LAXX: An Interactive Material From Tense to Relaxed

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ABSTRACT

This pictorial describes the iterative material driven design process of LAXX, a new material in the field of Interactive Materiality. LAXX is a material that combines sonic and haptic visuality. Through environmental sound and noise of the interacting user the material can reach a spectrum between tense and relaxed states. In the pictorial different explorations are visualized and discussed in the visual design process. Different materials used in the process are categorized in material mapping. This is followed by the synthesis and peer feedback through affinity diagramming, which is finally integrated in the detailing phase. This results in a material with its own behavior that cramps up when the environment gets too loud and needs to be soothed by the user to relax. Finally possible improvements are explored in the discussion.

AUTHORS KEYWORDS

Interactive Materiality; Shape Change; Interaction Design; Haptic Visuality; Tangible Interaction; Material Behaviour.

INTRODUCTION

The ability to merge small electronics with materials opens up the possibility to create intelligent and interactive materials. No longer are we designing the materials *for* the computer, but instead *with* the computer [11]. Materials cannot only be used as they are, but they can be designed in terms of interactive and intelligent qualities [9, 11]. This means that these interactive materials can be used to transfer information in forms of inherent feedback and feedforward by changing these qualities dynamically [14]. They can also be designed to create an aesthet-

Fig 2. Touch as input and output modalities

ic experience, conveyed by the material's behaviour [7] and our perception, stretching beyond reasoning [8]. The dynamic, programmable material qualities is what can be described as Interactive Materiality. It's not a material with static properties, nor is it an interactive product. This contrasts with Stienstra, et al.'s notion of interactive materiality [9], as they apply these qualities on an (interactive) product level, rather than a material level.

Conveying a product's behaviour by manipulating "inherent" material qualities like shape and texture could make it easier for a user to create a conceptual model of the product and thus build and test expectations. One could argue that these qualities are in fact augmented, but because the computer, its sensors and actuators become part of the material, and these qualities appeal to our perceptual-motor skills, it is regarded as an inherent property [9].

We designed an interactive material that conveys a transformation in behaviour from tense under the exposure of noisy environments to relaxed in quiet environments (similar to RolyPoly [3]). Besides just providing output, interactive materiality also consist of the quality to function as an input device (see fig. 2). By gently stroking the (tense) material, it opens up and conveys relaxation. The transformation towards tense is indirectly controlled by the user and the environment [6] to give it a sense of having its own behaviour. The response upon gentle touch strengthens this idea, and gives the user direct control [6] over a seemingly self-aware material. Vallgårda calls this response to human presence a computational composite [11].

By combining perceptive abilities of different senses, we played with sensorial incongruity. E.g. the material looks soft but feels rough (fig. 1.1 - 1.3). While this could have potential in some areas of design, regarding interaction design, the idea to intentionally confuse our senses is disputable. For example, the frogger framework of Wensveen, et al. argues for coupling action and function in order to achieve intuitive interaction [14]. Leaving some of these couplings away could result in ambiguity, and when done carefully, evoke creativity [13]. However, deliberately creating confusion has no benefit in the creation of interaction, unless it's purely artistic. This is in line with Ross and Wensveen's notion of practical value in aesthetic interaction [7].

Touch, being the only reciprocal sense [2] allows for more depth in terms of information transfer and behaviour as well as more interesting and aesthetic interactions. It goes beyond the haptic visuality described by Marks [5], although I do think interactive materiality should build their haptics on their haptic visuality.

By building on the haptic visuality, a material can achieve unity in aesthetic looks and feeling, and context of use (soft warm blanket for sitting cosy on the couch), making it more intuitive to use. This is in contrast to the commonly used interactive "material" of touch screens (and other touch sensitive surfaces), which lack clear haptic -and inherent or functional cues (feedforward [14]). The material itself (a touch sensitive glass plate) is disconnected from the context of use and is unable to communicate a haptic or aesthetic experience. The only action-perception coupling is present in augmented (graphical) feedback. And while this therefore does not comply with my earlier mentioned definition of interactive materiality, as it is not an interactive material, but instead an interactive product, it is a reminder that we need to be aware that flexibility and dynamics of material qualities comes at the cost of inherent feedforward.

Commercial developments regarding this interaction style is unfortunately not towards more meaningful interaction styles, but rather takes a purely technological perspective in the development of flexible displays (e.g. foldable phones and bendable TVs), which could enable more interesting interactive materials by changing shape (e.g. ReFlex [6]), and thereby recover a meaningful link between action and function.

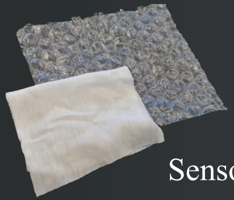


fig.1. 1

Sensorial Incongruity

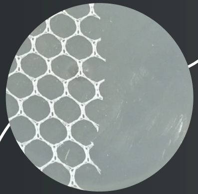


fig. 1.2

Texture transitions

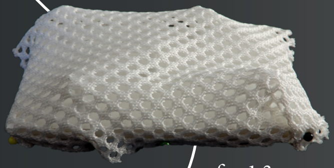


fig. 1.3

Shape Transitions through Texture Change

fig. 1.4

VISUAL DESIGN PROCESS

To structure this project, the Material Driven Design process was used as guide. This process consists of 4 steps, starting with understanding the material [4].

Understanding and exploring the material

Through material mapping and sketching [2], we explored haptic experiences and technical characteristics of different materials. Texture drew our attention, for it is perceivable through touch, as well as vision and even sound (e.g. rubbing).

