation	Raw material orders	Email, invoices, and organic self-control log.
2020-2024	retrospective observation	A1's baking process	Notes
2020-2024	Documentation and self-reflection	Audio recordings	Telegram chat

organic production log throughout 2023-2024, providing a detailed record of material choices and sourcing decisions. The process was further documented through audio recordings, which were archived in a Telegram chat (2020-2024), capturing Author 1's process, as well as retrospective observations and reflections.

The subsequent analysis is structured upon four dimensions aimed at capturing both the chronological and the interpretive aspects of the data considered (see Table 2). The *Time frame* column is the temporal sequence of events, tracking the order of material interactions and decision-making. *Type of data* identifies the format of documentation providing reference to the nature of each entry. *Data content* presents the documented interactions, exchanges, and observations. Finally, *Observations and reflections* captures the reflexive dimension, documenting immediate responses, technical insights, and emerging understandings about material behaviors and their implications. This structure enabled an analysis that allowed for a reading of the documentation through the experiential knowledge of Author 1 (see Mäkelä & Nimkulrat, 2018).

DATA ANALYSIS

We used a *diffractive approach* to analyse how different elements of the bread-baking practice interfered with and shaped each other, allowing us to trace multiple patterns and possibilities that enabled the generation of form. Diffraction, in this context, is not about reflecting on isolated pieces of data but about reading data relationally to understand the entangled effects of human and other-than-human agencies (Haraway, 2004). Moving beyond a reflective approach, where data can be read to produce a mirror-like image that 'talks back' to the researcher (Mäkelä & Nimkulrat, 2018), a diffractive analysis involves reading multiple insights through one another and from a multiplicity of perspectives. Diffraction thus facilitates an analytical procedure "in which data can be reoriented to explore the creation of new relationships" (Vega, 2024, p. 41). In other words, whereas reflection allows researchers to understand what certain pieces of data could mean, diffraction implies asking *what else* those pieces of data can produce.

This approach led us to close-read our data with a focus on difference—not to find consistency, but to account for how form emerged in a context where the bakers and other-than-human agencies were making-with (i.e., convivially) and co-evolving (i.e., symbiotically) in practice. In such a way, we examined how material changes created a network of interconnectedness through baking. When reading our production logs through raw material order records, we observed how different flour types interfered with production rhythms, prompting adjustments in kneading time, hydration levels, and batch size, which in turn opened up new possibilities for the emergence of form.

For instance, when the *Sangaste* rye became unavailable, the bakers initially approached this as a simple ingredient substitution. However, reading this material change through their production logs revealed how the new rye's properties challenged established ways of making, generating changes in baking modalities: the loss of honey and acidity notes that came with the new rye variety did not simply lead to adaptation or acceptance; they prompted an acknowledgement of how the flavour profiles and characteristics develop through the interaction of grain (varieties), milling methods, and fermentation processes. Recognising these features implies a deeply embedded form of experiential knowledge that can only emerge through practical and attentive engagement with materials.

When examining flour combinations in the recipe mix, the bakers observed how variations and experimentation with different relative ratios of cereal varieties allowed for the emergence of possibilities for bread to acquire form. When the sifted *Dala* flour ran out, they mixed Farm 2's strong but extensible flour with einkorn and spelt or emmer wholewheat, and they were allowed to learn how strength, tenderness, taste, and mouthfeel could become in the baked bread. By varying proportions to allow for each ingredient to express its potential, the bakers were able to experience alternative, in-becoming forms. This opened up new perceptual insights about form-making that were not predictable from either flour's individual characteristics, and that emerged only through the practice and from being-together-as-many with all the other interdependent actors in the process of baking (see Haraway, 2016; Ingold, 2013; Puig de la Bellacasa, 2017).

