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DOI

[10.1145/3656156.3663717](https://doi.org/10.1145/3656156.3663717)

Publication date

2024

Document Version

Final published version

Published in

DIS '24 Companion

Citation (APA)

Andersen, K., Goveia da Rocha, B., & Voorwinden, M. (2024). Making in the Dark: Diffraction Re-interpretations of a Sample Archive. In A. Vallgård, L. Jönsson, J. Fritsch, S. Fdili Alaoui, & C. A. Le Dantec (Eds.), *DIS '24 Companion: Companion Publication of the 2024 ACM Designing Interactive Systems Conference* (pp. 88-91). ACM. <https://doi.org/10.1145/3656156.3663717>

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Making in the Dark

Diffraction Re-interpretations of a Sample Archive

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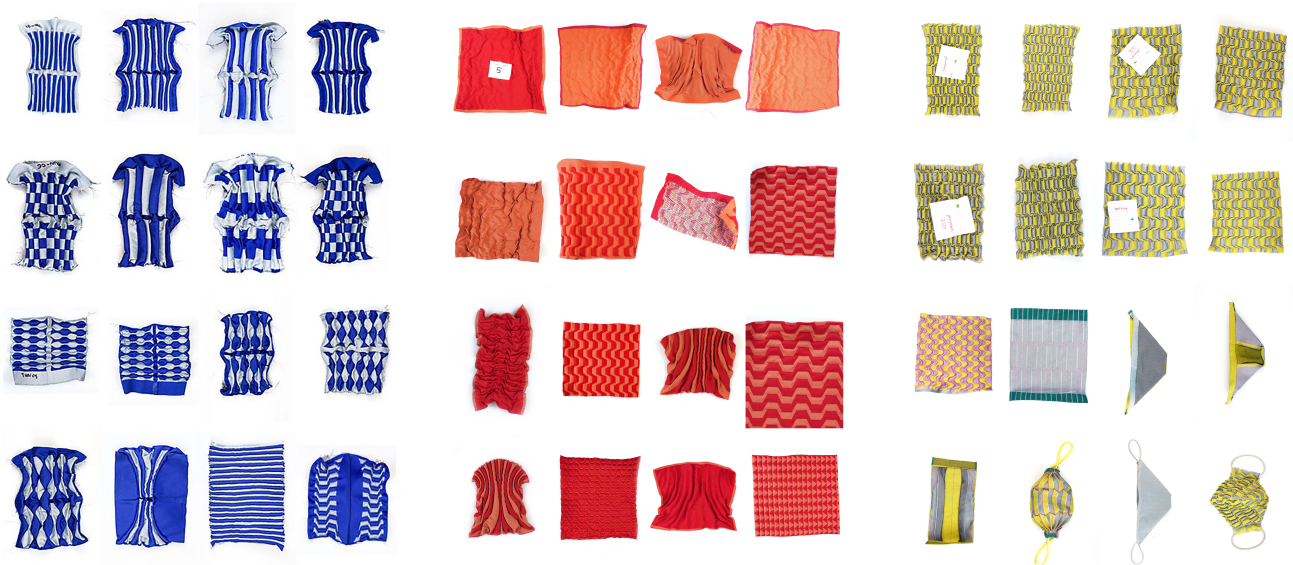


Figure 1: Array of woven samples made in the development of a textile with filtering capabilities.

ABSTRACT

Sample making and documentation are well established practices in digital craftsmanship. However, we rarely discuss how we return to these collections to look for starting points and new understandings. In this provocation, we propose diffraction as a way to describe how we revisit and reconsider samples in different times and contexts. In doing so, we can imagine what other knowledge might be present in them and interpret what else they might do. We use the example of the development of a filtering textile, based on a set of woven samples developed for other purposes and projects. Through this, we show how a relatively simple strategy can support us to investigate material samples and collections through a kind of makers' science, in which both inspiration and proof may lie in the material samples themselves.

CCS CONCEPTS

• Human-centered computing → Human computer interaction (HCI).

