



UMEÅ UNIVERSITY

DESIGNING FOR INTERCONNECTEDNESS

Strategies for More-Than-Human Experiences

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Abstract

More-than-human design represents a paradigm shift that decentralises the human in relation to the rest of the living world. As part of this movement, scholars call for a new worldview that recognizes the interconnectedness between human and non-human beings. Prior studies have focused on the experience of human-human connections, leaving the more-than-human largely unexplored. Addressing this gap, this study explores design strategies for fostering feelings and reflections of interconnectedness towards the more-than-human world and associated emotions. With a research-through-design methodology, two workshops were conducted, resulting in six key design strategies and an "interconnectedness experience framework". The strategies were evaluated through a prototype in partnership with AquaPrint, a Swedish company that up-cycles fishing nets into designer furniture. Future research should evaluate the strategies individually and in combinations as well as in a field setting. The presented framework and strategies are intended for practitioners as inspiration in design projects to promote noticing the more-than-human world, and encouraging a posthuman perspective.

Keywords: Research through design, interconnectedness, more-than-human design, design strategies, noticing, sustainable HCI, 3D-printing, circular material flow

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1. Introduction

Humanity has had and continues to have, a profound impact on the rest of the living world, fundamentally affecting the livability of planet Earth (Tsing, Bubandt, Gan, & Swanson, 2017). This geological epoch is often referred to as the Anthropocene, a widely accepted term coined by Crutzen (2002) that describes the planetary-scale ecocide that humans are knowingly causing. In the field of human-computer interaction [HCI], there have emerged two main movements that represent different ways of approaching this crisis we now face. The first is the field of sustainable HCI, first introduced by Blevis (2007) and further developed by DiSalvo, Sengers, and Brynjarsdóttir (2010), which aims to promote sustainable behaviour through interactive technologies and can further be used as a critical lens in the design of interactive systems. The second approach is termed more-than-human design. This is an

approach consistent with many scholars who argue that a crucial part of the problem is anthropocentrism and how we view ourselves and our place in relation to the rest of the living world (Foth et al., 2021; Hickel, 2020; Merchant, 1990; Wakkary, 2021). This view has led to the call for a new ontology of post-humanism where humans are no longer regarded as being at the centre of all things, but are instead seen as being part of a complex ecosystem of non-human actors.

When discussing the role of human progress and design in relation to the ecological crisis, Wakkary (2021, 2) envisions an ideal state in which we “see no ‘other’ in what we call human”. By doing so, we care for all that is not human and exist together in a thriving cohabited biosphere. Similarly, when discussing how the current economic model of capitalism has influenced the climate and the rest of the living world, Hickel (2020) argues that only changing our economic model will not be enough to tackle the crisis — we must also “change the way we see the world, and our place within it” (p. 34). Further, the author states that this other perspective is not about looking at the world in terms of limits, but instead of interconnectedness.

A company that tries to have a positive impact on the world is AquaPrint, our collaborative partner in this project. By fostering a more circular economy, described as promoting the reuse and recycling of material and the ambition of creating waste-free circular material flows (Corvellec et al. 2020), AquaPrint aims to transform human consumption and the view of waste. AquaPrint addresses the issue of plastic waste from broken fishing nets, where the difficulties of discarding them safely pose a potential risk to marine life. By collecting these nets and repurposing their materials through large-scale additive manufacturing, AquaPrint creates design furniture that not only helps protect marine life but also extends the material's lifespan.

Though AquaPrint manages to address issues of the non-human, how can one create a feeling of interconnectedness between the human and more-than-human world? Studies have addressed concepts such as “strategies for mediating intimate relationships through technology” (Hassenzahl et al., 2012) and “strategies for fostering genuine connection in technologically mediated systems” (Stepanova et al., 2022). While these studies are valuable, they primarily focus on human-to-human connections and remain within an anthropocentric framework, overlooking the more-than-human dimension called for by scholars. To our knowledge, there has been no previous attempt to explore strategies of how to design for a feeling of interconnectedness. By employing a research-through-design methodology and using AquaPrint as a case study, we aim to extend the works of Hassenzahl et al. (2012) and Stepanova et al. (2022) by formulating design strategies that embrace a posthuman perspective and encourage feelings and reflections of interconnectedness with the more-than-human world. As a way of encouraging reflection, the act of noticing (Poikolainen Rosén et al., 2022) will form a key part of our study. We, therefore, propose the following research question to guide the case with regard to feelings and reflections on interconnectedness:

What are some potential strategies for fostering feelings of interconnectedness to the more-than-human world through an interactive experience, and what emotions are associated with this experience of interconnectedness?

We intend that the proposed strategies can be seen as guidance, inspiration, or a starting point for practitioners when designing for interconnectedness or intimacy with the more-than-human world. Failing to address the research question leaves no alternative specific design strategies to rely on when designing for such an experience. This makes it more difficult to achieve the posthuman perspective of the world that many scholars call for. Additionally, the strategies can contribute to society's adoption of a posthuman perspective. Although these targets might seem ambitious, our project is best seen as part of a growing movement that challenges our anthropocentric view of the world.

2. Related Work

In the following section, we will present related research that is relevant to our study in the areas of sustainable HCI, the turn towards the more-than-human, noticing, interconnectedness, and similar design strategies.

2.1. Sustainable HCI

The field of sustainable HCI is a relatively young research topic that stretches back approximately 15 years (Hansson et al., 2021). Many consider the starting point of the field to be the 2007 CHI conference and the landmark paper on sustainable interaction design by Blevis (2007) that came out the same year (Hansson et al., 2021). Blevis (2007) explores how interactive technologies can be used to promote more sustainable behaviours, and how sustainability can be used as a critical lens and seeks to understand the material effects of use, reuse, and disposal in interaction design.

Since 2007, the field of sustainable HCI has grown considerably and has been turned into an important subfield of HCI. The field has had a strong focus on individual behaviour change, of which the effectiveness has been questioned by critics (Mankoff, 2012; Knowles et al., 2014; Foth et al., 2020; Bremer et al., 2022). Research has found that sustainable HCI has, in recent years, become more diverse and holistic by including challenges such as biodiversity loss and sustainable food production, but has also moved away from addressing the imminent climate crisis (Bremer et al., 2022).

2.2. The turn towards the More-than-human

In light of the Anthropocene, scholars, mainly in the humanities, have in recent decades developed the field of posthumanism that seeks to move beyond the anthropocentric perspective that has been dominant in Western thinking since at least the Enlightenment (Forlano, 2017). An important characteristic of the posthuman perspective is that it distances itself from traditional binary ways of thinking. It rejects the dualist view of separation between mind and matter and instead regards knowledge, and the mind, as embodied and situated —

knowledge is positioned to who is doing the knowing (Haraway, 1988). Another example is the separation between humans and technology, as humans and things are widely regarded as being ontologically inseparable (Introna, 2014). Further, posthumanism recognizes the profound importance of the nonhuman contribution to our lifeworld (Poikolainen Rosén et al., 2022). The more-than-human world, a concept introduced by Abrams (1997), draws inspiration from shamans in indigenous cultures that were regarded as voyagers between human and more-than-human realms. They connected humans and the nonhuman world, encompassing animals, insects, various trees and plants, weather patterns, and bodies of water. The more-than-human world involves ideas of human-nonhuman entanglements (Whatmore, 2002) and acknowledges the complex interdependencies between humans and nonhumans (Coulton & Lindley, 2019). Applying a posthuman perspective to design is often referred to as more-than-human design (Giaccardi, 2020). This field decentralises the human in the design process by encompassing the more-than-human world and recognizes the intelligence, agency and interconnectedness of nonhuman entities.

2.3. Noticing

Noticing is a culturally and politically sensitive skill that acknowledges the interconnectedness of economic, ecological, and cultural systems from a more-than-human perspective (Tsing, 2015; 2020). It involves being aware of and recognizing things that are worthy of notice (Poikolainen Rosén, 2021). However, noticing goes beyond perceiving the obvious as it encourages reflection on aspects that may not be immediately perceptible, such as patterns, structures, or behaviours. Prior research by Goodwin (1997) suggests that increased awareness of one's surroundings improves the ability to identify new encounters in it. In other words, practice does play a role in developing the skill of noticing, indicating that perception alone is not the sole determinant of noticing. Cultural background, values, knowledge, and previous experiences also influence noticing (Poikolainen Rosén, 2021).

Notably, noticing differs from other methods in that it embraces preconceptions. Other methods, such as interviews or thematic analysis, usually aim to minimise the influence of prior experiences as they may influence the person being interviewed or the things brought up to analyse resulting in interviewer bias or perception bias. Noticing on the other hand embraces earlier experiences, feelings, interests, and reflections as they shape what we notice and make for a unique reflection. However, humans are often trained to notice within an anthropocentric view, but with practice one can learn to also notice from a more-than-human perspective (Poikolainen Rosén, 2021). Encouraging this way of noticing is one of the ambitions of this project. Additionally, noticing will be used to identify where it is worth designing (see Step 1: Select).

