

POUCHES AND PIVOTS

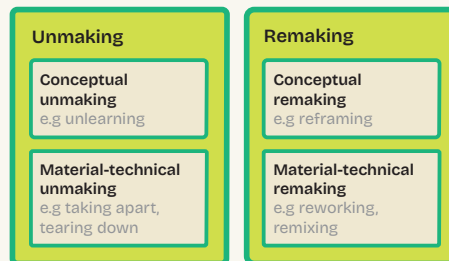
REVEALING UNMAKING IN TANGIBLE INTERACTION DESIGN RESEARCH JOURNEYS

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Drifting



ABSTRACT

Reflecting on a one-year design-research project, we examine design drifts by documenting and analyzing three distinct conceptual and technical shifts that took place. We extend the notion of drifting by framing through stages of unmaking and remaking —where unmaking involves reversals of progress and remaking incorporates these reversals into new research framings. While remaking has been discussed as emergence and reframing, we argue that unmaking during design research is often hidden yet equally significant. This pictorial presents a visual reflection on our artifact's development. We also characterize how a drift may form as a six-step process. We emphasize unmaking's contribution to drifting: it embodies reflection-in-action with materials and helps generate designerly knowledge for future research.

Authors Keywords: unmaking; remaking; drifting; design research; design journey. **CCS Concepts:** Human-centered computing-HCI theory, concepts and models; Human-centered computing-Interactive systems and tools

INTRODUCTION

Research through Design (RtD) [5, 10, 20, 47, 49] is now widely adopted in HCI. Discussions of RtD as drifting [21, 34], reframing [48], or emerging [10] all highlight how RtD follows non-linear paths. Rather than a direct line from intent to outcome, RtD's open-ended inquiry is characterized by iterative changes in its methods, modes, questions, and/or frames throughout the process — changes that themselves yield knowledge.

Despite the understanding of RtD's non-linearity, much design research documentation and scholarship emphasizes a narrative of linear progress that ignores the messy reality of drifting [10, 18]. Scholarship often presents rationalized post-hoc accounts that mask the actual uncertainties, reversals, and conceptual pivots that occurred during research. This gap in documentation and narrative is particularly evident in conceptual changes — shifts based on the researcher's design judgments that can be difficult to articulate or justify within traditional research frames.

Building on prior work on drifting in design [21, 34], we examine its relationship to recent discussion of unmaking (e.g. [39, 40, 43]). We propose characterizing drifts through two reciprocal processes: making and unmaking. Making establishes research frames and advances progress in conceptual, technical or material implementations. Unmaking counters this by undoing

decisions, abandoning directions, and deconstructing established frames and artifacts. Unmaking often results from conversations with materials [38] and the iterative designerly judgments that underlie aligning artifact's affordances with conceptual framings. While making aligns with concepts of emergence and reframing, unmaking represents an underexplored contributor to design research journeys.

To demonstrate and analyze these processes, this pictorial documents a case study of drifting within a one-year RtD enacted by the first author. This research centered on the development of an interactive inflatable pouch with machine learning (ML) and generative sound output. Multiple drifts unfolded, motivating re-enactments and re-designs of both material and technical artifacts. Ultimately these three drifts led to four distinct conceptual framings. Through process documentation, research journal entries, and reflections, we trace these drifts. Our analysis situates these drifts within a six-part process of making and unmaking and how it unfolds across both conceptual and physical layers. This case and the discussion we present illustrate how unmaking is central to drifting in RtD, as well as the need for greater attention to the multiple forms of unmaking — material, technical, and conceptual — in documenting and sharing design journeys. Our work contributes to RtD by:

- Illustrating the intersections between drifting [21] and unmaking [40] through a case. This case aims to extend and reconcile recent RtD accounts of drifting and unmaking further demonstrating their complementary role in shaping design research.
- Broadening unmaking from recent positioning in sustainable material innovations to reconnect with origins in Fry's designerly acts of disassembly [7], material-conceptual takeaparts, and breakdowns.
- Offering a six-step process that characterizes how conceptual and material-technical unmaking and remaking coexist and interact within an emergent design research project.

RELATED WORK

Material Unmaking in HCI: Unmaking, and related terms such as un-crafting [26], unfabricating [45], and undesigning [32], typically emphasize unmaking as a designed property of a *finished* technology or system. Unmaking of technology is most often used to address sustainability concerns [6, 22, 45], for example, by unmaking polluted soil through participatory design

FRAMING UNMAKING

In this work and through our documentation of the design journey, we attended to the disjoint between drifting and unmaking found in prior work. We found that each drift can be decomposed into reciprocal acts of unmaking and remaking. The elements of unmaking similarly entailed the conceptual (destruction of the previous frame), material (taking apart or setting components aside), and the technical (erasure of code or implementations).

Thus, we consider **drifts can be deconstructed into two reciprocal stages of unmaking and remaking**. Further, this involves different design actions: the conceptual framing of the research or program, or actions upon material-technical artifact (the designed thing). We represent these relationships in the figure linked by the thread above. Within our view, unmaking within emergent design research can thus be organized as three related acts:

Conceptual Unmaking can be thought of as unlearning [17, 31] and encompasses the conceptual dismissal of a frame or research question, unlearning conceptual expertise [30], unpacking, unknowing [28], intentional forgetting, and unmaking “values, habits, beliefs, affiliations, and knowledge that obstruct acting [7]”.

Technical Unmaking is the technical reversal or erasure of implementations and encompasses undesigning technologies through inhibition, removal, exclusion, etc [32].

Material Unmaking involves tearing down and taking apart artifacts and may encompass un-crafting interactive artifacts [26], disassembly and tear downs [7], “destruction, decay, & deformation [39]”

Similarly, remaking is organized as: **conceptual remaking** that constructs and re-establishes a conceptual frame (a.k.a. reframing [48]), and **material-technical remaking** that reworks and remixes existing and new implementations [21, 34].

In the journey, we highlight two key features
“**concept**” and “**artifact**” using these icons.

They are unpacked
on p10.



[22] or unmaking 3D prints to examine the potential of decay and destruction [39] to creatively support material re-use. Re-use, enabled by disassembly and reverse engineering are integral parts of research with material artifacts [26]. Therefore, un-crafting — deconstructing interactive artifacts — offers a reflective process for material inquiry that can yield knowledge about technologies and support reinterpretation of existing artifacts. These approaches orient towards unmaking prior work or the establishment of an artifact that can be unmade. Here, unmaking is typically an agenda that imposes constraints onto material and technical iterations towards a pre-defined goal; the driving conceptual frame behind the work is neither unmade nor reconfigured. In contrast, emergent design research iteratively explores the conceptual possibilities of a material-technical artifact.

