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Following a Material's Journey to Unravel Becomings and Systems in Human-Material Interaction

Bilge Merve Aktaş

Despite the increase in digital products and practices, humans are still sociomaterially tangled with material-based design and tangible artefacts in their everyday lives. From the designer's perspective, recent research shows that materials significantly affect the design processes, ideation, tools, and use areas. From the human/user perspective, research shows that experiences and interactions with tangible outcomes affect behaviours, expectations, thinking, and cognitive development. On the other hand, from the environmental perspective, new material development has been a crucial topic in managing production, consumption, regeneration, environmental impact, and self-sufficiency. Thus, materials convey performative roles in realities that design creates or relates to. With changing knowledge and sensitivities, revisiting traditional practices and craft materials can deliver insights to tackle material interaction from cultural and systemic perspectives.

In socio-material entanglements, multiple elements, systems, and histories come together across time and space, shaping ever-changing understandings of material's role in design, use, and nature. In the continuous becoming of humans, interacting with materials plays a significant role. By looking into human-material entanglements in the design scope, this paper aims to bring an expansive approach to studying the reciprocal creation of natural and human-made systems.

To discuss the layers and multitudes of systems that design practice is part of, the paper follows the material journey of a felted artefact as an example. Felting

is an art, craft, design, and industry practice that typically relies on entangling wool fibres to create a compound surface. Through an ethnographic study of interactions embedded in the potential lifecycle of a felted artefact, this paper sheds light on various actors, relations, and systems that different stages of design practice entangle. Having the examination on a small-scale studio practice provides a concrete explanation of how even seemingly simplistic practices embody deeply intricate relationships.

Following the vital materials perspective, the paper elucidates a material journey map of a felted artefact divided into five stages of becoming: matter, material, design, use, and afterlife. By following the becoming of material, the paper exposes underlying aspects and intricacies of systems and underscores the importance of comprehending these interwoven situations. In this way, the paper identifies key points to consider when studying different relations and proposes a lens to study direct and indirect interactions embedded in design practice. The developed material journey map can also be proposed as a tool to be employed by designers when studying use areas and the potential impact of emerging materials.

KEYWORDS: material journey map, becoming, felting, material connections, design

RSD TOPICS: Cases & Practice, Mapping & Modelling, Society & Culture

Introduction—human-material interaction

The current state of the world dictates reviewing the most common consumption/production behaviours and mindsets to maintain a living earth. Parts of the problem are landfills of items made of all sorts of materials and exploitation of nature for material generation. New materials have been developed for bio-degradable and sustainable solutions to minimise the destructive impact. These endeavours emerge through research and development projects as well as designer-led small-scale experiments to explore potential raw materials, develop recycling methods for new and existing materials, and manage waste and material innovations require an

understanding of materials, technologies, and production methods (Kääriäinen & Niinimäki, 2019).

Understanding materials also facilitates understanding humans as we constantly interact with materials in the form of artefacts, raw materials, or matter found in the natural environment. These interactions with the outside world shape how humans think in the extended world with their minds and bodies (Johnson 2007). Therefore, studying material interaction can provide insights into human thinking and sustainably co-exist with the world.

This paper examines a material's journey, namely wool, as an example to scrutinise different settings where human-material interaction takes place. It aims to present the entangled situations that materials are part of to bring attention to the materials not only in specific and independent phases, such as recycling or generation, but from an interdependent perspective to see their relations to various systems. The paper proposes material journey mapping as a tool for studying its relations in various material contexts.

Background philosophies to study material interaction

Humans are constantly in dialogue with their material surroundings. They couple with materials and act with them. Cognitive archaeologist Lambros Malafouris (2013) argues that the human brain is extended beyond the body, and human cognition becomes what it is through material engagements over time and across space. Therefore, humans think with and through things (Malafouris, 2020), and materials and nonhumans mediate their cognitive *becoming* (Ihde & Malafouris, 2019); through material interactions and engagements, humans become what they are.

This view of *becoming with other things* challenges perceiving the world as a passive background and highlights interdependencies among various beings and species. Philosophers Gilles Deleuze and Felix Guattari (1980/2019) discussed material vitalism to study how humans join in an itinerary of matters. Referring to artisans and their creation processes, Deleuze and Guattari argued that makers should follow materials in various contexts, even before making begins, to join in the material's becoming and itinerate with it to create artefacts.

Taking material vitality further, political scientist Jane Bennett (2010) proposed materials and nonhumans as vibrant and brought attention to their performative and agential power in affecting their surroundings. By discussing the vitality of nonhumans, Bennett challenges political structures that rely on the domination of one species, group, or even knowledge type. The approaches to seeing materials as active force humans to re-evaluate their own capacities when it comes to how much they can control and how much they can change.

Studying the activeness of materials and their significant role in shaping our thinking has also been a topic for creative fields. Notions such as making and designing as a *dialogue* or *thinking through making* have tackled how makers and designers receive feedback from their materials and tools while executing their design intentions. With these notions, the material's role has been studied to examine how different material behaviours and limitations affect ideation, user experience, and technology development.