2.4. Interconnectedness

There are many published works covering similar or theoretically overlapping concepts of interconnectedness: interdependency (Ávila, 2022; Davis, 2009), connectedness (Stepanova et al., 2022), incorporeal connection (Desnoyer-Stewart et al., 2020), self-other overlap (Hassenzhal et al., 2012), entanglement (Frauenberger, 2019), and transcendent emotions (Stepanova et al., 2022). However, there is no consensus or unanimous agreement on the usage

of these terms. In other words, the same term can have completely different definitions between two studies, or there may be new terms for concepts previously defined differently. However, it does nearly always include a relationship between entities where these are linked, or connected. Although the human-human relationship is the most studied, interconnectedness extends beyond the anthropocentric relationships and encompasses studies on human-to-animal, human-to-nature, and human-to-other relationships, further contributing to the complexity of the topic.

Within the context of close interpersonal relationships i.e., human-to-human, Aron et al. (1986) conducted an investigation, wherein they discovered that individuals integrate aspects of their partner's identity, resources, and perspectives into their self-concept, thus being interconnected with their partner. Subsequently, Aron et al. (1992) created a measuring scale, a representation of interconnectedness, to depict the inclusion of the other within the self. This was done by implementing a Venn diagram where the circles, initially representing separate entities ("self" and "other"), gradually overlapped to illustrate the extent of interconnectedness. This representation has been adapted in many succeeding studies, extending its application to contexts involving the relationship between the self and nature (Wesley Schults, 2001; Schults et al., 2007). Schults (2001) proposed that increasing the overlap between the self and nature could lead to greater engagement in environmentally conscious behaviours. Davis (2009) further explored this idea and found a correlation between interconnectedness and a self-reported environmental worldview. When regarding interconnectedness with nature it is described as a "sense that the well-being of nature can affect the well-being of individuals (and vice versa)" (Davis, 2009). The experience of interconnectedness, on the other hand, is described by Ronowden et al. (2022,p. 521) as "a reciprocal relationship with nature through embodied and sensorial experiences [...] [fostering] an awareness of our interconnectedness with the natural world". Based on these descriptions and the presented literature, we understand interconnectedness as an experience, or feeling, reflecting on the reciprocal relationship between humans and nature. As this case study emphasises the shift away from anthropocentrism, we will slightly modify this understanding. Taking further inspiration from Hickel (2020), who defines interconnectedness as "radical intimacy with other beings" (p. 33), we will define interconnectedness as *an experience that evokes feelings and reflections regarding the intimate, reciprocal, and interdependent relationship between the self and the more-than-human world*.

2.5. Design strategies

Although little research has been conducted to establish design strategies to foster interconnectedness with the more-than-human, there have been several reviews performed that examine possible strategies employed in artefacts designed to mediate connection and social interaction between humans. Hassenzahl et al. (2012) reviewed 143 artefacts and were able to identify six strategies for creating and fostering feelings of relatedness in long-distance relationships: *awareness, expressivity, physicalness, gift-giving, joint action, and memories*. Li et al. (2018) built on this framework and performed a review of 52 artefacts that adds the

seven categories of *unobtrusiveness, playfulness and joyfulness, personalization, coincidence, reassurance, effortlessness, and effortful investment*.

Stepanova et al. (2022) reviewed 50 systems that they consider to be designed for a genuine feeling of connectedness. The researchers arrived at nine strategies: *affective self-disclosure, reflection on unity, shared embodied experience, transcendent emotions, embodied metaphors, interpersonal distance, touch, provocations, and play*. Their review was non-exhaustive as they chose to review systems that would give their strategies a wider scope, as opposed to performing a systematic review that would provide a comprehensive view of a narrowly defined field. The authors state that their developed framework is intended as a source of inspiration for designers. However, they did not conduct empirical testing of their strategies through the creation of an artefact using the strategies they proposed.

A field with similarities to HCI and interaction design is architecture (Vallgård, 2013). Biophilic design is a subfield within architecture that promotes human well-being and connectedness with nature through natural features within built environments (Richardson and Butler, 2021). As such, it overlaps with our project's interest in promoting feelings and reflections of interconnectedness. Kellert and Calabrese (2015) present three strategies for biophilic design: *direct experience of nature*, which uses direct contact with natural features, *Indirect experience of nature*, which uses contact with representations of nature, and *experience of space and place*, which uses spatial features that are characteristic of natural environments.

3. Case

Our research question will be explored in the context of a collaboration with AquaPrint, a Swedish small-medium-sized enterprise founded in 2022 that aims to lessen humanity's impact on the planet's oceans. AquaPrint makes furniture with the unique material Penylon®. This material is acquired through their company partner which operates out of Peniche on the coast of Portugal. There, the material is made from ground-down fishing nets that could otherwise have ended up in the ocean (70%), and leftover limestone from the stone industry (30%). It is turned into pellets and transported to Sweden where it is used to print the furniture through large-scale additive manufacturing. The material's process can be seen in Figure 1.

Contrary to the ordinary way of production, which subtracts material from a larger piece, additive manufacturing allows for the creation of three-dimensional objects by continually adding layers of material based on a digital model. Some consider additive manufacturing's biggest potential to be addressing sustainability challenges by reducing waste, increasing design flexibility and supporting multiple product life cycles (Sardon, 2022; Sauerwein, 2019; Colorado, Velásquez, and Monteiro, 2020). This aligns with AquaPrint's goal of enabling a circular material flow. The resulting furniture (Figure 1) is designed in Sweden and is intended for both private homes and public venues, making them popular with many different customers. Part of AquaPrint's business plan is that they buy the furniture back from their customers so that they can grind the material down, turn it into pellets again, and make new furniture from it.

AquaPrint is a young company, founded in 2022, and we saw it as an opportunity to collaborate with them as they are still shaping many parts of their products and services. They also do something positive for the world, which we are inspired by.



Figure 1. AquaPrint's material going from fishing nets to finished furniture. The photographs are taken by AquaPrint.

4. Research method and results

In the following chapter we will describe our research methodology and how it led to the study's results. We structured our study in four main phases based on Zimmerman and Forlizzi's (2007) research through design process described below: *select*, *design*, *evaluate*, and *reflect*. The first phase aimed to identify opportunities for design. The second involved formulating preliminary design strategies and gaining a deeper understanding of the experience of interconnectedness. In the third phase, the results from the second phase were evaluated, and finally, the fourth phase focused on developing our final suggested design strategies.

4.1. Research through design

This project follows a research through design [RtD] approach, described by Gaver (2012) as a research methodology aimed at producing design theories and artefacts using applied design methods. Further, RtD is characterised by the same author as being a generative endeavour that produces theories that are provisional, contingent and aspirational, i.e., that it is a methodological approach whose goal is "not to develop theories that are never wrong, but to create theories that are *sometimes right*" (ibid., 2012, p. 940). Frayling (1993) defines RtD as a methodological approach where knowledge is generated through the design process and design artefacts. Similarly, according to Redström (2017), RtD is a methodology that produces theories and knowledge in the context of design through the practice of design and designing, experimenting and making.

Zimmerman and Forlizzi (2007) suggest a five-step process for a RtD project. The first step is *Select*, which involves choosing a research problem worthy of investigation. Second is *Design*, where fieldwork can be conducted, workshops can be held, and experimentation can be done. Third is *Evaluate*, a continuous process of making, critiquing, documenting, and challenging the initial framing until an artefact worthy of evaluation is formed. The evaluation

is conducted following a selected RtD practice. Fourth is to *Reflect* on what has been learnt and disseminate the information. The fifth and final step is to *Repeat*. This step is pointed out as the way to achieve the best results in RtD (Koskinen et al., 2011). We chose a RtD approach because of its emphasis on designing, evaluating, and reflecting, enabling us to test and iterate the strategies we develop. Another important reason was that we could create design ideas specifically for the concept of interconnectedness as we defined it in this project.

Koskinen et al. (2011) describe three types of RtD projects: lab, field, and showroom. Studying things in a lab setting requires taking something out of its natural environment and bringing it into a controlled area. The benefit of lab research is that it is isolated from the real world, reducing the amount of affecting variables. This can, however, be a limiting factor as things can happen in a lab that does not happen elsewhere, or vice versa. In a field setting, designers aim to make sense of a context by studying a thing in its natural environment. In a showroom setting, design research is presented in “shop windows, exhibitions, and galleries rather than in books or conference papers” (ibid, 89).