Unmaking Concepts and Knowledges: Unmaking is not restricted to tangible artefacts or systems. Critical unmaking is a form of provocative design action that can be deployed to spark debate in local communities [36]. Sabie et al. also expanded definitions of unmaking to an “emancipation category for social justice” in HCI [37]. Similarly, unmaking has been used to frame actions that challenge the dominant view such as decentering the human in more-than-human design with AI [27] and pluralizing marginalization [43]. Another productive expansion of unmaking can be found in the concept of “unlearning” from the social sciences. In cognitive science, unlearning has been conceptualized as a process of reducing or abandoning the influence of old knowledge and/or behaviors [15, 17]. The emotional effects of unlearning have been highlighted [17], such as grieving the loss of prior perspectives and values [23]. Unlearning can also take an organizational frame, where most unlearning processes in organizations do not start with a clear goal to unlearn “toward” [31]. Instead, unlearning often starts with “a novel, unexpected or difficult situation”, and an agent then pursues the urge to solve the problem. Peschl argues that the unlearning agent should be receptive to the environment and “co-become” with the unfolding reality. Unlearning is also not unrelated to unmaking in design research. Fry notes that unmaking encompasses both the disassembly of things as well as the “values, habits, beliefs, affiliations, and knowledge that obstruct acting”[7].

Drifting in Design Research: Prior works argue that design researchers have the ability to work beyond the functionalist view of technology and incorporate

culture and aesthetic decision-making [8, 9]. As a result, design research is not a linear process of engineering implementation. Redström observed the program-experiment dialectics, which reflect how design research experiments and the research program co-shape each other as the project unfolds [34]. Using the term “drifting”, Krogh and Koskinen formalized intentional changes in the design research process as “those actions that take design away from its original brief or question and lead to a result that was not anticipated in the beginning” [21].

Recently, emergence [10] and reframing [48] are suggested as core processes of design research warranting documentation and recognition as knowledge contributions. Gaver et al. argue that design research is “emergent”[10] and use this term to describe the conceptual and methodological changes as the project “unfolds”. In contrast with the “intention-bound” research, they value the “exploratory” nature of design research and its “surprises”. Similarly Zimmerman et al. demonstrated how they established reasons for drifting away from one experiment to a subsequent frame through acts of “reframing” [48].

We consider their word choice as forward-oriented, emphasizing how something arises rather than fading out and giving the impression that RtD is a forward-driven process, where unexpected changes can turn into valuable next steps, thereby prioritizing generating something new over stepping back from or untangling prior frames. These echo Howell et al.’s observation that many failed attempts and experiments are simply “folded into cycles of iterative improvement” [18].

Despite contributing to drifts, focusing on forward movements alone does not fully capture or represent drifting in design research. Previously, Fry asked authors of new technology to carefully consider the dialectics of destruction and creation [6]: creation can lead to the unsustainment of the item being created, and destruction makes it possible to create something new. Unmaking has been used to imply acts of destruction that pave the way to remaking [36, 39]. Echoing [3, 18], this highlights how the unsustainment of creative acts is a frequent component of emergent processes. As we present the design research journey below, we invite the readers to pay special attention to the unsustainment and destruction during each drift and seek insights from reflecting on the judgments and decisions made in those moments.

THE JOURNEY

The following pages are the visual reflection in the voice of the first author of the journey through three drifts and four framings.

PROLOGUE

The pouch with a sticky interior was the starting point of this journey. Its fluctuating sensor signal made it hard to be implemented as a precise sensor, which inspired me to ground this project in speculative design [4].



MAKING

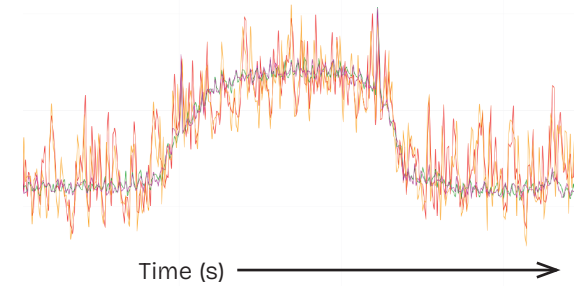
INTIMATE AMBIGUITY

I planned to investigate the topic of ambiguity in the signal and the self-love by developing an on-body system of air pouches that would sense body gestures and capture the ambiguity of the wearer's attitude towards themselves. Then an associated custom natural language model would generate ambiguous language about such intimacy. Each set of similar body gestures would be mapped to elements in the language model, which would be customarily trained to produce ambiguous output in the form of poetry. With these components, I hoped to build an interactive experience of self-intimacy that opens the conversation around what discussions wearable digital devices could engage with around one's body.

The original pouches were made with two layers of 3M duct tape with copper tape on the exterior as electrodes, following the implementation of Multi-Touch Kit [33]. When the pouch was manipulated, the inner contact area changed shape and modulated the capacitive sensing signal. However, this change in signal was distinct from a traditional button: **it could be observed yet it was hard to quantify as an event due to noise in the signal.**



AnalogRead



Paralleling the observation of the ambiguity in the signal, I was in a phase of self-exploration. I sought varied relationships between my body and my mind. I wanted to tap into the complexity of somaesthetic design [19], and **I wanted to design with this ambiguity [11], bridging my self-love and the pouch signal.** The soft pouches seemed perfect artifacts to put on the body.

POSITIONALITY

This one-year design research project is situated in the Computational Design program at Carnegie Mellon University, which emphasizes a socio-technical approach to design research and encourages student researchers to blend material, technical, and socio-historical exploration within a self-directed, thesis research project. The first author who led the project had an undergraduate degree in physics with strong making skills. With the shift to design-based research cultivated by this program, she hoped to explore the critical and speculative potential of engineering through building tangible interactions. Throughout the project, she responded to the technical, material, and conceptual challenges and opportunities that emerged while staying inline with this intellectual goal. Hence many design decisions were made not based solely on feasibility or utility, but a holistic alignment of personal values, the emotional arc of inquiry, and the provocative potentials of the design.