Describing the designing process as a dialogue points out the coordination between the hand and the mind that is mediated through the dialogue between the maker and the material (Sennett, 2008). Through these attentive processes, designers evaluate their ideation while engaging with materials. Therefore, they think through making. While making, designers anticipate how the material will react to their decisions, and they link the changes in the outcome with their ideation (Dewey, 2005). By following and joining in the flow of the material, designers do not merely use the material to realise an artefact, but they work with it to co-create an artefact (Ingold, 2013).

As a result of this active relationship, materials were discussed as having agency in the sense that they can create significant change in their surroundings. Discussions on nonhuman agency propose that humans and nonhumans are entangled in dynamic, situated, reflective and interactive relationships (Aktaş, 2020). When the togetherness of humans and nonhumans is explained as an entanglement, humans and things become united. An entangled situation, such as a wool lump, does not follow a particular pattern or direction, but things connect by the temporarily leading elements in their situations (Figure 1). These entanglements embed various socio-material elements as part of their ever-changing ecologies.

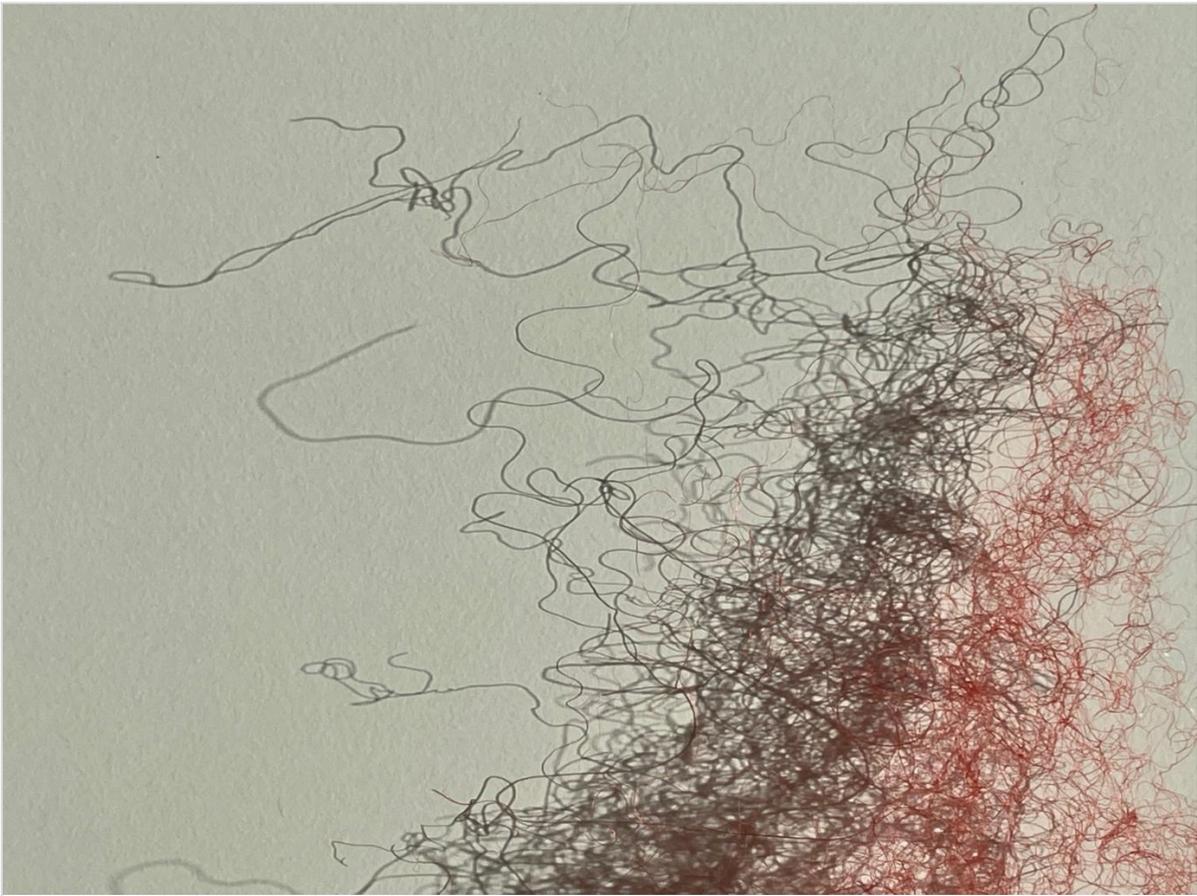


Figure 1: Entangled wool fibres. Photo: Aktaş.

On the other hand, with human domination, the material interactions of everyday lives create significant environmental and political impacts. Therefore, studying these entanglements is crucial not only for philosophical examinations of human behaviour but also for finding more sustainable ways of co-existing with the material world. This rethinking can lead to response-able acts that are based on developing ethical sensitivity and nurturing capacities for living for and with others, as Haraway (2016) describes.

Currently, designers are largely alienated from the source of their materials (Anusas & Ingold, 2013; Aktaş et al., 2021). However, design practice and its various elements and actors are relational, reciprocally mediated, creative and exploratory, situated, embodied, and skilled (Aktaş et al., 2022). Having a concrete understanding of the

materials we engage with can bring new understandings to repair the exploitation-based human relationship with the world (Aktaş, 2022).

