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Moments of entanglement
Following the sociomaterial trajectories of an intersubjective studio practice

ABSTRACT
This paper investigates the sociomateriality of collective creation in the context of a design studio project. Grounded in a relational approach that has influenced a multitude of studies in various fields, the notion of sociomateriality accounts for the constitutive entanglement of the social and the material in practice. How this entanglement occurs or what exactly is subjected to it, however, remains largely unarticulated, especially in studies where the handling of materials lies at the heart of the research process. By adopting a relational approach operationalized through qualitative network analysis, we traced the sociomaterial trajectories of a studio project to identify the moments in which various actors were entangled. The resulting network visualizes these moments and assists in explicating how they enabled the instantiation of intersubjective design ideas.

Keywords:
co-creation, craft and design, qualitative network analysis, sociomateriality, studio practice.

INTRODUCTION

Design studios are creative environments where thinking occurs primarily through acts of making. Because making entails the manipulation of matter rather than the articulation of thought, studio practitioners are professionally competent in performing cognitive tasks that differ from other kinds of problem solving by being non-linear, generative, and abductive. Handling materials to instantiate design ideas involves the deployment of multiple modalities in which intention and intuition fluctuate in very rapid iterations (Gherardi & Perrotta, 2013; Ingold, 2013; Mäkelä, 2016; Nimkulrat, 2012; Rajmakers & Arets, 2015). Often referred to as *thinking through making* (see e.g., Ingold, 2013), this mode of working illustrates how such ideas are not preconceived but rather *flow* throughout the creative process.

When thinking through making happens collectively, however, the instantiation of design ideas demands a certain degree of intersubjective articulation. Studio practitioners who engage in co-creation projects need to devise proper mechanisms to render their creative intentions intelligible (Vega, 2018). Whereas some of these mechanisms are enforced via social interactions, some others can only be mediated through active engagement with materials. As a result, design studios operate as multifaceted spaces where various social and material flows entangle in a network of cognitive resources that are tacitly shared among practitioners (cf. Hutchins, 1995; Salomon, 1993). This feature of studio practices accentuates the importance of investigating the sociomateriality of co-creation and the intricate nature of thinking through making in the context of collective projects.

Sociomaterial networks and entangled practices

This paper advances research on studio practices by qualitatively analyzing the sociomaterial network of a collective studio project. Qualitative network analysis differs from its quantitative counterpart in that it examines networks situationally rather than statistically (Carolan, 2014; Decuypere, 2019; Scott & Carrington, 2011). Nevertheless, both orientations conform to the *relational turn*, an ontological positioning that highlights the primacy of relationships in the constitution of phenomena (Dépelteau, 2013). Multiple studies stemming from relational perspectives also emphasize the methodological importance of networks in the qualitative study of practices (see e.g., Coole & Frost, 2010; Latour, 2005; Law, 2002). In the same vein, we employ the concept of 'network' as a method, aiming to *present* the qualitative features of the mentioned project rather than *represent* its factual structure (Decuypere, 2019; Knox et al., 2006). To that end, we draw on the theoretical premises of *sociomateriality*, a research stream extant in the field of Science and Technology Studies (STS) that accounts for the "constitutive entanglement of the social and the material" (Orlikowski, 2007, p. 1438) in practice.

The notion of *entanglement* is perhaps the most used term in sociomateriality, yet it tends to populate the literature metaphorically rather than descriptively. Information systems scholar Matthew Jones (2013) reminds us that, in regard to this term, the growing stream of sociomaterial research suffers from a generalized lack of consensus. He asserts that "[w]hile it may be desirable on aesthetic or stylistic grounds to employ [certain terms] when discussing a topic, the choice of a particular term brings with it certain associations that may have implications for how the topic is conceptualized" (ibid., p. 201). The lack of consensus about the notion of entanglement in sociomaterial research has hindered the delivery of concrete explanations of what is meant by 'the social', what is meant by 'the material', and, by implication, how the social and the material are meant to be constitutively entangled. In this paper, we address this issue by localizing the entanglements of a collective studio project, providing a systematic description of the elements that are entangled therein.

Another important debate in sociomaterial research concerns the concept of sociomateriality in itself. Strictly speaking, sociomateriality accounts for a relational ontology that assumes no a priori distinction between the social and the material. However, multiple fields of inquiry have adopted this concept as an umbrella term to describe a myriad of theoretical and methodological approaches that seem to ignore this ontological positioning (see e.g., Moura & Bispo, 2019). Most of these fields use the word 'sociomaterial' merely as an adjective, sometimes even spelling it with a hyphen (i.e., 'socio-material'), thus conflating an ontological claim with a descriptive word. Further, Jones (2013, p. 211) notes that different domains have demarcated the emergence of multiple strands of sociomateriality,

leading to divergent understandings of what exactly constitutes the research stream of sociomateriality as such.