KEYWORDS

Samples, diffraction, weaving, digital craftsmanship, research through design

ACM Reference Format:

Kristina Andersen, Bruna Goveia da Rocha, and Milou Voorwinden. 2024. Making in the Dark: Diffraction Re-interpretations of a Sample Archive. In *Designing Interactive Systems Conference (DIS Companion '24)*, July 01–05, 2024, IT University of Copenhagen, Denmark. ACM, New York, NY, USA, 4 pages. <https://doi.org/10.1145/3656156.3663717>



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DIS Companion '24, July 01–05, 2024, IT University of Copenhagen, Denmark
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ACM ISBN 979-8-4007-0632-5/24/07
<https://doi.org/10.1145/3656156.3663717>

1 WHERE IS THE KNOWLEDGE?

Research through design broadly concerns itself with making to generate knowledge and provoke new insights [15]. As a subset, digital craftsmanship can be seen as research-through-making with production systems that rely on digital materials and digital fabrication tools [8]. In the context of manufacture and fabrication, this means that we engage directly with tools of production in order to

consider and explore, what a particular system or material is capable of, and ultimately how both data and pattern may be used as design material. The main strategy for this is the making of physical samples – both as a way to explore the possibilities in a design and to investigate a subject or an intention. The outcomes are not just final design objects, but more importantly a large body of samples made along the design journey [11]. This making *with* process can be seen as itinerative (each sample is both the result of a previous development and preparation for the next) [12] and informed by the very real implications of the systems and materials involved. As a result, the knowledge embodied by the physical samples, is rich, multifaceted, and situated [11].

Our practice is deeply entwined with a broad international community working with textiles as a method for creating new kinds of material opportunities. Zheng et al [19] work with weaving as a method to elicit new behaviors, Buso et al [5] explore 3D weaving for textile-form interfaces, Posch and Kurbak [14] explore crafting textile electronic components from scratch, Albaugh et al [1] explore soft actuation through computational knitting, and Oogjes [13] works on ways of understanding weaving as post-human explorations, to name but a few. In this context, we focus on sample making and knowledge production [10], as well as forms of collaboration in the cross section of traditional craft and emerging modes of production [2]. We find that a large part of our efforts goes to finding ways to document our samples, with inspiration from the field of textile crafts where the preservation of physical samples is a longstanding tradition [4]. We do this in the recognition that the sample always holds more information than we are cognizant of in the moment – in other words, at the point of archiving, we only understand a sample in relation to our experience of making it [11].

In this provocation, we propose that the preservation of the physical sample enables us to revisit not only the information understood at the time of documentation, but that, maybe in a parallel with forensics, we gather new insights when viewing them through a different temporal, conceptual or contextual lens. While we know this in principle, we still search for specific strategies for performing such revisits and processes, as well as vocabulary to describe the ways we already perform them. We propose diffraction as a way of understanding how we may do this, based on our experience of developing a filtering textile during the pandemic.

2 DIFFRACTION IN DIGITAL CRAFTSMANSHIP

Sample collections and archives are always in flux, new samples are added, while others go missing or decay. Their contextual knowledge might be thoroughly documented, or under-described or even lost over time. In any case, they become detached from the context in which they were made, but this loss of context is also what allows us to look at them again and see different things. How designers loop back to reconsider previous work is often simply described as "being inspired by". We propose that diffraction might be another way to describe this process of revisiting samples, and that making explicit use of this notion might enable us to read them through new contexts and different designerly speculative interpretations.

Inspired by Karen Barad [3], diffractive reading has been used in design as a way to create shared ownership between designers of the concerns located in subjective and lived experiences, without necessarily looking for a shared truth [7]. "Diffractions, such as the complex wave forms created when light is beamed through slits, are 'attuned to difference' and, specifically, the way that those differences, expressed as regions of light and dark, are produced under specific conditions of analysis" [6]. This notion of diffraction can then be used to analyze design or design practice as a way to read "the way that multiple 'different' objects and memories can intermix to reveal new approaches, ideas, and understandings" [6].

We believe that this approach may be particularly suited to the revisiting of sample archives. As outcomes of entanglements of people, machines, (digital and physical) materials, and environments, samples created through digital craftsmanship embody intra-actions between entities of the complex system in which they are created [11]. This means that a focus on samples enables us to appreciate and diffractively reinterpret them from different perspectives.

In the following, we describe a project that we have later come to see as a diffractive process. The project focused on developing a technical textile on the basis of the existing sample archive of Milou Voorwinden, an expert weaver and co-author, as an account of designing *with* [16]. We believe that this process can be seen as a sort of upside-down makers' science, which evidences a process of traveling [9]; as well as an example of how design practice might find its place inside the technical opportunities that arise between material science, traditional crafts, and industrial opportunities.

3 CASE: A FILTERING TEXTILE

In 2020, we found ourselves in the grip of what we now understand as a pandemic, and like everyone else we wondered: what can we do, how can we help? In the slow sustained urgency of the situation, a group of design graduates, students and researchers worked together with Milou Voorwinden to develop a washable mask that would be able to filter viral particles effectively. We had an intuition that we could apply our material knowledge to create 3D multi-layered woven materials that could function as filters. The idea had its origin in our encounters with Milou's sample archive, as documented by the snippets of our conversations in the following.