To examine this close relationship, we need to study material in multiple contexts across time and space. To truly understand how material shapes its surroundings, beyond the boundaries of the design studio or when they are being used, its own journey should be followed that starts when it is a matter rather than material and ends when it becomes matter again after being discarded. Paying attention to this complex journey would bring precision to the ever-expanding boundaries of human-material entanglement.

As an example, this paper maps the potential journey of a felted artefact and the wool it is made of to explicate the complexity of this entangled situation and study visible and invisible interactions embedded in human-material togetherness.

Methodology

This paper examines wool, the primary material for making a felted artefact, in different contexts to study various conversations and actors. The data and discussion in this paper mainly stem from my personal experiences and encounters in fieldwork at the felting studios in Turkey and sheep farms in Turkey and Finland since 2016. The personal experiences and field notes from ethnographic studies provide insights into fractures of the material's journey.

According to Haraway (1991), when encountered for knowledge building, the world is an active entity with whom one needs to build social conversations. What we know and learn are situated, which requires humans to be aware of their own positions and declares objects of knowledge, such as materials, as active agents of world-building (ibid.). This approach emphasises the power of concrete experiences to grasp an idea fully and highlights the importance of the study context.

As a practitioner-researcher, I have been working with wool to make felt and academically researching its role in felting since 2016. Hence, I am a participant in wool's ecologies and have research and personal experience in the field that positions me as a part of the entanglements and conversations that wool builds.

When practitioner-researchers focus on practice as the unit of knowing rather than their individual knowledge, performative actions bring a relational understanding of the study topic (Vega, 2021). This results in thinking through making in ways that are distributed among various elements that affect the practice (ibid.). Being a participant in the research positions me as an insider, enabling me to study with the material rather than on it (Ingold, 2013).

Relying on data collected in fieldwork, my mundane encounters with wool in various settings, and existing secondary data, such as online resources, build the basis to unravel the journey of the material. Anthropologist Tim Ingold (2007) proposes that objective and subjective knowledge and experience act together while engaging with materials as the mind couples with the matter. Accordingly, I pair my subjective knowledge and experiences with objective or widely accepted knowledge and experiences to unravel wool's journey.

When studying wool in different contexts, I adopted three schemes: the user journey scheme, the iceberg model, and a scheme for material connections of a felt maker that I previously developed (Aktaş et al., 2020).

When the iceberg model is crafted for certain use areas, for example, for co-design, its layers can bring a systemic review of the area of research from multiple perspectives, for alternative futures, or multiple values (Smeenk, 2023). It can also facilitate thinking beyond the easily accessible elements of a large system. So, I started by applying an iceberg model to a felted artefact to identify the visible and invisible elements, influences, and aspects involved in making an artefact (Figure 2).

The visible-invisible spectrum works in two directions. The downward direction traces the artefact back to the origins of its material, as far as possible, and identifies the procedures that wool goes through to become a felted artefact. The upward direction anticipates what happens to the artefact when it is in use and its afterlife. Therefore, the model resembles a double iceberg to trace back to the material origins and forward to its potential future.