like (V)
love
cry
see
look for
hear
listen
smile
touch
tell

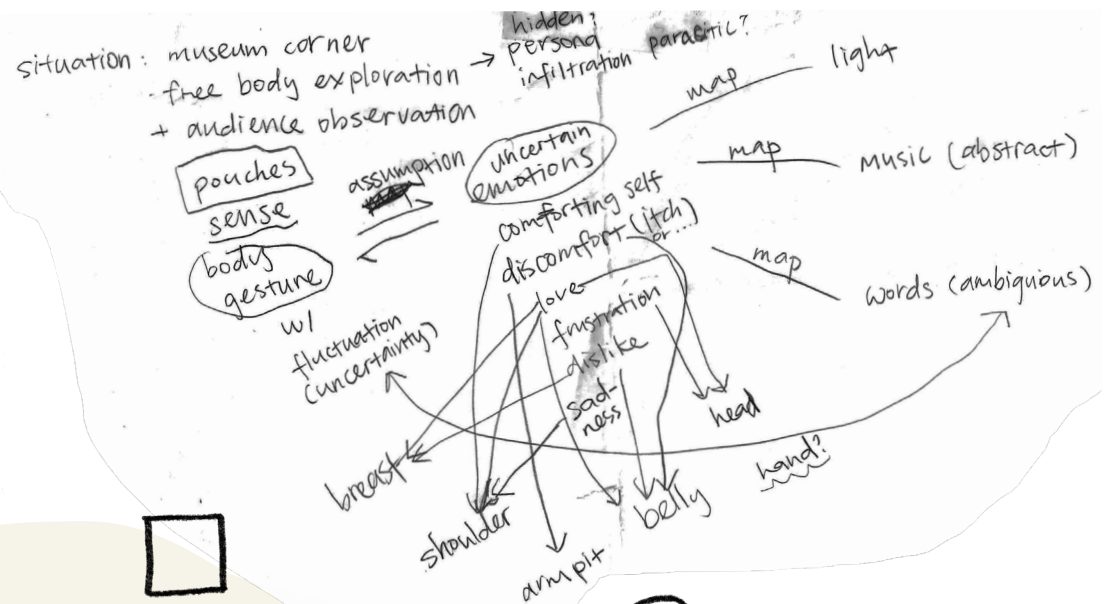
Lips (N)
stony
smile
shoulder
legs
breast
hands
imagination
fantasy
sex
waist
body

quietly (A)
fiercely
afternoon
morning
at home
in park
at bar
lovingly
gently?
careful
safe
silly

I curated three lists of words with coded rules to mimic a language generation model for ambiguous love language. The rule would select one verb, two nouns, and an adjective/adverb to form a sentence. The selection logic would later be implemented with pouch sensing values mapped to a word embedding space [44]. However, at this fiction stage, **the sentences formed did not capture the essence of love language I had in mind.**

*I look for
your legs
in the park...*

This marked the beginning of aligning what the pouches afforded and what concept I strived to embed in them.



I drew a mind map of how different gestures of touching myself could reflect different emotions so that the touch pattern on the inflatable pouches could be mapped to the wearer's emotions. However, I noticed that many gestures do not have a singular meaning. For example, tapping one's head could signal frustration, or simply deep thought. **This unbounded ambiguity challenged me to unmake the assumption that self-love can be read directly from body gestures.**

angry
bitter
lonely
sad



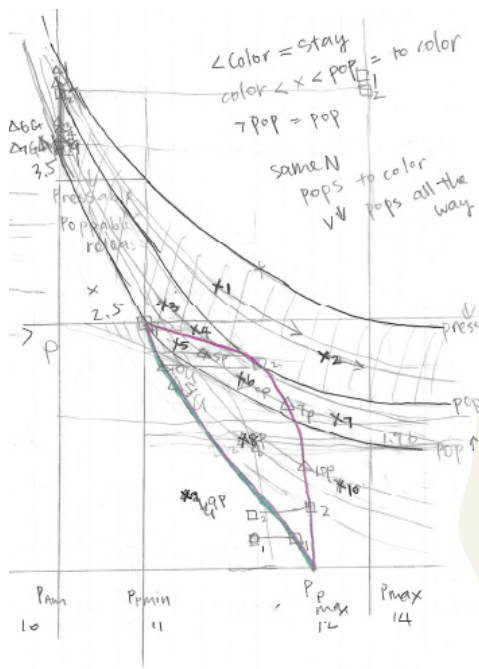
I also unmade the capacitive sensing pouch, which resulted in more fittings for future prototypes.



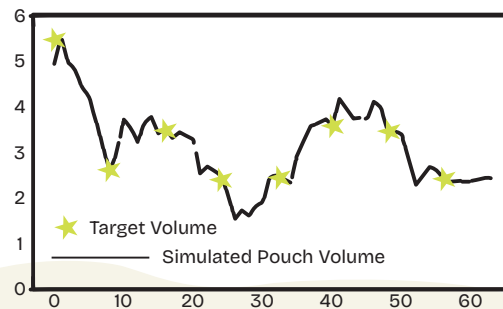
UNMAKING

INTIMATE AMBIGUITY

After realizing that the layers of ambiguity in language generation and emotion mapping were too vague to tackle, I moved away from the language model. I saved the notes but stopped the development of language generation. At this stage, I also unmade the original pouch since I no longer pursued fine-grained sensing, which resulted in more tubes and tube fittings I could use to experiment. I started to question if ambiguity [11] should be a core concept to design around. After all, the ambiguity provided a resource and anchor but did not give me a forward direction to designing an artifact.



The hand calculations for the RL model.



To explore the human-pouch interaction, I experimented with a simple linear regression model of pump speed, and eventually a reinforcement learning (RL) model that could respond to changes in pouch volume in simulations. However, the RL model required an ideal, air-tight pouch with precise pressure sensors, **which seemed to deviate from the desired focus on interaction and lean towards a system control problem.**



Conversations with a new research advisor brought me to consider the mechanism of pouch sensing. Could I add pumps to the pouches so that **they may assist the humans in achieving certain shapes or play against them as in collaborative AI [50]**? What does this antagonistic relationship afford?

External feedback played a vital role in the exploration stage before remaking.

Journal:

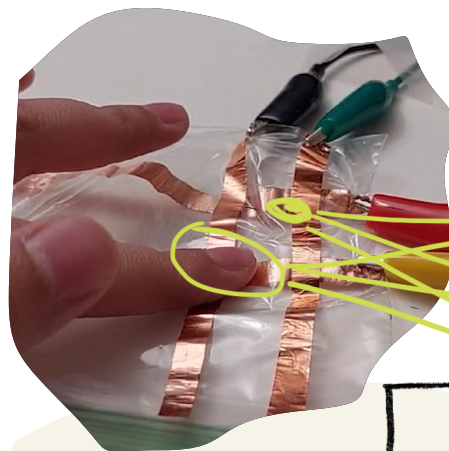
[Jan 23] My roommate told me she heard me singing all night.

