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Material Connaissance as a Tacit Knowledge Co-Creation Method

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This paper builds on a model developed to engage in shared material experience in a protocol inspired by wine tasting: the Material Connaissance Method. In this paper the theoretical framework and motivation is discussed. In the first section the material experience model based on wine tasting protocols is briefly presented, followed by a literature review in the fields of material experience and tacit knowledge co-creation. The paper concludes with a reflection of the initial pilots of the protocol and their theoretical repercussions. The main contribution of the paper is the proposal of a framework for engaging in research through design as a way to understand the tacit dimension of material experience in the context of upcycling.

Keywords: Material experience; upcycling systems design; design for sustainability; circular economy

1 Introduction, rationale and method

This paper aims to present a theoretical backdrop upon which the development of a wider research through design project rests. This doctoral project includes the development of different studies, tools and practical material explorations to address each layer of the model we present and argue for. The model proposes a three-layered model to understand material experience (Karana et al, 2013). The nature of each layer is such that the type of methods and ontological models around which these tools are unpacked, exhibit a high degree of variety. Striking a balance between theory and practice in the context of this type of design scholarship, is always a precarious affair. We feel the need to elevate “night science” and challenge academic tradition by sharing the authentic and real stories of ongoing designerly research. We view the construction of this research programme as an iterative and mismatched collection of prototypes, that are a part of a bigger picture when seen from a distance. In addition, given the open-ended nature of doctoral projects we have to manage and re-evaluate the goals and expectations as the results of ongoing experiments inform the initial research question. This paper acts as a midway point of this project reflecting on the work that has been done so far to recontextualise the theoretical background and to plan for the next steps. The central contribution of this paper is a conceptual model that deconstructs the material experience in order to facilitate a deeper understanding of its constituent parts. Tacit knowledge was selected as the most

underrepresented facet of this model and emphasis was given in reflecting on our practice to see its traces in our work so far. Throughout this project we have been building the cognitive apparatus to better support this type of design, as with any Research-through-Design project, times of action are followed by times of introspection and reflection. This paper aims to report on the key insights that have emerged from said reflection.

This paper is structured in four sections. In the next section the theoretical background that informs the positionality of this project is presented. This includes previous work undertaken and other relevant studies. In the following section the proposed model of material experience is presented. We zoom in on tacit knowledge's role in the design of new materials and products through the material driven design method (Karana et al., 2015) and argue for the need for it to be better integrated in practice. We conclude this paper by reflecting on the work undertaken so far and speculating on directions that tacit knowledge might be better leveraged to design novel materials.

In the context of design practice, the creation of new materials from waste aligns with non-extractivist models, which prioritize the responsible use and regeneration of resources rather than exploiting them unsustainably. This shift fosters an ontological transition, where the fundamental principles of materiality, production, and experience are re-examined, leading to a paradigm shift in how we view materials. Embracing non-extractivist models and ontological transition in design practice contributes to a more harmonious relationship between human activities and the environment, facilitating a truly sustainable and regenerative approach to development.

2 Material Connaissance

Within the methodological framework of Material Driven Design, steps 2 (Material Vision) and 3 (Material Understanding), we identified a gap in the literature concerning deciding and communicating the tacit and aesthetic qualities of materials. To bridge that gap, we have proposed a conceptual framework for the communication and verbalization process of materials experience, that combines wine tasting methods and, accordingly, follows a specific script and specialized language. This framework also aims to enrich the MDD (Material Driven Design) methodology proposed by Karana, Barati, Rognoli, & Van Der Laan, (2015) in its second and third stage, namely the creation of material experience vision (2nd step) and the communication of it through user studies (following the proposed framework) for manifesting material experience patterns (3rd step). MDD can be used on steps 2 to 5 within the Upcycling Systems Design framework, which will be analysed on the next section, although other design methods can be used as well.

