


Article

Designing towards the Unknown: Engaging with Material and Aesthetic Uncertainty

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Received: 9 August 2017; Accepted: 12 December 2017; Published: 26 December 2017

Abstract: New materials with new capabilities demand new ways of approaching design. Destabilising existing methods is crucial to develop new methods. Yet, radical destabilisation—where outcomes remain unknown long enough that new discoveries become possible—is not easy in technology design where complex interdisciplinary teams with time and resource constraints need to deliver concrete outcomes on schedule. The Poetic Kinaesthetic Interface project (PKI) engages with this problematic directly. In PKI we use unfolding processes—informed by participatory, speculative and critical design—in emergent actions, to design towards unknown outcomes, using unknown materials. The impossibility of this task is proving as useful as it is disruptive. At its most potent, it is destabilising expectations, aesthetics and processes. Keeping the researchers, collaborators and participants in a state of unknowing, is opening the research potential to far-ranging possibilities. In this article we unpack the motivations driving the PKI project. We present our mixed-methodology, which entangles textile crafts, design interactions and materiality to shape an embodied enquiry. Our research outcomes are procedural and methodological. PKI brings together diverse human, non-human, known and unknown actors to discover where the emergent assemblages might lead. Our approach is re-invigorating—as it demands re-envisioning of—the design process.

Keywords: craft; materiality; embodied interaction; aesthetics; design process; wearables

“Alchemy is the old science of struggling with materials, and not quite understanding what is happening.” [1] (p. 19)

1. Introduction

The Poetic Kinaesthetic Interface project (PKI), investigates what we might learn, as designers, if we hold our focus tightly on a struggle with as-yet-unknown materials. Can we engage productively with the unknown potential of as-yet-unknown materials by crafting embodied interactions using materials that are familiar? Might interweaving: embodied engagement with materiality; and emergent interim forms that we expose to different publics; bring us to metaphorical cloths of gold that suggest new ways forward? Might alchemical acts of “combining or redirecting the flow of these materials in anticipation of what might emerge” [2] (p. 9) hold a key to designing towards the unknown?

In this sea of questions, we are not looking for answers, per se. Following Haraway [3], we are trying to stay with the trouble. How do designers design in such unstable times? How do we design in the face of uncertainty? How do we stay with this trouble, long enough to find new ways of responding?

PKI is an ongoing series of moves towards new procedures and methods for designing in the face of material and aesthetic uncertainty. The project has had false starts and missteps, and at moments has

leapt like a gazelle—with crystal clear intentions and pathways forward. Yet even at such moments, we disrupt our process to return ourselves to a state of unknowing so that we can be careful to really follow where our as-yet-unknown materials might want to lead. Ingold [2], assures us that “what people do with materials (. . .) is to follow them, weaving their own lines of becoming into the texture of material flows”. In PKI we ask what might happen if we enable the materials to use us—the designers and our collaborators—to weave their own lines of becoming?

Our aim thus is to enable the materials to guide us more powerfully than they do in our craft practices. As Rosner et al. [4] explain, how a craftsperson plays with their materials leads them towards finding what it is they want to make. In our case, treating the concepts, materials and techniques at play in the PKI project as material elements of our craft practices is leading us to understand what it is the materials might want us to do. Sometimes it seems we listen well. Sometimes we might listen more carefully. In either case, we hope to discover if material desires can assist us to design into an unknown. Material things, like people, are processes—their real agency lies precisely in the fact that “they cannot always be captured and contained” [5] (p. 60) in [2] (p. 8). This concept is only more valid in these times of radical material—and everything—flux. Following Ingold’s lead, we are therefore following the materials.

We describe here our motivations and the theoretical underpinnings of the PKI project, and how the project has unfolded to date. Our processes are informed equally by Research through Design, New Materialism and Feminist Technoscience. They are at once emergent, participatory and performative. They combine textile crafts with interaction design to shape participatory, embodied, speculative engagements with materiality: bringing together diverse human, non-human, known and unknown materials—combining and reconfiguring them, redirecting their flow—to discover where the emergent assemblages might lead us. As we will discuss, this entangled methodology is re-invigorating, as it re-envision the design process.

2. PKI: Motivations

2.1. Conceptual Drivers

PKI aims to challenge and enrich the constrained norm of body-typical to include hypermobility, physical disability, and the evolving abilities of the mature or ageing body. The project interweaves: embodied engagement, choreography, motion capture, structured textile research, material and spatial explorations, garment and object construction and public engagement in an emergent co-design process.