Our documentation of observed milling variations provided another possibility in our effort to understand what was happening. When Farm 1 delivered finely milled *Dala* wholewheat flour, the bakers contrasted it

Table 2. Chronological record of the data used in this study

Time frame	Type of data	Data content	Observations and reflections
W36/2023	Raw material order email+ phone call	Bad harvest for Öland, it's not available. Farm 1 suggest switching to wholegrain Dala	
W38/2023	Production log	Wholegrain Dala is delivered, but it's milled very fine to use all the grains in storage and make it usable for baking.	Mixing and shaping bread changes substantially. Weaker gluten structures, unpredictable proofing and fermentation, flat loaves
W39/2023	Raw material order email	Order from Farm 2 of their more modern wheat, which has a strong but very extensible gluten	Trying varying the mix of the Campagnolo to obtain a tasteful but easier to handle dough that is more consistent
W40/2023	Raw material order email + phone call	Exchange with Farm 1 regarding the change of rye variety that was delivered	Sangaste had a bad harvest and was not available that year. Farm 1 substituted it without initially informing with some other rye variety milled by another mil. Taste was very mild, and it lost all honey and acidity that sangaste had.
W41/2023	Production log	When sifted Dala also runs out of stock, we substitute for the Farm 2 sifted strong flour and mix in a bit of einkorn sifted flour from Farm 1	The sifted Dala is an heirloom variety that gives a soft dough mix with a very "gentle" gluten structure and a melting crumb when baked. Farm 2 white flour is much stronger yet more extensible, but missing the melting taste due to its strength. Mixing-in other, tasty and weaker flours, we try to find a new balance
W2/2024	Raw material order email	Substitute Dala wholewheat with a mix of emmer and spelt from Farm 1	The new wholewheat mix contributes a renewed flavour profile that was becoming very flat due to missing the Sangaste rye for the starter and the Öland for the wholegrain part
W3/2024	Raw material order email	Ordered wholegrain rye from Farm 2 to test	Very freshly milled flour, still having quite a lot of own humidity retained and very active in fermentation. Had to change the hydration of the dough to obtain the needed consistency and closely monitored the fermentation time

with their previously assumed standard milling characteristics of the *Öland* wholewheat. This action of remembering (how baking with *Öland* was) and exploring (how baking with finely milled *Dala* is) generated new understandings and consequences for gluten development, fermentation characteristics (e.g., speed, consistency, and flavour development), and the behaviour of the mixed dough. When reading these variations in the light of our production, daily adjustments showed how form emerged not through mastery and control over the involved actors, but through adaptation, understanding, and intuitive embracing of fluidity aimed toward attuning to new material properties, technical constraints, and necessary adaptations.

FINDINGS

Throughout this study, we understood that the form of bread neither pre-exists its becoming nor is predefined, but emerges through the dynamic processes of negotiation and interaction among a multiplicity of actors. Within—and through—the work performed in the emergent prototype that supported this mode of symbiotic conviviality, we illustrate how and why form emerges in contexts where making is not based on a designer's intention but a convivial, symbiotic, and multi-actor process. Below we outline the two main practical implications of this study, focusing first on the effects of understanding form relationally and subsequently on the potential of symbiotic conviviality as a framework to anchor design activity in an ethos of regenerative, evolutionary, co-existence-based survival.

THE FORM OF BREAD AS A SYMBIOTIC PROCESS

The form of bread is not a predetermined characteristic imposed upon inert ingredients but emerges dynamically through a process that is attentive to the correspondence of material and discursive practices. In the baking of *Campagnolo*, the final form evolves through the active interplay of, for example, a blend of different flours, the environmental context, and the intentions of the baker. The properties of flour, water, and starter cultures directly influence the dough's texture, appearance (see Figure 3), and flavour, exemplifying and making accessible the idea that materials entail their own agency and vitality (Bennett, 2010).

The process of form-making is simultaneously shaped by discursive activities that accompany the practical part of the work. The bakers' ongoing observations, reflections, adjustments, and documentation are not only records, but elements that participate in an effort to negotiate and interpret the emergence and unfolding of form. This effort articulates the continuously changing state of the dough, and it posits baking as a practice where the formation of meaning, matter, understanding, and knowledge is produced and experienced in and through practice (see Ingold, 2013; Redström, 2017). This speaks of an expansion of the idea of correspondence between maker and materials, where form emerges through attunement to material flows as well as through understanding an extended social dimension that includes "things", actions, feelings, and meanings that lie beyond fixed socio-technical categories.

Figure 3. The crust opening at the scoring of Campagnolo, after baking. Image: Gianluca Giabardo.

Seen in this light, and through our case, practices of bread-baking provide an exemplary means to refute conventional hylomorphism, as there is much more beyond matter that is at play. Bread and its forms are seen as emergent, arising from dynamic interactions within what we may call an *extended terroir*. This refers to a site that embraces not only the environmental conditions of production but the entire ecology of the practice. This extended terroir includes at least the physical characteristics of ingredients, technical mediations, microbial activities, and social relations that contribute to the bread's becoming (Trubek, 2008; Paxson, 2010). Bread is an agri-cultural product, but not all bread can speak of its origin, manifest the taste of its ingredients and of the land it originates from. This is due to bread becoming an industrialised product where its core ingredient is not anymore able to tell of its origins and path but is instead just used to offer a gluten scaffolding to other ingredients with the goal of maximising production volume, speed of production, and profit.