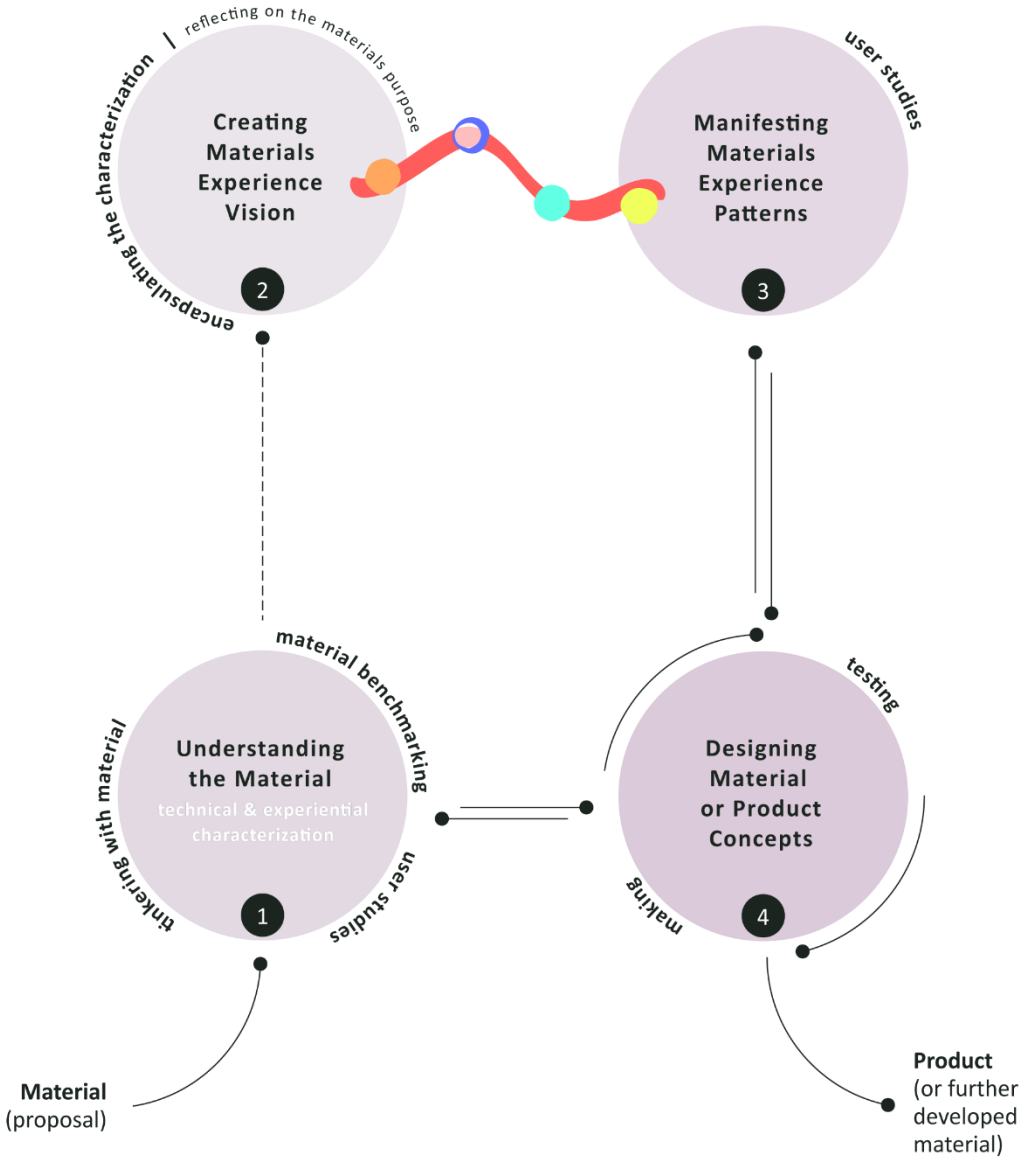

Figure 1. The Material Connaissance method in relation to Material Driven Design

This previously proposed framework, The Material Connaissance Method (Boukouvala & Bofylatos, 2022), consists of two parts, equally important for the communication of materials attributes and the overall materials experience. The first part follows a specific script of actions, just like in wine tasting, aiming in the conceptualization of narratives for the materials by evaluating their sensorial qualities, while the second one is the creation of a complementary vocabulary and language, for materials, or the synthesis of a materials experience lexicon. By creating a richer vocabulary, we wish to facilitate the expression of these narratives in a more poetic and expressive way. These two parts are intended to be used in relation with each other, as the use of a specific language would amplify the results of the user's experience with materials and vice versa (ibid.).

This method aims to enable material designers in ascertaining and evaluating, whether or not the desired experience has been created and communicated correctly, through a collective effort, taking into consideration the views, thoughts and experiences of people that have zero involvement in the conception and creation of said materials, and therefore their opinions are the least biased (ibid.).

The 4 sequential steps of the Material Connaissance Method, shown in the schematic representation below (figure 2), go as follows:

Step 1: visual evaluation | building expectations

The first step, in which each participant is called to visually interact with the objects (material samples or products) by making private notes and observations, related solely on the visual sens, is the expectation building phase. The participants should take into consideration the looks of a material or a product, regarding some predefined qualities.

Step 2: tactile + olfactory + auditory evaluation | matching expectations with reality

Next, the participants would be called to compare the impressions and expectations that emerged from the visual evaluation, with the physical reality of the objects relating to tactile, olfactory and auditory sense, regarding the same predefined qualities as previously. Memories and knowledge from previous experiences are strongly present in this phase, therefore creating strong emotional links with the objects. The language used in both step one and two, aims to be mainly metaphorical and to build associations with the feelings and thoughts of the users. This step is the one that is strongly connected with tacit knowledge as the connections between memory and material experience tend to lean on the empirical and experiential knowledge.

Step 3: personal narrative establishment | material stories

Once the sensorial evaluation is over, the participants must compose their personal narratives for the material by reflecting upon their personal observations and notes. During this process, sensorial incongruities might occur, because the interpretations of the senses are subjective and, in a way, unique to each individual. In proposing and using this framework, we focus on how the properties of a material are perceived by each participant in relation to their personal experience and history, utilizing tacit knowledge and intuition, and not on the literal values and characteristics of an object. The previous life of DIY, upcycled and bio-fabricated materials, as well as the process of giving new life and purpose to waste, is an aspect of the circular economy that is necessary to foster behavioural change and acceptance of such materials, therefore the creation of material narratives and stories is much needed.