To avoid issues of demarcation, we concentrate on the relational strand of sociomateriality initiated by STS scholars Wanda Orlikowski and Susan Scott (2008), thus challenging the structural separation of people and things in the study of empirical phenomena (Jones, 2013, p. 221). As Orlikowski pronounces (2007, p. 1437), "there is no social that is not also material, and no material that is not also social". In the context of studio practices, this means that we do not examine practitioners and materials as isolated, pre-given entities. Instead, we analyze practices as performed relations of practitioners-and-materials (cf. ibid., p. 1438). Therefore, we conceive of studio projects as intrinsically relational: their existence depends on sociomaterial relationships. This observation points to another key principle of sociomateriality, which stresses that the unit of analysis lies at the level of practice and thus assists in examining studio practices as unitary systems.

Previously, we have examined collective practices of making from a sociomaterial perspective (see e.g., Vega, 2018; Mehto et al., 2020), yet this paper is our first investigation of a professional, craft-oriented design studio project as a network. Because design studios operate as multifaceted spaces where various sociomaterial flows are entangled, further research is needed to comprehend the relational nature of this entanglement. Along these lines, the paper at hand asks the following research questions: (1) *what are the sociomaterial flows that entangle in collective studio projects?* and (2) *how do these entanglements contribute to the formation of such projects?* In what follows, we lay out the research setting and describe our methods of data collection and analysis. Subsequently, we present the results, revealing the flows that entangle in collective studio practices and providing concrete examples of how they are entangled. Finally, we discuss the implications of this study by focusing on its methodological contribution to craft and design research.

RESEARCH SETTING, METHODS, AND DATA

We investigated a studio project undertaken by a group of three craft-oriented design practitioners in Finland. The objective of the project was to discuss ecological concerns through the production of ceramic vessels based on the use of local natural materials. The vessels were built by hand and painted with motifs of species of flora and fauna that are under critical threat due to the impact of anthropogenic activity on the Finnish soil. The project, entitled *Critically Endangered Species* (CES), took place within the premises of the *Soil Laboratory*, a temporary studio space designed for the *Soil Matters* exhibition, which was held from September 2020 to January 2021 at the Design Museum in Helsinki. The Soil Laboratory was conceived as a collaborative design studio and a space to facilitate the collection of data for the research at hand and other investigations. Additionally, it served as an open platform to encourage the public to participate in the CES project, specifically by sending soil samples that would later be transformed into clay slips to paint the vessels. This tactic also allowed the public to follow the work of the practitioners throughout the exhibition period.

The CES project was part of a larger research endeavor concerning the use of ceramic practices as a means to explore ecological questions on the relationship between humans and nonhumans (see Latva-Somppi & Mäkelä, 2020). The paper at hand, however, does not focus on such questions but rather employs the CES project as an empirical setting to investigate the sociomateriality of collective studio practices. For this reason, it is important to mention that the tasks performed by the practitioners were not briefed by the researchers. Instead, all of the activities performed by the practitioners in the CES project conformed to their ongoing, evolving explorations. The production of ceramic vessels was the continuation of a previous project, and it was also determined by the curatorial intention of the Soil Matters exhibition. This means that the practitioners worked with preexisting ideas and under predetermined parameters.

It is also important to note that the CES project benefited from the integration of the skills of the three practitioners, which means that each practitioner played a different role in it. Practitioner 1 participated by making the vessels and painting them with the species' motifs. She has more than fifty years of experience as a professional ceramic artist, thus possessing expert-level skills in hand-building

techniques. Practitioner 2 co-curated the studio setting and defined the brief of the CES project. Her expertise lies in painting ceramics with clay slips made from natural materials. Therefore, she participated in the painting of the vessels as well. Practitioner 3 worked as a project coordinator. She received the soil samples sent by the public, transformed them into clay slips, pre-selected the motifs to be painted on the vessels, and documented the entire creative process that took place at the studio. Practitioners 2 and 3 also participated as the second and third authors of the present study. Their contributions are explained in a separate section at the end of this paper.