Fig 3. First iteration outcomes of the workshop

During these first iterations the inherent material properties of certain materials are explored. Mainly by altering a material through design principles like changes in structure, texture, weight and construction. This was done by techniques like cutting, folding and sewing (fig. 3). Ultimately different transitions were connected to the material's behavior.

We started combining different structures like the silicone and mesh (fig. 1.2). The rough and smooth inherent material qualities combined can create a surprising effect when touched.

Fig 4. Paper sewn together with fabric

Another rough and smooth combination that interested us was paper and fabric. Sewing them together and pulling the sewing yarn together created an unexpected bumpy texture (fig. 4). Reflecting back upon this process we can see that we like the surprising effects that came with certain transitions.

With all these materials we noticed that the following transition piqued our interest; soft to hard, weak to strong, fluffy to rough & smooth to rough. An inspiration for these transitions is having goosebumps while cold. Rubbing over your skin will warm it up and make the bumps, i.e. the texture, disappear. Another relation to goosebumps is in the subtle manner of change. The change of texture is only perceivable through gentle touching. Especially in later explorations, these subtleties come forth more.

Texture Change through Stability

fig. 1.5

fig. 1.6

Movement Tense to Relaxed

fig. 1.7

Flexible Silicone Shape Iteration

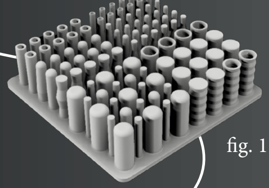


fig. 1.8

fig. 1.9

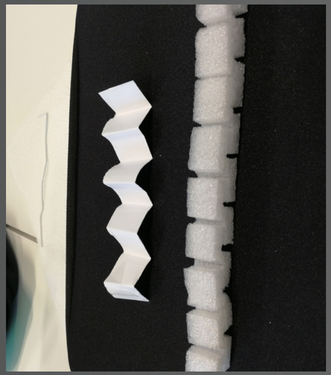


Fig 5. Foam and paper with cuts and folds

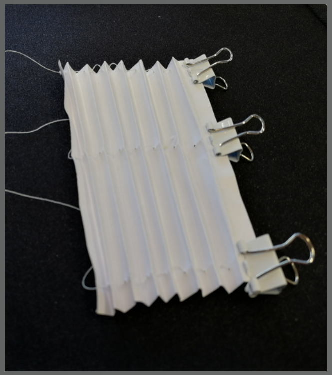


Fig 6. Folded paper with strings to create movement

The previous mentioned materials were mainly soft materials that we tried to make rough by altering its behavior through an additional material. In the end of the workshop we worked with only one material to see if we could change its behavior through cuts and folds (fig. 5 - 7). We created a more fine grained transition from bumpy to flat using strings to move the material (fig. 6).

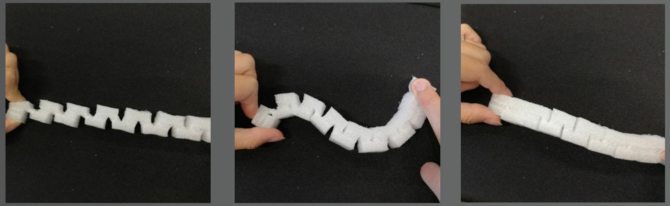


Fig 7. Three different movements of foam with cuts (bended, pushed, pulled)

With foam we noticed that pushing a material convex and concave results in different open and closed structures that feel rough or smooth depending on if they are closed or open (fig. 7). This either gives a satisfying feel or uncomfortable sensorial emotion. This was an inspirational source, which we wanted to explore further in the following iterations.

The focus of these transitions during the first workshop was on the texture of the material. Ultimately we chose for the transition Rough to Smooth, although each of the above mentioned transitions could result in a similar visual experience. We chose to accomplish this transition with silicone. We opted for silicone since the sensorial experience of the materials showed us that silicone is a very diverse material. It can stretch and bend in many directions as well as collapse for a more tense feel. The 3D printed mold (fig. 1.9) was created as a tool to test this transition by creating different shape textures (fig. 1.8) such as done with the origami shapes (fig. 1.5 and 1.6). When the mold was ready, the silicone was poured into it.

After choosing silicone as our material we had the design principles of structure and direction in mind to create our rough to smooth transition. When the pillars bend inwards they move closer together and feel more tense. After having thought of this material, we wanted to test it out to sense the actual material experience. Since the process of pouring and drying silicone takes a while, we used foam cutouts and folded paper as a way to imitate the desired silicone model as can be seen in figures 1.5, 1.6 and 8 - 11.

