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AnimaTo: Designing a Multimorphic Textile Artefact for Performativity

Alice Buso
Industrial Design Engineering, TU Delft
Delft, the Netherlands
a.buso@tudelft.nl

Holly McQuillan
Industrial Design Engineering, TU Delft
Delft, the Netherlands
h.l.mcquillan@tudelft.nl

Kaspar Jansen
Industrial Design Engineering, TU Delft
Delft, the Netherlands
k.m.b.jansen@tudelft.nl

Elvin Karana
Industrial Design Engineering, TU Delft
Delft, the Netherlands
e.karana@tudelft.nl

ABSTRACT

Multimorphic textile-forms, obtained through simultaneous thinking of material and form that change in design and/or use time, have the potential to elicit diverse performances in the use of textile artefacts, thereby extending their relevance in our everyday lives. We present AnimaTo, a multimorphic textile artefact designed for performativity that reacts to water exposure via the shrinking and dissolving of its fibres. Adopting a material-driven design approach, we engaged in material tinkering with these qualities to achieve changes in the texture, size, and shape of AnimaTo. Following this exploration, we conducted a pilot study to gain insights into AnimaTo's temporal behaviour and performativity in use. In the further development of the artefact, we highlight the challenges that arise in producing high-fidelity prototypes. This work grants insights into how designers can tune material, form, and temporal qualities of textile artefacts towards multiplicity of use and prolonged user-textile relationships.

Authors Keywords

HCI Textiles; performativity; material-driven design; materials experience; multimorphic textile-form

CSS Concepts

• Human-centered computing~Interaction Design

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INTRODUCTION

Over the past decades, textiles have sparked the interest of many HCI researchers for their ubiquitous nature and their potential to support intuitive [13] and seamless [32] interactions with everyday artefacts (e.g., [14, 26, 30, 31]). Previous literature introduced wearable devices and garments (e.g., [2, 6, 7, 43, 49]) and developed textile interfaces (e.g., [19, 29, 45]) to ultimately augment everyday objects (e.g., [1, 8, 17]). Next to traditional textile production methods such as weaving (e.g., [19]) and knitting (e.g., [22]), researchers employed advanced technologies and materials to embed change or responsive behaviour in textiles. For example, 3d-printing [10, 12, 38] and bioactuators [52] were used to obtain a variety of textile artefacts with embedded morphing behaviour manifested through shape changes (e.g., [24, 27, 33, 41, 44]), colour changes [6, 27], and material dissolution [47]. These works provided valuable contributions to the field by shedding light on methods to manufacture morphing textiles (e.g., [18, 27, 37]) and to control their spatio-temporal behaviour [23, 46]. Yet, little is known about the role of change in morphing textiles to prolong user-artefact relationships by affording multiple actions and recurring encounters (i.e., performativity [9]).

McQuillan and Karana [25] recently highlighted the performative potential of multimorphic textile-forms (MMTF), obtained via simultaneous thinking of material and form that change in design/production and/or use time. MMTF, thanks to their multiple embedded states and the actions required to transition from one to another, can invite users to act upon textile artefacts and situate them in multiple contexts assimilated in daily practices, a concept referred to as 'multi-situated materials' by Karana et al. [15]. Here, we see an opportunity to expand on this body of work to design an everyday MMTF artefact to explore the unfolding of performativity and multi-situatedness in use time.

This pictorial offers two main contributions. First, it provides a reflective account of our material-driven design process of AnimaTo, a multimorphic textile artefact designed for performativity. Second, it sheds light on how designers can tune textile artefacts' material, form, and temporal qualities to invite users to act upon them through multiple uses, towards creative appropriations and prolonged user-artefact relationships. In the following sections, we describe our material explorations, followed by a pilot study to test the unfolding of performativity in use. Then, we describe the challenges we encountered in scaling the fabrication of AnimaTo to industrial production to produce high-fidelity prototypes.

Multimorphic Textile-Forms

McQuillan and Karana [25] introduced Multimorphic Textile-forms (MMTF) as a design approach for conformal, seamless, and sustainable textile artefacts. Expanding on Talman's [40] notion of changeable textiles, it considers textile-forms' temporality in design/production and/or use time, simultaneously across material, production, use and ecological scales. In design/production time, MMTF have the potential to reduce textile waste compared to traditional production methods and to seamlessly integrate responsive materials or technologies into textiles. In the use time, MMTF allow designers to develop textile artefacts with multiple embedded states towards several product lifespans. To do so, designers need to be able to navigate across the matter/textile/form scale, i.e., where fibre/yarn, textile structure and form are simultaneously understood and conceptualised, the production scale, i.e., the context and processes to manufacture the artefact, the use scale, i.e., where the human-textile artefact interaction takes place, at the temporal scale, i.e., how the artefact may evolve over time, affecting its overall experience, and ultimately its extension over ecological scale.

Performativity in HCI Textiles

Giaccardi and Karana [9] proposed the concept of performativity to describe the actions elicited by materials through their unique materials qualities in everyday encounters. Textiles' performativity has been explored in fashion design (e.g., [20]), textile design (e.g., [34]), architecture (e.g., [42]), interior design (e.g., [35]), conceptual (e.g., [28]) and interactive arts (e.g., [51]). In HCI textiles, interaction studies explored how natural input actions could be used to activate textile interfaces, such as stretching [48], pinching and twisting [29] or grasping and deforming [16]. Others explored the performative qualities of e-textile objects in the context of art performances and immersive environments [36, 50]. Gowrishankar et al. developed a knitted radio to establish an intuitive interface logic between the digital functions of the radio and the actions required to control them [11]. The performative textile-form interfaces by Buso et al. [4] aimed to elicit actions that can be more easily embedded in one's already established interactions with everyday textile artefacts, e.g., rolling up one's sleeves or pulling curtains.

Despite these existing accounts, limited knowledge is available to designers of multimorphic textile artefacts who want to design through the lens of performativity, in particular when a textile artefact is aimed to elicit actions for multi-situatedness [15], to enable more engaging interactions and longevity in everyday use. To bridge this gap, in the following sections, we share our material-driven design journey in designing and producing AnimaTo.

1 | *AnimaTo's multiple states: a) initial state; b-c) shrinking state, after being exposed to water; d-e) unfolding state, after being washed.*

AnimaTo

AnimaTo is a multimorphic textile artefact that responds to water. Polyvinyl Alcohol (PVA) water-soluble yarn woven within a multilayer textile-form enables fibre-yarn (and ultimately form) morphing behaviour when exposed to water. Being multimorphic, AnimaTo presents irreversible changes over time in two stages: shrinking and unfolding. In its initial state, AnimaTo is designed to resemble an ordinary tea towel (Fig. 1a). When exposed to water, the PVA yarn woven across the layers is activated and causes the towel to shrink locally (Fig. 1b-c). This is the second or shrunk state. When submerged in water for an extended period or after washing in hot water (>40°C), the PVA yarn dissolves, allowing the different layers to separate (Fig. 1d). Subsequently, in the third and last state, AnimaTo is designed to morph into a large-scale planar textile artefact by unfolding into a cloth three times as long as the original size (Fig. 1e).