The labor I invested in training in the RL model inspired me to look for another type of labor: the labor required to train large ML models, such as data labeling [35]. Agre's critical technical practice [1] also informed my view on speculating on an alternative ML [12]. **Could I ask the wearer to train their own ML model and experience the effort?**

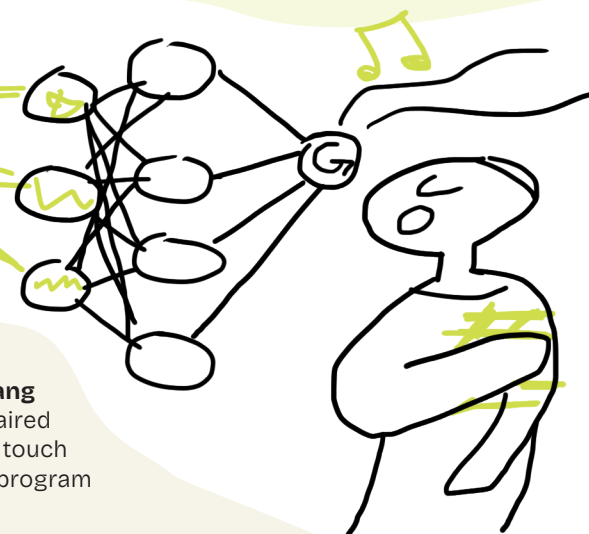
REMAKING

HIDDEN LABOR IN MACHINE LEARNING

I proposed making a wearable system that combines real-time machine learning with creative music generation and haptic feedback. This system would act together to spark reflections and conversations around a speculative AI development that is personalized and intimate. The on-body training experience would imitate, or hint at, the commonly hidden labor in the large-scale training of ML models. In addition, an intimate model unique to the wearer could elicit a sense of attachment to oneself that feels foreign compared with a generalized model. Most importantly, I hoped to encourage reflections and shed light on the deep implications of AI with this artifact.



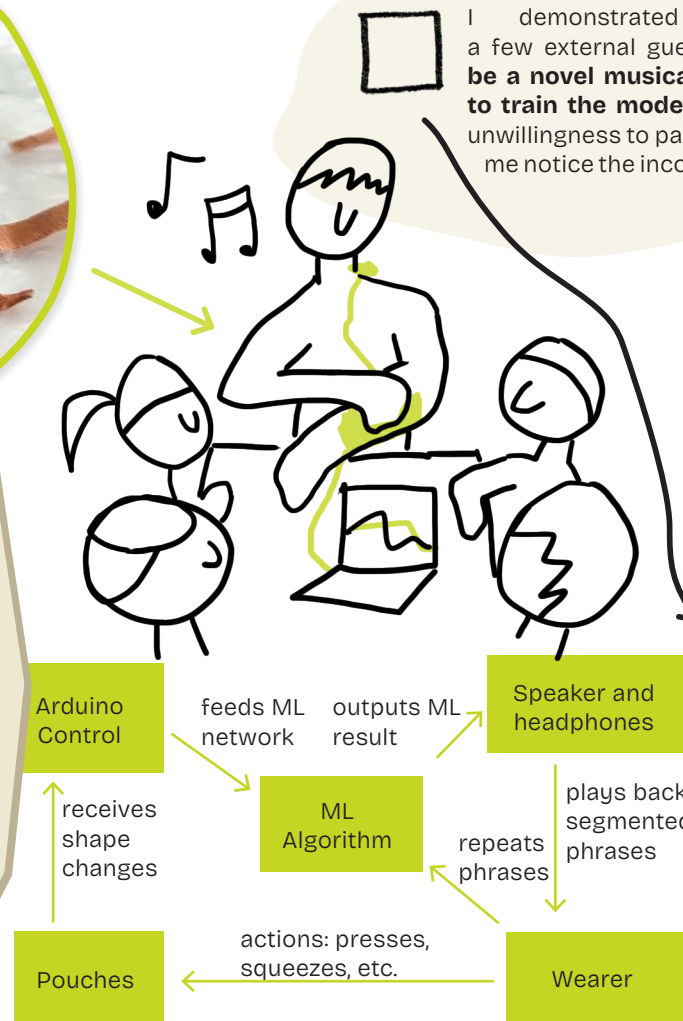
I implemented **a simple machine learning pipeline that captured the note the wearer sang and linked it to the touch sensing signal** as a paired dataset, so that when the user performed the touch pattern the program had previously seen, the program could reproduce the note.





UNMAKING HIDDEN LABOR IN MACHINE LEARNING

A few demonstrations of the prototype revealed a mismatch between the artifact's affordances (being a musical instrument) and what was perceived to be the guiding force of the concept (revealing hidden labor), so I chose to unmake both the music generation system and the hidden labor framing.

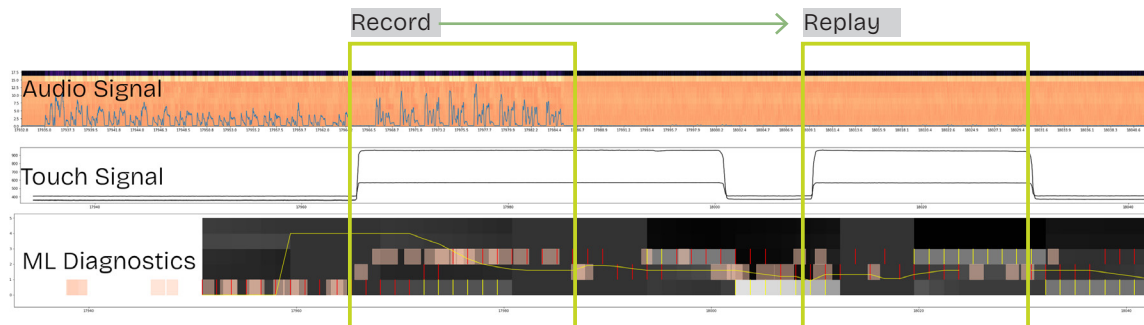


I demonstrated the ML-note generation system to a few external guests, who mostly **considered the pouches to be a novel musical instrument due to the low effort required to train the model**. A demonstration to peers revealed people's unwillingness to participate with the artifact. Their feedback helped me notice the incongruence in the design.

Reflection: In what I achieved to show my professor, I was singing and tapping on a piece of dubiously looking, partly shiny piece of plastic fabric laid over my arm in a very small frame ... and the main screen showed floating curves and bar charts as diagnostics. ... Eventually, he arrived at the conclusion that I was trying to make a digital musical instrument with an unconventional input interface.