Organic Latex dipping


fig. 1.10


fig. 1.11

Filaflex 3D printing

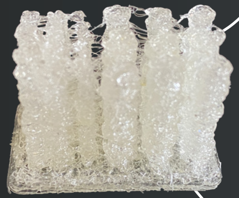


fig. 1.12


fig. 1.13

Organic structure of Filaflex

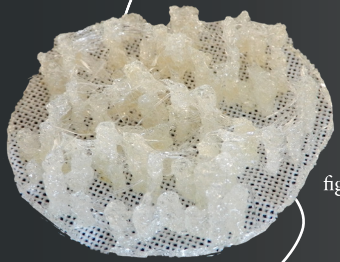


fig. 1.14

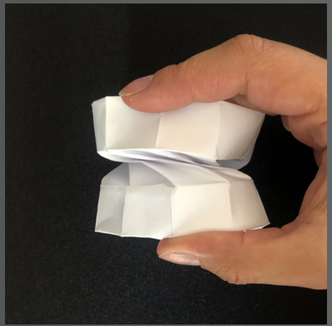


Fig 8. Folded paper to test tense state

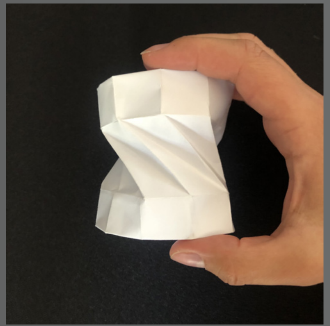


Fig 9. Folded paper to test relaxed state


Fig 10. Foam with cuts to test tense state


Fig 11. Foam with cuts to test relaxed state

Reflecting back upon this iteration, the realisation was made that the size and the material itself do not communicate the transition properly due to scale. The samples were too big in order to measure the interaction that we were aiming for, with the touch of a finger. From a critical point of view, the interaction was not subtle enough, since the only way you could interact with it was the touch of your whole palm.

We realized the transition we were designing was in fact from tense to relaxed, rather than rough to smooth. Silicone can open up and bend in many directions, conveying a relaxed state, as well as collapse for a more tense feel due to higher density of cones. We saw an opportunity to give a natural behaviour to the material, similar to cramping up (tense) when you get cold (goosebumps) and opening up when warm (relaxed). We believe this adds depth to the interaction, rather than having a meaningless material response to actions.

In the process of creating the flexible material with cones, several problems occurred during the exploration with different materials and manufacturing techniques. Some of these were due to limitations of the techniques or materials, but some also due to lack of knowledge or experience. This resonates with Qamar, Groh, Holman & Roudaut who illustrate the knowledge gap between material scientists and designers [15]. Some of these issues could've been prevented or solved by consulting experts or using specialized tools, though the latter is only scarcely available. Eventually, an expert was consulted to use a (very expensive) 3D printer to create the flexible material.

The silicone's mixing proportions were hard to get right in our small volume and the model sucked vacuum inside the cast (fig. 1.9).

Filaflex 3D printing on Kirigami structures


fig. 1.15

Flexible lasercutting patterns


fig. 1.16

LAXX
material behaviour from tense to relaxed

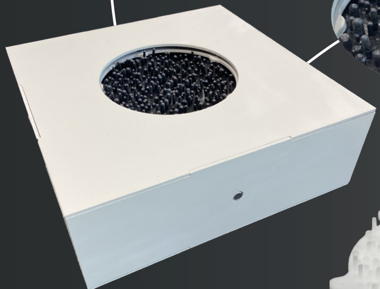


fig. 1.17

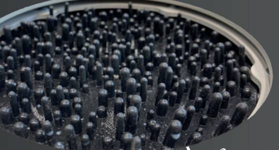


fig. 1.18

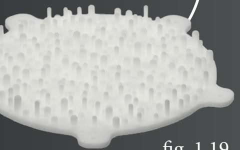


fig. 1.19

The silicone was difficult to work with and a long process, therefore the alternative of Latex was chosen since it is cheap and easy to work with (fig. 1.10 - 1.11). However Latex limits in a way too, since it needs to be exposed to oxygen to dry, and complex molds have to be created to get to a certain shape.

At the same time, the options of using a 3D printer with flexible filament were explored. However unfortunately, this did not result in the desired outcome, since it was not precise enough and created rough material properties that were too stiff to fit the relaxed state of the transition. (fig 1.12, 1.14 - 1.15).

To create a more dynamic and flexible shape, kirigami patterns were laser cut in fabric on which filaflex material was 3D printed (fig. 12). The chosen fabric however was too thin and needed too much support to move from concave to convex in an organic way.

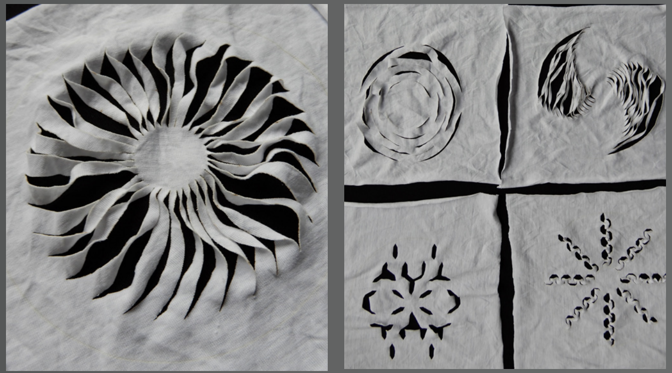


Fig 12. Laser cut fabric in Kirigami shapes

Due to all those reasons and learning objectives, the conclusion was made to opt for the more expensive and precise alternative of Objet printing (fig. 1.18).

MATERIAL MAPPING & ANALYSIS

Now that the transition has been defined as discussed in the previous paragraph, it can be translated into tangible interactions. To start with, several movements were explored that could communicate the stage from tense to relaxed. Besides the interaction, several materials were explored to find the right fit for the design.

One of the first materials that was explored after deciding on the transition was silicone (see timeline fig. 1.8 - 1.9), poured into a 3D printed mold. Multiple complications were faced throughout that exploration, which resulted in a sticky and not desired end result. So, the decision was made to explore other options such as latex and 3D printing with filaflex filament.

Various objects were dipped into the latex, where the earplugs and silicone mold (see fig. 1.10 - 1.11) were the most interesting. This because, both allowed a completely different interaction and feeling. The earplugs allowed a more squeezable interaction whereas the silicone mold a more petting and touchable interaction. But both did not look as aesthetically pleasing due to color changing of the latex.