We designed the initial state as a tea towel because it is an common and familiar object that people use daily, multiple times a day and for different purposes. Because of its ordinary nature and planar form, it allowed the material qualities of AnimaTo to be the focus of our investigation. After some use in its everyday context, the animated behaviour slowly emerges, inviting users to perform different actions to carry out diverse activities with the towel. We derived the name "AnimaTo" from this first function: an *anima*ted *to*wel. Then, we deliberately designed the different stages of the artefact, shrinking and unfolding, to disrupt the initial function (hence, to resemble less to a tea towel), asking its users to consider novel purposes and uses.

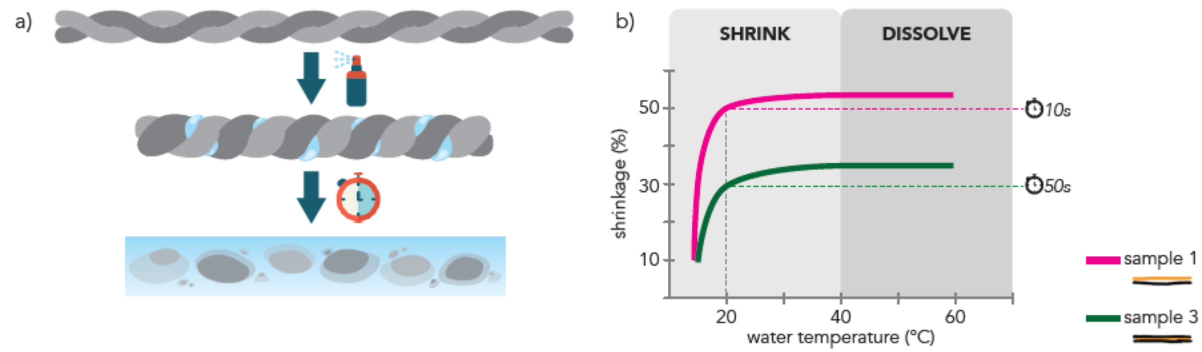
The overall design process lasted five months. We started with a material exploration of reactive yarns in woven textiles. Then, we crafted an early prototype to iterate on the animated behaviour and temporality of AnimaTo. For the second and final prototype of AnimaTo, to create an 'authentic' artefact that people could easily accept and use, we moved to industrial weaving and adapted the design to the required specifications given by industrial jacquard looms. In the following pages, we will describe the steps and challenges we encountered in designing and producing various prototypes of AnimaTo.

MATERIAL EXPLORATIONS

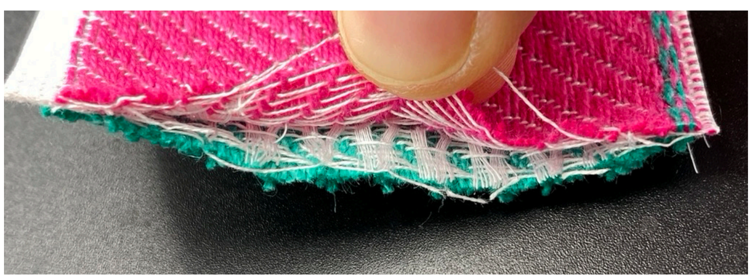
The overall design process of AnimaTo took place within a multidisciplinary team consisting of two interaction designers, a material scientist, and a textile and fashion designer. As the goal was to develop high-fidelity prototypes, the limitations of industrial looms were always a factor in our material explorations and the development of prototypes. For example, reactive yarns were always inserted in the weft direction, and we excluded techniques such as discontinued weft that would not be possible later on standard industrial looms.

Our process started with a first exploration of reactive yarns, inspired by the work of Talman [40]. On our TC2 digital jacquard loom, we sampled using Comfil, a yarn that stiffens with heat, Pemotex, a yarn that shrinks and becomes textured with heat, and Kuralon PVA, made of a water-soluble synthetic polymer that can be spun into yarns. PVA reacts to water by shrinking and ultimately dissolving. From this initial exploration, we decided to limit the number of variables to explore by selecting PVA as the reactive yarn for AnimaTo. From the very beginning, PVA attracted our attention because of its variety of possible responses through shrinking and dissolving (Fig. 2). Fig. 3 illustrates more in detail the relationship between water exposure and its shape-change. We envisioned that integrating PVA into our samples could open up the design space and provide us with multiple and, potentially, sequential morphing behaviours. Therefore, in the second phase of our material exploration, we tinkered with PVA more systematically to gain insights into the relationship between the shrinking and dissolving behaviour of fibers and morphing textile-form (Fig. 4-5).

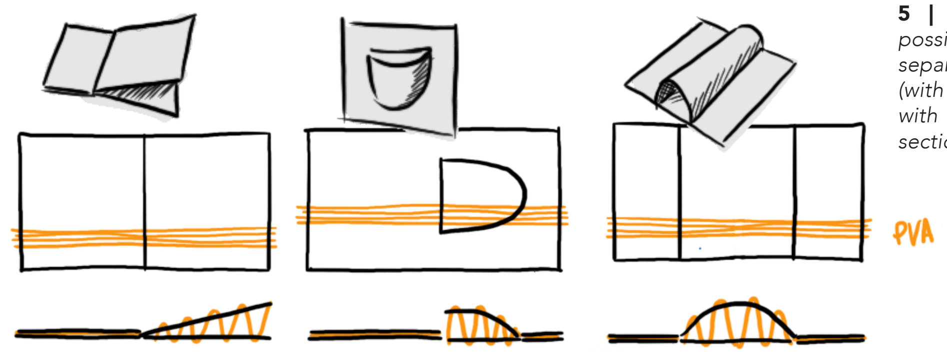
2 | *Initial samples with PVA yarn. Long floats create a 'terry cloth' effect (satin 7/5) (a). Inverting orientation of compound weaves (b). Alternating stripes of more (tabby 1x1) and less dense weave structures (satin 6/3) creates a 'crêpe' effect (c).*