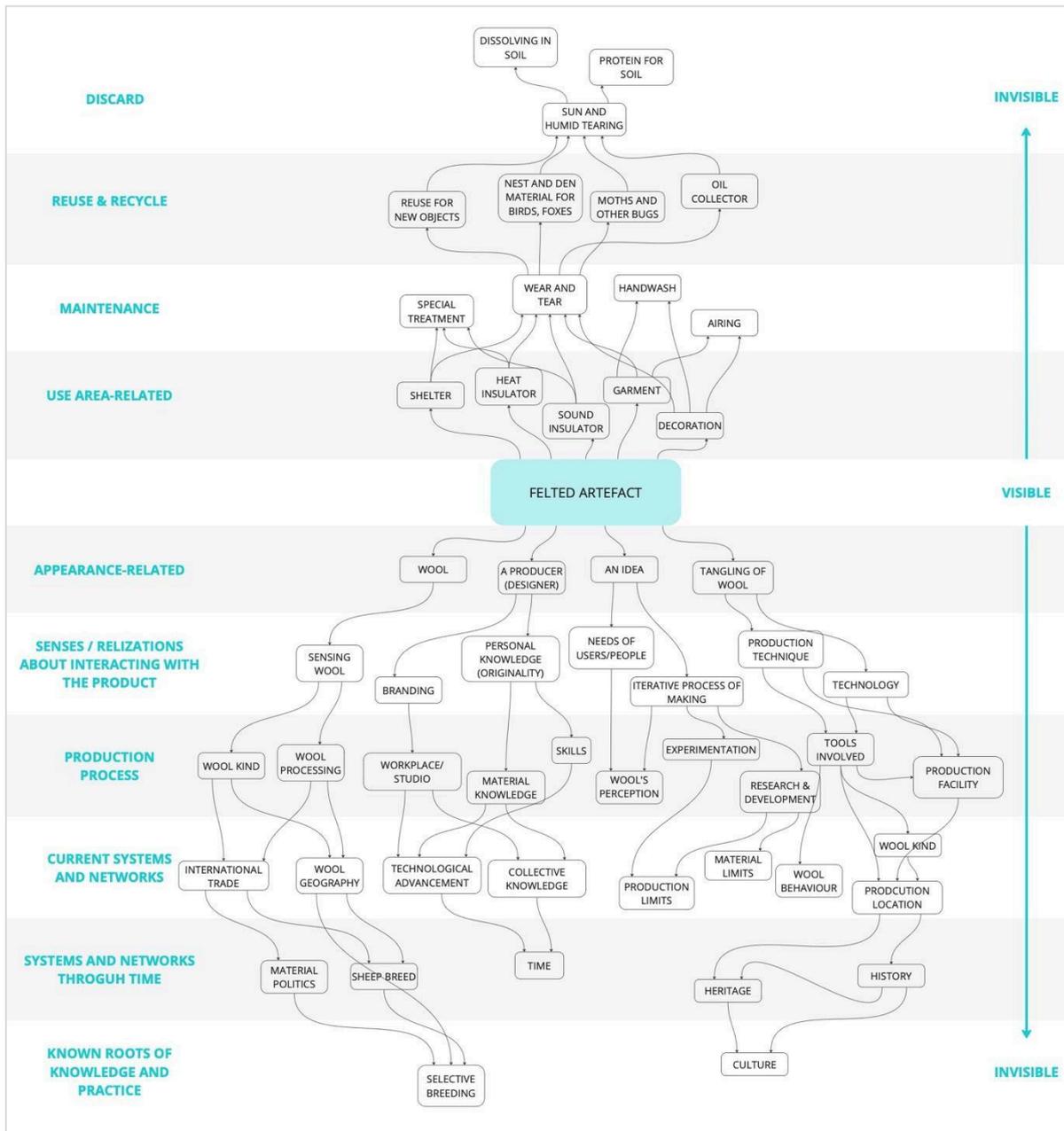


Figure 2: Mapping the visible and invisible elements that lead to a felted artefact's emergence and disappearance.

The initial mapping presented elements in the transformations that wool goes through. The categories pointed out different actors involved in the emergence of a felted artefact through collective endeavours over a long time. These categories indicated wool's five stages of becoming:

1. wool as matter,
2. wool becoming a textile material,
3. wool transforming into a product,
4. wool becoming an artefact-in-use,
5. wool-artefact becoming waste.

The five stages of materials can also function as scales for systemic change. Previously, nine dimensions of scaling were proposed to achieve systemic change (Mulder et al., 2022). These dimensions include *scaling across* to examine who/what has power, *scaling in* for developing an introspective sense of systemic knowledge, *scaling long* to examine impact over time, and *scaling back* to do a retrospective study of the topic (ibid.). The stages of material journey mapping deliver information that can facilitate studying different scales within the material system.

Later, I developed a material journey map as a tool to illuminate the invisible elements within and across these stages. User experience journey maps identify possible problems and pain points users might experience while interacting with a product. Journey maps typically list and identify the user's actions, tasks, and feelings to overview their journey and the improvement opportunities to foresee possible challenges. Previously, I have also analysed the material connections of a felt maker and how initial decisions about their material connect them differently to the field they are practising in (Aktaş et al., 2020). By bringing together insights from user journey maps, the iceberg model for wool, and the material connections of a felt maker, for this paper, I have developed a tool to reveal the journey of a material. This material journey map works as a matrix that connects five stages of the material, developed with the iceberg model, with the elements adopted from the felt maker's material connections analysis. These elements are people, other entities involved, geography/location, transformations, goals/purposes, tools, actions, and relations to larger infrastructures. These elements can be further grouped into the following systems: social, spatial, creative, behavioural, cultural, and political (Figure 3).