The aim is to understand:

1. How to give people the feeling of being in someone else’s body, someone with perhaps very different abilities and constraints.
2. How designers might effectively prototype advanced material interactions, where the characteristics of the materials in question might not yet be concretised.
3. How designers and scientists might effectively cross-fertilise research-in-process with public opinions around the social, ethical, personal, political and cultural implications of what life would be like if yet-to-be-concretised technologies were readily available, and part of people’s lives.

The objectives are fourfold, to:

1. Develop new forms of embodied and wearable interactions that challenge participants’ notions around terms such as: ability, disability, body typical and normative or normal.
2. Expand the ways that we, as design researchers, engage with technological potential.
3. Investigate how design actions might afford productive cross-fertilisation of social imaginaries and concerns with scientific development, and
4. Ascertain whether, or how, doing so might productively influence perceived social relevance of research.

These aims and objectives are explored in parallel in, with and through a participatory, embodied Research through Design (RtD) process that crafts our inquiry into graspable, wearable and otherwise *em-body-able* form. Em-body-able artefacts can be engaged with through the body—no matter their form or scale. They may be micro or macro, self-contained or systemic, or otherwise materially, physically or conceptually challenging in terms of what humans typically grasp or wear form (c.f. Section 3). Considered interim outcomes, our forms are tested in participatory actions that rely on em-body-ing design—situating ideation, engagement, interaction and evaluation in, with, and through the experiential human body—to access embodied participants’ extra-discursive capacities. This approach anchors dialogue in the personal, social, political and environmental, and enables conversations to take place that otherwise might elude articulation.

2.2. Theoretical Drivers

We describe our method as crafting RtD, informed by participatory, speculative and critical design, New Materialism and Feminist Technoscience. The research is thus informed by theories of practice, practice, and philosophies relating to Science and Technology Studies (STS), which destabilise and thereby move the thinking- and research-in-practice forward.

We use an applied action-reflection approach to RtD [6] (pp. 189–192), where the emphasis is on the research objective of creating design knowledge, rather than a project solution. We have a Scandinavian-inspired approach to participation: collaborating with people who might eventually be served by as-yet-unimagined designs, as co-creators in the process [7]. The resulting research-in-practice is constructivist in its unfolding. Materials, making, collaborator and participant feedback are drawn on in a hermeneutic cycle based on creativity and self-reflection: information and findings are used to move forward, but also revisit previous considerations (c.f. [8]). What emerges is a speculative and indeterminate progression reminiscent of what Tim Ingold [9] terms wayfinding in comparison to navigation: feeling one’s way rather than using a map. This way of working affords a continual feedback mechanism that is open, flexible and responsive. It enables us, like craftspeople, to calibrate the motions of our actions in direct response to the actions just performed, and thereby advance towards where the research, design enquiry, and participant reactions lead at each moment.

The resulting design actions constitute an emerging hybrid of narratives that inform and are informed by the research concerns. They use embodied, post-disciplinary and disruptive strategies [10] to engage varied social and technoscientific imaginaries. *Thinking-through-making, -moving and -doing* are key attitudes within this process. As is using the socially familiar context of crafts [11] to engage participants to bring difficult to articulate concepts to the scale of the body. Bringing attention to the body in diverse ways supports diverse publics to find language for complex topics. It enlivens imaginaries and invites creative (re)positioning of everyday, intimate experiences into what Rosi Braidotti [12] (p. 41) calls posthuman assemblages: where the human perspective is but one among many. We thus are carefully, and continually constructing dynamic ‘research-assemblages’—comprised of researcher, respondents, data, methods and contexts—as a way to “assess, critique and potentially engineer [new] research methods and methodologies” [13] (p. 11) by continually shifting the relationship between researcher, researched and audience.

This approach acknowledges that a capacity for ‘agency’ extends beyond human actors to include materials and the relationships between the human, non-human and inanimate [14–16]. It thus opens our research-assemblages to new forms of reading, wherein we evaluate our materials by their capacities to affect [17] (p. 3), and assists us to radically destabilise how we might otherwise support, and read participant actions in a co-design context. Instead of focusing on the reactions of our human participants, we can bring focus to all of the forces (or affects) operating at the level of actions or events [13] (p. 27), including those in which our human collaborators play a relatively minor role. There are “no structures, no systems and no mechanisms at work in new materialist ontology; instead there are events; an endless cascade of events comprising the material effects of both nature and culture that together produce the world” [18] (p. 7) This way of thinking opens the way to responsively craft

the different—human and non-human—elements in our research process. By taking ‘things’ seriously, we can “recognize more fully how these [things] come to be constituted and thought in and through particular worlds in which ‘we humans’ are but one nominated set of players” [19] (p. 115). According to Lindström & Ståhl [20], such an approach: “means not only to open up the body, but also to open up technology as materials that are related in somewhat stabilized ways, but which can be rearranged”. By paying “attention to the discursive and material, in one move, through recognizing relationality and coconstitution of agency” we can go beyond only considering the concerns of the user [20].