Speaking of terroir and bread is thus also a tool to reconnect food to a condition where baking is always *baking-with* as it is a concretely sympoietic, convivial, and relational achievement afforded by the interplay of multiple agencies. We suggest that adopting such a lens can substantially benefit other forms of design practice, particularly because it entails a hands-on approach to understanding relationality and sustainability, as well as how the correspondence between material origins and trajectories have an effect on intended design processes and outcomes.

SYMBIOTIC CONVIVIALITY AS A FRAMEWORK FOR REGENERATIVE, EVOLUTIONARY, CO-EXISTING SURVIVAL

In this light, the bakery functions as a site that goes beyond the production of bread to become one where multiplicity is not only possible but also *visible* and *researchable* through the materialisations of dough and bread. When reading these symbiotic occurrences, we are drawn to the human point of view: we are the ones writing, yet the bakery and the bread challenge this duality and propose an alternative to integrate multiple agencies and points of view.

All actors co-exist to be able to exist; they co-evolve in continual symbiogenesis. Illich's conviviality, which reasserts individual freedom in interdependence, and the ability of controlling the tools that grant our survival and challenge the mass-produced capitalist system that controls the production, is used here also in an expanded acceptation to include the original meaning of living-with. We cannot own the tools but only make-with them. This small but significant shift allows for a renewed understanding of how "making kin" is the foundation of our interwoven fabric of existence

(Haraway, 2016). Thus, *cum-vivere*—conviviality or living-with—speaks of a sort of living, fluid, emergent commons where dualistic boundaries are dissolved into everyday/domestic/productive practices of care and shared survival.

Sourdough bread, through the lens of this paper, demonstrates that everyday—even commercial—practice can reveal these complex interdependencies where care, emergence, and survival are co-instantiated by human and non-human agencies, but also by visible and invisible labour, thus highlighting ways to challenge extractive, exploitative, and anthropo-techno-scientific models of making to favour more sustainable and regenerative approaches. By approaching form-making in this light, the current paradigm of doing design can become better attuned to more ethically sensitive frameworks, especially concerning how we can conceive of being-with the material world and other individuals. The framework presented here emphasises the importance of acknowledging where materials come from and how they actively shape practice. Furthermore, it aligns designing with contemporary making-centred movements that promote convivial and more socially just modes of working.

DISCUSSION

Throughout this paper, we have explored how bread form emerges through the dynamics of multiple actors participating in its making. The investigation into our bread-baking practice exemplifies how form is not predetermined but fluidly negotiated through visible and invisible interactions happening at the levels of human and non-human agents, environmental conditions, process variations, personal interpretations, and technical mediations. This understanding challenges hylomorphic understandings of form-making and lifts alternative conceptualisations of creative practices, including design, as inherently symbiotic and convivial.

The idea of emergent prototype we extracted from the research framing and from the bakery's conditions, operations, and premises expands practice-led design research methods and provides an opportunity to operationalise its occurrence within boundaries that are mobile, self-evolving and (re)defining. This offers a space to prototype a practice while practicing in the prototype. This means that we are able to set up a context that is not artificially bounded for academic needs but that operates within the desires, aspirations, and inspirations of the researcher/practitioners in a context that is exposed to all the forces, influences, and challenges that are available outside of "in-vitro" practices. We believe that expounding upon the notion of emergent prototypes and what kinds of *forms* these may take is a fruitful avenue for future research, especially because it reclaims prototyping as a research method and amplifies the relevance of emergent and adaptive ways of working to contemporary design research.

The analysis of the work performed within the bakery and its constantly mutating adaptations revealed how form emerges not through mastery over materials but through attentive attunement to changing conditions. Yet the baker's knowledge on how to navigate the sensual perceptions that the process makes available enables guidance for form-making toward a desired outcome. This only happens when we *acknowledge* (i.e., we accept that we can know what we get to know, while we also accept that we cannot know or understand the whole set of interdependent actions) as a form of expanding one's embodied and implicit knowledge to embrace other actor's knowledge(s). This aligns with Ingold's (2013) notion of correspondence between maker and materials, while extending the sociomaterial conditions of practice to encompass what we term an extended terroir. Understanding *terroir* is thus a way to connect the soil to the table by recognising—or in fact acknowledging—how form emerges through the dynamic interplay of multiple agencies and labour, from soil to water, from microorganisms to milling technologies and from environmental conditions to human practices.