Stappers (2007) argues that a prototype in RtD can be regarded as an embodiment of the theory that it seeks to test. Koskinen et al. (2011) refer to this as a “physical hypothesis”. However, Stappers points out that prototyping is more than theory testing as it is also a design act. As such, a prototype goes beyond the theory that inspired it to also test the design. Koskinen et al. argue that this creates tension as “the more they do, the more difficult it becomes to say with confidence that the theory that inspired design actually works” (Koskinen et al., 2011, p. 62).

4.2. Ethical considerations

This research has followed the principles outlined in the General Data Protection Regulation (GDPR, 2018) to protect the privacy and rights of all participants. Before initiating workshops and testing, the participants were required to carefully review and provide their consent by signing an informed consent form, outlined by the General Data Protection Regulation (GDPR, 2018) and Umeå University. All personally identifiable information collected throughout the project has been subjected to anonymization techniques and has been safely stored in accordance with regulations. Furthermore, this research has been conducted with the utmost respect towards both humans and non-humans alike.

4.3. Step 1: Select

In this section we will present the method and result from the first step of the RtD process: *Select*. This step involves choosing a research problem worthy of investigation (Zimmerman & Forlizzi, 2007). To address this we aimed to gain a deeper understanding of our collaborative partner AquaPrint, further using noticing (Rosén Poikolainen et al. (2022) as an important method to identify where in the immensely complex more-than-human interdependencies it might be beneficial to act/design. The result will present our identified design opportunity as well as findings from noticing.

4.3.1. Method

To gain insight into AquaPrint’s operational context, we visited Stockholm Furniture Fair — one of the world's largest platforms for Scandinavian design. This is a five-day event that

gathers more than 400 exhibitors and an audience of more than 26 thousand interior designers, furniture designers, industrial designers, and other people interested in furniture design (Stockholm Furniture Fair, 2023).

During the course of the event, we had the opportunity to take photographs, field notes and interview visitors and the founders of AquaPrint (Figure 2). Our ambition was to form an understanding of the project's design space. Noticing (Poikalainen Rosén et al., 2022) became a central part of the visit as we aimed to identify where it might be beneficial to design.



Figure 2: One of the authors interviewing a visitor about AquaPrint's furniture (left). AquaPrint's stall at Stockholm Furniture Fair (middle), and the furniture's texture (right).

4.3.2. Result

At the time of the fair, AquaPrint had two colours available on their furniture: olive green and kelp brown. Visitors to the fair described the green colour as better at communicating the material's connection to the ocean and the material origin - fishing nets. One visitor also described that she would have liked to have some sort of representation of its origins on the furniture itself, perhaps in the form of a tiny 3D-printed wave, fish, or a net. We also noticed that the furniture's story and origin were always perceived as something positive; it piqued interest and was recognised as something that was good for the world. Considering these responses, the article from Stepanova et al. (2022) that served as a big inspiration for this project, and the turn toward the more-than-human, we saw an opportunity to widen the scope and design for feelings and reflections of interconnectedness, extending beyond the ocean to include the entire more-than-human world.

After a total of four interviews with two of the founders of AquaPrint, we formed an understanding of their service and their customer touch points and identified possibilities for design within their model, pictured in Figure 3.

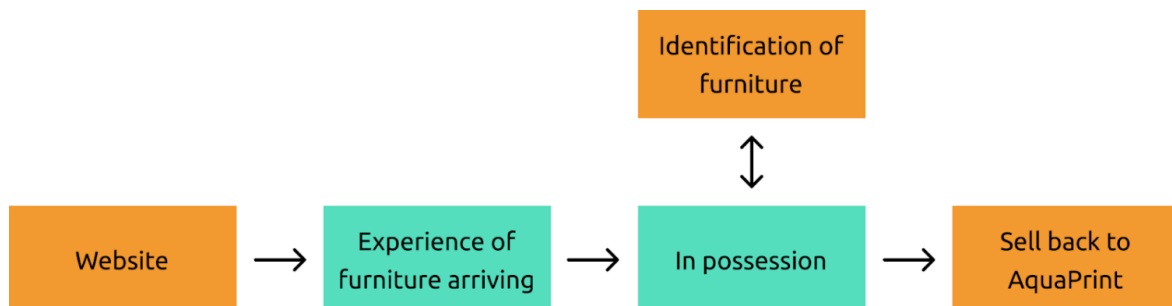


Figure 3: Model of AquaPrint's customer touchpoints and opportunities for design.

The model pictures AquaPrint's website where their customers can buy furniture, the experience of the furniture arriving, the possession of the furniture that hopefully lasts for many years, and selling the furniture back to AquaPrint so that they can recycle the material and make something new of it. As part of AquaPrint buying the furniture back, they need to be able to identify each individual piece of furniture to see where the material is from and which generation it is. One way to achieve this identification is through digital means. This is where we saw an opportunity for design as it had not yet been explored by the company, and it had the potential to facilitate a fully interactive experience where we could test our strategies.

4.4. Step 2: Design

This section presents the methods and results from the second step of our chosen RtD process: *Design*. First, we will present the design of the workshops, a method beneficial for gaining multiple perspectives by including several disciplines and cultures (Koskinen et al. 2011) and because it encourages a rounded approach to a project, keeping it rooted in reality (Stickdorn et al., 2018). Second, we will present how the outcome of the workshops was analysed with regard to our research question. Last, the results will be presented.

4.4.1. Method

Workshop design

With regard to the benefits presented by Stickdorn et al. (2018) and Koskinen et al. (2011) we opted to gain our first set of data through workshops. This would let us be present whilst designers explored the theme of interconnectedness and the possibilities to design for it. Further, we could present our own definition of interconnectedness, ensuring a uniform understanding, and that the formulated concepts would be exclusively targeting our definition of interconnectedness.

Two workshops (WA and WB) were held for 90 minutes respectively. WA was recorded with field notes and by taking photographs, and WB was recorded with video and audio. We structured the workshops in two halves, separated by a break of 10 minutes. The first half explored the theme of interconnectedness through personal stories, emotional maps, and discussions. The second half focused on ideation for designing an experience of interconnectedness. We iterated the design of WA based on feedback and observations. Schematics of the workshop designs can be seen in appendix A and B.

The purpose of the first part of the workshops was to explore and form an understanding of the experience of interconnectedness. The first part of the two workshops was identical with the exception of the warm-up exercises. The first workshop's warm-up was *squiggle birds* (Strimaityte, 2019), where participants draw squiggles on a piece of paper, draw one into a bird, and come up with a name and a backstory. The birds are then presented in the group. The warm-up of the second workshop was *Make Your Sandwich* (ibid) where participants drew their life and personality layered in a sandwich and presented them to each other.

To gain a joint initial understanding of more-than-human design and the concept and experience of interconnectedness between ourselves and the participants, we then held a short presentation on the different definitions. Participants were given opportunities to ask questions or comment.

Participants were then asked to think of a moment in their life when they felt or reflected on being interconnected to the more-than-human world, and then draw that moment on a paper. Participants then presented their drawings and personal stories to each other. Participants were then given 1.5 minutes to write down all feelings that they thought were related to the experience of interconnectedness on physical post-its. These feelings were then placed to form an emotional map (Figure 4) that graded each feeling according to intensity. Each participant was asked to explain the feelings they had written down and their placement. A discussion was then held to see if there were any similarities or differences between participants' perspectives or to add to others' descriptions.

With the insights from the first part of the workshop in mind, the goal of the second part was for the participants to generate design ideas that would encourage feelings and reflections of interconnectedness. Emotions identified by the participants in the previous exercise were written down on a large piece of paper by the facilitators of the workshop, and placed in the middle of the table for the participants to look at and gain inspiration from during the following ideation exercises. The participants then got eight minutes to ideate around ideas that could foster feelings and reflections of interconnectedness. For this first method, participants were asked to focus on the quantity of ideas. After a presentation of all ideas, participants were asked to select the idea that they considered to have the most potential and draw it on a piece of paper together with a written explanation. With intervals of two minutes, the ideas were passed around, allowing each participant to build on the previous idea. After 2–3 repetitions, the final concepts were presented and discussions were had on how the ideas connected to the previously identified related emotions of interconnectedness, and if this inspired any new ideas of how more could be integrated, or utilised differently, in some way.



Figure 4: Participants placing emotions related to interconnectedness at Workshop A (left) and Workshop B (right).