At the same time, 3D printed samples were made with filaflex filament (fig. 1.12) to create the same bouncy effect as the silicone should have had. However, the 3D printer encountered some issues while printing, which caused it to burn (see fig. 1.13). And the cones were too precise to print which led to lots of strings which made it more sturdy than wanted.

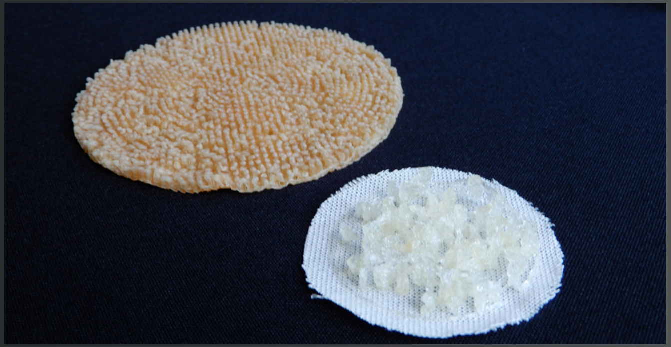


Fig 13. Result of organic structure with different heights

To conclude, the latex sample suited best with the gesture and therefore the decision was made to go for a more organic structure with different heights of cones (fig. 13). However, this is hard to realize with latex due to the drying process. That is why, another model was made to print with the filaflex material.

As briefly mentioned before, the decision was made to use the Objet printer for the final design. This because it has a high accuracy (especially in comparison to regular 3D printers) and gives the possibility to print with a material of high flexibility, which could generate the desired high flex cones, with a strong resilient base. However, there was not a lot of room for material experiments due to the printing time and price. Therefore additional features were needed to be added to the material in a later stage. This will be further explained in the detailing chapter.

SYNTHESIS

To create the desired results, multiple experiments have been done with the construction behind the interactive material.

First a low-fi test was done with cardboard and fabric (fig. 1.7). This was done to test the convex and concave movement of fabric in a box. Each side of the fabric was tied down with yarn that exited at the bottom middle of the box. This resulted in a fabric that was pulled down and bunched up in the center. The interaction of this movement however was not reversible which let us reason the thickness of the to be pulled material should be thicker. This can guide the convex and concave movement more.

In the final design, the material is controlled by a single 180 degree servo mounted underneath the 3D printed sheet and two microphones (fig. 14). It connects to the material with multiple threads. Next to these threads is the internal microphone located. This sensed vibrations in the material as a result of touch. A microphone pointing outside of the box senses the environmental noise level.

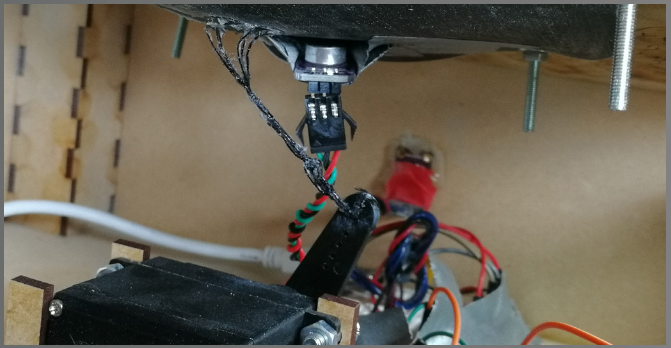


Fig 14. Inside of the box where the servo an internal microphone are attached to material

The difference between these volumes is what determines the angle of the servo, and therefore the tension in the material (down is tense, up is relaxed).

Fig 15. Material in tense and relaxed state (photos by J. van Zilt, 2020)

LAXX literally becomes tense, which can be perceived by touching it. Since the cones have moved together and the material does not bounce anymore. The internal microphone has a much lower threshold which makes it more sensible for vibration by touch.

Visually, there is only a small difference visible, similar to the subtle change of skin texture when getting goosebumps (fig. 15).

In order to create a more natural response from the servo, an easing effect is programmed. The closer the servo's angle comes to the target angle (the result of the difference from the internal and external microphone), the slower it moves (see fig. 16).

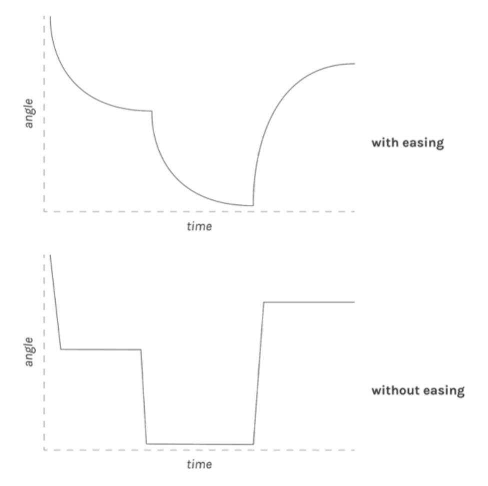


Fig 16. Graph showing the behaviour of the servo

DETAILING

Affinity diagram

Feedback of peers is mapped in an affinity diagram. Results inspired final refinements. The feedback took place in two rounds. Haptic visuality, without touching the material, and experience of the material and interaction (see appendix III for raw results).

From the first round of feedback the following categories are extracted:
1. Level of appeal, 2. observations, 3. color properties, 4. comparisons, 5. general remarks.