In PKI we are thus speculating possible aesthetics for new material technologies that might help us to think in different ways. Feminist technoscience and new materialist ontologies assist us to think these new ways through our design research practices. They thereby provide potent lenses through which to engage with our unknowns.

3. PKI: Crafting Design Interactions

3.1. Weaving a Way Forward

From a theoretical as well as practical perspective, PKI is extremely dynamic. It leans on textile crafts and interaction design to support dynamic relations between: emerging materials, embodiment in social imaginaries, and disability aesthetics. The making leans heavily on textile crafts, interaction design, participatory and speculative design, using the social familiarity of crafts to reach a broad audience. Partners come from scientific and design backgrounds, as well as performance and disability. Participants come from diverse publics constituted at cultural and community events, specialist fora and pop-up happenings (c.f. [10,21]).

The project, to date, has two phases:

- Phase I began with motion capture experiments with four alternately-abled creative professionals, and culminated in open, participatory actions with diverse publics;
- Phase II involves closer collaboration with materials scientists and engineers, and further open experiments.

In Phase I—the focus of this article—we use design actions to probe participant relationships to divergent bodies and technologies. The actions are shaped as frameworks-for-thinking, and use interim outcomes, rather than conceptually completed artefacts to expose our thinking to public scrutiny as it evolves, rather than waiting until concepts are neatly formed. This approach is enabling us to carefully craft speculative interventions using familiar materials, and to propose assemblages of yet-to-be-imagined materials and technologies for as-yet-unknown applications. The resulting probes are conceptually ambiguous, and serve to prompt people to imagine and express novel ideas.

To structure our design actions we draw on the metaphorical language of weaving. An ancient and universal craft practice performed on a loom [22]. A loom consists of two interlacing sets of threads—the warp and the weft. The warp threads are held by the loom and provide structure. This structure can be dynamically altered by lifting and lowering selected threads. To weave, varied weft threads are interlaced through the warp, to fill it and so complete a cloth. The action of weaving is thus a complex lively interplay between material, tool, technique and weaver. It is morphogenetic in approach [23]; at once emergent, immersive and performative.

In PKI, we posit each participatory event as a loom. In our looms, the warp is a dynamic constellation of conceptually evolving probes, and the weft is the public’s engagement and responses to these probes, as guided by the varied weavers: US researchers and our varied human and non-human collaborators. In this interplay of varied forces and concerns, the construct of the loom is extremely useful. The interaction between the warp elements and our dynamically changing weft enables different formations and patterns to emerge that we posit as metaphorical cloths: the alchemical cloths of gold, alluded to in the introduction. As discussed below, when handled in different ways, these cloths privilege different perspectives: they conceptually and theoretically embody different relationships

between the research ideas, probes and participant responses. They thus serve to guide our thinking, moving forward. Following, we describe our first two looms, and reflect on their usefulness. We then unpack the notion of the metaphorical cloths that result from their use.

3.2. Two Looms

3.2.1. Loom 1: Australia

Our Phase I Loom was presented at The National Gallery of Victoria in Melbourne, Australia [24]. In this loom we limited explorations to what we call *no-tech*: using no contemporary, new or emergent digital or biological technologies. (For a discussion of *no-tech*, *low-tech* and *emerging*- or *yet-to-be-imagined-tech* please see [10].)

Three series of probes were developed for this loom:

1. *Green Knits* (Figure 1): graspable structures that emerged directly from research into biotensegrity—the interplay of compression and tension in the human body [25]. These probes serve as a material guide for moving, as well as understanding how to move, linking the cognitive with the kinaesthetic and proprioceptive in unexpected ways
2. *Blue Cushions* (Figure 2): felted wool lumps that serve as sweet deformities or temporary scars that can be put on and taken off at will. These probes place pressure on different muscle groups and nerve pathways to change perception of movement.
3. *Sleeves* (Figure 3): curious partial-garments that alter movement pathways through the imposition on the wearer’s body of a hidden or constantly shifting maze.