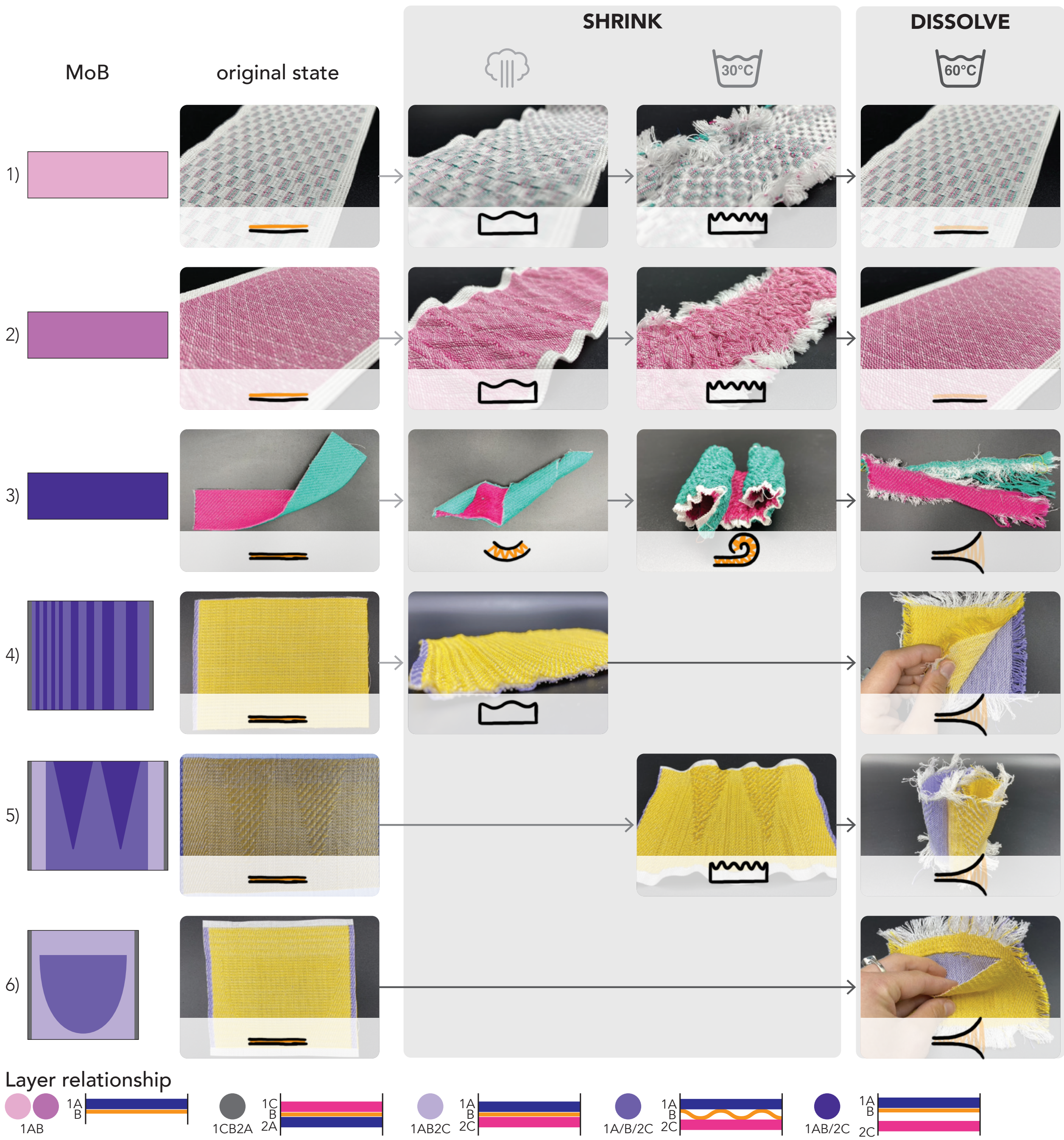
3 | *a) When the PVA yarn is exposed to water, the fibres swell and absorb H2O molecules, starting the dissolution process and resulting in a thicker but shorter yarn. When the yarn is exposed to water for a longer time, it completely dissolves. Warmer water (>40°C) speeds up this reaction. b) The placement of PVA yarn in the textile affects its reaction speed and intensity. For example, a single-layer compound woven textile (sample 1 on p. 5) sprayed with ambient-temperature water (~20°C) reacts immediately and shrinks up to 50% within 10s. Under the same conditions, a two-layer woven textile (sample 3 on p. 5) starts shrinking within 20s and shrinks to 30% within 50s. This happens because the passive yarns around the PVA hinder its ability to shrink.*



4 | *Close-up picture of a sample (sample 3 on p.5) in which the PVA is used as a "binder" weft yarn. You can see the white yarn (PVA) is keeping the pink and green layers together.*

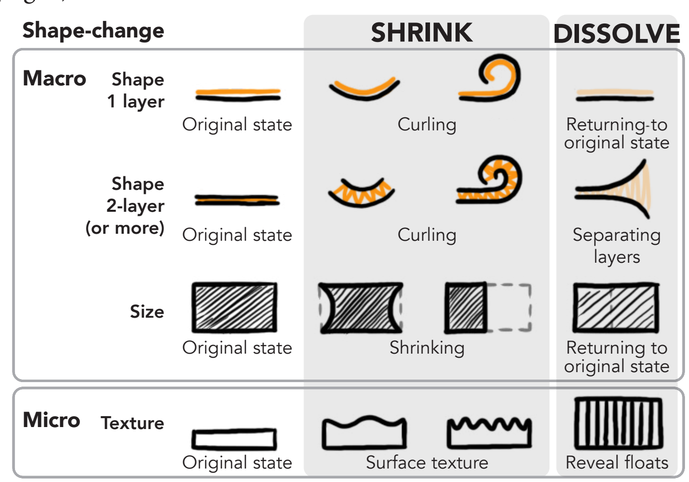


5 | *Sketching textile-form possibilities by combining separable textile sections (with PVA yarn as a binder) with some inseparable sections.*



The table on the left shows a selection of samples grouped around the shrinking and dissolving behaviour of PVA yarn (Kuralon K-II, dissolving temperature 40°C). We wove the samples on a TC2 digital jacquard loom and exposed them to water following different sequences of stimuli, such as steaming, washing at 30°C and/or washing at 60°C (see arrows). For every sample, we included the Map of Bindings (MoB) and the layer relationship [3]. We also included icons representing the most evident shape-change in each state. In samples 1 and 2, we explored the relationship between the textile structure and the morphing behaviour in single-layer textiles. Steaming caused surface patterns to appear. Washing at 30°C accentuated the existing patterns. Instead, washing at 60°C decomposed the PVA yarn, returning the sample to its original size. In samples 3 to 6, we explored double-layer textiles and textile-forms. Steaming and washing at 30°C caused the passive layers to contract, enabling changes at the textile structure (micro) level. Instead, washing at 60°C led to changes in form (macro). We also explored other manual processes to finalise the change. Flipping revealed self-supporting tubular structures (sample 5) and cutting the top layer revealed hidden pockets (sample 6) .

Below, we synthesised our findings by classifying textiles' shape-changing behaviour at the micro and macro levels that can be obtained through the shrinking and dissolving qualities of PVA yarn (Fig. 6).