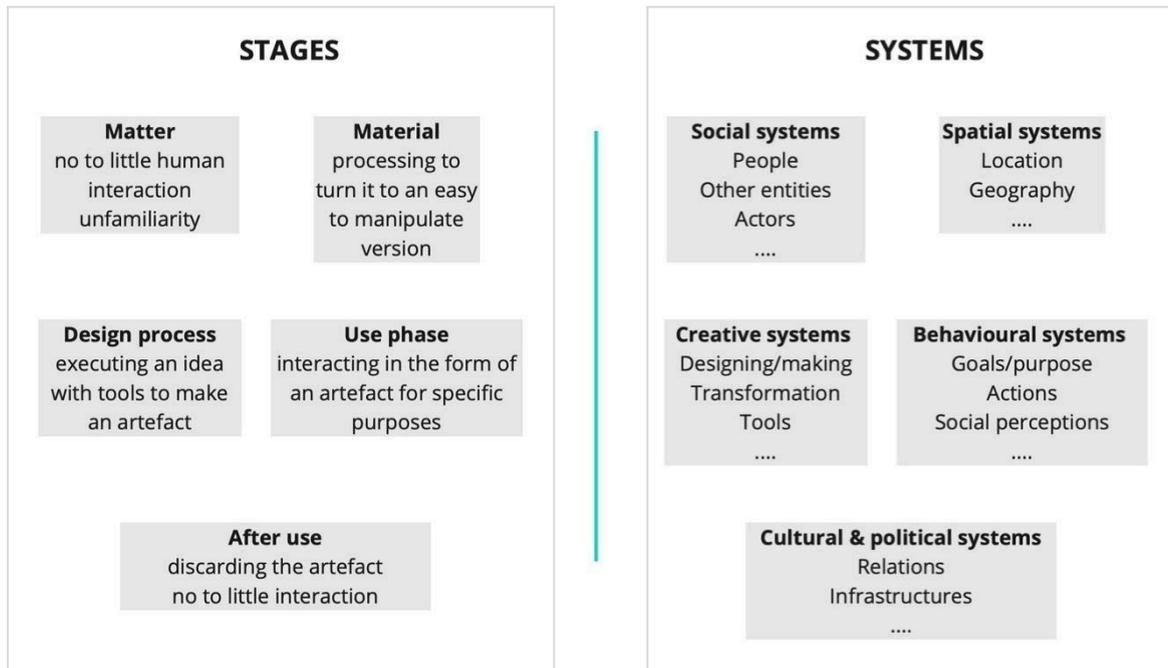


Figure 3: Five stages of wool's being and related systems.

The following section will briefly review each stage to ponder how stages and systems connect.

Following wool in its journey

Wool as matter

Wool helps sheep touch the world. It covers the sheep's body and regulates their body temperature (Dwyer, 2008), filters UV light from sunlight, and senses the surroundings (Millington, 2006). Like human hair, wool comes in various thicknesses, shapes, and colours. It has a high capacity to adapt to the environment where sheep live (Ryder, 1973). As a result of such great features as the capacity to insulate and the flexibility suitable for being shaped, humans started domesticating sheep around 11.000 years ago (Demirci et al., 2013). By selection based on the thicker undercoat, small hair diameter, and white colour, some sheep breeds' population has expanded while some have been eradicated (Ryder, 1991). The amount of wool production per winter and the number of sheep that would not moult their wool were other important criteria for

selection (Dwyer, 2008). While the remaining wild sheep breeds shed their wool, the domesticated ones require human shearing (ibid.).

On average, five kilograms of wool annually is shorn off a merino sheep, the most popular breed for textile production. Because of selective breeding based on wool growth, domesticated sheep require human care. For example, in 2015, a sheep was found wandering around alone in Australia. This merino breed, named Chris, was carrying 41 kilograms of wool on itself, holding the world record for heaviest fleece shorn from a sheep (NMA, 2023). Although Chris's story was extraordinary, it is not a unique example. A quick online search of "sheep found after years" brings up several other sheep, mostly Merino, each carrying a high amount of wool with poor health conditions. Selective breeding based on wool amount bypassed natural shedding and created a situation where the wellbeing of sheep largely relies on the existence of and the maintenance by a human, creating an interdependency between the two species (Figure 4).

Wool becoming a textile material

With domestication, wool became material for humans for various purposes, such as textiles, insulation, or fertiliser. Despite its significant use in the textile industry in most countries, the production market is centralised in countries like Australia, New Zealand, and Iceland. This decision is often made based on the wool qualities, such as the fine qualities of merino sheep. In many countries, sheep breeding is done for its meat, and wool that does not meet expectations of thin and soft hair is perceived as a byproduct of sheep breeding with insufficient recognition and the additional burden of needing to be discarded. In my farm visits in Turkey and Finland, farmers shared similar stories:

During my visit to a sheep farm in Aydin, Turkey, in 2021, I had a chat with the farm owner. After my questions about sheep and wool, he escorted me to a place behind one of the cabins, where he showed me several bags full of fleece and offered me to take as much as I wished. After seeing I collected only an armful of wool, disappointed, he told me he hoped that a wolf would steal the wool to make their den (From my field notes, 2021).



Figure 4: Sheep in need of shearing. Photo: Aktaş, 2017.

Often, the solution farmers found is to burn the wool as storing wool requires large spaces due to its low density in large volumes (Figure 5). This shared problem has attracted many initiations; however, solutions still need to be developed (for European context, see Circular Wool, 2016).

Depending on the different qualities that wool has, its perceptions also change. Ingold (2007) proposes that material properties act like its history. This history changes in relation to how the material is involved in its surroundings and how it engages with the world (ibid.). Materials often do not have fixed definitions that make them be something; rather, they are part of ongoing becomings of something else (Ingold, 2013). In most cases, the matter becomes material when humans recognise and perceive their capacities to be employed for specific purposes, thus initiating their becoming.

Designers, inventors, and innovators work with one material in many ways and develop many ways of being with them. For instance, while thin fibres are essential for garment making to have a soft sensorial experience, thick and rough fibres are suitable for insulation to filter the air with the increased space between fibres (Figure 6). Although properties do not necessarily change, how they function and become purposeful does, depending on the conditions in which wool is used.

When matter becomes material, gaining abilities to control the raw mass becomes important. This need leads to physically transforming fleece through additional practices, such as combing, spinning, and carding, to prepare the material for felting, knitting, or weaving. For instance, for felting, the fleece is cleansed of dirt with shaking machines and combed to untangle the fibres. After being processed, the fleece, raw material, turns into a form that designers and makers can easily control and manipulate to create an artefact.