Data collection

Since Authors 2 and 3 contributed to this study from an insider's perspective, our data collection framework benefited from a double strategy. On the one hand, Author 1 adopted an ethnographic approach to enter the field of practice and gain a contextual understanding thereof, and Author 4 contributed to the ethnographic reading of the data. On the other hand, Authors 2 and 3 employed a practice-led approach based on self-documentation methods (Mäkelä & Nimkulrat, 2018; Groth, 2017; Pedgley, 2007; Scrivener, 2002). This double strategy yielded two datasets, hereafter called Dataset A and Dataset B, which consist primarily of transcriptions, field notes, and photographs (Table 1).

The collection of data contained in Dataset A occurred in two stages. In the first stage, we conducted non-participant observation (Liu & Maitlis, 2010) at the studio to become acquainted with the working dynamics of the practitioners. The observation shed light on two aspects needing further attention: (1) the role of the personal, subjective input of the practitioners in giving form to the project and (2) the role of other actors, either social or material, in mediating this formative process. The second stage of data collection targeted these aspects by proceeding with semi-structured interviews (Flick, 2014) mediated by materiality. We used part of the data contained in Dataset B, i.e., the materials generated by the practitioners as means of self-documentation, to *invite* such materiality into the conversation (Hultin, 2019; Woodward, 2016) and stimulate the discussion of how other actors contributed to the accomplishment of the project.

TABLE 1. Data collection framework illustrating our double strategy.

Research approach and dataset produced	Stage of data collection	Objective	Time and place	Data collection methods	Data recording tools
Ethnographic approach, Dataset A	Observation	To enter the field of practice and conduct exploratory observations	September 2020 Soil Laboratory, Helsinki; Kultela, Somero	Non-participant observation	Field notes, Photographs
	Verbal elicitation	To elicit verbal data based on the non-participant observation stage	October 2020 Soil Laboratory, Helsinki	Semi-structured interviews	Transcriptions, Field notes
Practice-led approach, Dataset B	Self-documentation	To collect non-verbal data for further verbal elicitation	September 2020 Soil Laboratory, Helsinki	Documentation	Photographs, Prototypes

The observation stage occurred in situ at the studio, and it was supplemented with a field trip to Kultela, a village in Somero, Finland, where the ceramic material used in the project was sourced from. Conforming to the relational tenets of sociomateriality, the field trip was conducted to observe how the material is also social (i.e., how it is has a social life outside of studio practices), and it included a visit to one of the open pits where the soil is dug to obtain clay. The observations performed at the studio were

distributed in 20 days of uninterrupted periods of three hours each. The observations performed in Kultela lasted five hours. In total, this stage allowed for 65 hours of non-participant observation from which empirical data were recorded via field notes and photographs.

The semi-structured interviews occurred in separate sessions with each informant at the studio. They lasted one hour on average and were fully transcribed. We invited the practitioners to recount how different types of social and material interactions had influenced the development of the project, utilizing materiality as a means to elicit verbalization. Practitioner 1 was asked to articulate her thoughts while she was building a ceramic vessel. Echoing the notion of *reflection-in-action* as conceptualized by philosopher Donald Schön (1983), this method sits somewhere in between of what design researchers call *think-aloud protocols* (Ericsson & Simon, 1993) and sociomaterial researchers call *interviews to the double* (Moura & Bispo, 2019). Then, Practitioner 2 was asked to let the prototype of another vessel *speak* through her voice, resembling what social anthropologist Sophie Woodward (2016) calls an *object interview*. Similarly, Practitioner 3 was prompted to provide verbal accounts of the evolution of the CES project based on her documentation of the studio practice. The last two interviews allowed Practitioners 2 and 3 to engage in a process of retrospective self-reflection. Described by Schön (1983) as *reflection-on-action*, this process constitutes a widely employed method in practice-led research (Groth, 2017; Nimkulrat; 2012; Scrivener, 2002), thus enabling us to integrate both of our research approaches.

Data analysis

To explicate how the entanglement of various sociomaterial flows enabled the accomplishment of the CES project, we followed a four-step procedure. First, we analyzed the transcriptions, field notes, and photographs to identify the actors that participated in the project, making no distinction whether these actors were social or material. Second, we detected the moments of the project in which each actor participated. Third, we defined a trajectory for every actor by creating sequences of events based on the moments of the project in which they participated. And fourth, we visualized a network of trajectories to map how the combination of trajectories generated such flows. We conducted this procedure by adopting a relational perspective as well, taking the trajectories of individual actors as the unit of observation and the project itself as the unit of analysis. This procedure benefited from a combination of thematic analysis (Ryan & Bernard, 2003) and qualitative network analysis (Carolan, 2014; Scott & Carrington, 2011) that allowed us to alternate back and forth between the particular and the general (Nicolini, 2009).