Step 4: construction of collective materials experience | communication

In the final step of the process the participants should discuss, compare and combine their individual experiences, to reach a deep and mutual understanding of the material and finally construct the collective narrative to be communicated.

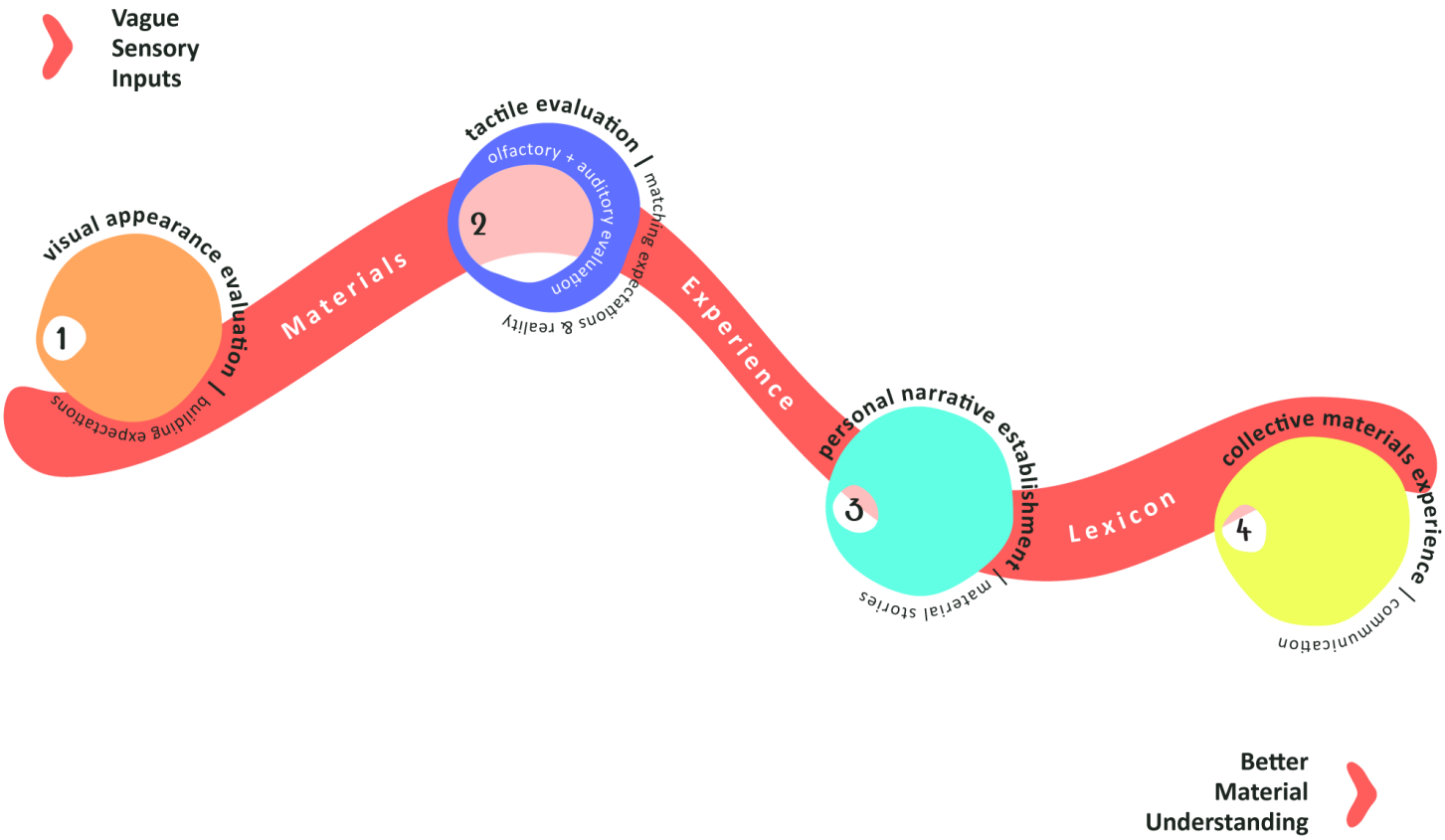

Figure 2. Schematic Representation of the Material Connaissance Method: the script steps that constitute the first part of the method, in relation to the second part, that is the Materials Experience Lexicon.

3 Upcycling Systems Design

In earlier work we have developed a framework for designing upcycled materials through a holistic view of waste streams in a local context (Bofylatos 2022). The Design Out Waste Methodology (DOWM) is based on the first principle of circular economy which places the reuse of waste as a pillar of design and aims at its effective utilization through the creation of new upcycling processes. Using an old material in a different and innovative manner, provokes enthusiasm for its potential and brings it back into the value cycles of the economy.

DOWM consists of three parts: The first part is centred around understanding the material flows and the feedback loops that decelerate their transformation into waste. In the second part, the “Upcycling Systems Design” methodology aims to transform a flow of waste into a new upcycled material. The third step is the documentation of all relevant information including the properties, the making

process, mechanical data, aesthetic qualities and narratives around the material, as well as its background information.