The awkward interaction quality resulting from the artifact's implementation led me to question whether it was a design opportunity or a setback I should engineer away. **I was embarrassed and disappointed.**

Disappointment, showing a mismatch in design program and implementation, drove the decision to unmake.



After the demonstrations, I partially unmade the note generation pipeline and replaced the input with a **repository of longer clips**. The user would repeat a phrase for a couple of times into the microphone, and the system would pick it up and register it with the corresponding touch pattern.

Technical explorations could drive the emergence of the next framing.

To reuse earlier touch patterns, I coded the ML model to drop earlier data pairs at a fine-tuned rate such that the model could "forget" and learn new sounds. This led to **the concept of the entanglement of machine and human memory.**



I explored **different use scenarios of a capacitive sensing raincoat implemented through the phrase pipeline.** One development was a comic of a lonely girl talking to the raincoat every day before bed so that the raincoat could help her forget her day.

REMAKING

FALLIBLE DIGITAL MEMORY

The literature on human memory in a world of technology [24] led to conceptual remaking. I reflected on this intermediate and malleable stage of constructing the argument of machine forgetting, creating possible analogies to the sound mixing pipeline's algorithmic "forgetting" of training data. The forgetting of memories also tapped into the relationship between the body and the mind. As the user repeated the phrase while performing certain gestures, the memories could be first encoded in the body but then forgotten by the machine, symbolizing a coevolving joint memory storage system.



The wearer would create a touch pattern with the capacitive sensing patches.

The raincoat prototype
(drawn as laid on a chair in the girl's room in the comic)

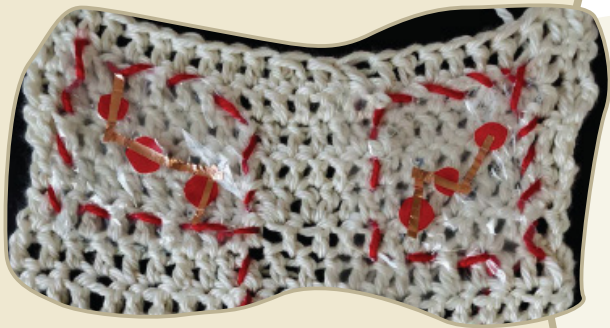
The phrases would be stored in the prototype. This is the machine memory.

The phrases could be erased from the memory by removing the touch pattern from the raincoat. This is the forgetting.

A thought experiment like this could reveal overlooked details in design rationales.



However, as I was drawing the comic, it became apparent that I was **confused about what the algorithm's artificial forgetting means to the wearer.** Will the girl remember the day better because of the repetition?



Parallel to the conceptual development, I explored **various wearable forms beyond the raincoat prototype**, inviting back the pouches with a sticky interior as I still would like to have them as part of the wearable system. I embedded them into several crochet garments I made.

[Feb 7] [testing the phrase segmentation pipeline] makes me extremely self-conscious and embarrassed by the sound I repeat. Therefore I prefer humming to words, but also short complaints and humorous remarks about my state of life.

First-person experience offered valuable cues to the quality of interaction I was not aware of previously.



UNMAKING

FALLIBLE DIGITAL MEMORY

The confusion of forgetting and remembering and the mind mapping activity prompted me to think deeper into not only the naming of "machine forgetting" but also the entire framing. Who is forgetting? Who is remembering? As well as the bigger question: so what? I knew I always wanted the project to have broader societal implications, and the "so what" question my advisor frequently asked prompted me to thoroughly examine the framing of forgetting and remembering.



At this step, I unmade the raincoat prototype as well as other crochet-pouch hybrids because I started to **question if a large form factor is truly effective in conveying an intimate mental process.**

I also unmade the concept of forgetting after drawing a series of mind maps around the affordances of the artifact and the relationship between the machine and the mind. **The dialectics of remembering and forgetting were negotiated, and the theme eventually drifted from the subtractive forgetting to the generative framing of "here and now".**



Should've said sorry...
Should've said sorry...
Should've said sorry...

REMAKING

TANGIBLE RUMINATION

In the end, I found rumination, i.e. aimless going over a thought repeatedly [25], a closely related concept which I used to frame how I interacted with the phrase segmentation pipeline in this final encounter. By repeating a phrase, the user could be less fixated on its meaning, inspired by cognitive defusion in Cognitive Behavioral Therapy [29]. The interactive artifact became a rumination companion [46].



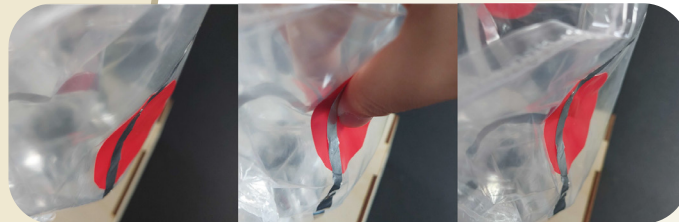
Building on the concept of the here-and-now, I was inspired by Cognitive Behavioral Therapy which contains a technique called cognitive defusion related to repetition [29]. **This technique could help the client detach from their thoughts by repeating them out loud and the phrases would eventually sound meaningless.** The repetition was precisely the interaction the phrase segmentation system required.



The pouches eventually formed a shape like a diving mask or a funnel, with four of them connected and four electrodes running across them connecting the sticky patches. When I repeated my thoughts into the microphone inside, **the mask would create an isolated, meditative space.**

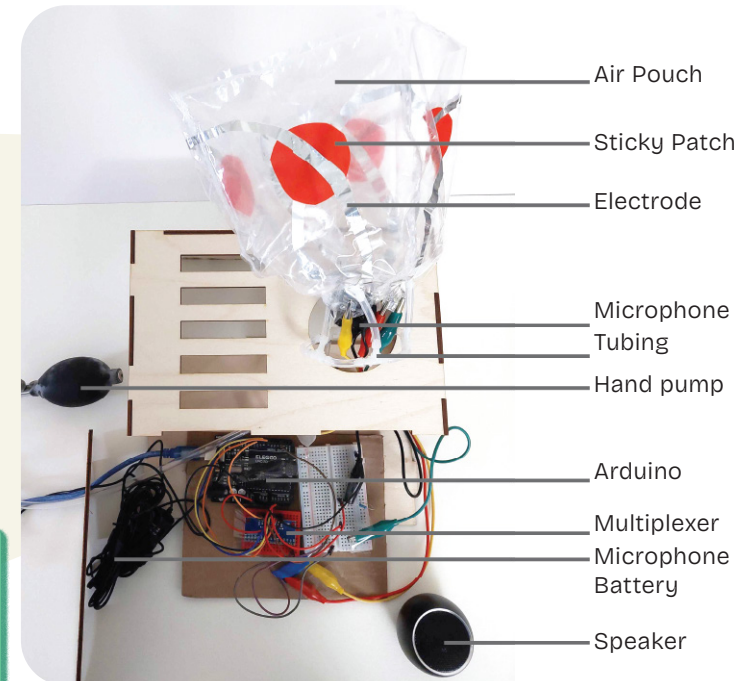


Soldering the edge of the sheets with a soldering iron, sandwiched between parchment paper.