After a break, the participants were introduced to the case of AquaPrint including their story, service, process, and furniture. Miniature 3D-printed AquaPrint furniture was introduced to the participants as a further source of inspiration (Figure 5). Participants randomly drew one of six scenarios that described a setting that the furniture could be in — eg. a Norwegian cabin,

a friend's home, or a mall. The participants were then given five minutes to come up with ways of identifying the individual furniture. This was followed by a presentation of all ideas, where the participants got the option to enact and play out the scenario on a stand-in piece of furniture. The participants were introduced to the case of AquaPrint as we wanted to gain a wider data set and explore more ways of designing for an experience of interconnectedness. Both design freely for an experience of interconnectedness and within the context of a real case.

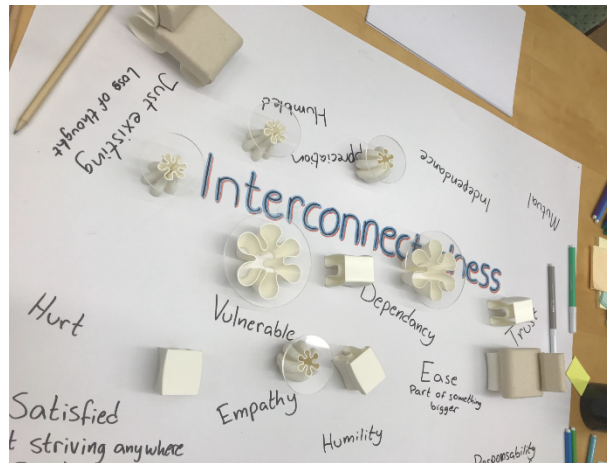


Figure 5: Feelings identified during the workshop together with the miniature furniture.

The first workshop differed from the second in that participants were always asked to design within the context of Aquaprint's case. However, after the first workshop, we noticed that the ideas that were generated seemed to have reached the point of saturation. Therefore, we decided to open up the design space for the second workshop and have the participants generate design ideas that would enable an experience of interconnectedness outside of this case. As stated previously, this also allowed for a more diverse set of data.

Participants

As the workshop included a lot of design tasks and concepts, we reasoned that a background in design and familiarity with the ideas of more-than-human design were going to be necessary. Further, we hoped for participants with different design backgrounds as it would increase the chances of divergent ideas and provide more perspectives. We attracted interest for our workshops by placing posters at two university campuses with design programs, as well as introducing them during a short presentation at the weekly briefing event, which all students and staff were attending. Our approach can, therefore, best be described as purposive sampling (Myers, 2020) where participants are recruited based on sought-after characteristics. The sampling strategy yielded a total of eight students educated in UX design (5 participants), interaction design (2 participants) and advanced product design (1 participant). Five participants attended the first workshop and three attended the second.

Identification of associated emotions

As the workshops were divided into two parts, we analysed the data in the same way. With the result from the workshops in hand, we saw an opportunity to structure the emotions related to interconnectedness, revealed in the first part of the workshops into an interconnectedness experience framework [IEF].

For the analysis of the first part of the workshops, we utilised a thematic analysis approach, described by Braun & Clarke (2006) as a method for identifying, analysing and reporting patterns or themes within data. To familiarise ourselves with the data, the participants' presentations and discussions around their personal stories and related emotions were transcribed and coded in-vivo. The codes were added to digital post-its and inductively grouped into early themes. The themes were iterated on through discussions and by going back and forth between the extracts, the data set, and the themes. The themes were formed into the IEF, which was then iterated upon further by checking with the data set.

Development of preliminary design strategies

For the analysis of the second part of the workshops, ideation sessions were held to generate ideas for potential strategies. The ideas from each method from the workshop were ideated upon individually, eg. all ideas from the first brainstorming session in workshop A were ideated upon separately, then the second method and so on. Before every session, we went through each idea and discussed the participants' motivation behind the design to make sure that no idea was overlooked or misunderstood. Ideas for potential strategies were written down on Post-its (Figure 6). Each ideation session lasted seven minutes, and in total six sessions were held. In total 89 strategies were suggested, although many were similar or identical. Affinity diagramming (Hanington and Martin, 2012) was used to group all similar strategies together and form themes. The groups were iterated upon through discussion and by occasionally going back to the initial ideas to review the designer's motivation. The groups were named when they were of sufficient quality, and early descriptions of each strategy were created. The named

groups and descriptions were then checked with the original ideas from the workshops and iterated further.

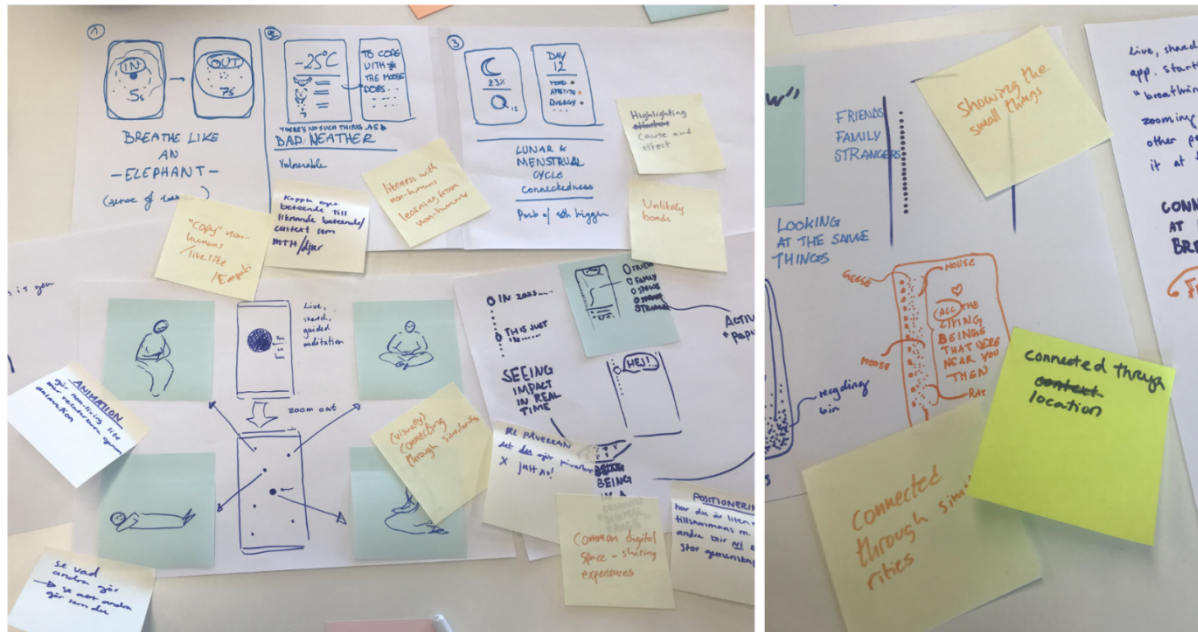


Figure 6: Ideas from the workshop with suggested design strategies (yellow post-its).

An idea from Workshop B that formed the starting point of one of our strategies can be seen in Figure 6. The idea was that smartphone users could get information about which insects or other animals were in their vicinity, and by tapping on each species they could learn about them. As the participant stated when explaining the idea: “Anything from ‘did you know you had this many bees in your vicinity?’ to that you get to learn about their function [in the ecosystem]”. We suggested three strategies for this idea: *Connect through location*, *Connect through similarities*, and *Show the small things*. During the analysis, the final suggestion was clustered with three other ideas whose commonality was, we argued, that they tried to make things that were previously invisible to the naked eye possible to notice. Therefore, the strategy was first called *Make the invisible visible*. Later, through discussions and iterations on the strategies, the strategy was changed to *Make the imperceptible perceptible* to increase its scope to include all modalities, not just the visual.

4.4.2. Result

Interconnectedness experience framework

The feelings related to interconnectedness are grouped according to the themes and patterns that arose in the discussions during the workshop and are presented as an IEF (figure 7). The groupings play a vital role as the parent feeling describes the context in which a subsequent feeling belongs. For example, feeling terrified was described by a participant in the context of being dependent on the ecosystem and speculating about what would happen if it were to collapse.