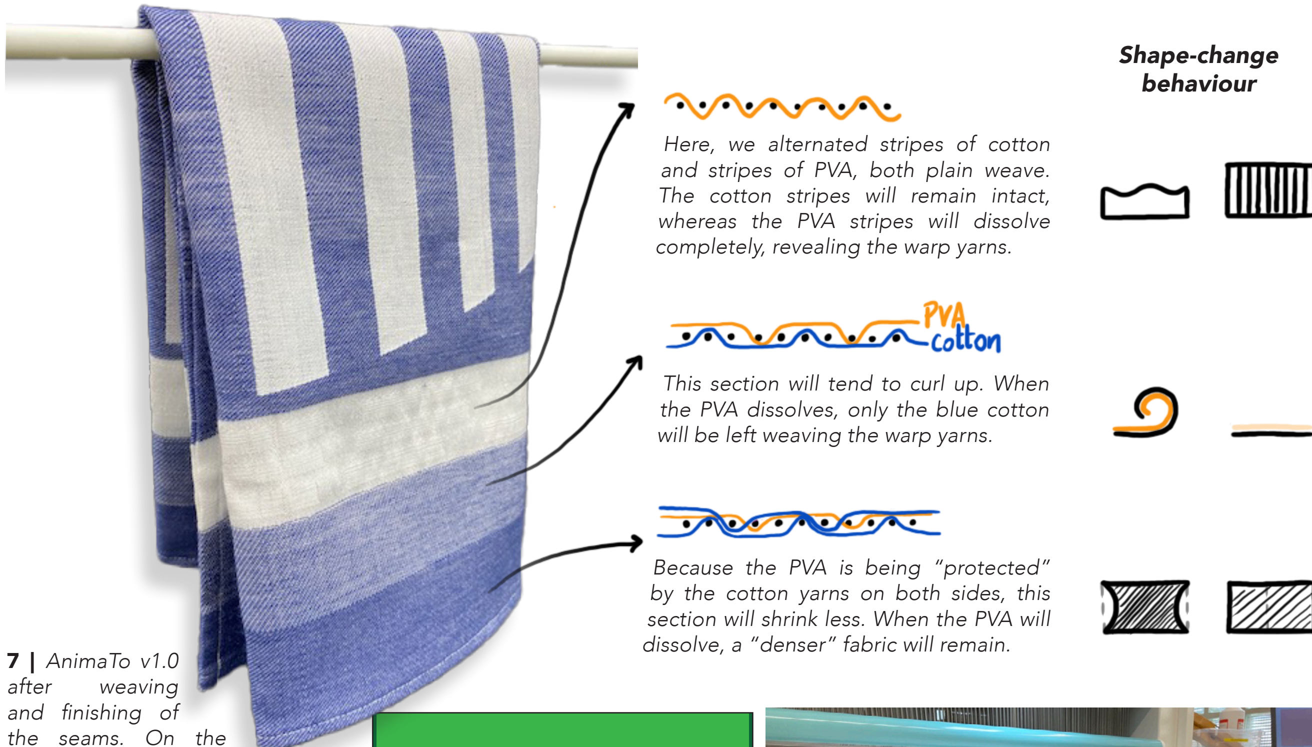
6 | *Shape-changing behaviour of PVA-embedded woven textiles.*

DESIGNING ANIMATO V1.0

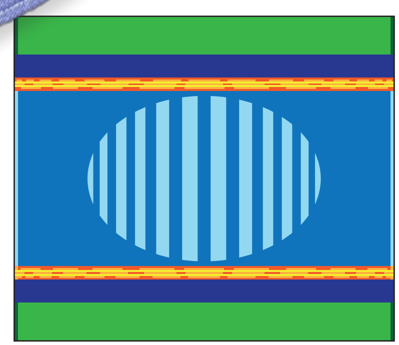
Parallel to the material exploration, we also collected pictures of towels and other domestic textile artefacts in stores and from the authors' houses to direct the design of our artefact to evoke a sense of familiarity. The aesthetic references that emerged suggested soft, warm, pastel qualities together with striped patterns.

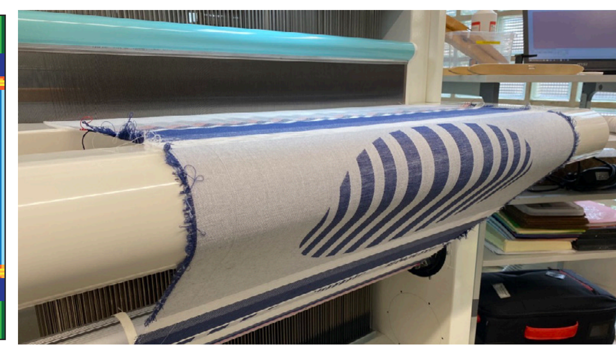
Informed by these explorations and inspired by previous examples of textile artefacts with multiple embedded stages [39], we ideated the first prototype, AnimaTo v1.0 (Fig. 7). We intended this prototype to be tested by the first author to speculate on how AnimaTo would be used "in the wild".

In this first iteration, we deliberately avoided multilayer weaving techniques to limit the number of variables and their relative responsive behaviours during use. Therefore, we designed a single-layer woven textile in which diverse weave structures react differently to water, causing heterogeneous shape-changing behaviour. Specifically, the weave structures were informed by the design space of PVA-embedded woven textiles synthesised in Fig. 6. We wove AnimaTo v1.0 on our TC2 digital jacquard loom (Fig. 8-9). Details about the specific weave structures and materials used can be found in Supplementary Materials.



7 | *AnimaTo v1.0 after weaving and finishing of the seams. On the right, the icons show the most evident expected shape-change behaviours.*





8 | *MoB of AnimaTo v1.0. Each colour represents a different weave structure.*

9 | *AnimaTo v1.0 while being woven on the TC2 loom. We inserted the PVA solely in the weft direction and avoided techniques such as discontinued weft to be able to scale the production of the towel to industrial looms.*