Together these three series of probes constituted our first warp (see: [10]).



Figure 1. Loom 1 probe-set (1): *Green Knits*.

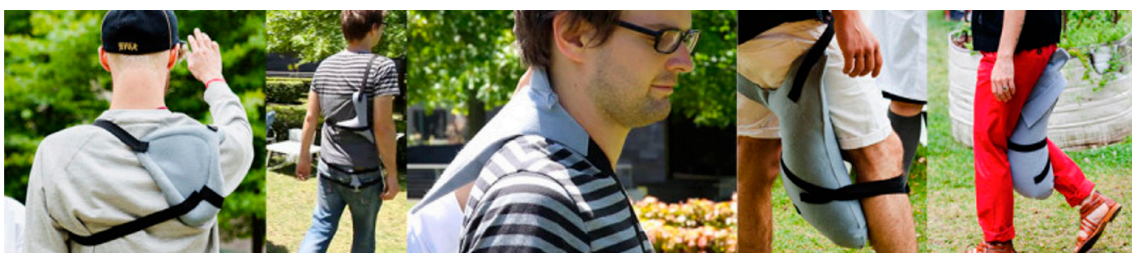


Figure 2. Loom 1 probe-set (2): *Blue Cushions*.



Figure 3. Loom 1 probe-set (3): *Sleeves: (a) Yellow Sleeve; (b) Red & Black Sleeve.*

These three constellations of enquiry constituted the warp threads, through which we interwove—both led and followed—our participating public(s): our weft. As we interwove the materials, concepts and public(s), we also literally crafted on site, making responsive modifications and additions to pieces, and creating new prototypes in response to what was happening. Crafting thus provided a structure for ongoing experimentation and risk-taking with our research framework. It also provided a recognizable space for storytelling and sharing [26]. It kept the research ideas accessible and lively; allowing people to observe, linger, tell stories and ask questions. The entire construct became a highly social site for collaborative creativity and exchange.

There was much curiosity in the act of observing us crafting on site. Comments such as “my mother knitted” led to conversations that might not otherwise have occurred. Seeing us at work with our hands blurred boundaries between making and testing. We found that craft, when thought of as a verb [27], offers a dynamic, sensory and performative way to enable engagement that is inclusive and non-threatening. As we worked the loom, we were constantly confronted with surprising levels of openness and sharing by participants that we encountered only once. Gaver et al. speak of deep relationships between researchers and participants emerging out of repeated interactions [28]. From our experience as researchers, evaluating the processes at play led us to understand that it was the openness of the prototypes, with their apparent contextlessness, as well as their varying levels of resolution that afforded this same kind of openness in our participants. These findings support the concept that craft is a powerful site of connection and communication [27]. Textile crafts offer entry points for participation: dynamic, sensory and performative means through which to enable engagement that is inclusive, non-threatening and instrumentally valid. The construct of the loom affords highly responsive—alternative—ways of working that are flexible in structure, yet robust enough to be trusted to lead to useful outcomes. Drawing on the constant interplay between tacit knowledge and self-conscious awareness of craft [29] through this construct enables us to reach out and connect with participants and craft a robust structure. Further discussion of Loom 1 is at [10].

3.2.2. Loom 2: Denmark

Our second loom was set up in Kolding, Denmark, during the Design Research Society Experiential Knowledge Special Interest Group annual conference (EKSIG 2015, [30]), at Kolding Design School. We had a three-week research residency at the Design School before setting up our loom, during which we undertook a range of experiments with material and embodied interactions. We focused on both *no-* and *known-*technologies, to investigate what might emerge if we did what we already knew. Unlike the Loom 1, which was open to a broad range of participants, this loom was designed first and foremost for the textile and design researchers who would be attending the EKSIG conference. These conference participants would know a lot about the project before they engaged with it, having seen a presentation of the work. This knowledge impacted our decision-making process.

We at once wanted to experiment with extreme open-ness, and leverage the background knowledge and findings from Loom 1. The three probe-sets that resulted are:

1. *Embodied paper prototypes* (Figure 4): dynamic forms developed through an embodied prototyping process (This probe-set was developed by Mary Karida and Erica Vannucci, students at The University of Southern Denmark). Each form opens and closes in various ways, depending on how they are placed on the body and how the wearer moves. The purpose of this probe-set is to investigate (a) how participants might engage with forms that can be placed anywhere on the body, and (b) whether doing so might impact a persons' understanding of the body in movement, and in what way.
2. *Creatures + Straps* (Figure 5): diverse knitted elements. The *Creatures* are inspired by transparent marine animals that—like alien creatures—can hug the body in different ways, and in doing so dynamically alter their form. These shape change capabilities were informed by the embodied paper prototyping experiments (described above), the possibilities and constraints afforded by machine-knitting 3D structures, and our Phase I findings (reported at [21]). The *Straps* are inspired by kinbaku-bi—a form of Japanese bondage that focuses on the aesthetics of tying, knotting and constraining the body [31], again informed by our findings from Phase I. This probe-set represents a series of aesthetic leaps, and is conceptually far more sophisticated than the other probe-sets in this loom.
3. *Sensors + Sounds* (Figure 6): hand-made textile stretch sensors patched into a computer running the Max sound programming environment. These sensors were aesthetically matched to the sea creatures, as they were originally intended to form part of the same probe-set. We kept them separate for two reasons. First, we wanted participants to determine in what ways the different probe-sets might be paired, without being guided by our prompting. Second, by separating sonic feedback from the visual and physical feedback provided in probe-sets (1) and (2), we hoped to observe how participant behaviour might differ in response to the different sensorial trigger. The sonic interactions of this probe-set were developed by students from The University of Southern Denmark (SDU) and Kolding Design School (From the SDU: Ferran Altarriba Bertran and Mirzel Avdic; from Kolding Design School and Tongji University College of Design and Innovation: Yu Keyu; with additional technical support provided by: Jonas Leonas (Kolding Design School)).

Compared to Loom 1, Loom 2 was far more open in terms of how the probe-sets might be paired with the body. The probe-sets were also uneven in terms of their conceptual sophistication. In contrast, the probe-sets for Loom 1 sat along a clearly identifiable spectrum, and were equally matched in terms of material language [21].

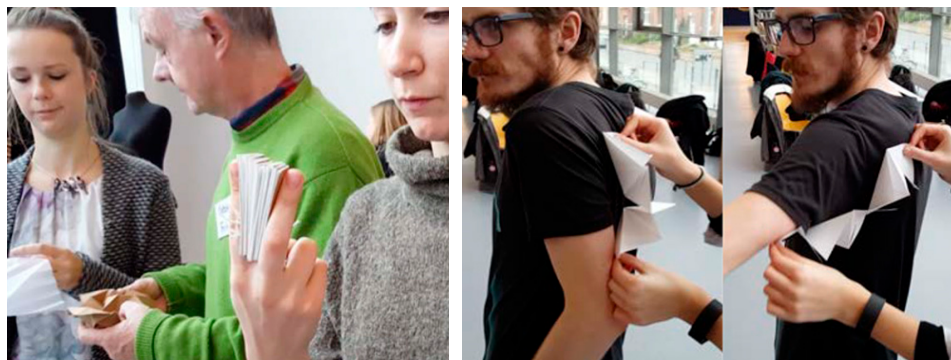


Figure 4. Loom 2 probe-set (1): *Embodied Paper Prototypes*.