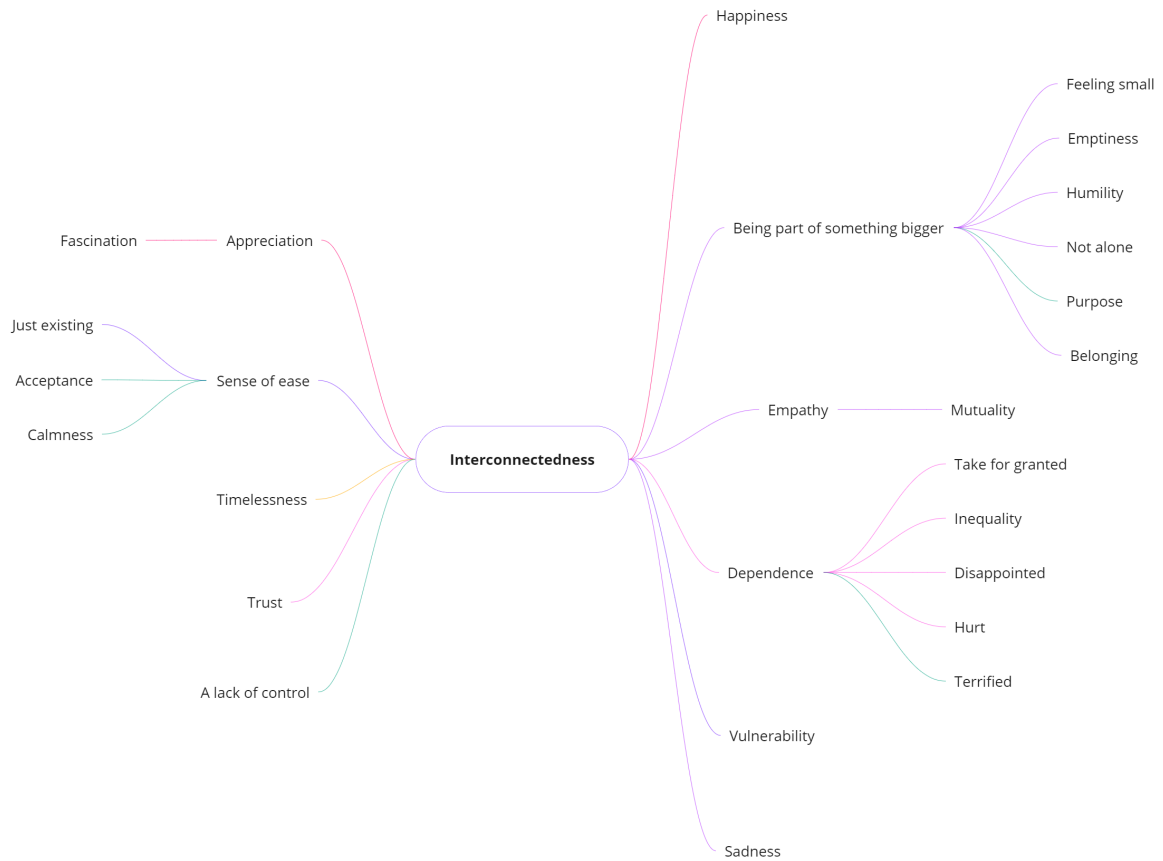


Figure 7: Interconnectedness Experience Framework.

Preliminary design strategies

The analysis resulted in seven different design strategies for fostering feelings of interconnectedness (table 1). We considered the strategies to still be open for changes as more time and reflection might change our perception.

Table 1: summary of the suggested strategies that emerged from the workshop.

Preliminary Strategies	Description
Non-human first-person storytelling	Ideas often involved storytelling from a first-person perspective and making the furniture the main character, incorporating backstory, analogies, and/or metaphors.
Storytelling about/through material	Ideas often structured a narrative about the material of the furniture. Some attempted to counter feelings of mass production and overconsumption by highlighting the uniqueness of the piece.
Establish community	Some designers created collective spaces that nurtured a sense of familiarity by encouraging the sharing and visualisation of experiences.

Identify and connect through similarities	Some ideas identified similarities between beings and connected them through location, time, common traits, behaviours, aspirations, and/or needs.
Make the imperceptible perceptible	Some ideas highlighted small things that are not visible to the naked eye, showing the interconnected nature of that which is big and small.
Relate to nature	Many ideas used representations of nature through images, sound, and colour to create a calming atmosphere.
Provide a different perspective	Some ideas were aimed at providing different perspectives. They did this through global views, timelines, showing cause and effect, and providing facts for reflection.

4.5. Step 3: Evaluate

This third step, *Evaluate*, aimed to assess the strategies that were developed during the previous step. We, the authors, used the strategies when designing an interactive experience in the context of Aquaprint's case. This resulted in a prototype that was to be evaluated with participants to test if the strategies effectively fostered feelings and reflections of interconnectedness. We chose to apply the strategies with regard to the design opportunity presented in step 1: furniture identification (figure 3) that had the potential to facilitate a complete interactive experience. This section will first describe the methods used for ideating and prototyping with the design strategies. Second, the methods for testing the prototype will be presented. Finally, the results of the prototype and its implemented strategies will be presented, as well as the result from the tests.

4.5.1. Method

Ideation and prototyping

The IEF and the design strategies were used as inspiration during ideation sessions and were often applied in combination with the method of *how-might-we* (Stanford University, 2018). For example, the strategy of *Visualise community* was formulated into a question of "How might we visualise community in a meaningful way?". We often went back to the framework and strategies to check if we could build on ideas further or to check that we were targeting the right emotions. In total 16 ideation sessions were held using crazy eight (Knapp, Zeratsky, and Kowitz, 2014) and brain drawing (Gray, Brown, and Macanufo, 2010). The ideas were then evaluated through discussions and dot-voting (Gray et al., 2010) and further iterated upon through making prototypes, having critique sessions, and challenging our framing.

When later evaluating the ideas with test participants, we aimed to enable a comprehensive experience. Therefore, our approach involved the creation of an experience prototype. This method allowed us to explore, comprehend, and effectively communicate design ideas and concepts while enabling participants to subjectively grasp the experiential qualities, as highlighted by Buchenau and Fulton Suri (2000). Several prototypes were built by sketching, modelling in Blender, and creating an interactive user interface in Figma. The development of the prototype took place over a two-week period, gradually increasing resolution, interactivity, and look and feel.

Testing

To evaluate the strategies manifested in the prototype, a test was performed with seven participants. A lab setting (Koskinen et al., 2011) was chosen to remove potentially disturbing factors in the environment which could have compromised the calm, reflective experience. The participants were recruited through personal contact using convenience sampling (Myers, 2020). All participants were Master's students in UX design and none of them had taken part in the workshops.

A space was set up to simulate a smaller living room where we were able to borrow furniture from AquaPrint, increasing the realness. Before commencing, the participants read and signed a consent form (Appendix C) and were subsequently given a pair of headphones and a smartphone to complete the experience. The test started when the smartphone prompted the participant to find and scan an NFC tag placed on the furniture. The participant took between six and ten minutes to go through the prototype at their own pace.

The test was followed by a semi-structured interview (Myers, 2020) where questions had been prepared beforehand (Appendix D). This enabled diverging from the script when interesting topics emerged. The strategies and the IEF served as the basis for the prepared questions and incorporated aspects of momentary and episodic experience (Roto et al., 2011). After some initial questions about the participant's feelings right after the test, the participants were asked to go through the prototype a second time and explain what they felt or reflected on throughout the prototype. Interviews were held in both Swedish and English.

Analysis

The interviews were recorded and later transcribed using Microsoft Word's transcription function for interviews held in Swedish, and Otter.ai for interviews held in English. The transcriptions were then deductively coded by using the IEF and the suggested Design Strategies to identify patterns and themes. The interviews were analysed individually before codes across all interviews were placed in themes correlating to the design strategies.

4.5.2. Result

Experience prototype

The experience prototype started with the smartphone prompting the participant to scan an NFC tag. This tag was located on the base of the furniture and upon scanning the participant was brought to the introductory screen. Here the table introduced itself through a text (*Non-human first-person storytelling*). After a tap, the participant was presented with a story, told from the table's perspective, of its background. It started with a view of planet Earth (*Represent nature, Provide a different perspective*) that had different locations, important to the table's story, connected by beams of light (*Establish community*, figure 9). Calm, meditative music played. After tapping to continue, the beams of light faded away, and currents in the ocean that connect the world were visually represented through lines that flowed (*Make the imperceptible perceptible*). Next was a birds-eye view of the ocean with a small, distant boat present (*Provide a different perspective*). The sound was wind, ocean, and birds while the table kept telling its story through text (*Representing nature, Non-human first-person storytelling*). Then a view from underneath the boat, looking up at the surface (*Provide a different perspective*, figure

10). The sound shifted to peaceful underwater noise. The participant was then prompted to scroll down further and further towards the bottom, where an octopus and other ocean life were present. The table told the story of how fishing nets can be lost in the sea (*Storytelling about material*). By continuing, the perspective moved again toward the surface while the table said that the nets it was made of instead got saved. The same calm, meditative music from the start of the experience played again. After some facts for reflection about the table's sustainability benefits (*Storytelling about material*), a screen of several AquaPrint furniture connected by dots of light was shown (*Establish community*, Figure 11). The participant could look around and orient herself. Finally, when the participant chose to end the experience, the table said goodbye and thanked the participant for being part of its story.



Figures 8, 9 and 10: Frames from the experience prototype created with the strategies Establishing community and Provide a different perspective (left), Providing a different perspective and Representing nature (middle), and Establishing community and Storytelling about/through material (right).