Wool transforming into an artefact

While making and designing, Deleuze and Guattari (1980/2019) argue that designers and artisans join in the life of the material by “following the matter in its movement and flux” (p. 476) even before making begins. They propose that artisans should be able to find the right material, join in its becoming, and itinerate with it.

When I first started felting, I knew wool. I had known it mostly as yarn for knitting or as fleece for bed-filling. Felting wool and creating a nonwoven, compound surface out of it required re-learning it and attributing new meanings, such as paying closer attention to the fibre length and focusing on their movement. In a way, it requires getting to know the material again, this time through another lens (From my field notes, 2022).



Figure 5: Fleece waiting to find a home. Photo: Aktaş, 2021, Finland.

Ingold (2009) takes this thinking further by proposing travelling with the material instead of itinerating to bring attention to being with the material and remove it from the one itinerating. While making, an artefact co-emerges from the process through assemblages of matter, tools, the circumscribing bounds, and the maker (Bolt, 2007). For this, designers find a middle ground between their own ideas and material capacities. Through such conversations, the material shapes the design of an artefact.

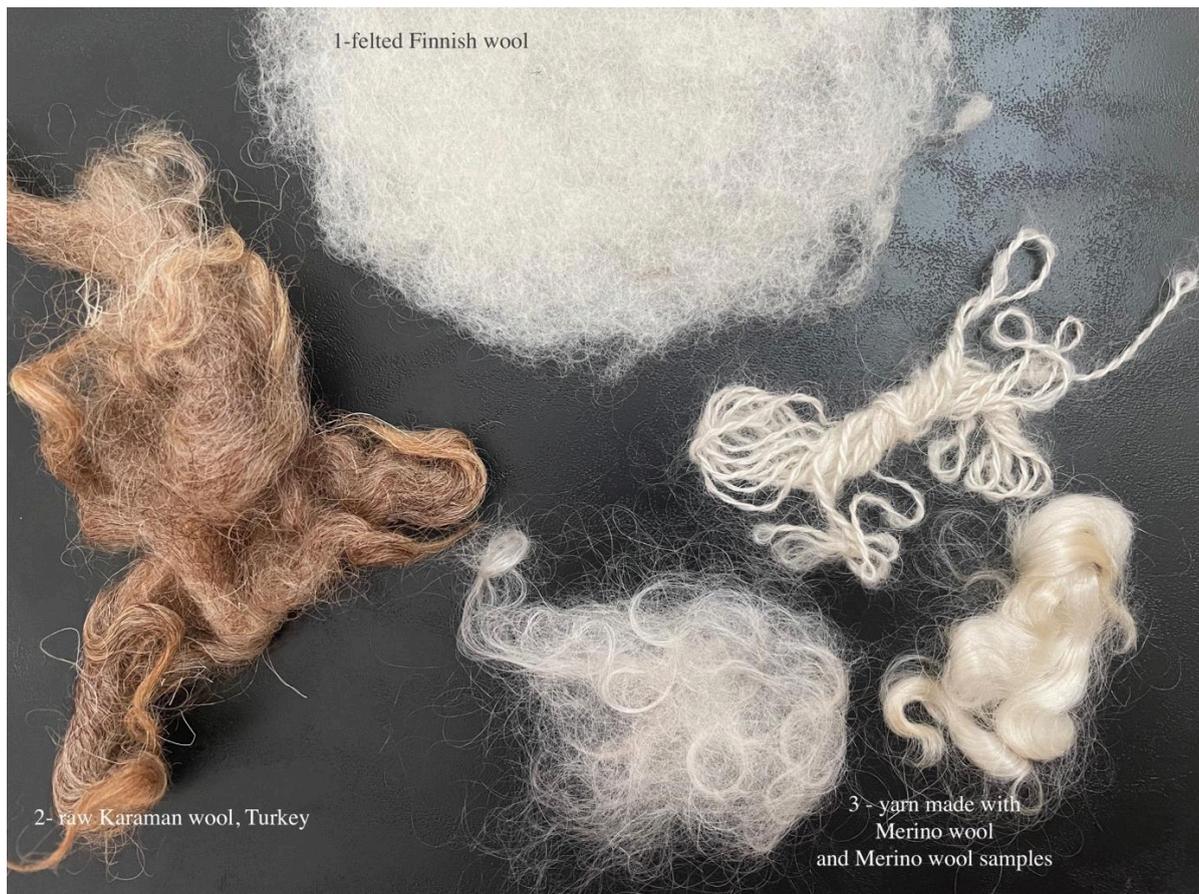


Figure 6: Samples for wool's being. Photo: Aktaş, 2023.

Travelling with the material proposes that idea generation, or designing, continues while making. When designers come up with an idea, they search for a travel companion, a material to think and make with and to explore its possibilities. In this process, the designer investigates the potentiality of the material, their applicability, and performance. The designer seeks relations between the ideas and the materials to find ways of working with the material. Thus, the process emerges through experimentation in nonlinear and interactive ways. As the designer and the material act, they are also acted upon. Therefore, the human-material interaction in the making is also co-creation: the human and the material create an artefact together while new versions of both are also created.