The user would press a red dot with electrodes on the mask while repeating a phrase, and the system would register the capacitive sensing signal with the phrase. Then, the user could replay the phrase through the speaker by pressing the corresponding red dot.

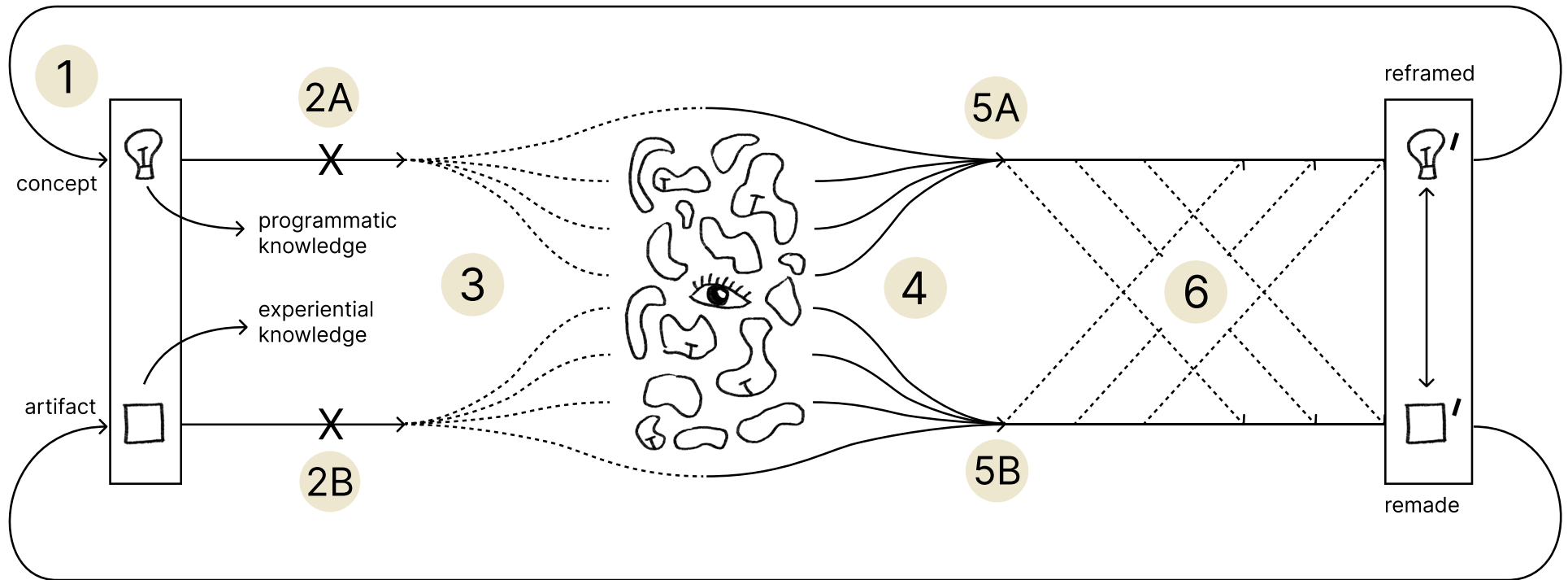
The Journey ends here - but not really. More concepts and sketches were made and unmade to reflect on and disseminate the project, and I carried my experience with unmaking in design research forward into other research.



MAPPING UNMAKING IN DRIFTS

As we analyzed how a drift progresses through unmaking and remaking across conceptual and technical-material layers, a six-step mapping resulted. This builds on Redström's [34] work that shows how stable programs can shift to experiments and insights that challenge, and ultimately cause a drift to a new program.

- 1 Locating Knowledge**
Researchers identify experiential knowledge in artifacts and programmatic knowledge in concepts, observing their dialectic relationship.
- 2 Sensing Forces of a Drift**
Destabilizing forces emerge from either conceptual gaps 2A or technical limitations 2B. External feedback can initiate these drifts, or the designer's own judgment or frustration with concepts or artifacts.
- 3 Unmaking in the Environment**
The researcher engages in both conceptual and material-technical unmaking through design experiments. This involves reducing old knowledge influence and experimenting with deconstructed materials—essentially “conversations with materials.”[38]



- 4 Initiating New Experiments**
An intermediate phase where researchers gather remnants from unmaking and explore new directions. Parts of prior concepts may persist while new experiments generate insights for development.
- 5 Emergence of New Concepts & Artifacts**
Researchers enter an emergent state, formulating new preliminary concepts and material arrangements inspired by experiments. Development can follow either conceptual or material-technical directions.

- 6 Synthesizing New Frames**
Researchers cultivate the next stable pairing of concepts & artifacts, synthesizing results from unmaking and remaking experiments to yield a new research program.



Here, **artifacts** are counterparts for **concepts**. Artifacts are material-technical results that explore the design space suggested by the program [34]. The **concept** parallels Redström's program, while the design environment [10, 41] is a container for the researcher's "situated actions" where **artifacts** draw resources (technology, materials, participants, time) and take shape through design experiments. Drifting occurs when both concept and artifact are destabilized in this environment.

UNMAKING IN THE ENVIRONMENT

Drifting [21], reframing [48], and emergence [10] all point to how intentional change is entangled with design knowledge. Fry reminds us that creation and destruction are dialectically linked [6] and unmaking has been described as destructive acts that enable new forms of making [37, 40]. Our work similarly foregrounds how the unsustainment of creative acts frequently catalyzes emergent processes and our documentation aims to reconcile disjunctures between drifting and unmaking. Across the drifts (see recap→), we experienced how unmaking encompassed conceptual (dismantling prior frames), material (disassembling or setting aside components), and technical (erasing or rewriting code) transformations, shaping how we ultimately framed unmaking (as outlined on p2). It also led us to understand drifts as six reciprocal steps between unmaking and remaking that unfold across conceptual framings of the research and designed artifact. Next, we highlight additional moments of unmaking, instead attending to how the first author engaged the design research environment—the container of materials, space, time, feedback, and participation—through situated action [41] and reflection-in-action [38].