Test results

In the following section, the result from the analysis will be presented as a descriptive text. This will be structured and presented following the strategies we implemented: *Non-human first-person storytelling*, *Storytelling About/through material*, *Establish community*, *Identify and connect through similarities*, *Make the imperceptible perceptible*, *Represent nature*, and *Provide a different perspective*.

Non-human first-person storytelling

Most participants did not seem to reflect on an inanimate object telling a story at first. However, for some participants, that changed during the interview. One participant mentioned that “It’s like meeting a stranger or meeting someone new. This object that had just been in front of me became an actor”. When describing the feelings at the end of the experience he described that “it was like saying goodbye to my new friend”. A second participant explained that “When it’s telling [the story] from its own perspective it’s like I have a connection to it in some way” and that they “Gained a more emotional bond with it”. A third participant said that “It became more alive”. Two participants stated that this personification only lasted for the duration of the experience, and that “Now it’s just a table again”. One participant also described an increased feeling of emotional attachment, stating “I liked that it was talking like a person, directly to me. I think it would be more difficult to get rid of it” and that “One was carried away even though it is a piece of plastic and doesn’t actually have a personality”. Many of the participants also described that they reflected on the background of the specific chair in front of them, as opposed to the model or brand.

Representing Nature

When asked about the overall experience of the prototype, which prominently incorporated nature-themed images and sounds, five participants expressed feelings of harmony, calm, or a sense of ease. One participant stated that “I also think that this feeling just in general is serenity [...] for me that is nature, kind of, that you feel calm and stuff like that”. Others reflected upon their own experience with nature that occurred in similar situations as the one presented. For instance, when one participant caught sight of the octopus on the ocean floor, it triggered a recollection of a previous diving experience where she had encountered a real-life octopus. The nature sounds were often noticed and appreciated in particular. One participant reflected that “The sounds emphasised the entire feeling [...] it feels like you are part of it, like you are there”.

Provide a different perspective

The different perspectives represented in the prototype caused a participant to reflect on humanity’s responsibilities, stating: “It is the perspective that gives a little feeling that ‘ah this is Earth, it’s what we’re trying to take care of’”. Another participant shared that viewing the water’s surface and the floating net from beneath caused her to reflect on debris in the ocean. She described feeling as if she was the plastic that was descending to the ocean floor. Similarly, another participant said, “It [the perspective] very much internalises that this is what the material is going through in its lifecycle”. An additional participant described that she reflected on how the world is a lot bigger than one would think, how the ocean is a global system, the consequences of not taking care of it, and its interdependent nature. Like in *Representing nature*, providing different perspectives seemed to cause some of the participants to reflect on their own life experiences as they shared similar situations from their personal lives.

Storytelling about/through material

Four of the participants described how the story made them empathise with the ocean and its inhabitants, as well as reflect on the problems that humans are causing to their environment. As one participant expressed: “This [debris] is really bad for the ocean [...] and the sound

reinforces that whole feeling”. Another stated: “The fact that they have used these nets and made something good out of it, maybe one can establish a more spiritual kind of connection to them, you know, feeling like we are together and we need to make things good”.

Make the imperceptible perceptible

When referring to the visible currents, one participant expressed that “This is a global phenomenon. It isn’t *someone’s* problem, it’s *all* our problem that these nets are floating around in currents connecting the world” and added that “This can kind of effect everybody, animals and humans and [the nets] can be washed up anywhere”. Another participant stated that “It gives you that step back of thinking the world is connected by currents. I don’t usually think that way.” and “Seeing a kind of flow state gave the feeling of ‘maybe I’m connected to all the objects’”. An additional participant described liking the idea of seeing the currents and reflecting on how the ocean is alive and that “We need to take care of what we have been given”.

Establish Community

When shown the view of the community of furniture connected by lights, one participant stated that “It’s like meeting its family or friends”. Another participant said “I want the nets to be removed from the ocean and when I see this little community of furniture I turn positive” but that she felt no connection to the community as there was no clear connection between herself and the pictured community. When presented with the visual lines that connected the places on the earth that was important to the table’s history, one participant stated that “I don’t have a personal connection to these places on the planet. [...] That’s how I feel about this spot. I don’t know anything about this spot” and described that it lacked a connection to himself and where the table is now.

4.6. Step 4: Reflect

The fourth step of the process is to *Reflect* on what has been learnt and disseminate the information (Zimmerman and Forlizzi, 2007). In this section, we will present the outcome of the reflection in a table including the names and descriptions of the strategies, and how they can be perceived (Table 2). A more detailed reflection will be presented in the discussion (see 4. Discussion). Finally, we will present considerations when implementing the strategies.

Table 2: An overview of the suggested design strategies fostering feelings and reflections of interconnectedness to the more-than-human world.

Suggested Strategy	Description
Use non-human first-person storytelling	<p>Give a non-human actor a voice and use a first-person storytelling approach.</p> <p>This can be perceived as a playful approach that increases emotional connection, empathy, and familiarity by providing a feeling of personification. However, it is likely that the feeling of personification only lasts for the duration of the experience.</p>
Represent nature	Use references to nature through images, sounds, and more.

	<p>This could promote calm and serene feelings, as well as help the mind turn towards more abstract thinking and foster reflection regarding personal experiences with nature.</p>
Provide a different perspective	<p>Present a different point of view of place, time, or show the perspective of non-humans. These alternative viewpoints can elicit reflection of the more-than-human world or provide insights into how non-human entities perceive the world.</p> <p>This can encourage reflection on responsibilities towards Earth and promote feelings of connection, empathy, feeling small, and understanding. Utilising the strategy can also foster reflection on similar personal experiences to the scenes depicted.</p>
Storytelling about/through material	<p>Highlight what is unique about the design material through storytelling, or by using the material itself to communicate a story. This could for example be through shape, color, texture, and/or size.</p> <p>This can provide a new way to empathise with the non-human affected by the material and cause reflection on the problems that humans are causing to their environment.</p>
Make the imperceptible perceptible	<p>Translate that which is not perceptible by humans into a modality that is available to one or more of their five senses; or highlight that which is not likely to be noticed.</p> <p>This enables people to experience phenomena of the more-than-human world that is otherwise unavailable to them, encouraging reflection.</p>
Establish Community	<p>Form a sense of community through connections between the self and the non-human. For instance, this could be accomplished through the use of visualization techniques.</p> <p>Connecting the self with a non-human community through various representations has the potential to promote a feeling of interconnectedness.</p>

It is possible, and perhaps most effective, to combine multiple strategies at the same time. The strategies can be combined with other design methods, for example, how-might-we (Stanford University, 2018). Example questions could be “how-might-we provide a different perspective that promotes reflection?” or “how-might-we make [something imperceptible] perceptible in a meaningful way?”.

5. Discussion

Through our chosen research methodology, we aimed to establish potential design strategies to foster feelings of interconnectedness to the more-than-human world through an interactive experience as well as emotions associated with the experience of interconnectedness. The result was six proposed design strategies. While no prior studies have investigated strategies

for fostering interconnectedness with the more-than-human world, there have been overlapping findings from studies examining strategies for human-human connectedness as well as in biophilic design in architecture. The strategy of *awareness*, proposed by Hassenzahl et al. (2012), identifies that artefacts designed for human-human connectedness often let individuals experience a sense of knowledge about each other's environment. The authors state that this should be achieved subtly, peripherally, and unobtrusively in order to promote connection. The strategy of *awareness* aligns with two of the strategies proposed in this project: *Making the imperceptible perceptible* and *Represent nature*. While Hassenzahl's strategy and our strategy of *making the imperceptible perceptible* both involve making individuals aware of aspects of their surroundings, this study further suggests highlighting elements that would typically go unnoticed — it should actively present the imperceptible to foster reflection.

Representing nature, on the other hand, is a more passive and peripheral approach to fostering interconnectedness. Other than overlapping with *awareness*, this strategy shares similarities with the broad biophilic design principle of *Indirect experience with nature* (Kellert and Calabrese, 2015). In the prototype, nature is represented both visually (through images of nature) and audibly (through sounds of nature). Interestingly, the sounds of nature appeared to be especially effective in fostering calmness and serenity, which our results show are associated emotions of interconnectedness. This could be caused by the peripheral nature of the visual modality, or as suggested by Stepanova et al. (2022), it may be because other sensory modalities, such as auditory “allow for a more embodied and pre-reflexive processing of the signal, resulting in a more intimate and intuitive form of interaction” (Stepanova et al., 2022, p. 21). Based on these findings, future research could investigate how the effectiveness of the proposed strategies vary depending on the modality.