During the first step, we analyzed the verbal data recorded in Dataset A (i.e., transcriptions and field notes) and supported the analysis with part of the documentation coming from Dataset B (i.e., photographs). We identified patterns and recurring elements in the transcriptions (Ryan & Bernard, 2003), generating codes for every actor involved in the project. As mentioned above, the codes were generated by treating all actors equally an indeterminately (Orlikowski, 2007), avoiding hierarchical distinctions or categorizations. Table 2 includes two excerpts from the transcriptions to illustrate how we proceeded with the coding.

TABLE 2. Coding the transcriptions.

Verbal data	Examples of codes generated
Practitioner 1: I have **the basic idea of the [vessel] in my head**, but then… I'm just building it as it comes, because when you start to work with **clay**, and build things, you have to know how to direct the **material**.	Practitioner 1 (code F) Internal representation (code I) Clay (code C) Clay (code C)
Practitioner 2: We have this book. [The publishers] have done **research on, you know, some of [the species] are under critical threat**. I was selecting the species that I felt somehow inspired by as a painter … I ended up selecting these very, kind of, **abstract images**.	Practitioner 2 (code G) Scientific discourse (code K) External representations (code J)

Based on the coding logic described above, we identified twelve actors that participated in the CES project: (A) nature (i.e., the natural environment), (B) culture (i.e., the cultural milieu), (C) clay, (D) soil, (E) tools, (F) Practitioner 1, (G) Practitioner 2, (H) Practitioner 3, (I) internal representations (i.e., ideas in the mind of the practitioners), (J) external representations (i.e., existing visual materials), (K) the scientific discourse underpinning the project (i.e., research output about critically endangered species), and (L) the public. We treated clay and soil as different actors because they had different origins and played different roles in the project: clay was sourced from a single location and used to build the vessels, whereas soil was sourced from multiple locations and used to paint the vessels.

In the second step, we analyzed the transcriptions to track the sequence of events that contributed to the formation of the project. We used the twelve codes to organize these events as *moments* in which various actors were entangled. Since we collected our data drawing on a relational approach, some parts of the transcriptions already yielded information about these entanglements. For example, the first excerpt contained in Table 2 shows that three actors participated during the moment of building a ceramic vessel. These actors were Practitioner 1 (code F), the clay she was handling to build the vessel (code C), and an internal representation of that vessel (code I). However, the information contained in this piece of the transcription was incomplete. The rest of the recorded data (i.e., field notes and photographs) showed that various tools (code E) were also present during that moment.

The step described above enabled the detection of 27 moments of entanglement. Table 3 organizes these moments chronologically and specifies which actors were entangled in each of them. Moments 1 to 12 describe the sociomaterial entanglements that supported the formation of the project, whereas moments 13 to 27 describe the sociomaterial entanglements that occurred within the project. We continued with the third step by tracing the individual trajectories of all twelve actors. To determine the trajectory of an actor, we tracked the sequence of moments in which such an actor was entangled. Table 4 renders this information, exhibiting that some actors pursued multiple trajectories. For example, nature (code A) followed three trajectories, which are described by the sequences of moments 1–2–3–5, moments 8–14, and moments 9–10–11–12, respectively. Whether an actor followed one or multiple trajectories was determined contextually by cross-checking both datasets.

In the fourth step, we visualized the trajectories in a network to analyze their entanglements relationally. In network theory, actors are called *nodes*, and their connections are called *edges* (Scott & Carrington, 2011, pp. 11, 30). To explicate how different actors contributed to the accomplishment of the CES project, however, we did not aim at connecting nodes but at tracing the trajectories of individual actors entangled in those nodes. In other words, we wanted to identify where these actors were coming from and where they were going (cf. Spuybroek, 2011, p. 240), in a similar way to what social anthropologist Tim Ingold (2007, p. 15) describes as "following a trail". To make this possible, we took the moments of entanglement as the nodes of our network, generating 27 nodes comprised of multiple actors each. Then, we formed the trajectories, as described in Table 4, by joining sequences of edges connecting the same actor. In the next section, we visualize the sociomaterial flows of the CES project as a network of entangled trajectories.