Wool becoming an artefact

After the designer completes an artefact, its journey of becoming continues. As Deleuze and Guattari pointed out, interdependent relationships exist between humans and nonhumans. They propose that things are ongoing becomings where they facilitate “moving, living, co-creative entanglements of humans and other beings” (van Dyke, 2015, p. 12). A part of those entanglements brings together humans/users and materials in the form of artefacts. Engaging with designed artefacts affects human experiences and bodily movements. For example, garments shape how wearers move, act, and feel (Valle, 2019).

The becoming of the material continues through other external forces. For example, while being used, wool fibres can be damaged and torn through friction (Figure 7). The movement happening with the material creates a change in its form. This leads to new practices, such as maintenance and repair, and new appearances. Examples from garment repair show that while mending, users can create reconfigurations of the original design through a creative and iterative process (Durrani, 2018). Therefore, the becoming of the material continues in the form of artefacts in the use phases with influences from the user and the use environment.

Besides human use, wool and felted artefacts become materials for animals other than humans and sheep. Humans are not the only species that make use of wool to create things. It is a type of keratin protein and a source for some insects, beetles, and, more widely, moths. Moths use woollen textiles to leave their larvae and provide them with food (Medha et al. 2021), changing the appearance and textile structure. Other animals that commonly use woollen artefacts are birds, wolves, and rats to make their dens or nests. For example, Egyptian vultures carry wool as padding for their nests (Stoyanova, 2010).



Figure 7: Woollen sock– torn and reshaped. Photo: Aktaş, 2021.

While I was working in a felting workshop in 2017 in Tire, Turkey, a person brought a small felt mat to the felt maker. He asked if the felt maker could repair the mat as the owner left it in the garden at one point, and crows took some of the wool to build their nests. The master said he could re-felt those parts (Figure 8, From my field notes, 2017).

As these animals affect the possibilities for the material and the artefact, they change the behaviour of humans and potentially result in different actions, such as moth-repellent treatments or keeping the artefact indoors. Although these animals approach wool as a material rather than an object, I refer to them in this section as they usually appear when wool is separated from sheep and in human use, showing more instances of multispecies interactions embedded in the material's journey. With the use of artefacts by humans or other animals, materials continue to become their other versions.



Figure 8: A felted mat, some of its wool taken by crows. Photo: Aktaş, 2017, Turkey.

Wool-artefacts becoming waste

When the material or the artefact is not in use anymore, it is either recycled or discarded. Recycled wool is often made of shredding wool yarns or felts to create a pile of wool-like material. This reprocessed or reused wool is often used for insulation purposes. If the wool is discarded in a landfill, it dissolves in the soil and changes the soil content due to its protein-based structure. At times, humans have also materialised this aspect by using wool as a fertilising resource (e.g., Abdallah et al. 2019) or substrate (e.g., Petek & Logar 2021).

Following the journey of wool shows that an artefact's becoming is continuous even when there is no direct human contact. In tandem with Bennett's (2010) proposal of vibrant materiality and thing power, artefacts and materials have the power to make a change even when they are not in use. However, as artefacts and materials are human constructs, when there is no human interaction, they become matter again, and the matter can yet again make changes in its surroundings. Nevertheless, since they have gone through changes, this time, their effect diffracts to new journeys.

A review of the stages

The five stages discussed the becoming of matter to material to an artefact and back to material and matter again. Although I discussed it step by step, the journey of wool can also emerge differently. These stages are intricate and not necessarily linear: as matter is becoming through interactions with humans and the world, their contexts are also becoming sometimes in unforeseen ways. Therefore, when matter becomes matter again, context-wise, it is not the same matter, but it is understood through another lens. For instance, once valuable wool is discarded, it does not go back to matter as part of sheep but rather matter as part of soil systems. This means that while things are becoming their new versions, so are their contexts. Since human-material interaction embeds mutual acting and being acted upon, it changes elements of the ecology being interacted with.

The invisible steps of human-material interaction

As the journey of wool indicates, human-material interaction evolves in expansive and explorative ways. The elements that come together might be expanded, yet I limited it to the presented ones due to the limitations of a publication. Still, the material journey tool can help reveal possible systems involved in a material's life (Table 2).

	Stages	Matter sheep hair, fleece	Material processed wool, textile material	Design process turning wool into ideas/artefacts, production	Use phase felted artefact	After use when the artefact is discarded and becomes matter again
SOCIAL SYSTEMS	People		Farmers Breeders Business people Felt makers Users	Designer Producer User	Users Sellers	Historians Inventors
	Other entities	Sheep Nature	Machines Tools	Industry, Ideation related tools	Things in use areas, eg. furniture, animals, nature	Nature Animals Soil
SPATIAL SYSTEMS	Location	Meadows	Designated areas Workshops Factories	Studio	Homes, Offices Outdoors	Landfill Dumpsters Meadows
CREATIVE SYSTEMS	Transformation	Messy matter Fleece	Wild/raw fleece becoming tamed wool	Wool becomes an artefact	Wear & Tear Friction Erosion Disposable thing	Re-use by animals Dissolving
	Tools	Intrinsic qualities	Carding tools, Cleaning tools	Body, Needle, Machine, Soap and water	Body, Decor tools for the carpet	Animal body Nature Soil
BEHAVIOURAL SYSTEMS	Goals/purpose	Keep sheep warm & safe	Make it easy to be controlled and manipulated	Realise the intended purpose of the artefact - keep floors warm	Use it in the intended way - shelter, warmth, decoration	Animal shelter Dissolve for the ecological cycle
	Actions	Absorb UV	Untangling wool fibers	Tangling wool Ideating	Interactions with users Frictions, Sensorial experiences	Degrade Unravelling
CULTURAL & POLITICAL SYSTEMS	Relations/ infrastructures	Evolution of wool kinds Ecological harmony Selective breeding	Turning raw wool into a controllable version Crafting Research & Development Technologies	Thinking through making and material interaction Creative industries Craft culture	User experience with textiles in various context Material culture	Environmental impact Recycling technologies Journey continues