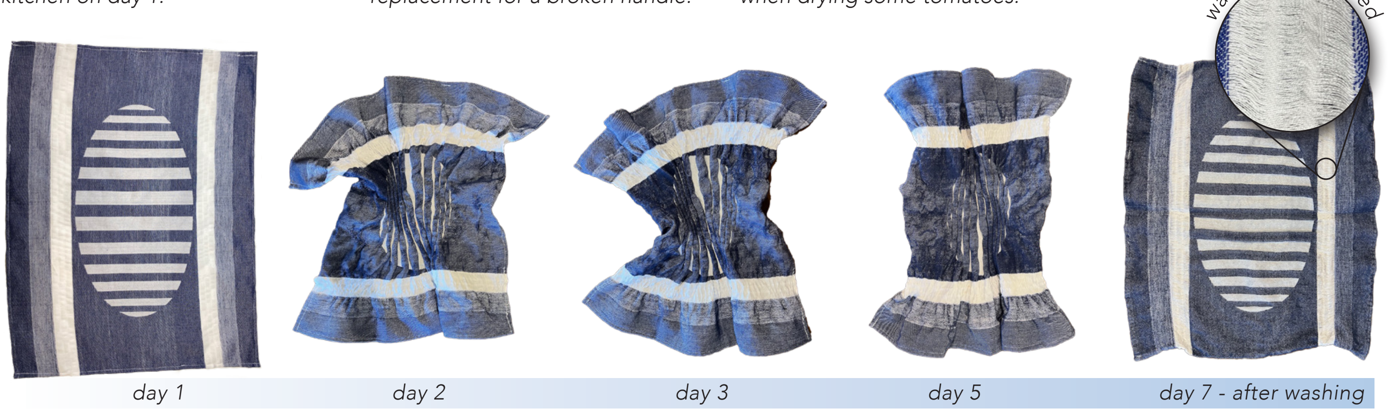
PILOT STUDY WITH ANIMATO V1.0

The first author tested AnimaTo v1.0 by living with it for a week in their parents' house, where multiple people could use the artefact. Every day, the researcher took photos, written accounts [21] and observations (Fig. 10-13). Despite the researcher's parents being aware of the goal of this pre-study, they provided useful insights into their lived experiences with AnimaTo V1.0. AnimaTo v1.0 showed the expected responsive behaviour, shrinking, from the first day of use. On day 6, the researcher washed the towel. By doing so, the PVA yarn completely dissolved, bringing the size of the towel back to its initial, non-shrunk state and revealing warp floats in some sections.

10 | *The towel hanging in the kitchen on day 1.*

11 | *The towel is used as a replacement for a broken handle.*

12 | *The towel started to shrink when drying some tomatoes.*



13 | *The more shrinkage, the stiffer the towel felt. This caused the users to move the towel from the usual hanging position, for example on chairs backrests, to lying horizontally on a stool to let it dry.*

Findings

The pilot study provided us with three main findings:

- *Anticipating what kind of actions were performed with the towel:* When the towel started to shrink, the first author's parents pulled the towel on the sides and sometimes squished it like a damp cloth while drying their hands. After washing, they held the towel against the light from the windows to see through it.
- *Informing a pool of possible experience scenarios* that could develop during use: The dissolving of the PVA brought AnimaTo v1.0 back to its initial size while still being recognisable as a tea towel. After washing, it was still used as a regular tea towel. This similarity between the initial and final states did not encourage multiple uses, limiting the exploration of performativity.
- *Understanding the temporal qualities of AnimaTo:* The transition from the initial to the active (shrunk) state was too sudden. On day 3, the towel already reached the maximum shrinking level, and the changes until the washing day were barely noticeable.

Next, we will illustrate how we addressed these challenges by conceptualising a multimorphic textile artefact.

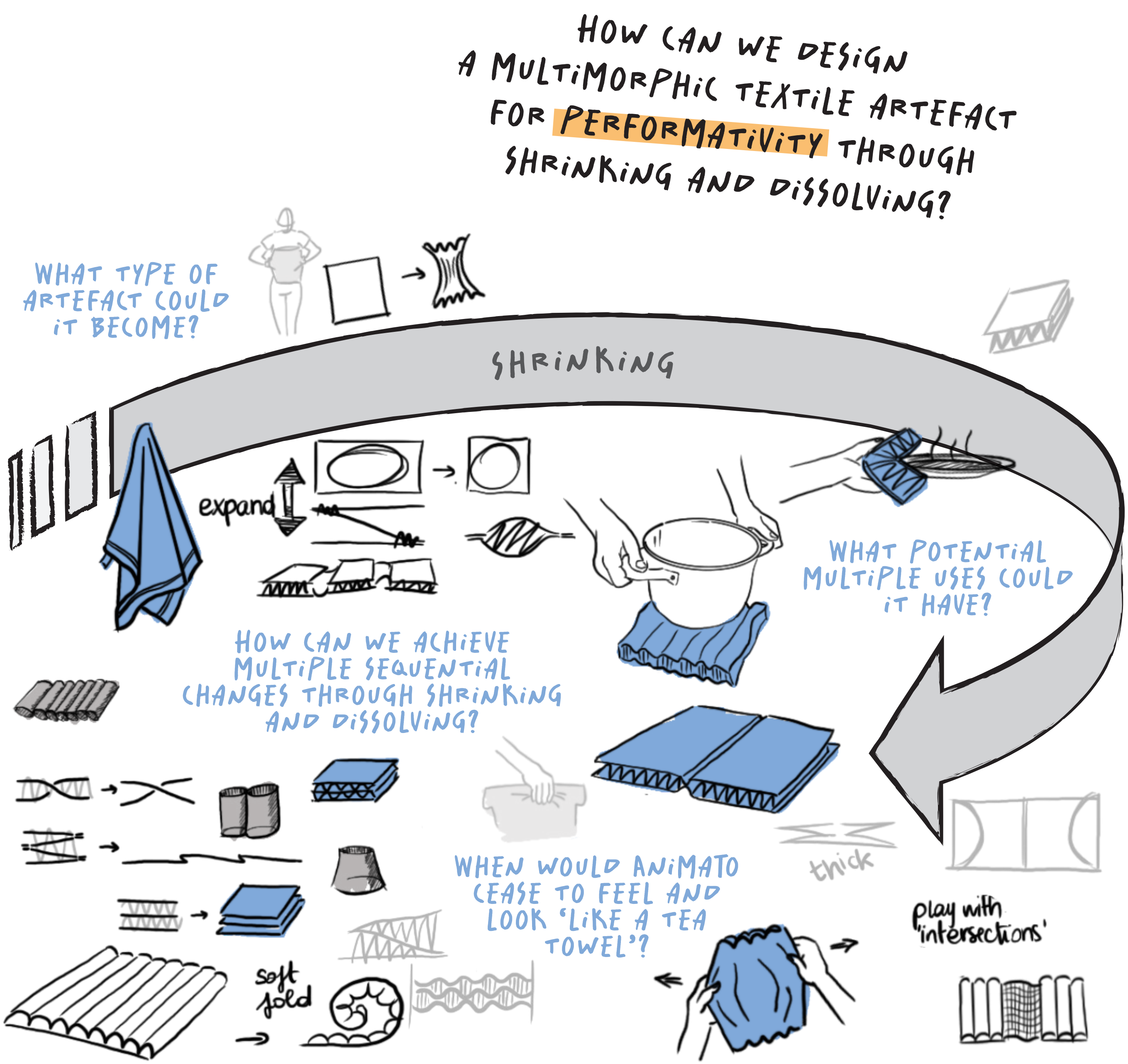
Following the pilot study, we developed the following design assignment for AnimaTo v2.0 for the research team to brainstorm how to design a multi-situated textile artefact.