The strategy *Identify and connect through similarities*, suggested as a preliminary result after the design step, could potentially align with Stepanova et al.'s (2022) strategy of *Reflecting on unity/seeing that we are all alike*. The former can be understood as an extension of the latter as it highlights both similarities and differences between entities in order to notice the more-than-human. Unfortunately, we were unable to test this strategy in the final experience prototype due to time pressure, despite having ideas on how to implement it. For this reason, it is not part of our suggested strategies.

The strategy of *Establish Community* was manifested in the prototype in two ways: by the beams of light connecting the locations important to the table's history on earth, and by the dots of light connecting the different AquaPrint furniture. In both cases, participants described not feeling connected to the pictured community because a connection to the self was lacking. This implies that connecting the self to a non-human community is an important factor for the strategy of *Establish community* to be effective which could be worthy of further research.

Similar to Stepanova et al. (2022), Hassenzahl et al. (2012) and Li et al. (2018) our suggested strategies were derived from interpreting others' work. While this study took a step closer toward the designers as the authors were present during the ideation phase, the approach may still have overlooked strategies or introduced bias. As mentioned earlier, we tried to minimise this effect through discussions about the designer's motivation behind each idea, as well as consulting recordings from the workshops if uncertainties arose. A remaining bias, however, could occur with respect to our educational backgrounds, beliefs, and prior

experiences. These diverse perspectives may have inadvertently influenced the noticing and suggestions of strategies which is why we suggest researchers with other backgrounds to be involved in establishing additional design strategies.

To our knowledge, this study is the first attempt to develop design strategies for an experience of interconnectedness. Therefore, it serves as a foundational exploration in this area. The prototype incorporated several suggested strategies, which made it challenging to pinpoint how each specific strategy contributed to the experience of interconnectedness. Further challenges arose when formulating our interview questions during the evaluation stage, as we needed to consider the tension described by Stappers (2007) and Koskinen et al. (2011) that regards how a prototype also embodies design values and not just the theory that inspired it. We therefore aimed to uncover the reason why a participant felt or reflected in a certain way through questions that were aimed to target each strategy. The responses varied between participants, some being able to reflect on and articulate their experience, while others seemed to find it difficult. The test itself further showed that participants had diverse experiences and reflections on interconnectedness throughout the prototype. Although some strategies seemed to have an effect on certain participants, they went unnoticed by others. This result highlights one of the, to us, signifying characteristics of the experience of interconnectedness — it is highly personal in that individuals notice different things and are influenced by prior experiences, confirming the work by Poikolainen Rösen et al. (2022).

Although the tested experience prototype is complex, we can conclude that a combination of the suggested strategies could indeed be utilised to foster feelings and reflections of interconnectedness. Further, there is a possibility that some of the strategies are more effective than others, i.e. resulting in a stronger feeling of interconnectedness. As they were implemented in a specific order in the experience prototype the result could potentially look different if they were placed in another order. Due to time limitations there was no possibility of creating a completely new set of prototypes that tested the order of the strategies. Future research could therefore explore the strategies and their effectiveness further by developing them in isolation and in different combinations as well as considering their order of presentation.

This study has utilised the methodology of RtD, however, the research question could in likeness with prior studies have been answered by conducting an extensive literature review or by evaluating existing designs. A benefit to the other approaches would have been the inclusion of more developed design ideas, artefacts, and experiences as part of our analysis. Additionally, these existing designs could potentially already have been evaluated, adding to the richness of the dataset. However, there would be a risk that the experience or identified artefact was not designed with a primary focus on interconnectedness, which could potentially cloud the suggested strategies as they would be influenced by other design values. Further, the many definitions of interconnectedness would pose a risk of designers having a different understanding than the one presented in this thesis. Finally, analysing the designs without being able to directly speak to the designers about their intentions and motivations could place further emphasis on interpretation.

For our study, a lab setting proved effective for testing the strategies as it offered practical advantages, for example, it saved time through effective testing and allowed us to isolate the

prototype from a busy environment, limiting potentially affecting variables. However, as the strategies are intended for real-world application beyond the lab, the next step in evaluating the strategies would be an evaluation in a field setting that could further contribute to our understanding of their use.

The workshops in this project provided important insights for our two contributions: the design strategies and the IEF. As emphasised throughout this thesis, the understanding and experience of interconnectedness can vary greatly. Initially, the IEF was intended as a means to understand the diverse interpretations and related feelings of interconnectedness among participants and to further refine our own understanding. However, by utilising the IEF in our design process, we were able to generate ideas that targeted specific related feelings of interconnectedness and subsequently combine them into a cohesive concept. This demonstrates the potential for the IEF to be used as a valuable tool during a design process. However, we would like to emphasise that the framework only provides a partial representation of the related feelings of interconnectedness. While we made every effort to accurately organise the expressed related feelings into smaller clusters and subclusters, they cannot be regarded as synonyms for interconnectedness nor can this representation be considered the only way of organising the related feelings. One aspect not captured in the suggested framework is the intensity of these related feelings, which was explored during the workshop. This decision was taken based on two insights: first, the relatively low number of participants made it difficult to generalise the findings in any meaningful way, second, and perhaps more important, some emotions that the participants described were unique, abstract, and in some cases even ambiguous or contradictory, for example feeling both happy and sad. This suggests that the unique nature of the experience of interconnectedness transcends any attempt at defining it in too much detail. It might be argued that by omitting intensity it becomes more challenging to prioritise emotions when designing. However, we argue that interconnectedness is, and should be regarded as, a complex sentiment that cannot be approached simply by ticking off a checklist. The addition of intensity to the framework, therefore, becomes redundant. Besides, the current framework should rather be considered an inspiring guide than a definitive tool.

We would like to address the decision to combine the data from Workshop A and Workshop B, despite their slight design differences. In traditional quantitative data collection, such an approach would not be considered rigorous, nor in several forms of qualitative data analysis. However, since we have adopted a research-through-design approach to guide our work, this decision can be justified as the central theme of both workshops was identical. Although some exercises in the workshops targeted interconnectedness within specific contexts while others allowed the participants to have more freedom, the overarching goal of both workshops remained the same: explore what strategies can be used to design for feelings and reflections of interconnectedness to the more-than-human world in an interactive experience. We argue that by opening up the design space and combining the workshop data, we were able to develop more comprehensive strategies on how to design across different scenarios and contexts.

Due to convenience sampling, all the selected participants in the evaluation were educated in UX design. As there was limited time to test other user groups and sampling methods, we can only speculate how the result would differ. Future studies are therefore encouraged to test

their prototype with a stratified sampling method to ensure a more accurate mix of participants. Additionally, we believe that testing with a larger sample size would be beneficial as the current size did not reach the point of saturation. On the other hand, the workshop participants were recruited through purposive sampling, resulting in a larger mix of design backgrounds. However, involving participants with more diverse design perspectives could still be beneficial when developing additional strategies. During the first part of the workshops, which focused on exploring feelings of interconnectedness, a background in design was not as necessary as it was in the second part. Therefore, it would be interesting to include professionals from other disciplines such as psychologists, anthropologists, and ecologists to provide more diverse perspectives. Furthermore, as it is proposed that the more experience one has with a context, the better one becomes at perceiving nuances in that context (Goodwin, 1997), it could be of further value to incorporate participants with cultural backgrounds imbued with notions of interconnectedness. An example of such a background could be Buddhism.

The prototype developed in this project was not intended to be used by AquaPrint in a commercial setting. Instead, the aim was for the company to use the developed strategies to foster experiences of interconnectedness for their customers, allowing them to build meaningful relationships with their furniture. Such experiences could help communicate their brand values of sustainability, minimizing waste, and a circular economy.

Finally, it is important to note that these results are not exhaustive. They represent an initial exploration of design strategies for feelings and reflections of interconnectedness to the more-than-human world as well as provide guidance when understanding the feelings associated with the experience of interconnectedness. Taking into account the research conducted by Davis (2009), which identified a correlation between interconnectedness and a self-reported environmental worldview, the proposed strategies could possibly foster sustainable behaviour. Consequently, these strategies possess the potential to be effectively applied in the context of sustainable HCI. Repeating the process of RtD is considered the way to achieve the best results (Koskinen et al., 2011), therefore, future studies could perform the fifth stage *Repeat* of Zimmerman and Forlizzi's (2007) process, building on our results. In the emerging field of more-than-human design, this study serves as a contribution toward bridging the gap between humanist and posthumanist perspectives, yet there is still much to explore in this field.