1. Level of appeal: The material clearly gave people the urge to touch our material and interact with it.

2. Observations: People wonder why the fabric is already bended in a resting phase and how it could even move through its stiff fabric. Due to these remarks we made the support plate more resilient to increase flexibility and upward forces of the material.

3. Color properties: the black color of the fabric creates a lot of reflections in the material which makes it very dynamic. Students relate to it as a positive bubble-like appeal, but also negatively think it makes it look more sticky for the same reason. Changing the color to white was considered, but it would mean the tactile properties of the material would change too (e.g. painting adds a more grippy top layer).

4. Comparisons: students compared our material to underwater species. One of our goals was to make the non organic material have an organic look and feel. Therefore the feedback is a good takeaway.

5. General remarks: show thought points, why do we make our box square? Why not make it bigger? Why is it not white? The answers to these questions can all be explained through our process.

From the second round of feedback, we identified four other groups: 1. Interaction, 2. Material criticism, 3. Material interest, 4. Pillar height.

1. Interaction: A lot of criticism was received regarding the interaction. It was not intense enough, the movement was too slow or too plain. We agreed with this statement since the material came out stiffer than expected. Yet another reason to modify the support plate to be more resilient.

2. Material criticism: Some peers regarded the material as too stiff and very sticky. These are all design choices making the interaction different then expected.

3. Material interest: A lot of interest was shown in the material by our peers. Even though some deemed it as stiff or sticky, others were intrigued with the material and even found it soothing. This is the natural experience we were aiming for.

4. Pillar height: We have chosen to opt for a diverse height of our pillars since it creates for a more organic structure that leads into a more dynamic interaction.

Adding resilience to flexibility

The material is mounted to a support plate underneath the top place. To compensate for the lack of resilience of the 3D printed material and thereby address critique from peers, we explored with laser cut patterns in MDF to create a resilient support plate (fig. 17 - 19).

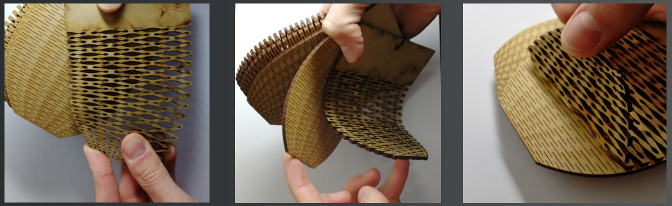


Fig 17. Flexible in two directions. Flexibility comes at the cost of strength

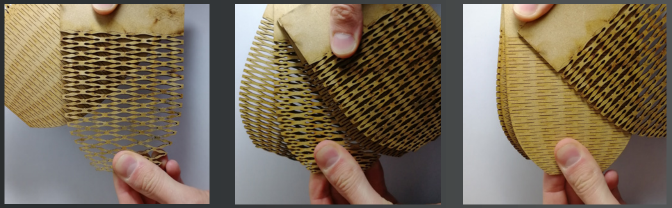


Fig 18. Stretchability, long to short and weak to strong

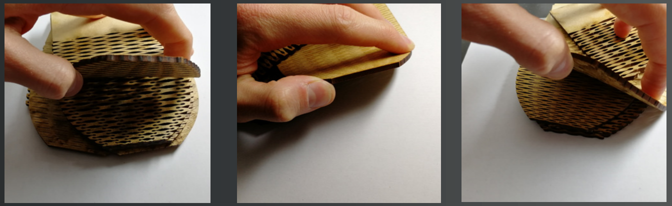


Fig 19. Bendability on a 2D curve, not, slightly, far.

The latter one was chosen (fig. 19 right), being the best balance between flexibility, resilience and strength. It also allows it to curve along with the circular shape of the 3D material for an even distribution of forces and shape.

Fig 20. Laser cut pattern in support plate

Final design

The result is a haptic and sonic material that responds to the environment and your touch, in a tense or relaxed manner (fig. 22). The material becomes organic and has its own personality, by responding 'scared' of environmental noise as it tightens, and soothed by stroking it (see fig. 1.17 - 1.19).

The interactive material shows a natural affordance since it stimulates touch. Depending on the way you interact with it, either stroke it lightly with just the fingertips, or with the entire hand (fig. 21), the material relaxes less or more. It produces different sounds by touching it in a different manner, therefore the material responds differently.

Fig 21. Showing the different possibilities to interact with the material (photos by J. van Zilt, 2020)

Striking was that the user wants to feel the movements of the material and hear the sounds it makes. In a room where sound control is of importance, this interactive material might live.

Since the prototype could only be printed in black, we decided not to change the color since it could adjust the material properties. A white model could change the haptic visuality of the material, illustrated by the sticky visual properties from peer feedback. Highlights that attract users with the black model are now shadows in the white material. In future work a white model might be interesting to work with since it offers a whole other visual experience (fig. 1.19).