RESULTS

The result of our analysis is depicted in Figure 1, and it was generated by inputting the information contained in Tables 3 and 4 into the network visualization software Cytoscape (version 3.8.1). To facilitate the visualization, we grouped the actors into five overarching themes by color-coding their trajectories. The themes describe the sociomaterial flows that entangle in collective studio projects (Research Question 1). These flows are: (i) context, (ii) materiality, (iii) individuals, (iv) abstractions, and (v) peripheral practices. Additionally, we assigned symbols to the nodes to divide the 27 moments of entanglement into three categories: social emergences, material assemblages, and sociomaterial interactions. These categories helped us analyze the flows relationally and identify how they contribute to the formation of studio projects (Research Question 2). As shown in Figure 1, flows constitute combinations of trajectories, whereas trajectories connect the moments through which individual actors moved as a function of time. In what follows, we answer our research questions by describing

the five sociomaterial flows of the CES project in light of the generated network. Due to the limited space, the descriptions concentrate on the most important features of the results. For a closer reading of these descriptions, use the in-text references to the nodes and codes expressed in Tables 3 and 4.

TABLES 3 and 4. Table 3: Moments of entanglement. Table 4: Sociomaterial trajectories.

	Node / Moment of entanglement	Actors entangled
1	Geological activity	A, C, D
2	Formation of soil	A, D
3	Formation of clay pits	A, C
4	Production of tools	B, E
5	Extraction of clay from nature	A, B, C, E
6	Clay usage in pottery practices	B, C
7	Establishment of ceramic practices and formal education in the field	B, C, E
8	Impact of anthropogenic activity on the soil	A, B, D
9	Emergence of discourses on the Anthropocene	A, B
10	Reflections on ecological matters	A, B, L
11	Production of knowledge about critically endangered species	A, B, K
12	Publication of scientific materials about critically endangered species	A, J, K
13	Design of the CES project	G, J, K
14	Recollection of soil samples	A, D, L
15	Sending of soil samples	D, L
16	Reception of soil samples	D, H
17	Convergence of personal stories	F, G, H, L
18	Soil milling and grinding to create colors and clay slips	D, E, H
19	Socialization of ideas and tacit understandings of practice	B, F, G
20	Articulation of mental models of "classical" forms	B, F, I
21	Negotiation about the form of the ceramic vessels	F, G, I
22	Production of ceramic vessels by means of hand-building techiniques	C, E, F, I
23	Circulation of scientific materials about critically endangered species	G, H, J, K
24	Pre-selection of the motifs to be painted in the vessels	H, J, K
25	Selection of motifs	F, G, I, J
26	Painting of the vessels	C, D, E, F, G, I, J
27	Finished ceramic vessels	C, D, J

	Code / Actor	Trajectory
A	Nature	1-2-3-5
		8-14
		9-10-11-12
B	Culture	4-5-8-9-10-11
		6-7-19-20
C	Clay	1-3-5-6-7-22-26-27
D	Soil	1-2-8-14-15-16-18-26-27
E	Tools	4-5
		4-7-22
		4-18-26
F	Practitioner 1	17-19-20-21-22-25-26
G	Practitioner 2	13-23
		17-19-21-25-26
H	Practitioner 3	16-17-18
		23-24
I	Internal representations	20-21-22-25-26
J	External representations	12-13-23-24-25-26-27
K	Scientific discourse	11-12-13-23-24
L	The public	10-14-15-17

Context

Studio practices do not occur in a vacuum. In addition to being held in proper workspaces, they distribute across multiple sites of activity. To clarify how this multiplicity of sites comprises a sociomaterial flow, we refer to *context* as the interplay of the natural, social, and artificial settings that