Upcycling Systems Design (ibid.) is a proposal for a research method which posits that the creation of a sustainable system will impact our strategies for waste management and resource efficiency by changing consumer perceptions of waste and switching to production models and consumption closer to the human scale. It aims to address issues of hyper locality, alienation of production and circular economy. The steps of the methodology are:

1. **Waste evaluation**: Identification and quantification of possible sources of materials for upcycling, following the taxonomy of 5 Kingdoms of DIY materials
2. **Material vision**: Experimentation and development of the raw material production process.
3. **Material understanding**: Testing of the mechanical and aesthetic properties of the upcycled material.
4. **Product concepts**: Prototyping objects iteratively.
5. **Production**: Starting of a new value chain situated at the end of a previously wasteful value chain.

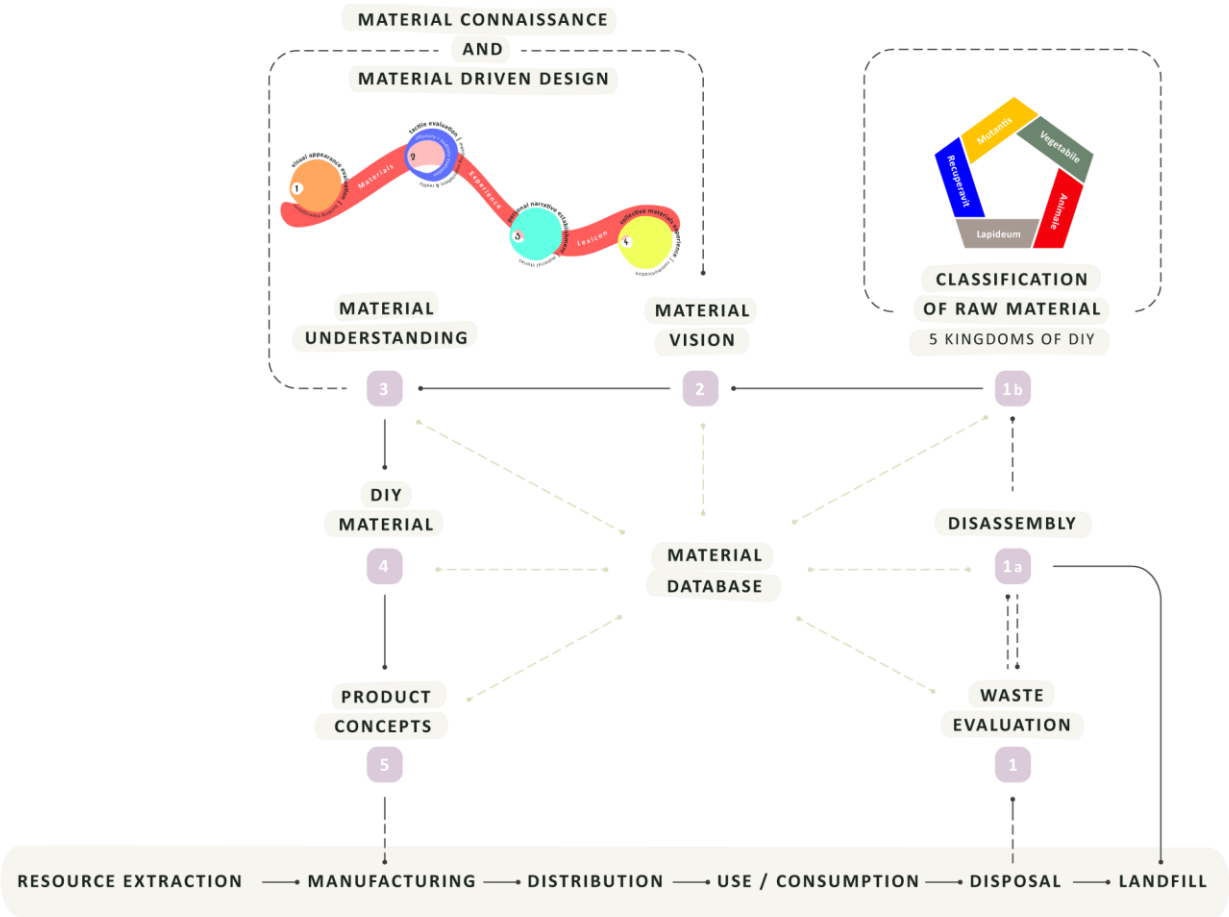

Figure 3. Positioning the Material Connaissance method in Upcycling Systems Design

Ultimately, the materials that will be produced through the Upcycling Systems Design methodology, incorporate and valorise the values of sustainability, circular economy and degrowth (Kalis et al, 2014). They embrace the imperfections that come with more human focused loci and age gracefully. Many modern materials lean on an aesthetic of perfection that is based on the use of brilliant smooth materials, such as plastics or MDF, that lose these aesthetic properties through extended use. By contrast, materials such as natural woods, brass or other bio-based materials become more beautiful as they age, incorporating the traces of use gracefully.

Upcycling Systems Design aims to aid material designers to utilize their surroundings as a space ripe with resources. Material designers are designers who are "trained to detect unused materials from technical or natural flows and transform them into circular materials by using their design aptitudes" (Llorach, 2017). This approach supports the transition towards sustainable lifestyles (Gaziulusoy, 2019) by creating the conditions that support the establishment of new business models for small and medium-sized enterprises with an emphasis on low-scale, quality production that acts locally, improving the natural and social environment and increasing employment in a human-scale economy addressing both environmental and social sustainability.