Fig 22. Final design: LAXX (photo by J. van Zilt, 2020)

DISCUSSION & REFLECTION

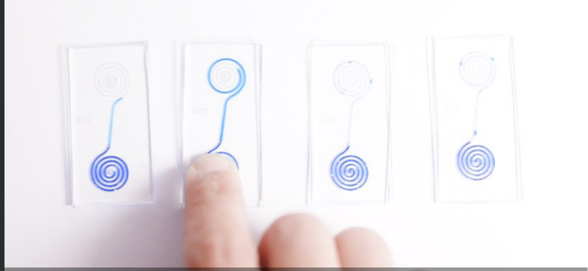


Fig 23. Venous materials [10]

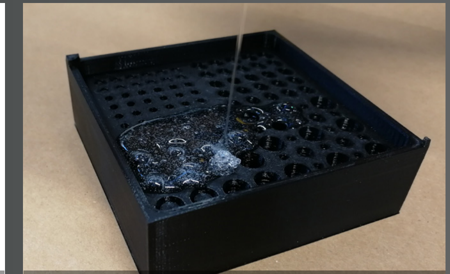


Fig 24. Air bubbles in silicone

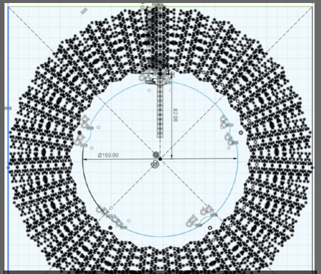


Fig 25. Flexibility pattern

During this project, we have created a computational composite [11] called LAXX by implementing behaviour into a material, making it interactive with a (predictable, once known) personality. LAXX allows for a new way of interacting; on a material level rather than mediated by explicit controls, tightening the action-perception loop.

The combination of materials used to create the haptic qualities of LAXX add additional layers related to sound and enhance the behaviour expression from tense to relaxed (bumping sound due to resilience of the pillars, squeezing sound due to grip on material, MDF support plate cracking sound due to bending, eerie pitch sound from servo). These are qualities I did not initially consider, which made me realize that, from an experience perspective, material qualities go beyond their haptics.

The interactive and dynamic qualities of LAXX are actuated by mechanical actuators. Saying that this combination is interactive materiality would imply that touch screens coupled to a speaker and vibration motor are also interactive materiality. The reason I still make a distinction between the two, is that for LAXX the material itself is altered by means of the actuator, while for the touch screen example, additional qualities are produced in terms of haptic and sound, but the glass plate does not actually change its qualities (arguably besides colour).

Not all interactive materiality includes computers and mechanical actuators. Examples of those are venous materials (fig. 23) [10], transforming pressure to patterns, and interactive tattoo ink [1]. However, these materials are more interesting to material scientists than industrial designers, as they require expert knowledge to produce, especially the latter. Qamar, et al. highlight this by mentioning a gap between different disciplines [15]. For designers to reach the potential of material science, new tools, like Feelix [12], need to be developed to help us explore and implement these technologies.

The gap between material science and design became visible in our own process, as we failed multiple times in creating the soft and flexible sensation of silicone, including silicone moulding (fig. 1.9 & 24), latex, 3D printer. Luckily, there are many tools and techniques available we can use to aid this making activity. I learned how to work with multiple of these tools during the course (including 3D printing with Objet and flexible filament, laser cutting, Kirigami, Feelix and Silicone moulding), allowing me to craft richer material and interaction qualities.

However, I still need to elaborate on my learning, as lack of experience posed new challenges. The flexible Objet print was in black and less elastic than anticipated, resulting in additional effort on making a resilient MDF support plate using patterns made with a laser cutter (fig. 25). This experience opened up new ways to make rigid materials (like MDF) flexible or resilient, and thus have access to a wider set of material qualities, not limited to haptic qualities of inherently flexible materials.

Finally, I have extended my aesthetic qualities vocabulary. Besides the ability to textually communicate subtleties in aesthetics, I have also become more aware of noticing those qualities. Though we need to be careful not to simplify aesthetic qualities to descriptions without actually perceiving them [8].

REFERENCES

1. Bruns, C. (2018, December). Could a tattoo help you stay healthy? TED Talks. https://www.ted.com/talks/carson_bruns_could_a_tattoo_help_you_stay_healthy#t-293984
2. Dassen, W., & Bruns Alonso, M. (2017). Aesthetics of haptics: an experience approach to haptic interaction design. In Proceedings of the 2017 ACM Conference Companion Publication on Designing Interactive Systems (pp. 254-259). ACM.
3. Fulda, J., Tierens, P., Mäntyharju, T. and Wimmer, T. (2014). Raising user impulse awareness: the sensitive rolypoly. In Proceedings of the 8th International Conference on Tangible, Embedded and Embodied Interaction (TEI ‘14). ACM, New York, NY, USA, 347-348. DOI=http://dx.doi.org/10.1145/2540930.2555205
4. Karana, E., Barati, B., Rognoli, V., & Zeeuw van der Laan, A. (2015). Material driven design (MDD): A method to design for material experiences. International Journal of Design, 9(2), 35-54.
5. Marks, L.U. (2004). Haptic visuality: Touching with the eyes. Framework: the finnish art review, 2, 79-82.
6. Rasmussen M.K., Merritt, T. Bruns Alonso, M., and, M.G. Petersen. (2016). Balancing User and System Control in Shape-Changing Interfaces: a Designerly Exploration. In Proceedings of the TEI ‘16: Tenth International Conference on Tangible, Embedded, and Embodied Interaction (TEI ‘16). ACM.
7. Ross, P. R., and Wensveen, S. A. G. (2010). Designing aesthetics of behavior in interaction: Using aesthetic experience as a mechanism for design. International Journal of Design, 4(2), 3-13.
8. Sibley, F. (1965). Aesthetic and Nonaesthetic. The Philosophical Review, 74(2), 135–159.
9. Stienstra, J.T., Bruns Alonso, M., Wensveen, S.A.G., & Kuenen, C.S. (2012). How to design for transformation of behavior through interactive materiality. In Proceedings of the 7th Nordic Conference on Human-Computer Interaction: Making Sense Through Design (pp. 21-30). ACM.
10. Tangible Media Group. (2020, October 13). Venous Materials. Vimeo. https://vimeo.com/420694121
11. Vallgårda, A. (2014). Giving form to computational things: developing a practice of interaction design. Personal and ubiquitous computing, 18(3), 577-592.
12. Van Oosterhout, A., Bruns Alonso, M., and Hoggan, E. (2020). Facilitating Flexible Force Feedback Design with Feelix. In Proceedings of the 22nd ACM International Conference on Multimodal Interaction (ICMI’20). ACM.
13. Wakkary, R. L., Desjardins, A., & Hauser, S. (2016). Unselfconscious interaction: a conceptual construct. Interacting with Computers, 28(4), 501-520. https://doi.org/10.1093/iwc/iwv018
14. Wensveen, S. A.G., Djajadiningrat, J. P., and Overbeeke, C. J. (2004). Interaction frogger: a design framework to couple action and function through feedback and feedforward. In Proceedings of the 5th conference on Designing Interactive Systems: processes, practices, methods, and techniques, 177-184. ACM.
15. Qamar, I. P., Groh, R., Holman, D., & Roudaut, A. (2018). HCI meets material science: A literature review of morphing materials for the design of shape-changing interfaces. In Proceedings of the 2018 CHI Conference on Human Factors in Computing Systems (pp. 1-23).