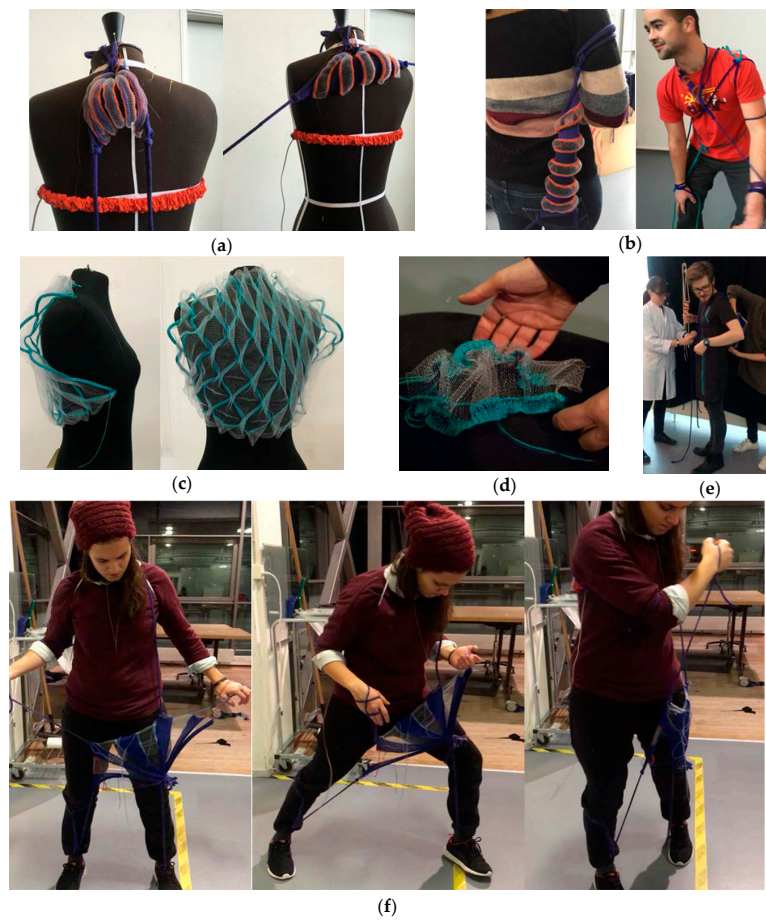


Figure 5. Loom 2 probe-set (2): *Creatures + Straps*. (a) + (c) studio testing; (b) + (d) participant play in the loom; (e) dressing a participant; (f) studio testing.

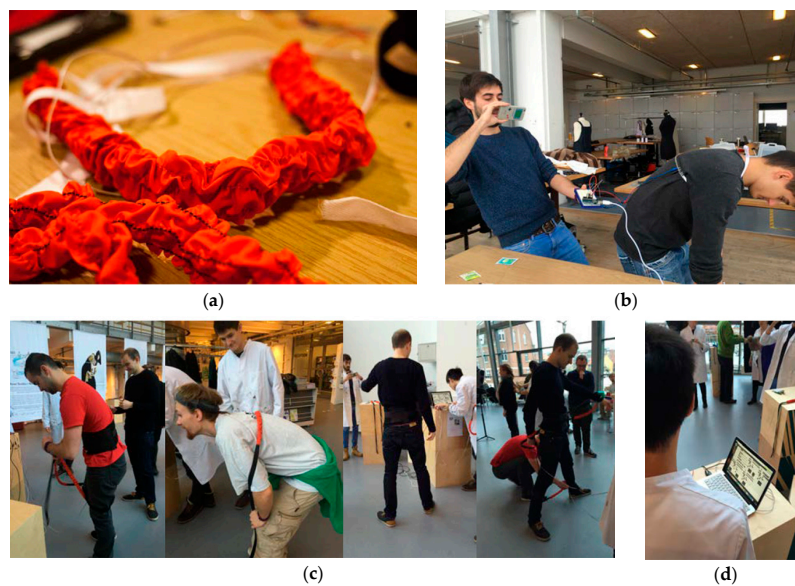


Figure 6. Loom 2 probe-set (3): *Sensors + Sounds*. (a) adjustable sensor straps; (b) studio testing; (c) participant play in the loom; (d) loom sound setup: computer running Max MSP with a live manipulated patch for sound experiments.

On analysis, the open-ness, and mismatch in Loom 2 was too extreme to gain useful insights from the interactions between warp, weft and loom. The resulting *metaphorical cloths* seemed dull, uninspiring—at times too open to be able to understand, at other times too tightly wound. It seemed the Loom 2 probe-sets (our warp) left participants without enough structure. There was nothing for them to hold on to when considering how to ‘play’ their potential. In contrast, the specificity of the Loom 1 probe-sets enabled participants to position themselves powerfully in relation to their strange familiarity. The coherency of the probe-sets in Loom 1—in terms of how each should be used—also assisted participants to commit to engaging.

Regardless of what felt like a set-back, the construct of the loom was helpful. It slowed down our thinking and provided space for greater reflection, as our reflections needed to be coherent with our metaphorical construct, as well as our research concerns. Over the course of the two looms, we gleaned the following insights into the benefits and limitations of this approach:

- Craft’s soft logic provides a framework that both supports and suggests alternative ways of working that are open and flexible, yet robust. The confidence this robustness engenders supports risk taking in us researchers and, we believe, the participants in our design actions.
- The social and performative nature of craft acts as a rich site for inviting and opening up exchanges of ideas [27].
- Exposing an audience to relatively unformed research, and researchers to audience responses at early stages of the work is effective (if not always satisfying).
- The level of commitment a participant brings to their participation with experimental probe-sets, is coupled to both conceptual resolution and ease of use.
- Warping a metaphorical loom with conceptually and materially uneven probes can challenge participants’ ability to engage with the unresolved nature of the work, whereas series of prototypes, developed to a similar level of conceptual or material sophistication, better affords triangulation, and therefore structure and engagement.