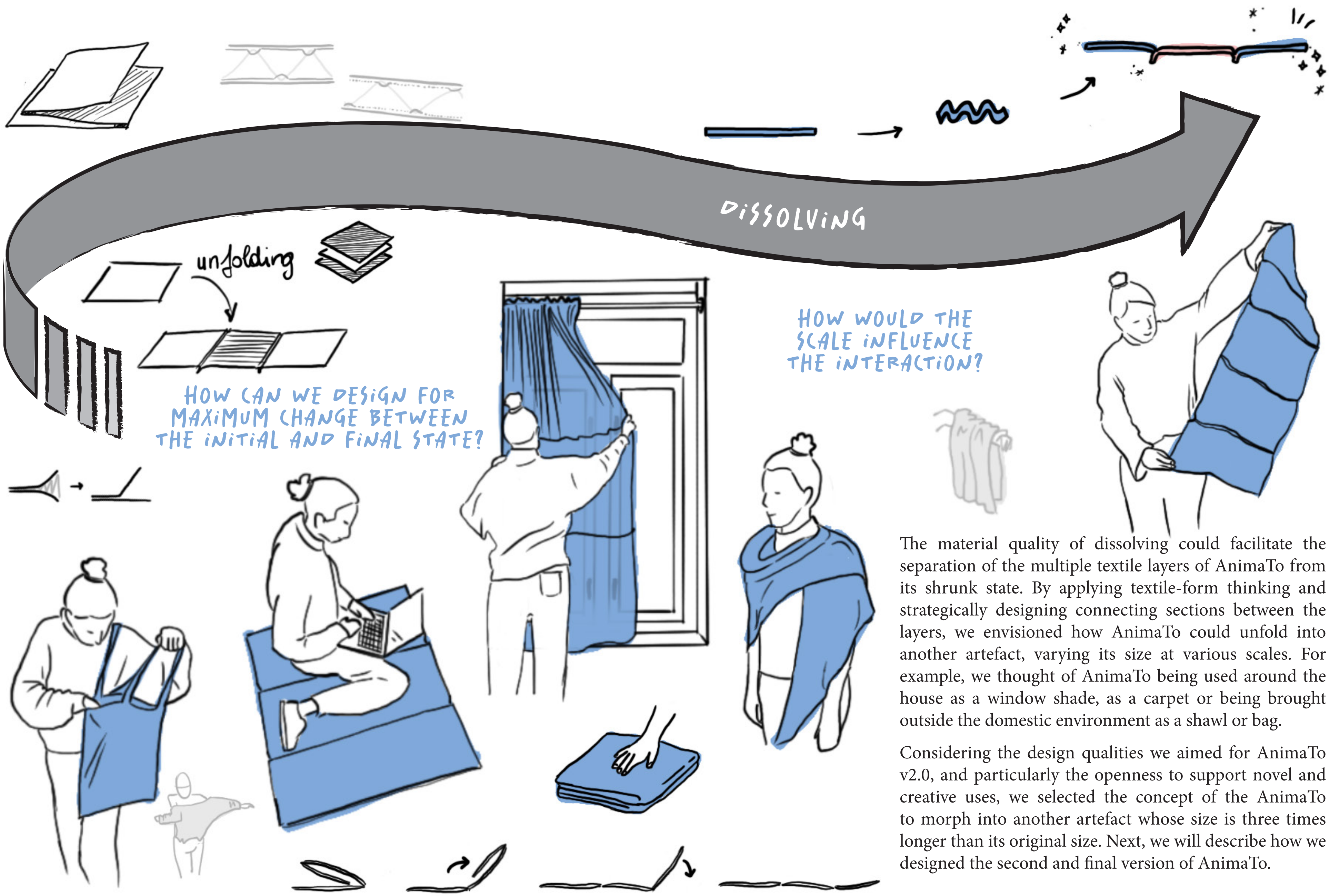
AnimaTo should:

- » *display slow and incremental changes from the initial to the active state that could surface over time during use (e.g., approximately a two-week timespan);*
- » *demonstrate a radical change between the initial and final state through shrinking and dissolving, preferably not going back to its original state;*
- » *transform into another open-ended artefact in its final state to invite creative uses.*

In this further design iteration of AnimaTo, we focused on the material qualities, i.e., shrinking and dissolving, envisioning it in use in different contexts and at different scales. Iteratively, we asked ourselves a series of questions (**highlighted in this colour**).

We reflected on which morphing behaviour we could achieve by combining the material quality of shrinking with multiple layers of textiles bound together by the PVA yarn. While shrinking, AnimaTo's texture would turn from smooth to furry and rough. Moreover, the shortening of the width would cause an expansion in volume. For example, we speculated that the increased thickness and stiffness of AnimaTo in the shrinking state could encourage users to use it to grab hot objects or protect hot surfaces.





The material quality of dissolving could facilitate the separation of the multiple textile layers of AnimaTo from its shrunk state. By applying textile-form thinking and strategically designing connecting sections between the layers, we envisioned how AnimaTo could unfold into another artefact, varying its size at various scales. For example, we thought of AnimaTo being used around the house as a window shade, as a carpet or being brought outside the domestic environment as a shawl or bag.

Considering the design qualities we aimed for AnimaTo v2.0, and particularly the openness to support novel and creative uses, we selected the concept of the AnimaTo to morph into another artefact whose size is three times longer than its original size. Next, we will describe how we designed the second and final version of AnimaTo.

DESIGNING ANIMATO V2.0

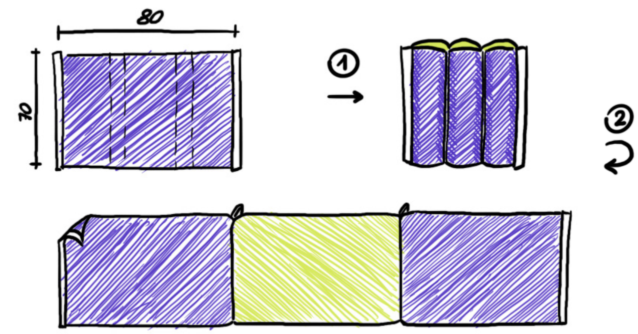
AnimaTo v2.0 (Fig. 14) consists of a three-layer woven textile in which the PVA yarn is woven as a binder yarn, and alternatively binding the middle linen layer with the cotton top and bottom layers (Fig. 15). The three layers are woven together in specific 'hinge' sections along the artefact's sides and the middle. A small hook is stitched at the top of the central hinge.