support the operation of studio practices. In the case of the CES project, these settings include the natural environment where the practitioners sourced their materials from (code A), the cultural milieus where the practitioners established their practices (code B), and the activities that the practitioners had to configure to produce the social emergences, material assemblages, and sociomaterial interactions (nodes 13 to 27) that gave life to the project. Although the CES project unfolded primarily within the premises of the Soil Laboratory, the activities that occurred therein were underpinned by a sequence of events that had to occur first (nodes 1 to 12). In the same way as practitioners source their materials from nature, they gain tacit understandings about their practices from the cultural milieus where they socialize throughout their professional lives. Even if these natural or social environments are external to studio settings, they permeate studio practices by being embedded in the practitioners' trajectories. It is the entanglement of these trajectories that shapes the sociomaterial context in which collective studio projects operate.
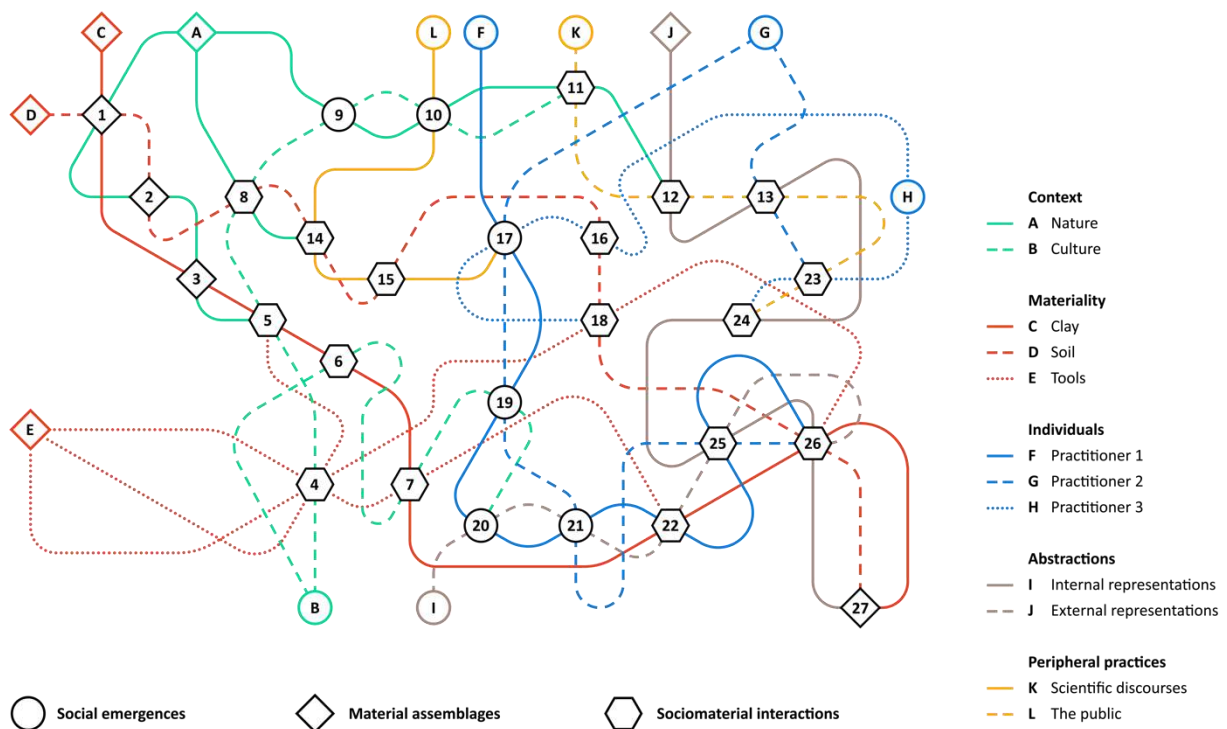

FIGURE 1. Network of entangled trajectories visualizing the sociomaterial flows of the CES project.

Materiality

To explicate why materiality is a sociomaterial flow, we need to speak relationally. In the CES project, practitioners handled clay (code C) and soil (code D) to make ceramic vessels (node 27). The ontological status of these vessels is relational by definition: we do not focus on what materials *are* but rather on what they *become* (see Deleuze & Guattari, 2004). Materiality is thus not a passive substance subjected to the intentions of practitioners but an active flow that practitioners learn to follow (Ingold, 2013). As shown in Figure 1, clay (code C) and soil (code D) were the only actors whose trajectories spanned the whole duration of the project. This finding confirms two important features of materiality: endurance (Latour, 1996; Leonardi, 2013) and affordance (Gibson, 1979; Malafouris, 2008). Clay, for example, *endured* in that it originated in a material assemblage (node 3, Figure 2) that occurred before the existence of the project and culminated in another material assemblage (node 27, Figure 3) that outlived the project. By being entangled with other sociomaterial flows, materiality *afforded* the formation of an object of pursuit envisioned by the practitioners: a dynamic and ever-evolving "cluster of concepts" that enabled the translation of design ideas into creative outputs (cf. Mehto et al., 2020, p. 1248). Because