While it remains unclear to what resolution our artefacts ultimately need to be developed for us to arrive at some kind of material and aesthetic certainty. Or if indeed, certainty is even required. What is clear is that constantly destabilising our beliefs and habits as designer–researchers through the use of our loom metaphor is proving as fruitful as it is challenging. Keeping ourselves in a state of unknowing affords greater sensitivity to where to go next.

3.3. *Metaphorical Cloths of Gold*

As discussed above, we consider the different formations and patterns that emerge from our looms to be metaphorical cloths: the alchemical cloths of gold, alluded to in the introduction. When handled in different ways, these cloths conceptually and theoretically embody different relationships between the research ideas, probes and participant responses. Following Redström, we suggest that these cloths are a ‘shared form of life’ that make visible gaps in knowledge and practice [32]. They are not outcomes, per se, nor resolved finished cloths, but rather sample cloths that materialise temporal moments of our emergent processes, actions and thinking, and serve to guide our thinking, moving forward.

Fabric sampling has a long tradition in textile design [33], as a way to test ideas and trial different materials, colours and patterning effects in combination. In PKI, our design actions, embodied in our looms—the warp and weft, and the act and conditions of their interweaving—affect the characteristics of the cloths. The resulting cloths assist us in better understanding our findings in non-linear ways. Though metaphorical, they make material McCullough’s understanding of craft as “the condition in which the inherent qualities and economies of the media are encouraged to shape both process and products” [34].

In PKI, we use craft’s sensory and emotive state as a way to open “the seemingly hard world of science to a wider audience, by using the ‘softer’ textile-making processes” [27] (p. 80). When we enact our looms, participant exchanges are varied and considered. People make connections back to

their own lives and their own situations. Discussions drawn from experience and personal stories cover topics such as the aging body, children with autism and how to keep active—all valuable insights for our research. The loom, as a whole, shapes the emerging design process and creates space for this diversity. It enables us—as design researchers *and* participant weavers in a morphogenetic process—to intertwine theoretical and conceptual threads of concern and birth our shared forms of life, our metaphorical cloths of gold: the resulting *cloths of possibility* that afford speculative consideration of propositions. The format as a whole supports deep engagement from diverse publics, and productive cross-fertilisation of social imaginaries and concerns with scientific development. Further, the loom enables us to effectively craft our research structure on the fly. Our task, moving forward, is to consider the different ways that our cloths of possibility might be draped and folded to bring to light different elements of our research and inform how we enact future phases of the project.

4. Reflections

The purpose of this article is not to reflect on the results of our loom, *per se*, but to reflect on the usefulness of an entangled methodology that converges: theories on practice; practice; theories on thinking; and thinking. Bringing new materialist and feminist technoscience ontologies into a crafted RtD process is enabling us to foreground non-human alongside human agency, which is helping disrupt assumptions we might make in terms of understanding our data.

The PKI project combines textile crafts with interaction design to shape participatory, embodied, speculative engagements with materiality: bringing together diverse human, non-human, known and unknown materials—combining and reconfiguring them, redirecting their flow—to discover where the emergent assemblages might lead us. We are thus crafting practice-based, practice-led and practice-oriented, critical design research; drawing on an expanded view of craft, as a fundamentally social way of working with people through the medium and intelligence of materiality [35] (p. 20).

With this entangled approach, we are literally weaving our way forward: from a loom as structural support for research practice and engagement, towards a flattened hierarchy informed by feminist technoscience. We envision the impact of this flattening on Phase II to open up how we conduct our collaborations with materials scientists and engineers. In the meantime, the weavers include a diversity of players: human and non-human. The non-human materials are weaving their way forward to new becomings. The human participants are weaving cloths of emergent understandings: of diverse bodies, new materials and approaches to embodied living and engagement. The design researchers are weaving new understandings of new aesthetics in relation to new materials, as well as new philosophical understandings of how to read our research actions. The weaving is thus engaging us in future-making: weaving material culture and imagination. “[M]aking as weaving emphasizes the mutual relationship between maker and material” [36] (p. 127), which “continually and endlessly com[es] into being around us as we weave” [37] (p. 64). Our loom, thus, is freeing us from relying on tested methods that may not be appropriate to *yet-to-be-concretised* materials.