Technical-Material Unmaking in the Environment

Technical-material unmaking operates in a physical environment. We next overview three themes behind the intentions for our technical-material unmaking.

Unmaking for reuse: Reusing materials from earlier prototypes is inevitable. This contrasts prior unmaking research that focuses on the end-of-life of a product, such as biodegradability and recycling. In our journey, the first silicone tubes and fittings were acquired for a project a year prior. That work was completely disassembled, the air pouches cut, and fittings recovered to make the subsequent artifacts, e.g. the inflatable mask.

Unmaking for feasibility: Code and pouches sometimes behaved in unexpected or unwanted ways which led to technical-material unmaking of pipelines and technical artifacts. Early in Hidden Labor in ML, in the face of irregularities of a stretchy, leaky pouch, neither constant-volume or constant-mass hypothesis held nor did the RL method perform against these factors. This triggered unmaking of the machine agency components. Here, a conversation with the material [38] catalyzed unmaking and drifting to new implementations.

Unmaking for subjective alignment: Sometimes technical-material unmaking could result from aligning the artifact with the concept to which the design researcher chose to align. The inherent irregularities in the pouch structure helped prioritize a move towards speculative design over sensor engineering. This encouraged unmaking the sensing pouch and later for ambiguity to become a central concept. Making a capacitive sensor or a musical instrument remained valid design opportunities as “roads not traveled” [13], yet they were unmade based on the subjective judgment and preferences of the design researcher, who prioritized the positionality of making a speculative device for no goal-focused use.

Conceptual Unmaking in the Environment

Concepts lived in the design research environment as elements to be connected, enacted, and narrated. We present two ways they, or their relationships, could be unmade: through mind mapping and thought experiments.

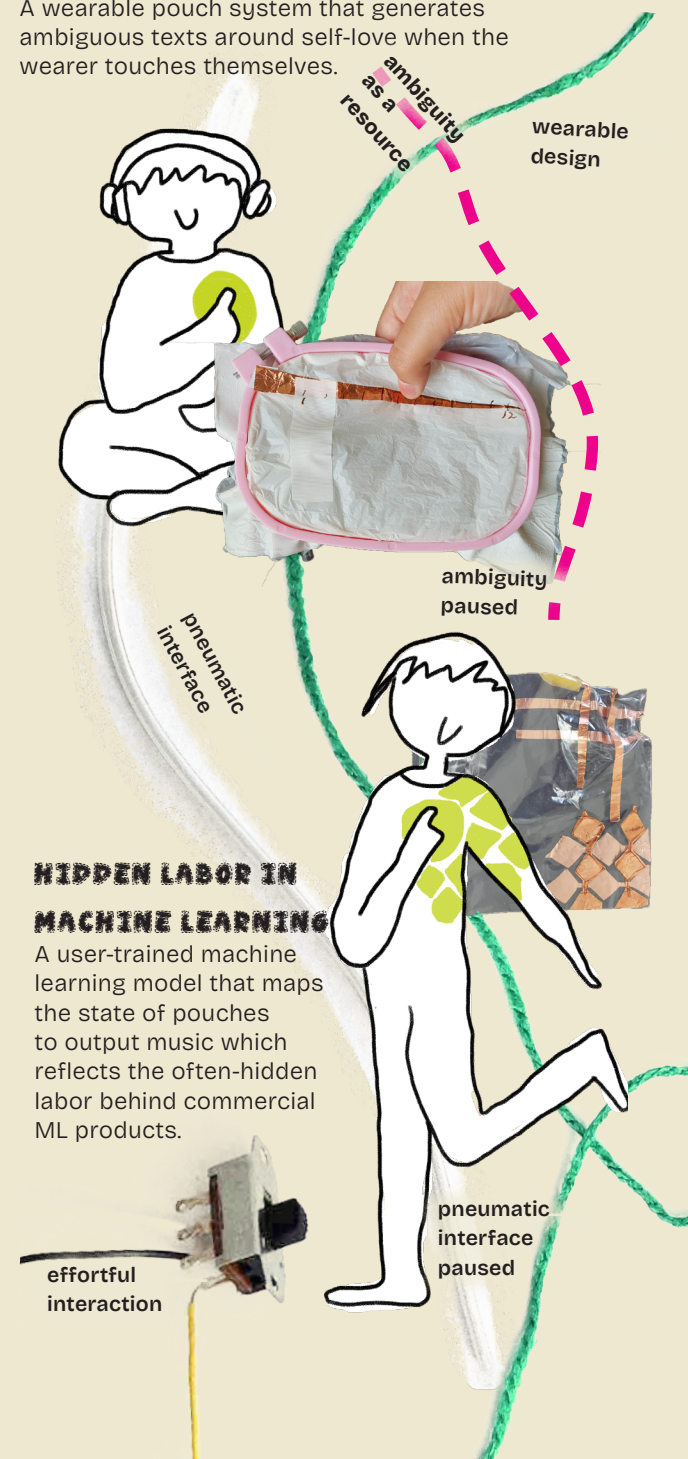
Unmaking through mind maps: Mind maps are tools to visualize related concepts and the first author used mind mapping extensively in every encounter of the journey. However, she observed that instead of leading to clarity, mind mapping sometimes led to the unmaking of concepts being mapped, such as in the unmaking of Intimate Ambiguity and Fallible Digital Memory. The mind maps that drove conceptual unmaking of ambiguity and forgetting echoed Suwa and Tversky's observation [42] that designers often use sketching and the “instability of interpretations of external representations” to challenge existing relations between elements and gain “release from previous interpretations”. Such release is key to conceptual unmaking.

Unmaking through thought experiment: Thought experiments and more recently design fictions have a long tradition in HCI research to carefully consider designs and systems not yet implemented [2]. Through experimenting on paper, the first author also observed that such careful consideration could be a destabilizing force for concepts. Notable examples are the word generation experiment for Intimate Ambiguity, and the confusing raincoat comic in Fallible Digital Memory. In the scenarios above, the design concepts were challenged by the perceived gap in what the technology afforded and what the research framing claimed. These unconnected dots in the narrative ultimately lead to conceptual unmaking.

JOURNEY RECAP

INTIMATE AMBIGUITY

A wearable pouch system that generates ambiguous texts around self-love when the wearer touches themselves.



HIDDEN LABOR IN MACHINE LEARNING

A user-trained machine learning model that maps the state of pouches to output music which reflects the often-hidden labor behind commercial ML products.