Most processes aiming to facilitate the decision-making process around the experiential and aesthetic decisions around materials, are undertaken by the designer alone. The choices are made based on individual understanding of the material through its technical and aesthetic properties, and could be characterized as an introspection or a monologue (Boukouvala & Bofylatos 2022). The designer attempts to take every aspect of the materials properties into account, but some of these properties are phenomenological and are connected to culture or memory. Designers can grow a more spiritual connection with their creations and may not be the most objective and sincere judges when it comes to the communication of their practice or the personal narratives around these materials. However, to ensure these aspects are concisely communicated, their practice needs to be informed by co-design and participatory methods.

As the complexity of material design increases, the tools that we utilize to understand, discuss, and disseminate the experiences generated by materials need to be expanded. To address this issue, instead of reinventing the wheel, we turned to an established language with its own grammar and syntax, that of oenology and wine-tasting, to be inspired. The Material Connaissance Method, mentioned earlier, is based on wine tasting language and protocols, and can include focus groups, making and experiencing workshops, surveys, interviews or other co-design activities.

With the general methodological framework decided and tested in our previous work we decided to further develop the Material Connaissance protocol and build specific tools for each stage. Developing the tools to build this framework is a "Research Through Design" (Frayling, 1993) project that has to be developed in an iterative manner. Research Through Design, defined as, "a research approach that employs methods and processes from design practice as a mode of inquiry" (Zimmerman et al. 2014), has been adopted in a variety of contexts, including artistic, empirical and social research (Binder et al., 2009). It is a tool that creates iterative design interventions to make new design theory (Redstrom, 2017), a necessary step in the emerging field of Material Design. We view material design as a space where most of the ontological and epistemological considerations are emergent and as such, a "night science" approach is being undertaken in order to create the conditions that enable such emergence (Gaver et al., 2022). The term "night science" refers to the unexpected, messy and at times

“unscientific” processes that researchers engage with, routinely. It is later tamed into day science, making it appear pure and reasonable by removing all the dead ends its development reached.

4 Three Layers of Materials Experience: Syntax, Grammar, Semiosis

For the framework developed, that of Material Connaissance, we have identified three aspects of materials experience and aim to develop methodological tools for each aspect. Based on earlier work, we adopted the semiotic model in design (Bofylatos, 2017; Zingale & Domingues, 2015) and identified three layers of the material experience, corresponding with the layers of the proposed methodology (Figure 4). The layers are the Syntax, the Grammar and the Semantic layer. Communication and semiosis on each layer are facilitated by: the use of Narratives on the first layer, Metaphors on the second layer and Tacit Knowledge on the third layer. This classification of the layers of experience also falls in line with Norman’s (2004) three layers of product experience: Visceral, Behavioural and Reflective. Three layers of product experience provide a framework for understanding the various aspects of user experience. The first layer, visceral, is associated with initial impressions, aesthetics and sensory cues, such as the appearance, sound, and feel of a product. The second layer, behavioural, concerns the interaction between the user and the product, including its functionality, usability, and ease of use. The third layer, reflective, involves the emotional and cognitive responses that the product evokes, such as satisfaction, pride, and sense of community.

Our motivation is to create tools that enable a more robust and successful communication and co-designed material experience. By looking at each layer alone, but also synthesizing these findings to a comprehensive methodology we look to enrich the methodologies around designing (with) upcycled materials. The synthesis of these tools is achieved by engaging in a Research-Through-Design approach for developing upcycled, sustainable and regenerative materials, using these tools and reflecting on both the materials as well as the effectiveness of the tools.

In this section we will briefly elaborate on the three layers and the ways of communication. The main focus of this paper lies in understanding the tacit dimension of the material experience (which constitutes the 3d layer) that is created while crafting materials and interacting with them.