"I saw your samples and they reminded me of things that had certain capacities. They reminded me of something that might filter, even if they were not made for that."

Part of the weavers' archive took the form of boxes filled with samples filed in harmonica plastic pockets, while other samples were selected and packed in bags ready to be considered for a new project. Each sample had a small paper label attached with enough information to be able to recall material, loom, and context.

"In every project that I do, I create new samples. So they are made for a specific purpose or I'm looking to achieve something in that project. But I think the goal of the archive is also being able to make new associations based on those samples."

Filtration is a somewhat mysterious property, it is not straightforward to filter particles and still allow air to flow through. Non-woven disposable medical masks work by making use of a layer

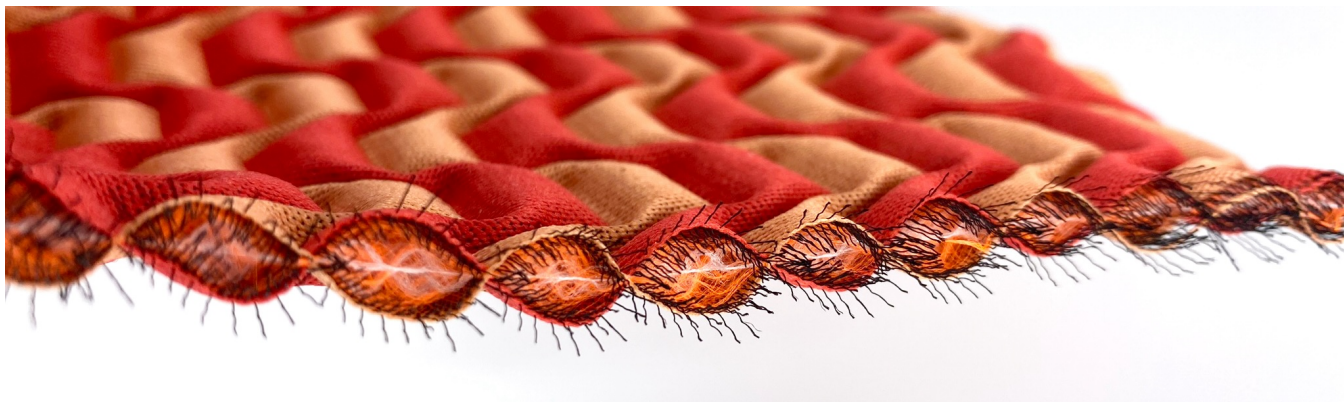


Figure 2: The double weave structure in combination with the irregular patterns were a breakthrough, showing that it is possible to have good filtration in a mask that has good breathability.

of melt-blown polypropylene, which has electrostatic properties boosting the filtration efficiency [18]. A thin layer of plastic is sprayed onto a paper mask, and it filters the viral particles with the use of static attraction. When such masks are washed, they lose their static charge and no longer filter effectively. Our project was born from a desire for a washable mask, and the imagination that complex woven structures might in fact work as filters.

To start the process, we went through the archive and selected samples that simply looked like filters to us. In other words, we used a kind of abductive reasoning along the lines of: "If it looks like a duck, and swims like a duck, it probably is a duck." This kind of inference can of course result in fundamental errors and to counteract this, we felt an urgent need to test our assumptions. To do this, the TU/e Darcy lab helped us construct a test rig, in collaboration with the /d.search lab. The resulting test equipment became the second main component of our process, and we started selecting existing samples as the basis for new woven samples, testing them and selecting new candidates to be combined in new rounds of weaving. The process of working in batches of samples (Fig. 1) combined with testing, allowed us to work through an intuitive makers' science and still arrive at measurable results.

"I think what we do is a kind of a science, but it's a strange intuitive science that maybe isn't the way we normally describe things."

In practice, it took a long time to move from initial hunch to measurable effect. Our first results were terrible, nothing worked, and we had to abandon almost all of our technical assumptions, leaving us with ONLY our designerly intuition as guideline and driver. Eventually, we arrived at a double weave design (Fig. 2) with elastomeric yarn, in combination with irregular patterns and filling yarn, and finally the samples began to show potential.