this cluster of concepts facilitated knowledge work through material instantiations, it typifies what sociologist Karin Knorr-Cetina (2001, p. 190) defines as an *epistemic object*. Put simply, the epistemic object of the CES project was a creative vision triggered by the production of ceramic vessels painted with motifs of flora and fauna, the *becoming* of which was primarily afforded by the very materiality of clay and soil.
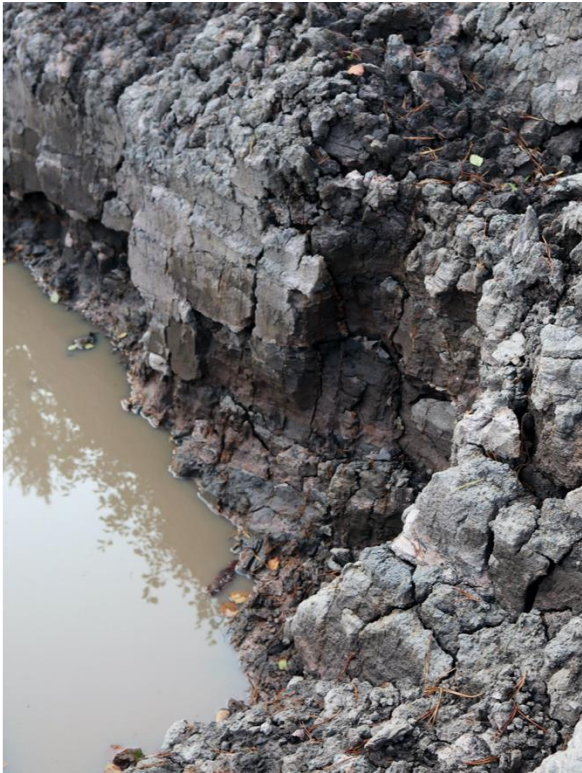
FIGURES 2 AND 3. Figure 2: Clay pit in Kultela (node 3). Figure 3: Ceramic vessel painted with motifs of critically endangered species (node 27). Photos: Tzuyu Chen.

Individuals

As noted earlier, the three practitioners involved in the CES project (codes F, G, H) performed different roles in it. Unsurprisingly, they followed different trajectories. What is important to highlight here are the moments in which these trajectories became entangled through sociomaterial interactions (nodes 23, 25, 26). These moments of entanglement occurred at a stage of the project in which the practitioners' epistemic object was being materially instantiated, either through design ideas conveyed via external representations or through the embodiment of such ideas into creative outputs. Selecting the motifs to be painted on the vessels (node 25) and painting the vessels with the selected motifs (node 26), respectively, are two examples of these material instantiations. Since both activities were performed intersubjectively, this finding suggests that the flow of individuals influences the flow of materiality as much as vice-versa. As mentioned above, materiality exercises this influence through affordances, whereas individuals assimilate it through what we call abstractions.

Abstractions

We refer to *abstractions* as the internal and external representations (codes I, J) that facilitate the articulation of ideas in intersubjective acts of making. In the CES project, various forms of abstractions appeared in social emergences (nodes 20, 21) and sociomaterial interactions (nodes 12, 13, 22, 23, 24, 25, 26) that contributed to the production of creative outputs. An example of an internal representation is what Practitioner 1 envisioned as a "classical" shape (node 20) before negotiating the form of the vessels with Practitioner 2 (node 21). An example of an external representation is the visual

documentation used by Practitioner 3 when she pre-selected the motifs to be painted on the vessels (node 24). By dealing with conceptual ideas rather than concrete facts, abstractions facilitate creative interactions among individuals as well as between individuals and materiality. Some of these creative interactions are, for example, the moments in which Practitioner 1 built the ceramic vessels (node 22, Figure 4), Practitioner 3 pre-selected the motifs to be painted on the vessels (node 24, Figure 5), and Practitioners 1 and 2 painted the vessels with the selected motifs (node 26, Figure 6).

FIGURES 4 AND 5. Figure 4: Practitioner 1 building a vessel by hand (node 22). Figure 5: Pre-selected motifs to be painted on the vessels (node 24). Photos: Tzuyu Chen.

FIGURE 6. Practitioners 1 and 2 painting the vessels at the Soil Laboratory (node 26). Photo: Tzuyu Chen.

Peripheral practices

In addition to incorporating the input of various practitioners into the creative process, collective studio practices often benefit from the participation of external actors. These actors can produce flows when the activities they perform steer the direction of projects. With *peripheral practices*, we thus refer to the combination of trajectories followed by these external actors. In the studio project analyzed herein, various moments that involved the participation of scientific discourses (code K), as well as the public (code L), produced social emergences (nodes 10, 17) and sociomaterial interactions (nodes 11, 12, 13, 14, 15, 23, 24) that significantly influenced the evolution of the studio practice. The publication of scientific knowledge about critically endangered species (node 12), for example, formed the basis of the CES project. Similarly, by sending soil samples that would later be transformed into clay slips to paint the vessels (node 15), the public actively contributed to the production of creative outputs. Although this kind of participation is indirect, it arguably aggregates in a flow that, as in the case of materiality, cannot be merely subjected to the creative intentions of the practitioners.