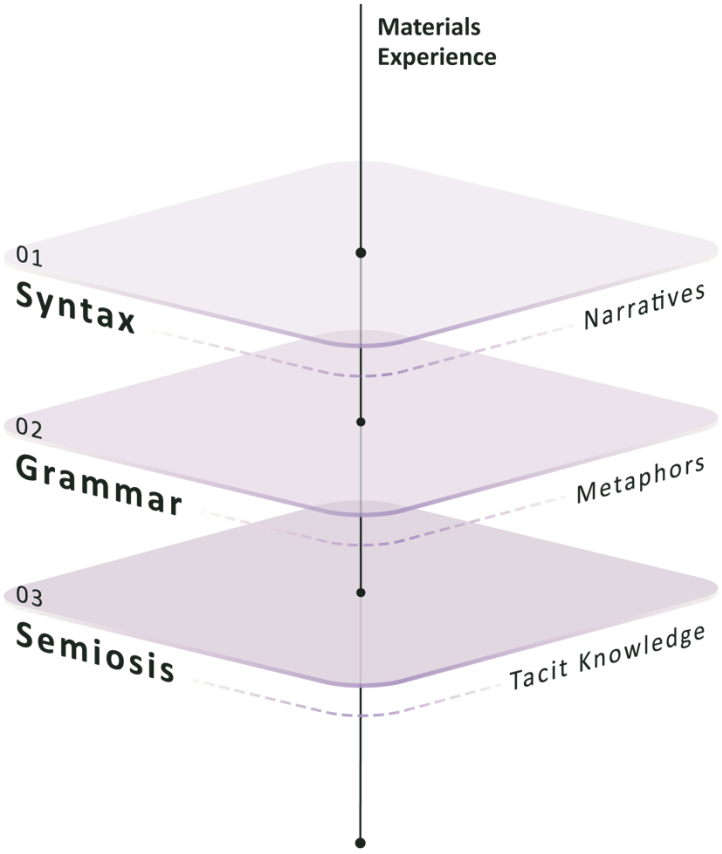

Figure 4. The 3 layers of Materials Experience identified in this paper: Syntax, Grammar, Semiosis, and how they manifest.

4.1 Syntax

The syntactic layer of the material, in the context of the framework developed and briefly analysed in this paper, is the narrative aspect. Upcycled materials are part of a design ethos that explicitly aims to make the notion of any kind of waste a word of the past (McDonough & Braungart, 2002). Communicating the ways that new value systems are being leveraged on existing waste streams is an essential part in fostering behavioural change and challenging the dominant view of what the end of life of a product or material means. These narratives play a twofold role in this process. Firstly, they valorise the upcycling processes and inform end users of how the circular economy innovates, by using crafting, making and creativity to see purposeful materials where in the past we only saw waste. Secondly, the story of the waste, its environmental impact before being diverted into re-use, and the people collecting and remaking these materials is an integral aspect of the narrative that surrounds the new products designed and produced. This human centred approach aims to minimize the alienation that traditional mass-produced commodities have been using to enable unfettered consumption with zero guilt (Stathern, 1988; Henare et al, 2006; Graeber, 2001), by suggesting sincere and transparent means of communication. The stories around and about upcycled materials, from natural and technical flows, might push consumers and designers into imagining the creation context, collaborations and effort being put in the realization of such materials. This process could result in a shift in people's mindsets that could make them consider products as more than just disposable and

ephemeral things, and to manage them as something of greater value to not only their individuality but also as part of a larger social whole to achieve sustainability and ethical co-existence.

4.2 Grammar

The second layer identified, referred to as the grammatical layer, is associated with the explicit aspects of the material experience. In this layer metaphors are the language used to communicate the aesthetic qualities of materials. Metaphors are ways of expressing meaning in a non-literal way by bringing together two objects or ideas that are ostensibly different but share an underlying property (Lakoff & Johnson, 1980; Hekket & Cila, 2015).

There has been growing recognition that metaphors underlie how people think, reason, and imagine in everyday life (Gibbs, 1994; Lakoff & Johnson, 1980; Sweetser, 1990; Fauconnier & Turner, 1998). People structure and experience most abstract concepts such as time, emotion, and taste, using the language of metaphor. This is evident in the wine tasting protocols we have turned to as inspiration. Each stage of the wine tasting experience is communicated through the use of metaphoric language. In order to pass on the smell and flavour of wines, wine experts widely use metaphors (Suárez Toste 2007; Caballero & Suárez-Toste, 2010; Paradis & Eeg-Olofsson, 2013) as well as a set of conventionalized descriptors such as specific source descriptions (Croijmans & Majid, 2016) and precise words (certain fruits instead of using the general term "fruit", etc.) (Lawless, 1984; Gawel, 1997). Tools in wine tasting, such as the use of metaphors, analogies and practical examples are of vital importance when communicating complex taste sensations (Herdenstam, 2011; Herdenstam et al., 2018).

The weaving of metaphors to communicate the beats of a grander narrative that describes the whole of the experience is in line with the Micro-Macro experience design approach, proposed by von Saucken et al. (2013). Macro user experience describes the product's purpose, asking "Why should a user need a product and its experience?", whereas Micro user experiences focus on the product embodiment design, without questioning its purpose, looking at snapshots that when put together paint a greater whole. Shifting the scope from the macro to the micro level when designing an overall experience is, again, in line with the gastronomy protocols that we have leaned on for inspiration. The sommelier builds a macro experience and a narrative around a specific wine by weaving together each micro experience to their overarching story. The smell, flavour, mouthfeel, bouquet etc. all are stages in structuring a gastronomic experience working together towards a greater whole.

4.3 Semiosis

The creation of metaphors to better describe the different stages of the material experience is seen as the grammar and the larger narrative within which these materials exist. In addition, the proposed method aims to create a space where the tacit dimension of material experience can be verbalized and communicated through metaphors and narratives. We have met "material connoisseurs", craftspeople who tacitly know a material they have mastered through a simple sensorial inspection. These experts have built a model that is very relevant to material design as they have managed to strike a balance of the three layers of the experience. Through this appropriation of culinary techniques in the field of material design, we aim to develop a framework through which material designers can cultivate this skill. In the next section we will discuss the nature of tacit knowledge, which is the third layer identified, in the context of Material Driven Design as the bedrock upon which the practice of Upcycling materials for product design is established.