These findings support the concept of sympoiesis (Haraway, 2016)—making-with—while grounding it in concrete commercial practice, thus encouraging and making available ways to sensuously experience the conceptualised idea of co-evolving survival. Bread-baking can also materialise and illustrate a process of endosymbiosis (Margulis, 1998), the biological principle that life forms do not evolve by competing in isolation but through complex symbiotic relationships. Our bread-baking practice reveals similar patterns of interdependence where yeasts, bacteria, materials, contexts and environment, and human actions become unitary components of a single process. This biological understanding of symbiogenesis—evolution through the merger of organisms living together—provides a powerful lens for understanding how bread emerges through the intimate cooperation of multiple agents.

The sourdough culture itself is a *living* example of symbiotic relationships, where wild yeasts and bacteria not only coexist but co-create conditions essential for each other's survival to later enable the transformation of flour into bread. This also extends Illich's notion of conviviality beyond tool-use to gain freedom and independence from centralised production systems to encompass *cum-vivere*: living-with the multiple actors involved in bread-baking. Where Illich focused on the social and economic meaning of having access to " tools" and by extension to the ability to use these tools to allow for convivial ways of production, our research reveals a deeper layer of convivial relations that includes microscopic life forms, environmental

conditions, and material agencies. This symbiotic and convivial perspective challenges both the industrial logic of controlling and concentrating food production, minimising quality to maximise profits, and the artisanal narrative of the master baker.

We suggest a model of practice centred on nurturing, caring, and engaging with complex interdependencies. This participation is enabled by embracing an open attitude to observing and working within the fluid interactions of material and discursive practices, requiring attention to shifting conditions and acknowledging the limitations of human control. However, the bakery experience also revealed significant tensions, particularly in the friction generated between the commercial viability of such approaches and convivial and symbiotic practices. The bakery's ultimate closure highlights the challenges of maintaining such practices with a focus on local care, food quality, and emergence within current economic systems. To support regenerative, convivial practices in contemporary production systems we need, as Puig de la Bellacasa (2017) suggests, new ways of thinking about care and maintenance in more-than-human worlds.

This study's implications extend beyond bread-baking to challenge how we conceptualise form-giving practices in design more generally. By understanding form as an emergent property of symbiotic relationships rather than a product of human-centred mastery, we aim to contribute to post-anthropocentric design discourse, practice, and methodology. Additionally, the concept of emergent prototype offers a novel space for practice-led research that embraces uncertainty and multispecies collaboration, while the ability to acknowledge the multiplicity of constituent actors in the process advances our understanding of how knowledge emerges through symbiotic and convivial practices.

CONCLUSIONS

Investigating how and why form emerges in contexts where making is not based on a designer's intention but a convivial, symbiotic, and multi-actor process is a relevant task for design practice and research. From a practitioner's perspective, we have illustrated how form emerges as a process of working with entangled relationships rather than with predetermined design intentions. The insights presented here thus offer a point of view about designing that shifts from aiming-at and controlling-for specific outcomes to nurturing and enabling conditions for emergence. In this vein, we encourage a move from *specifications* to *acknowledgement* and, by implication, from individual authorship to sympoietic agency.

This shift expands current understandings of what it means to practise relational design, yet it also underscores the methodological potential of convivial and symbiotic approaches to making for practice-led research. While current economic and market structures resist such approaches, the tension and friction themselves become generative, pointing toward necessary transformations in how we conceptualise and value design work in an era demanding more sustainable, cohesive, care-full, and regenerative practices.

This (re)framing is critical in the quest to address complex socio-ecological challenges, as it highlights the adaptability and openness to uncertainty afforded by making. Our focus on these aspects through firsthand material engagement expands design discourse beyond modernist understandings; it does so by showing how, through bread-baking, form materializes as sympoietic emergence rather than hylomorphic imposition. This work illustrates how an attunement to convivial and multi-actor processes can offer design practice a way to challenge authoritative models of creation through care, attentiveness, and acknowledgment.

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