DISCUSSION

This paper investigated the sociomateriality of collective making in the context of a design studio project. By examining intersubjective activity, we highlighted the importance of anchoring the notion of thinking through making not only in human-material interaction but also in social practice. Further, we presented a novel methodological approach grounded in a relational ontology, which in turn allowed us to address matters of scale, relationality, and the inclusion of nonhuman actors (i.e., materials and the environment) in the analysis of studio practices. Although the contributory significance of nonhuman actors is well documented in craft and design research (see e.g., Mäkelä, 2016; Groth, 2017; Nimkulrat, 2012), aspects of scale and relationality are largely overlooked in this field. Therefore, the following discussion concentrates on the methodological implications of addressing these two aspects.

Our findings suggest that craft and design research can address matters of scale by integrating multiple methods of data collection and analysis, especially when this integration promotes a plural perspective to the phenomenon under scrutiny. In our case, the process of data collection benefited from a double strategy that entailed the combination of knowledge from both *outside* and *within* the practice. This strategy facilitated the examination of the studio project from the perspective of the practitioners while moving the locus of knowledge production away from personal modes of inquiry. In other words, it assisted in clarifying the relationship between the practitioners as individual sources of knowledge and the practice itself as the unit of knowing. For the analysis of data, we employed a combination of thematic and qualitative network analysis, which led us to pinpoint the sociomaterial entanglements of studio projects. The results revealed that these entanglements occur at three different scales: the scale of actors, the scale of trajectories, and the scale of flows. Although this finding is already helpful in addressing matters of scale, further research is needed to illuminate how such matters can be tackled in larger or smaller empirical settings.

We also demonstrated that craft and design research can address matters of relationality by looking into qualitative network analysis. In this regard, we contend that our main contribution to the field lies in the development of novel methods stemming from external approaches. While adopting these approaches has enhanced our comprehension of studio practices, it has also signaled the need to articulate new vocabularies than can appropriately describe these practices as relational phenomena. In this paper, for instance, we have introduced concepts like *social emergences*, *material assemblages*, and *sociomaterial interactions*. Partly borrowed from the stream of sociomaterial research, these concepts are tentative ways to read the intricate nature of studio practices from a relational point of view. Such an attempt exemplifies another way of *following* that occurs not at the level of practice but at the level of research: the creation of these concepts did not conform to preconceived assumptions but rather flowed throughout the analytical process.

Another aspect we want to discuss is the benefit of tracing networks as a method in craft and design research. Although the network presented in this paper may seem to overcomplicate the phenomenon at issue, it is this complexity that allowed us to localize the features of studio practices

that we wanted to investigate. In other words, it was through this level of granularity that we were able to follow the trajectories of individual actors and, consequently, pinpoint the entanglements of the studio project. For craft and design practitioners, this web of entanglements is accessed tacitly and typically taken for granted. For researchers, however, the articulation of such a complex system of relations requires the deployment of proper analytical tools. In this regard, the tracing of networks renders an appropriate method to handle relational data, which in turn can make invisible connections visible and thereby researchable. Networks are also a fitting device to investigate studio practices as unitary systems, regardless of whether they are investigated through ethnographic or practice-led approaches. For this reason, we propose the use of networks not as a means of representation but as a method of analysis. The intention of tracing networks is thus not to theorize practices but to provide new methodological lenses to analyze empirical settings that extend beyond the individual.

To conclude, we would like to emphasize one of the key features of our approach. The network presented in this paper depicts the studio project we investigated as a multifaceted phenomenon of which multiple levels of analysis are possible. Due to the limited space, we could not include all facets of the analysis but presented only a few examples. We stress, however, that this method aims at visualizing relationships as instances, meaning that it is not limited to ceramic studio projects but can be applied to a variety of relational practices with similar characteristics. Central to this qualitative reading of practices are the explorative and narrative functions of networks (Decuypere, 2019). Because qualitative network analysis provides insights rather than answers, the analytical process should be systematically performed *in relation to* the elements that configure the research setting. For this reason, we believe that including an insider's perspective is crucial to the interpretation of results.

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