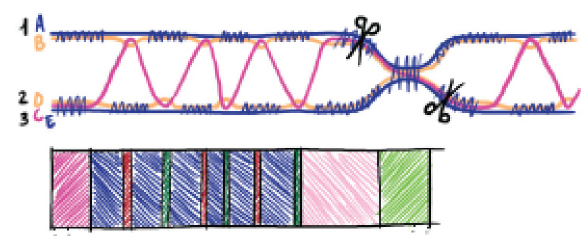
Compared to AnimaTo v1.0, this new structure allows for slower shrinking behaviour because the PVA yarn is protected by the top and bottom layers and, therefore, less exposed to direct contact with water (Fig. 16). Moreover, we designed the top and bottom layers so that the binding lines are almost unperceivable in the initial state of AnimaTo.

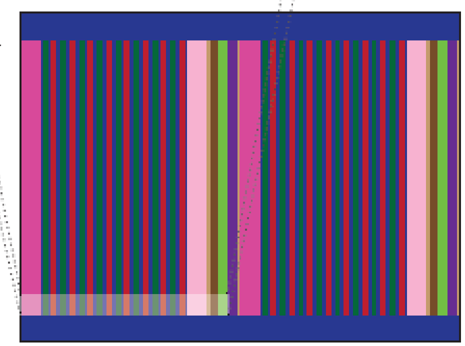
When designing AnimaTo v2.0, we had to consider the production and finishing processes that would enhance the authenticity of the tea towel and, therefore, ease the adaptation of use. Next, we will explain the challenges encountered and our key decisions to overcome them.

15 | *We sampled on our TC2 loom, looking for the optimal distance between the binding points to maximise the vertical expansion while shrinking. We also utilised long floats to let surface patterns emerge.*

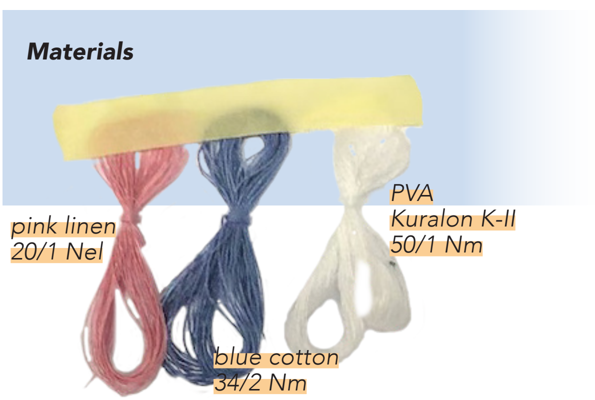
14 | *AnimaTo v2.0 after weaving on an industrial jacquard loom and finishing.*







16 | *MoB of AnimaTo v2.0 used to program the loom files. Top: enlarged view of the repeat and its cross-section view. Details on the specific weave structures can be found in Supplementary Materials.*

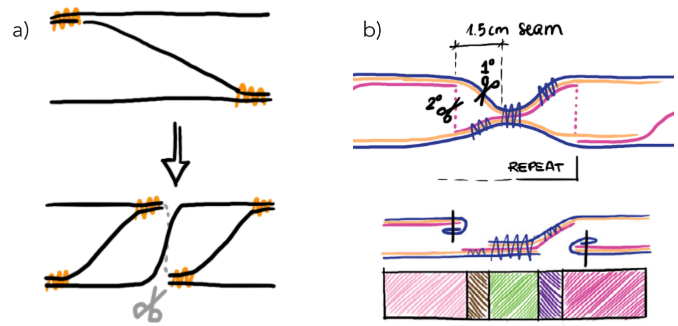


Industrial weaving

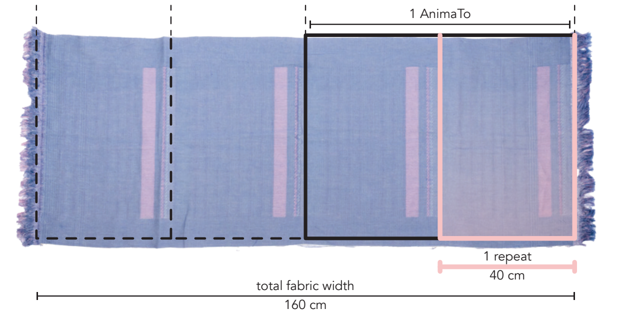
To produce multiple high-fidelity prototypes of AnimaTo, we shifted from the hand-operated TC2 loom to an industrial jacquard loom. The loom used in this project had four pattern repeats (Fig. 18-19). Because only the warp ends within the first repeat can be controlled autonomously, we adapted the initial design of AnimaTo. If we had to fit one artefact in one repeat, its final width would be too short, especially considering that it will decrease further during the shrinking stage. Therefore, we designed AnimaTo to extend over two repeats (Fig. 17). To do so, we ideated a structure that, if identically repeated twice, would still allow the wanted unfolding behaviour. We shifted the "hinge" mechanism from the side of the textile to the centre, hence to the right edge of the repeat. This way, the new central hinge was repeated four times across the total loom width, allowing us to produce two artefacts for every row of weaving. Only a small section of fabric on the right side of every artefact needed to be cut off.

Finishing

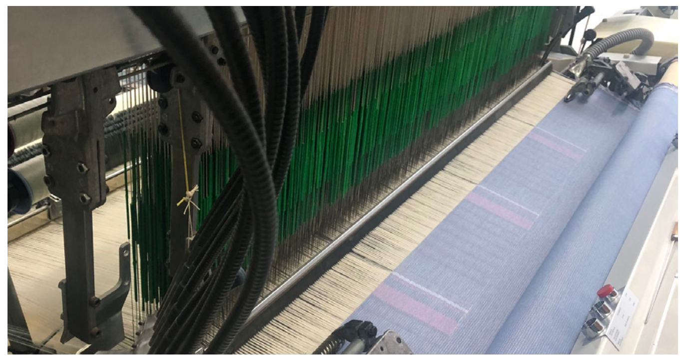
We intended AnimaTo to look like a finished textile artefact both in its shrunk and unfolded states. This requirement added an extra level of complexity to the design of AnimaTo v2.0. We identified two types of seams: the dissolving and not dissolving seams. We used a machine sewable PVA thread (Madera Wash Away) to sew the seams that would need to dissolve, allowing the unfolding behaviour during washing. Instead, we used white cotton thread for the seams that would need to last until the unfolded state. A strict construction sequence had to be followed in this phase to ensure the correct unfolding of the artefact (Fig. 20-21). For example, along the outer edges, we first stitched each layer with cotton thread, then stitched them together with PVA yarn to give the artefact a finished look. Because both the PVA and cotton thread are white, the difference between them is unnoticeable. In this way, the initial state the user is presented with would look like a regular tea towel (Fig. 22).