DISCUSSION

So far we have used our one-year design research project to illustrate the interplay of unmaking and remaking in a series of drifts. We follow the analysis of Krogh and Koskinen [21] who see the journey of drifts as a vital process of knowledge generation in design research. Furthermore, we argue that compared with forward-oriented activities such as emergence [10] and reframing [47], the unmaking step within a drift deserves more attention both in theory and research practice.

Technical-material unmaking moments reflect situated knowledge with the design research environment, especially when working with tangible artifacts. The activities in the environment, as in Step 3 Unmaking and Step 4 Initiating New Experiments, require the design researcher to be open and receptive to changes and have intimate knowledge of the situation. By acknowledging technical-material unmaking as an inevitable phase in design research, the researcher may feel less pressured to jump to conclusions or one-size-fits-all solutions, and instead listen to the "conversation with materials" [38] and respond with situated action [41].

Conceptual unmaking moments can reveal how designerly abilities function in design research decisions. Especially in Step 2: Sensing Forces of a Drift, we observed that the design researcher's subjective judgment played a big role in deciding what to unmake in the later steps. The design researcher often becomes aware of their own positionality and preferences. It is also a vulnerable moment, where mixed emotions might arise as noted in the literature on unlearning as well [17, 23]. Being aware of how the design researcher navigates this complex intellectual and emotional landscape could build reflexivity and communicating this process could help others better judge the work.

Regardless of what is being unmade, unmaking moments are key points to derive knowledge and can often mark opportunities for future work. It is self-evident that things unmade due to feasibility issues could be valuable lessons for other researchers. However, unmaking could signal alternatives not yet explored. Within our project, we observed that the concept of ambiguity in Intimate Ambiguity, unmade in Hidden Labor in ML, was revived in the third encounter, Fallible Digital Memory. This project also leaves

loose ends available for future pursuits, such as the possibility of making an inflatable sensor, a musical instrument, or a large wearable device, as well as the possibility to investigate new directions for the three earlier framings.

An Invitation

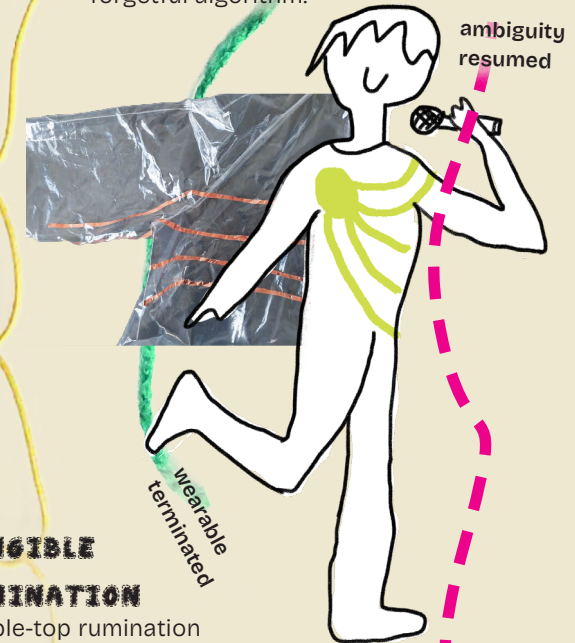
To reveal the material knowledge, designerly decisions, and the opportunities for future work, it is important that unmaking in design research is communicated. This pictorial joins the effort of theorizing design research journeys (e.g. [3]), as well as documenting and sharing drifts, e.g. [13, 14, 16, 47]. Echoing Zimmerman et al. [47], these documentations avoid presenting a "romantic and magical" account and present "proof" that the new frame is better than the old. Furthermore, we argue that communicating unmaking moments can be more than proof, but a valid tool for active reflection on subjectivity and design judgment, and the narrated journey could invite readers to co-explore and thus generate knowledge in their participation with the account.

CONCLUSION

Through the project documentation and reflection on drifting, we highlighted how drifting could be decomposed into two reciprocal phases, a generative, forward-moving phase presented as making, and an unmaking phase where progress on concepts and material artifacts were reversed. Via a six-step process, we characterized how conceptual and material-technical unmaking and remaking coexist and interact within an emergent design research project. We argue that unmaking tangible artifacts reveals situated actions [41] within the material environment and reflections-in-action [38] while unmaking concepts illustrates how designerly abilities function in design research decisions. Moreover, we believe that unmaking moments are key points to derive knowledge and mark opportunities for future work and we encourage the HCI community to document and share their drifting journeys.

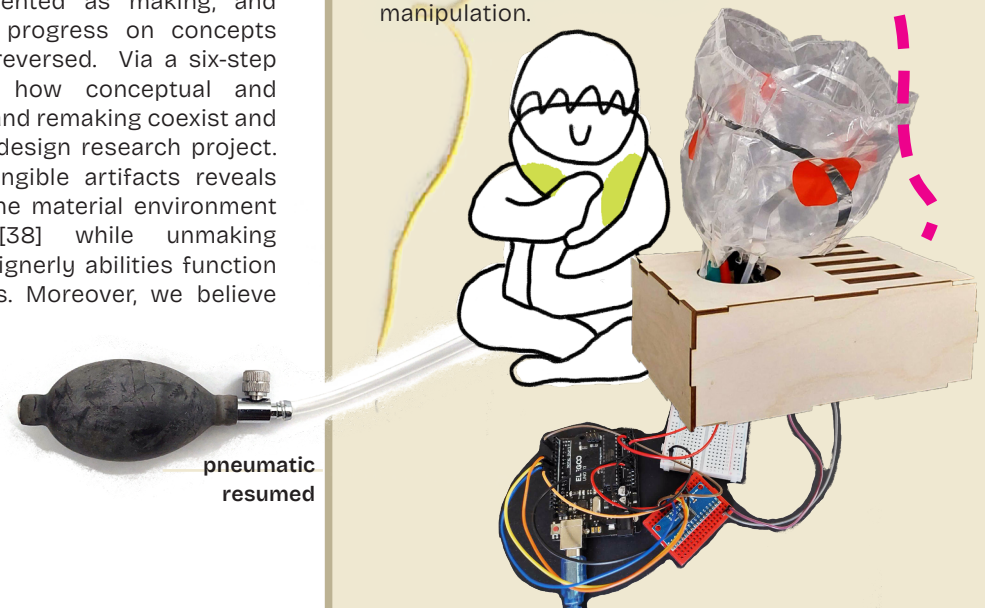
FALLIBLE DIGITAL MEMORY

An alternative memory storage device which maps the state of pouches to voice recordings with an unstable and forgetful algorithm.



TANGIBLE RUMINATION

A table-top rumination companion which the user records thoughts into via repetition and pouch shape manipulation.



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