APPENDIX I - Video links

Process video

https://vimeo.com/460495503

Final Concept Video

https://vimeo.com/474619725

APPENDIX II - Peer Review

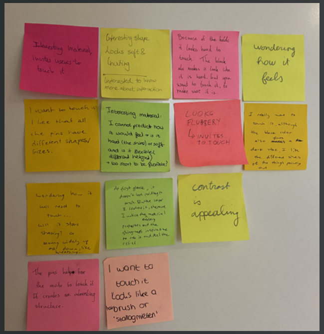
All in all, we were a good team. Communication went well, although we sometimes had different visions or interpretations. Both of my team members were more experienced with textiles and materials, resulting in a natural task division throughout the project. We discussed individual strengths and weaknesses at the start of the course, but I feel like we could have built on that more as a group, to exploit our individual strengths.

We collaborated during the entire course, resulting in interesting discussion from different perspectives. Many of my ideas were a result of an initial note from either one of my team members, which illustrates how we built on each other. The atmosphere in our group allowed for this too, as we had an exploratory and constructive “yes, and..” approach, rather than too analytic and critical “no, because…”. As a result, we failed often, but tried and learned a lot.

I would like to especially highlight Caya’s contribution, as she showed much dedication to the course and our team, even though she won’t be awarded with actual ECTS. This makes her a real team player in my opinion. Iris and I tried to compensate for that by means of the task division.

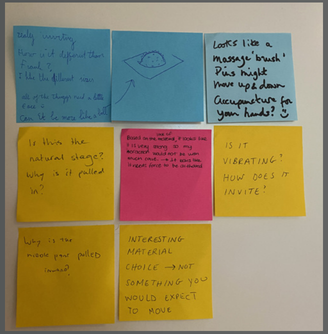
My only critique on this team would be the difficulty in understanding my team member’s skill set and vision. I find forming a varied team a major strength of the course’s structure. We now have a sort of merge between those probably, and I think it would have been interesting to highlight personal skills in the final prototype. Instead we went for a more exploratory approach, trying out many different new techniques and materials, making this course very educational, but the result a bit more superficial. A balance between applying skills and learning new things would be better in my opinion, starting with understanding individual strengths and weaknesses.

APPENDIX III - Affinity Diagram
Round 1



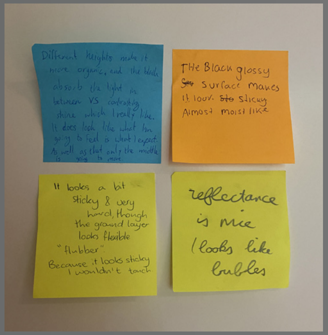
1. Level of appeal:

- Interesting material, invites users to touch it
- Interesting shape, looks soft & inviting
- Interested to know more about interaction
- Because of the bolts it looks hard to touch. The black also makes it look like it is hard, but you want to touch it, to make sure it is wondering how it feels
- I want to touch it! I like that all the pins have different shapes/sizes
- Interesting material: I cannot predict how it would feel > is it hard (the shore) or soft and is it flexible (different heights) > too short to be flexible?
- Looks flubbery > invites to touch
- I really want to touch it, although the black color also gives a dark vibe, I like the different sizes of ‘ the things pointing out.
- Wondering how it will react to touch… will it start shaking? or moving widely up and down, like breathing…
- At first glance, it doesn’t look inviting to touch. But the longer I look at it, the more I notice the rubbery material properties and the shiny-ness inspires me to rub it and feel the relief.
- Contrast is appealing
- The pins help for the invite to touch it. It creates an interesting structure.
- I want to touch. It looks like a hair brush or “sta lagmieten”.



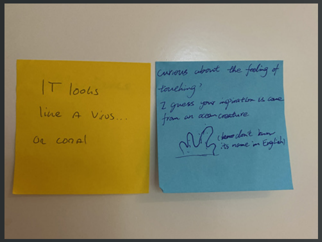
2. Observations

- Really intriguing. How is it different from Frank? I like the different sizes. All of the thingies need a little face. Can it be more like a ball?
- Looks like a massage “brush”. Pins might move up and down. Acupuncture for your hands?
- Is this the natural stage? Why is it pulled in?
- Based on the look of the material, it looks like it is very strong, so my interaction would not be with much care > It looks like it needs force to be activated.
- Is it vibrating? How does it invite?
- Why is the middle part pulled inward?
- Interesting material choice > Not something you would expect to move.