6. Conclusion

The purpose of this thesis was to address the call for a posthuman perspective in HCI. The research question was: What design strategies could foster feelings and reflections of interconnectedness to the more-than-human world, and what are the associated emotions? This was answered by adopting a research through design methodology and collaborating with the Swedish company AquaPrint which creates designer furniture from up-cycled fishing nets. By conducting two workshops with eight design students, we developed seven preliminary strategies and an interconnectedness experience framework. Six of the seven strategies were evaluated by designing and prototyping an experience that was tested with seven participants. The results showed that the strategies can be used to foster feelings and reflections of

interconnectedness to the more-than-human world, but that the experience of interconnectedness is unique to the individual and influenced by past experiences. Further, the six suggested strategies, modified after insight from the test, and the IEF, should be considered an inspiration for practitioners seeking to promote a posthuman perspective of the world. Future research should evaluate the existing strategies individually and in different combinations, test them in a field setting, and propose additional strategies.

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Appendix A: Schedule Workshop A

5 minutes	<ul style="list-style-type: none"> • Fill in consentform • Everyone presents themselves • Bird exercise 	<ul style="list-style-type: none"> • Drawing • Presenting • Pens & paper
4 minutes	<ul style="list-style-type: none"> • Present interconnectedness + our definition 	<ul style="list-style-type: none"> • Listen • Computer
10 minutes	<ul style="list-style-type: none"> • When did you reflect on being interconnected? • Draw experience 	<ul style="list-style-type: none"> • Presenting / storytelling • Pens & paper
10 minutes	<ul style="list-style-type: none"> • Emotional typology map • Write down subfeelings • Add to others discussion 	<ul style="list-style-type: none"> • Writing • Placing • Presenting • Small post-its, posters
6 min	<ul style="list-style-type: none"> • Introduce AquaPrint 	<ul style="list-style-type: none"> • Listen • Large pictures
10 min	Fika	
20	<ul style="list-style-type: none"> • Identify furniture in context • Role-play 	<ul style="list-style-type: none"> • Read • Interact • Role-play • Present • Pen & Paper • 3D printed models of furniture
20 min	<ul style="list-style-type: none"> • Page one comes to when scanning • Brain drawing • Stafettpinne • Discuss • Select 	<ul style="list-style-type: none"> • Ideate • Vote • Pen&paper • Dotvoting
5 min	<ul style="list-style-type: none"> • Explain the purpose of our research • Gain feedback • Thankyou for participating 	<ul style="list-style-type: none"> • paper

Appendix B: Schedule Workshop B

13.00-13.05	<ul style="list-style-type: none"> • Fill in consentform • Everyone presents themselves • Bird exercise 	<ul style="list-style-type: none"> • Drawing • Presenting • Pens & paper
13.05-13.09	<ul style="list-style-type: none"> • Present interconnectedness + our definition 	<ul style="list-style-type: none"> • Listen • Computer
13.09-13.15	<ul style="list-style-type: none"> • When did you reflect on being interconnected? • Draw experience 	<ul style="list-style-type: none"> • Presenting / storytelling • Pens & paper
13.15-13.25	<ul style="list-style-type: none"> • Emotional typology map • Write down subfeelings • Add to others discussion 	<ul style="list-style-type: none"> • Writing • Placing • Presenting • Small post-its, posters
13.25 - 13.35	<ul style="list-style-type: none"> • Fika break 	
13.35-14.00	<ul style="list-style-type: none"> • Design UI for interconnectedness • Brain drawing • Stafettpinne • Discuss • Select 	<ul style="list-style-type: none"> • Ideate • Vote • Pen&paper • Dotvoting
14.00-14.04	<ul style="list-style-type: none"> • Inroduce AquaPrint 	<ul style="list-style-type: none"> • Listen • Large picures
14.04-14.24	<ul style="list-style-type: none"> • Identify furniture in context • Role-play 	<ul style="list-style-type: none"> • Read • Interact • Role-play • Present • Pen & Paper • 3D printed models offurniture
14.24-14.30	<ul style="list-style-type: none"> • Explain the purpose of our research • Gain feedback • Thankyou for participating 	<ul style="list-style-type: none"> • paper

Appendix C: Interview Guide

Intro

Välkommen att testa vårt projektarbete! Vad kul att du vill vara med.

Vi tänkte börja med att gå igenom lite praktiska saker. Under tiden du genomför scenariot och tills dess att testningen är klar kommer vi att spela in ljud (och kanske bild) för att underlätta för oss att sammanställa data och analysera efteråt - hoppas detta är ok [ja/nej — skriva under på dokument]. Det här är en prototyp som är under utveckling, så det kan hända att du möts av felmeddelanden, om du får några frågor under testet kan du ställa dom till oss. Efter scenariot kommer du få svara på lite frågor. Allt som allt kommer testet att ta ungefär X minuter.

Känner du dig redo? Då sätter vi igång!

Jag vill att du tänker dig in i situationen att du nyss kommit in i ett rum där du ser den här möbeln - tja, det du redan gjort - och du skulle vilja veta mer om den. För att du ska kunna göra det kommer du få låna den här telefonen (eftersom detta är en prototyp och finns bara tillgänglig på den här telefonen just nu). Försök att behandla den som du skulle gjort med din egen.

[vi ger även hörlurar och säger att dessa kommer att behövas under testet, även att de får säga till om volymen ska justeras]

Har du några frågor?

utför testet

Okej, tack:) Är det okej om vi hör av oss imorgon på sms med några frågor till? Vi hoppas verkligen att du kan ta dig tid att svara dom! Toppen, tack!:)

—

Innan intervjun börjar:

Frågor

<Start recording, video, sound, or both> -

Episodic

- Hur skulle du beskriva känslan du känner just nu?
- Vad gillade du mest? Varför gillade du det? Vad kände du då? Varför tror du att du kände så?

Vi kommer ställa frågor kring... (mer helhets-feedback om dina intryck, vad du kände och reflekterade kring? Inte så mycket om detaljer kring layout t.ex.)

Också, på grund av att det är en prototyp är det viktigt med din ärliga feedback, så det är inte som att vi blir besvikna av att du svarar på ett visst sätt.

Om förväntningar

- Efter att du scannat möbeln, hade du några förväntningar på vad du skulle mötas av?
- Vad tyckte du om att skanna möbeln?
- Hur visste du att det var det du behövde göra?
- Hade du förstått att du skulle skanna om det inte kom en notis? om nej, vad skulle behöva vara annorlunda?
- Vad fick du för intryck av taggen?

Momentary

Så nu ska vi gå igenom prototypen tillsammans, och så får du beskriva vad du la märke till, tänkte på, reflekterade kring och kände under din upplevelse. *<walk through - med ljud - och diskutera tillsammans, alla tre — ta fram alla strategier för varje del och fråga lite kring dessa>*

<medan dem beskriver sin upplevelse försöka pricka in känslorna dem nämner och (kanske) intensiteten av dem - som en UX curve. >

- Hur skulle du sammanfatta den här upplevelsen? 5 whys — känslor, reflektioner.

Tack,

så för att ge dig en liten inblick i vad vi undersöker så vill vi öka känslan och reflektionen kring att vi lever i ett samspel / är sammankopplade med vad vi kallar more-than-human - d.v.s att människan inte står i centrum utan är del av ett system. Vad som är vanligt inom design är att designa med människan i fokus och glömma bort alla dem andra som påverkas av designen. Vi hoppas att ett första steg för att förbättra det är genom att designa för reflektion och en känsla av Interconnectedness.

- Hur skulle relateras din upplevelse av prototypen till interconnectedness?
- Hur skulle du beskriva en ideell upplevelse?
- Hur skulle du ändrat denna prototyp för att den bättre skulle passa din upplevelse/definition av interconnectedness?

Till sist skulle vi vilja tacka dig med lite smarrigt fika. Sen kommer vi också kontakta dig kort imorgon på sms om det går bra för att få ytterligare återkoppling. Lämna gärna det eller annat sätt att kontakta dig.

Post interview sms:

Tack för ditt deltagande på testet igår.:) Vi har några sista frågor som vi skulle vara jätteglada om du ville svara på: Har du reflekterat något kring upplevelsen sedan testet? När då? Vad har du i så fall reflekterat kring och känt? Vad kommer du ihåg mest tydligt nu en dag efteråt? Varför då? Tack igen!

/Anton och Flora

Appendix D: Poster

DESIGN FOR INTER-CONNECTEDNESS

A DESIGNWORKSHOP AT .LAB

MARCH 9TH 13.00-14.30

As part of our Master's thesis in HCI and UX design, we invite you to explore design strategies for enhanced feelings of interconnectedness between humans and non-humans. Register through the QR code as **Fika will be provided** for all participants. We welcome all students regardless of background up to 10 participants. Looking forward to designing for a more interconnected future with you!

For questions please contact
Flora Jameson (flja0004@student.umu.se) or
Anton Fischer (anfi0029@student.umu.se)



Register here