Table 2: A material journey map for a felted artefact, its stages of becoming, and the systems to which it relates.

Studying the reviews of the stages and the map points out six main findings:

1. Although I discussed five stages in an order in this article, the journey among these stages can be nonlinear. Still, a stage evolves in relation to other stages. Each stage affects the emergence of the ones that follow. For instance, a particular matter becomes material based on its behaviours and the potential contexts to use it in. Therefore, how it is as matter and how it can be used as a material heavily relies on each other. These potentials impact the source of the material. For example, Table 2 shows that selective breeding led to the transformation of raw fleece into controllable wool with developed tools based on certain qualities. These decisions resulted in the disappearance of certain sheep breeds while developing new cultural practices and heritage artefacts. **The material's emergence depends on its various and previous interactions and how it relates to different systems.**

2. In tandem with this, even when designers focus merely on creating artefacts with local materials, they participate in several systems, perhaps without realising it. Material interaction consists of many elements that cross time and space. Some of these could be more easily recognisable and visible than others. Still, they affect the interaction and the becoming of the material and humans. For example, even if the designer ignores the source of their material, they are participating in political decision-making behind the international material production chain. Therefore, as Table 2 shows, **the social, spatial, creative, behavioural, cultural, and political systems are entangled**. Although each system develops dependently, as they are connected, one system's growth independent of materials (or wool) still affects how material participates in other systems.
3. Following Finding 2, **the proximity of the actors to the action can vary and affect what is happening differently**. When the distance is larger, the connection to the action can be harder to recognise, such as users being unaware of the tools to process fleece or the artefact's afterlife.
4. Although the five stages present certain moments of wool's becoming, these moments are not frozen either. Within each stage, wool/fleece is still in action and slowly transforming. **Even within specific descriptions and common denominations, the being of material can be perceived in its multiplicity**.
5. Despite aiming to study the journey of material independently of humans, it is not easy since it is studied in the first place because humans have recognised them as materials. Therefore, even if we like to go beyond human-centred thinking, as we can only grasp and embody human thinking, this approach might not be entirely possible. However, **tools like the material journey map can demonstrate coexistence** to bring attention to finding more harmonious ways of being with others. For example, as the journey map points out, **wool's becoming is a multispecies journey that goes beyond humans and sheep**. Recognising such instances can widen the perspectives of designers and users to position themselves next to other active actors.
6. Finally, Table 2 shows that though we may experience the impact of invisible parts of the material's journey, they are either indirect or experienced implicitly. Still, the invisible past and future of the artefact affect its emergence and current experiences. The relationship with larger systems that extend to sparse space and

long time is not always easy to grasp. **To be able to follow the journey of wool, one needs to challenge personal understandings regarding the material's birth and its death, where it starts, and where it ends.**

Ingold (2013) proposed that materials embed generative or regenerative potentials, and because of these potentials, they should not be perceived with fixed definitions based on human needs but with their potential to become other things. Mapping the material journey can help understand various becomings of materials while also unravelling complicated entanglements to build more sustainable and ethical practices. Gaining such understanding is crucial as humans develop through material interactions, and the material impact of current lifestyles creates unsustainable living conditions.

Also, researchers and designers should find new use areas and production methods with emerging materials. Developing a material with desired qualities in the laboratory does not grant active use areas or sustainable impact. To qualitatively measure or speculate how new materials can impact existing systems, a material journey map can be helpful to show its relations to systems in various stages and to explore their potential environmental impact.

Different relationships emerge in intricate ways during the material's journey, creating entanglements. Building on the way wool is entangled, an entanglement is when the pieces of a unit create a new reality without losing their subjective existence. Each fibre is still accessible, but they act together to create one meaningful piece; unravelling an entanglement can illuminate these subjectivities to understand their unity more precisely while finding ways of being with it.

Conclusion

This paper discussed different contexts of materials to design a tool for studying material journeys. Building on the idea that materials shape how humans think and act, studying the material journey in the case of a felted artefact provided an approach to understanding the extent of the material's influence. Such understanding is vital as the material impact of human life creates significant changes in the world and affects environmental sustainability. A material journey map can help unravel complicated systems and illuminate the systems co-created by humans and nonhumans. This way, the impact of existing materials and the potential for newly emerging ones can be explored from a multispecies and reciprocal perspective.

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