There is strong precedence of textile-based craft metaphors as tools for thinking: devices for elaborating new meaning, and communicating processes that may be complex and non-reductive in form. Researchers are re-thinking art, aesthetics and knowledge production through metaphors such as “spinning to elaborate new meanings” [38] (p. 4) and “patchworking ways of knowing” [39]: both to know and to make the world in one move. But do such approaches offer a new foundation? Ajun Appaduri [40] (p. 9) posits design as a practice that continuously reimagines its own conditions of possibility, drawing focus to the forces of materiality in relation to design. He proposes that “materiality can be viewed as a design context, and design can be treated as a form of vibration (in the sense of Jane Bennett’s idea of “vibrant matter”) that disturbs and creatively animates the material world and adds new forms of movement to already moving and dynamic materials” [40] (pp. 9–10) (and [17]). In PKI, we treat the concepts, materials and techniques at play as craft elements, we are continually discovering what it is we would like to do. Engaging with craft techniques (including weaving, knitting, sewing, textile materials and the simplicity of techniques such as paper folding) we look to where these might

take us. At the same time, we continually reference back to the body as a site for enquiry, and the core aims and objectives of our research project. The exchanges afforded are prompting deep reflection around notions connected to disability, hypermobility and the ageing body, and continually renewing our intentions to find coherent ways forward with our inquiry.

By holding strongly to design as “immanent: never finished, always in progress” [41] (p. 15), we can engage with the emergent ideas as a process of becoming. Returning to Pollard [5] (p. 60), in Ingold [2] (p. 8): material things, like people, are processes—their real agency lies precisely in the fact that “they cannot always be captured and contained”. We thus try to stay with the trouble that new materials bring, in the hope that by doing so, while destabilising our practices and thereby our expectations, we might be able to bring the alchemical gold of a new aesthetic into being. By intertwining varied and varying perspectives on our concerns thus, our research is enabled to unfold as an emergent—open and responsive—activity that may at times diverge dynamically from intended planning. It thereby allows us to examine how to craft a response to the many questions driving our inquiry.

5. Conclusions

PKI is a live, volatile process, understood in the sense of Dewey’s ‘experience’ [42]. Rather than fitting clearly into recognisable domains, the probes, design actions, interim outcomes and metaphorical research cloths of PKI, define their own domain. Together, they enable us: design researchers, human and non-human collaborators, to break with limitations and pre-conceived notions around what materials might wish to become. Our entangled approach thus gives rise to unexpected responses to complex problems, deepened understanding of the problems as a result, propositions for ongoing actions, and a re-evaluation of diverse perspectives on research rigor that might be held by divergent disciplines—such as materials science or participatory speculation—that collaborate on developing future wearables.

Moving forward, our intention remains to design towards unknown outcomes, using unknown materials. In particular, we will focus more keenly on our metaphorical research cloths. We anticipate that the impossibility and uncertainty of this task will continue destabilising expectations, aesthetics and processes; keeping us design researchers, our human and non-human collaborators, in a state of unknowing that will open up the research potential to far-ranging possibilities. Further, by applying analytical frameworks from new materialism and feminist technoscience to our interim outcomes, as well as our understanding of the unfolding processes, we believe our findings will continue to re-invigorate and re-envision the design process, and thereby keep it, and us, in a constant process of becoming as we work more closely with material scientists and engineers.

Supplementary Materials: The PKI project website is available online at <http://www.daniellewilde.com/embodied-futures/pki/> [43].

Acknowledgments: We would like to acknowledge the Phase I choreographer/movers, in particular Benjamin Hancock and Sarah Mainwaring; Simone LeAmon, and everyone at the National Gallery of Victoria; Richard Lehner, Anne Louise Bang, everyone at Design School Kolding; Jonas Leonas; our Phase I collaborator: Rebecca Pohlner; and our Phase II student collaborators: Mary Karida, Erica Vanucci, Mirzel Avdic, Ferran Altarriba Bertran, from SDU, and Keyu Yu from DSKD and Tong-Ji University College of Design and Innovation. Design School Kolding provided a Research Residency for PKI Phase II, development and exhibition of Loom 2, in conjunction with the DRS EKSIG conference 2015. This article is based on a conference presentation at the 12th European Academy of Design Conference, Design for Next: Aesthetics, in Rome, Italy, 12–14 April 2017. The conference paper has not been published. Funding awards include: Besen Family Foundation, Australia, Creative Development Award (2015); Sidney Myer Foundation Fellowship (2012–14); Arts Victoria, Australia, Creative Development Fund 2013. No funds were received to cover the costs to publish in open access.

Author Contributions: Danielle Wilde conceived and designed the experiments; Jenny Underwood led the knit research; Danielle Wilde led the analysis, theory development and writing; Jenny Underwood contributed craft theory and analysis.

Conflicts of Interest: The authors declare no conflict of interest.

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