17 | *a) Initial design of the unfolding hinge (top) and final design with the hinge moved in the centre of the artefact (bottom). b) Detailed sketch of the new hinge design, including seam allowance to finish it.*

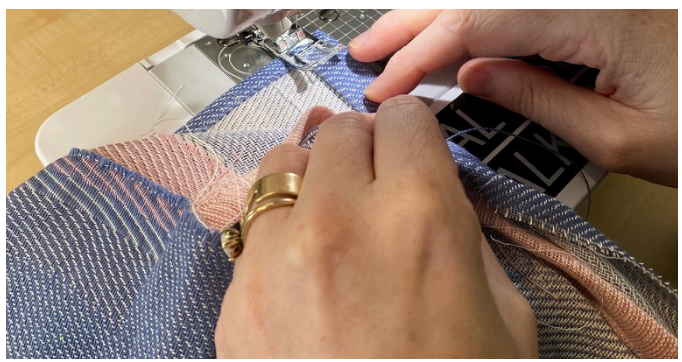


18 | *Section of the fabric in loom state, extending over four repeats. The final artefact resulted in a piece of textile of approximately 80cm x 70cm (before finishing).*

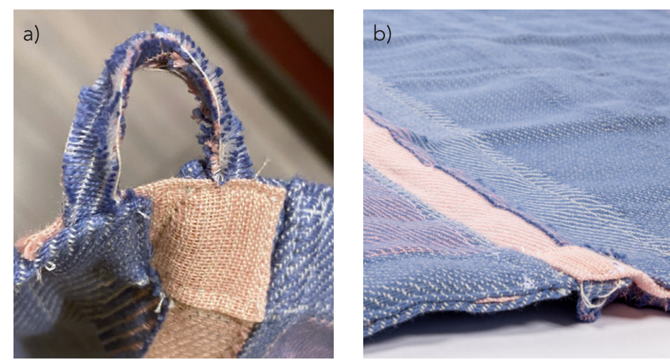


19 | *Industrial jacquard loom weaving AnimaTo. The four pattern repeats can be identified by vertical lines with different colors.*

20 | *a) Extracting one AnimaTo from the fabric roll. b) Cutting the top and middle layers in the middle of AnimaTo to release the hinge.*



21 | *Machine sewing the single layers seams with cotton thread. Later we stitched all the layers together with PVA thread.*



22 | *a) We added a hook on one edge AnimaTo by reusing the leftovers of the fabric. b) Detailed view of the central hinge after sewing.*

REFLECTIONS AND FUTURE WORKS

AnimaTo is part of a research project exploring the unfolding of performativity in textiles in everyday use. Through a longitudinal study, we aim to investigate the lived-with experiences with AnimaTo. Specifically, we are interested in understanding how the multiple changes of AnimaTo might affect these experiences and enable creative uses. During the writing process for this paper, 8 artefacts are deployed in 8 households (Fig. 23). Even though the project is not yet concluded, we can report that AnimaTo successfully displays the expected morphing behaviour and can open up new interaction opportunities (publication in preparation). Next, we conclude our discourse with some final reflections and implications for the textile-oriented HCI and design research community.

This work presents a first attempt at designing a textile-form artefact for performativity to support open-ended interactions and use in multiple contexts in daily life, with particular attention to its material qualities (i.e., multi-situated material [15]). Our material-driven design process was steered by two specific qualities of PVA yarn: shrinking and dissolving. We call the textile embedded with PVA a 'multi-situated material' because the changes to the material qualities ultimately elicit certain actions when the textile artefact is used. We invite designers to explore other material qualities which were not selected during our exploration, e.g., the stiffening of the textile once the PVA is wetted and dried, or the colour changing due to the local shrinking and stiffening behaviour. The shrinking and dissolving material qualities of PVA cause irreversible changes due to the chemical reaction of PVA in contact with water, and that cannot be reversed. Instead, designers could explore those material qualities that lead to reversible morphing behaviour (e.g., hygromorphicity in natural fibres such as wool or linen) in order to open up to novel experiences through recurring encounters or over multiple cycles, thereby prolonging the relevance of the artefact whose multi-situated material is made of.

AnimaTo serves as a practical example of how textile-form thinking, which is intrinsically a material-driven approach, can support the design of a multi-situated artefact. In our process, we had to span across multiple levels and scales of textile systems, as indicated by McQuillan and Karana [25]. At the matter/textile scale, we carried out our material explorations and sampling process to understand the qualities of the material at hand. At the form scale, we considered how these material qualities unfold and impact performativity as the material changes shape and size. At the production scale, we adapted the initial design of AnimaTo v1.0 when shifting from sampling on a hand-operated loom to producing on an industrial loom, and we developed a strategy for finishing the seams while still allowing the unfolding behaviour. At the use scale, we developed an artefact that would look like an ordinary textile artefact to ease its adaptation of use and guarantee a smooth field deployment. At the temporality scale, we explored the relationship between AnimaTo's material qualities and its morphing behaviour over time in the lab through experiments and in the use time through a pilot study. Lastly, at the ecological scale, we developed AnimaTo to explore how performativity could lead towards longer artefacts' lifespans. Therefore, this work urges designers to question traditional ways of designing textile artefacts. We suggest considering textiles' ability to deliver "complex enduring narrative experiences" ([5], p.141) when designed through the lens of performativity, exploring this realm by questioning how their textile artefacts could serve multiple purposes through, for example, adaptability and transformability.

When designing multi-situated artefacts, designers should take into account the different states the artefact could transform into and the time required to complete the change from one state to another. While changes that are too slow to be perceived by humans could fail to attract users' interests, changes that are too fast might use up all of the "change potential". Moreover, designers should consider when this change is perceived as a transformation into another artefact and if it aligns with the intended materials experience of the initial state. Therefore, we invite designers to simultaneously reflect on the nature of such changes in the short term (e.g., the speed of change, reversibility, and perceivability) and over more extended temporal frames, across-life, and end-of-life scenarios.

In this work, we delineated our material-driven design process in the making of AnimaTo, a multimorphic textile artefact designed to explore performativity over long-term use. We carried out material explorations followed by an auto-ethnography study to test the first prototype of the artefact, AnimaTo v1.0. We described the benefits of leveraging specific material qualities of a multi-situated material, i.e., shrinking and dissolving, to design for multiple purposes and open-ended interactions. Lastly, we conceptualised and produced a small series of AnimaTo v2.0, an artefact that shrinks and unfolds into a longer cloth without a predetermined function. By doing so, we also described how we overcame the increased complexity of designing a multimorphic textile artefact to be industrially manufactured and finished to ensure authenticity and robustness during use. Ultimately, this work grants insights into how designers can tune material (textile), form, and temporal qualities of textile artefacts across scales towards multiplicity of use, recurring encounters and extended user-artefact relationships.

23 | *AnimaTo ready to be delivered to the longitudinal study participants.*

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