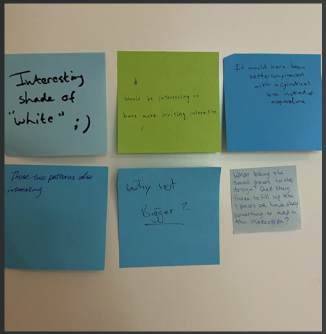
3. Color properties:

- Different heights make it more organic, and the black absorbs the light in between VS contrasting shine which I really like. It does look like what I’m going to feel is what I expect. As well as that only the middle is going to move.
- The black glossy surface makes it look sticky. Al most moist like.
- It looks a bit sticky & very hard, though the ground layer looks flexible. “flubber”. Because it looks sticky, I wouldn’t touch it.
- Reflectance is nice (looks like bubbles).



4. Comparisons:

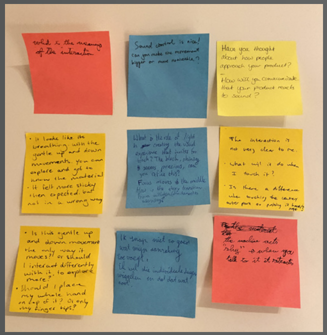
- It looks like a virus… or coral
- Curious about the feeling of touching? I guess your inspiration comes from an ocean creature.



5. General remarks:

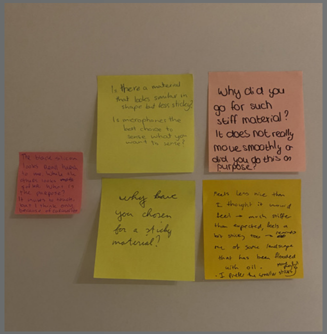
- Interesting shade of “white” ;)
- Would be interesting to have more inviting interaction
- It would have been better to comparted with a cylindrical box instead of a square one.
- These two patterns also interesting
- Why not bigger?
- What brings the small pieces to the design? Are they there to fill up the spaces or have they something to add in the interaction?

Round 2



1. Interaction:

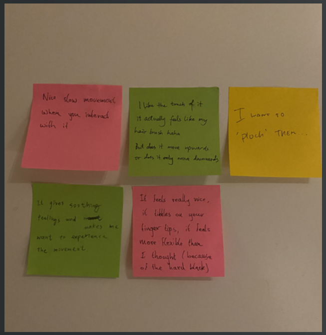
- What is the meaning of the interaction
- Sound control is nice! Can you make the movement bigger or more noticeable?
- Have you thought about how people approach your product?
- How will you communicate that your product reacts to sound?
- It looks like it’s breathing with the gentle up and down movements. You can explore and get to know the material.
- It felt more stick than expected, but not in a wrong way
- What is the role of light in creating the visual experience that invites for touch? The black, shining seems precious, can you refine this? Focus moves to the middle, how is the story transition from invitation (affordance) to interaction?
- The interaction is not very clear to me. What will it do when I touch it?
- Is there a difference when bouncing the center outer part of pushing it hard/soft?
- Is this gentle up and down movement the only way it moves? Or should I interact differently with it to explore more? Should I place my whole hand on top of it? Or only my finger tips?
- I don’t understand what my touch adds. I want to wiggle the individual things.
- The material acts “shy” and when you talk to it, it stretches.



2. Material criticism:

- The black silicon looks really harsh to me. While the others look softer. What is the purpose? It invites to touch, but I think only because of curiosity.
- Is there a material that looks similar in shape but less sticky?
- Is microphones the best choice to sense what you want to sense?
- Why have you chosen for a sticky material?
- Why did you go for such stiff material? It does not really move smoothly or did you do this on purpose?
- Feels less nice than I thought it would feel. Much s

stiffer than expected, feels a bit sticky too > reminds me of some landscape that has been flooded with oil. I prefer the smaller sticks, more playful.



Nice slow movement
when you interact
with it

I like the touch of it
it actually feels like my
hair brush haha
But does it move upwards
or does it only move downwards

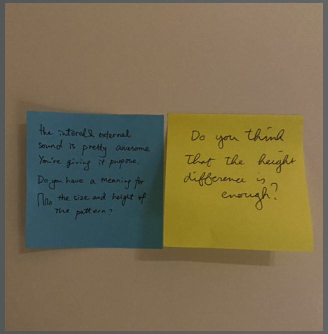
I want to
'ploch' them…

It gives soothing
feelings and ~~want~~ makes me
want to experience
the movement

It feels really nice,
it tickles on your
finger tips, it feels
more flexible than
I thought (because
of the hard black)

3. Material interest:

- Nice slow movements when you interact with it.
- I like the touch of it. It actually feels like my hair brush haha, but does it move upwards or does it only move downwards?
- I want to “ploch” them…
- It gives soothing feelings and make me want to experience the movement
- It feels really nice, it tickles on your fingertips, it feels more flexible than I thought (because of the hard black).



the interal & external
sound is pretty awesome
You're giving it purpose.
Do you have a meaning for
the size and height of
the pattern?

Do you think
That the height
difference is
enough?

4. Pillar height:

- The internal and external sound is pretty awesome.
- You’re giving it purpose. Do you have a meaning for the size and height of the pattern?
- Do you think that the height difference is enough?