5 Tacit Knowledge

Professional craftspeople, makers and designers, through reflective practice (Schon 1968), create materials, artifacts and methods to communicate the value of tacit knowledge, that is created through their practice, to their clients. They have to create the tools to convince and educate others about limitations and possibilities of their work. With this in mind, we want to see if the practice of material designers engages with processes relevant to the translation and reframing of knowledge from one type to the other. The relationships between empirical and scientific knowledge have been widely discussed in epistemological cycles for the past 50 years, and thus we decided to focus on the often-forgotten tacit knowledge, associated with material experience, especially in the context of upcycled materials.

Victor Papanek (1985) in his revised definition of design "Design is the conscious and intuitive effort to impose meaningful order", suggests that the intuitive dimension of the creative practice, is equally important as the conscious effort one makes. According to Papanek, "intuition affects design in a profound way. For through intuitive insight we bring into play impressions, ideas, and thoughts we have unknowingly collected on a subconscious, unconscious, or preconscious level. The "how" of intuitive reasoning in design doesn't readily yield to analysis but can be explained through example". Intuition is closely related to tacit knowledge because it is based on past experiences and knowledge that is not easily expressed or articulated. In other words, intuition is often informed by tacit knowledge. It is the result of years of experience, observation, and practice, which have been internalized and integrated into one's way of thinking and acting. Therefore, intuition and tacit knowledge are interdependent, and they can work together to enable individuals to make quick and effective decisions in complex and uncertain situations.

Experiential and tacit knowledge found on craft disciplines, provide understanding for the relationship between material manipulation and embodied mind (Groth, 2016). The material plays a quintessential role in both the user and the designer logic, as it provides the trigger to create tacit knowledge. This semiotic cycle starts on the side of the material designer who is in an open dialogue with the material. In the context of craft, you do not get to create what you want, but what the medium allows to create. You can't make the same thing you would make out of wood with marble. Every material has its own life and as such we should not force them to speak our language, but try to engage in a dialogue that will lead to the shared space between the material, the designer and the user (Pallasmaa 2012). By engaging in this dialogue with the material the designer can use abduction by engaging in what Pye refers to as "workmanship of risk", a frame of mind where the craftsperson will try new things without being afraid of failing or destroying the work produced (Pye 1968).

6 Tacit Knowledge Co-Creation

The biggest challenge in the proposed model, lies in the creation of tacit knowledge. Firstly, tacit knowledge, due to its nature and close relationship with the material, has to be co-created (Pallasmaa 2009; Kiem 2011), while engaging with the material reality in an embodied way. In his book, "The Craftsman", Sennett (2008) states that "When the hand and mind, art and application, technique and science are separated, it is the mind that loses in both expression and understanding". The designer's contact with the materials, tools and processes enables the emergence of knowledge that is impossible to get otherwise and, without which, design thinking is incomplete. Secondly, the

worldview and value system of modernity has pushed such ways of knowing out of the decision support process, due to it not being able to exist within a quantifiable scientific model.

Two main ways to reintegrate tacit knowledge in design have been identified. The first is to have the user engage in an apprenticeship and create the necessary knowledge with the material by engaging with it. In this process the design logic is focused on creating propositional artifacts (Walker 2012) that aim to engage the audience in the creation of said knowledge. The second way to integrate tacit knowledge in the user's logic is through traces, "the perceptible enduring marks that are brought about through people's engagement with the material" (Ingold, 2013). These traces act as carriers of tacit knowledge and can, in some cases cause the emergence of tacit knowledge in the user logic side of the mediation.

Dewey (1986) argues that processes of circular action, driven by intention, are the essential core of knowledge generation. The separation of thinking as pure contemplation and acting as bodily intervention into the world, becomes obsolete; quite the reverse: Thinking depends on real world situations that have to be met. Thinking activity is initiated by the necessity to choose appropriate means with regard to expected consequences. According to Dewey, "knowing is a manner of acting and "truth" is better called "warranted assertibility". Schon's (1983) epistemology of "reflective practice" can be regarded as the design-related description of these concepts. It is this special unspecific (generic) pattern, which Cross (2001, p. 54) characterizes as "designerly ways of knowing".

For the pragmatists, the praxis is the basis of any new knowledge and Research has a central role in the production of meaning and constructing reality, based on this new knowledge (Morgan, 2014; Dixon, 2020). Practical research is as an element central in the process of craft and it highlights its holistic nature. Thinking and practice, mind and body are inseparable and integrated in the practice of intelligent making. Multidisciplinary research, aiming a holistic approach of the context, extends beyond the manifestations based on scientific and objective knowledge, through personal experiences (Niedderer & Townsend, 2016).

The DIY and human scale of production of the materials and artifacts produced through the Upcycled Systems Design, ensure the production of tacit knowledge by their makers. Succinctly communicating this knowledge to the people who come in contact with such materials, either as active participants (i.e designers who want to use a new material) or passive audience (i.e users of goods made by such materials). The unique characteristics of tacit knowledge fosters difficulties to working with them. Very few design methodologies exist to design with. In our view, the model proposed offers a way to design an integrated experience that communicates all three layers of knowledge in tandem and leverages tacit knowledge to tell the story of an assembly of people, materials and properties.