To our relief and delight, the final batch (Fig 1, on the right) generated samples that filter as well as a disposable paper mask (74% of particles with a diameter of 3 micrometer) with a breathability value of 30 Pa/cm². In retrospect, the double weave structure in combination with the irregular patterns were a breakthrough, and we are now able to produce a multi-layered woven structure that filters to the level of disposable polypropylene masks. Strangely,

the fabric performs better when washed. We speculate that this is due to the shrinkage of the filler yarn, and that the rotation of the washing machine might be aligning the fibers. But we do not really know whether this is technically true.

It is worth noting that we worked on this project in a chaotic and changeable time, and as we went in and out of lockdowns, the science on airborne infections developed around us. A crisis is in its nature unpredictable, and ironically our breakthrough happened just as the interest in masks waned, and the pandemic was declared over, leaving us both happy with the textile and with the fact that it is not currently needed.

"The knowledge you have as a weaver, which is a combination of technical skill, experience, the physical sample itself and then the pattern, the actual instructions for the loom and the loom itself and the material, the threads, the warp and the weft. Together, there is a knowledge there that is invisible."

We set out to explore the idea that woven structures have potential for filtration, and we found that by following our design intuitions, we could arrive at functional and measurable outcomes. Through this process, we moved towards patterns that work both intuitively and actually. Over time, the testing equipment became our design companion as much as the loom, but the central design strategy can be seen to be diffractive, in the sense that we worked from a sample archive of material originally developed with no consideration of filtration, and we re-visited them through the lens of an entirely new context and urgency. With the knowledge of viral particle filtration incomplete and developing around us, we were essentially forced to perform this context shift for each batch woven. As a result, we found ourselves moving between diffractive analysis and intuitive design fabulations in it(in)erative cycles.

4 MAKING IN THE DARK

"... intra-actions enact agential cuts, which do not produce absolute separations, but rather cut together-apart (one move). Diffraction is not a set pattern, but rather an iterative (re)configuring of patterns of

differentiating-entangling. As such, there is no moving beyond, no leaving the 'old' behind. There is no absolute boundary between here-now and there-then. There is nothing that is new; there is nothing that is not new." Karen Barad [3]

Multiple worlds and kinds of knowledge are present in our samples; that is why we keep them. For each re-visit we bring new contexts, understandings and desires for different outcomes. These conditions, or lenses, can be seen as cuts to diffract the affordances and characteristics of the samples into new configurations. We propose that this relational understanding can support us in finding glimpses of insights without erasing traces of other possibilities; nor replacing designs with theory.

As designers, we often focus on outcomes, whose mechanics we feel we understand. However, with this provocation, we suggest an alternative to this tendency to trust the measurable over other designerly ways of knowing. With the filtering project, we see a case where not-knowing why a sample worked, was good enough to move forward. This instinct for possibilities and surprising outcomes is a maker's skill, and it formed the backbone of this project together with the weaving and the testing.

Designing a woven textile depends on complex interactions between fiber, weave structures, tensions on the loom and the pattern, making it often very hard to predict the outcome of your textile [17]. The complexity of the process means that there will always be surprising aspects of a sample, but without making them you will simply never know. The outcomes may behave totally differently than expected, directing the work to proceed in entirely new directions [9]. We believe that these qualities together with the potential of diffractive re-interpretations enable us to rest within the not-knowing as well as, in Barad's terms, "re-turn as a mode of intra-acting" [3] and departing into other directions.

5 TRAVELING BACKWARDS, LOOKING AHEAD

As researchers, we make things that generate insights, all the while knowing that these things always hold more knowledge than we can see in the moment. However, we still search for vocabulary to unpack both our making and revisiting experiences. We have found that diffraction supports the understanding of possibility that lives in our archives. With this provocation, we propose that revisiting the physical things of past projects, not for evidence and historical nostalgia, but as material for looking ahead, can be enabled by processes of diffractively reading the material.

Looking back, we still do not know for sure why our final sample worked, but we do know that this knowledge is present within the sample itself. The samples in this project have joined the weaver's archive (and ours), ready for us to loop back in the future.

Traveling backwards by working from the archive gave us the opportunity to respond to an unfolding crisis through the lenses of skills, material, and looms. The urgency of the circumstances generated a kind of upside-down makers' science, in which we navigated a period of fear and hope through making in the dark. In an appropriation of our colloquial understanding of the scientific method "mess around, find out!" - we propose an addition: Mess around, find out, and re-turn.

ACKNOWLEDGMENTS

The mask project was supported by CLICKNL with grant number TKI1906-CI20013. We would like to thank Anna Merl, Iris Bekkers and Armando Rodríguez Pérez and the many other students and staff members from TU/e, By-wire, and EE Labels who worked on the project.

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