7 Reflection

In this section we put forward the ongoing steps of this wider research project and our reflections on how they achieve the goal of providing material designers with the tools to better understand how tacit knowledge can ground material experience. We look back at the research and making activities that we have undertaken in the past years to remake the theoretical framework (Redstrom, 2017) developed and to speculate on the future directions of this research project.

In this paper we have argued that the tacit knowledge dimension, the third layer of our material experience identification, semiosis, is the most interesting and hardest to share in the context of design, craft and, more specifically, material design. This is better explored by a combination of praxis, reflection and autoethnographic writing. In order to decoct a personal, experiential and context specific experience and then share it with the world through a material, we need both personal and collective approaches. Reflection and iterative work are the ways that designers come to learn about the tacit dimensions of their practice. Autoethnographies of making are, as such, an important tool that facilitates guided reflection and the deeper understanding of these things unsaid. To test, validate and uncover personal biases in the results, we have developed a focus group format that facilitates the reflection of participants in relation to the aesthetic qualities and other micro experiences of materials. Aesthetic appraisal and the feelings it may raise can be very personal and, as such, the focus groups of the Material Connaissance Method aim to see if the personal narrative is in line with the collective one.

An additional approach, that has enabled us to see the co-creation of tacit knowledge in action, is making workshops. In these workshops a group of participants are replicating material recipes and engage in a guided making process around a specific material. Once the making is done the participants engage in a structured dialogue about the personal narratives and feelings that emerged during and after the making process. Through this activity, each layer of the proposed model becomes populated with appropriate knowledge and how the higher level representations are grounded to the tacit knowledge that emerged through the making process.

In another workshop format, the participants were asked to participate in a focus group to discuss the aesthetic qualities of the materials, then make the materials and, finally, reflect on the shifts in their perspectives around said materials as they become informed by the tacit knowledge associated with the making of the materials. Through this study we wanted to see the results that co-creating tacit knowledge has in the perceived aesthetic qualities and narratives around DIY materials. The observations during this study support the value of tacit knowledge in appreciating the making processes of these material and connecting them to values of sustainability as it pertains to materiality and our perception of waste.

For the second layer, that of grammar and metaphor usage, we have turned outwards to the emerging community of material designers. We have designed and began implementing a large-scale social study, looking at existing, established practitioners in the field of material design and upcycling. Through a semi structured interview, we are examining the types of metaphors that material designers have adopted to communicate their material experiences. This ongoing engagement with the community has been fruitful on many levels. Once the collection of the metaphors has reached a critical mass, we aim to organize them through a theme analysis. The envisioned output of this study is a material experience lexicon, much in line with existing wine tasting tools, that includes the adjectives and metaphors used to describe material experiences. We posit that using the "five kingdoms of DIY materials" (Ayala et al., 2017) typology as the theme to organize the information around, will be meaningful and will further validate this typology. We view this tool as an open-ended database that will be further populated by material designers in the future. We feel this mapping of the second layer of the proposed model feeds back to the Material Connaissance method and provide a richer vocabulary for the characterisation of the key dimensions of material experiences.

In relation to the first layers, that of syntax and narratives around these materials, we are looking at existing marketing and communication codes that have been produced for products that utilize upcycled materials. With this, we aim to document how companies and makers communicate the narratives around their work and how they frame the material experience they aim to deliver. In later stages we aim to analyse this macro user experience in relation to the metaphors used to signify the micro user experiences around specific aspects of the material.

The use of upcycled and bio-based materials, that are more sincere and embrace the imperfections that come with more human focused loci and age gracefully, to create timeless artifacts, can eventually lead to a more conscious consumption model. The narratives created and communicated around and about these materials can help accelerate the process of material acceptance and widespread use by giving them a more humane substance and helping understand them. The use of metaphors to create unique material experiences will create personal relationships with the materials, based on emerging associations related to memory, during the exploration of the aesthetic qualities and reflection of feelings.

The profession of design holds liability. Designers can bring about change. Societal, environmental, cultural. By investing in an environmentally friendly practice, popularizing the techniques and processes of DIY, bio-based and sustainable material making and the methods for materials experience exploration to co-create knowledge, we can bring a change by shifting production and consumption models that, facing the environmental and societal problems of our times, is very much needed. Sharing experiences, know-how and all types of knowledge, inside the Material Designers emerging community, is very important to create a strong base or to trigger a movement in the sustainable era. By collecting the testimonies of the designer's, apart from the parts that have to do with our research in the relationship between them and their creations, we can start to demystify the world of material making and suggest proven solutions to common, yet crippling, problems to help hesitant designers make a confident start in material exploration and making.

The transitions necessary to be undertaken in order for sustainability to emerge are many and require a fundamental reorganisation of many facets of our current understanding of the world. The reintegration of tacit knowledge in the design process is a necessary ontological transition, in our view. Integrating tacit knowledge in material-driven design is vital for transitioning towards sustainability and fostering an alternative values system. While evidence-based reasoning has its merits, its exclusive reliance has led to unsustainable scientific models, overlooking qualitative insights, indigenous ways of knowing and the interconnectedness of ecological and social complexities. Embracing both empirical evidence and tacit knowledge offers a holistic approach to address sustainability challenges effectively and responsibly.

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