



Slanted Speculations: Material Encounters with Algorithmic Bias

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ABSTRACT

Over the past few years, AI bias has become a central concern within design and computing fields. But as the concept of bias has grown in visibility, its meaning and form have become harder to grasp. To help designers realize bias, we take inspiration from textile bias (the skew of woven material) and examine the topic across its myriad forms: visual, textual, and tactile. By introducing a slanted experience of material and therefore of reality, we explore the translation of fraught machine learning algorithms into personal and probing artifacts. In this pictorial, we present nine pieces that materialize complex relationships with machine learning; ground these relationships in the present and the personal; and point to generative ways of engaging with biased systems around us.

AUTHORS KEYWORDS

Algorithmic bias; machine learning; materiality; arts; speculative design; design practice

CSS CONCEPTS

- Human-centered computing~Interaction Design~Interaction design theory, concepts and paradigms

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INTRODUCTION

AI bias is all around us. We read about it in morning newsfeeds and encounter it in the sorting algorithms that power them [3,5]. We learn about it in documentaries and watch it unfold in the recommendation algorithms that arrange that content on video streaming platforms [9,14,33]. As designers, some of us grapple with digital applications biased against us; others of us develop those biased applications; and most of us contribute to systems that perpetuate the very bias we try to design away.

But across each of these contexts, what exactly designers mean by bias — its scope, location, duration, and ontological status — can be hard to pin down. Look up the term bias in the dictionary, and a range of meanings emerge. The term can invoke unfair prejudice against a person or group. Or, it can refer to systematic error. But bias can also draw from its etymology in textiles to prove powerful and new. In the garment industry, bias refers to the intentional skew of material. Think of an ordinary handkerchief turned on the diagonal. That tilt (or bias) allows the fabric to drape and stretch in ways it couldn't before—making anything from baby diapers to gowns. When it comes to bias, it's tempting to suggest that designers just need to remove it [6,26,34]. But our capacity to imagine otherwise might also depend on it.

In the pages that follow, we explore this algorithmic complexity by putting material bias in conversation with cultural bias. Following the foundational work of historian Marisa Fuentes and English scholar Linda Brodkey to complicate the process of reading and writing along the bias [9, 21], we use textiles as a metaphor. We describe a series of course projects that examine the multiple etymologies of bias in machine learning systems and our approach to cultivating a slanted speculative practice. The concept of slanted speculation grows out of a long tradition of artistic practice [8,16,26,38,42] that treats bias as a skewed use of material and AI bias as a skewed use of computational design. Where speculative design tends to ask questions of “What if?,” slanted speculation tends to

emphasize questions of “Yes, and?.” The projects we describe do not remake a given machine learning system; they instead use the system to create new and different orientations—pointing to varied oblique and non-conventional perspectives on the political form and texture of computational developments.

Across this work, the “bias cut” functions as a metaphor to work with cultural bias and not against it—to repurpose it and to create new effects (fluid versus straight, etc.). We illustrate how the work we created as a result of this framing displayed a techno-poetics of algorithmic bias—a material and personal engagement with the machine learning systems around us.

Through this process of engagement, we make three contributions to design scholarship. First, we present nine projects to provoke and inspire material and speculative approaches to the question of bias in AI systems. Second, we identify three strategies for slanted speculation: folds, knots, and ellipses, which offer preliminary tactics for working with the current machine learning landscape and skewing its many narratives. We end with a reflection on material approaches to algorithmic bias, hoping they stimulate conversations around personal, exploratory and generative slants towards the biased AI systems we live with.

ALGORITHMIC BIAS IN HCI AND DESIGN

A large body of work within design and HCI literature considers the consequential role of personal and cultural bias in the development of algorithmic systems. Drawing on scholars like Ruha Benjamin [5] and Sasha Costanza-Chock [13], HCI researchers have pointed to the feminized tone of voice assistants [50]; the harmful misgendering of airport scanners [47], and the dangerous misrecognition of Black people's faces by police scanners [34]. Running through this body of work is the argument that data is neither neutral nor objective and to “do” data science requires we ask certain questions: who counts and how? Whose interests are represented and what narratives are put forward [15,48]? To date, this work has offered a range of approaches for addressing bias, including the potential for “debiased” systems [28] and the importance of recognizing the role that access to rapidly growing datasets plays in infrastructural surveillance [23], as well as rethinking the assumptions and beliefs that inform data labels and categories [28].

SPECULATIVE AND MATERIAL APPROACHES TO ALGORITHMIC BIAS

While empirical, technical and critical approaches to algorithmic bias are prevalent in design, speculative and material approaches remain underexplored. Artists and activists have been developing projects that engage with questions such as the politics of data collection [39], invisibilized labor [17,25], resource extraction [15], privacy concerns and the intimate nature of our relationships with AI [38], among others. This body of work from the arts leverages “aesthetics as the common language” [18] to invite a larger audience of non-experts to reflect on and ponder the impact of AI systems on citizens’ lives, with particular attention to communities historically left out of these systems’ designs [19]. For instance, in her piece Not The Only One [18], artist Stephanie Dinkins explores the multigenerational memoir of a Black American family as told from the perspective of a deep-learning system. The new narrative form that emerges reveals both the generative quirks and the limitations of AI to deliver certain kinds of (his)stories. These works are not offering to “solve” bias but rather to give more entry points into the “sneaky and diffuse” [17] forces – geopolitical, social, material and cultural—that operate through AI systems.

These forces, however, are not shapeless. Subtle and hard to trace as they may be, they often take on tangible and seemingly mundane forms, which the following nine projects consider. Whether it’s through visual means, with deep fakes and GAN imagery; textual explorations, with natural language processing algorithms; or tactile probes, which materialize otherwise intangible interactions and encounters, the projects presented in this pictorial engage with the various forms of machine learning and bias—amplifying what often remains a computational murmur and slanting the AI-controlled narrative to reveal its subtext.

The projects grew out of original work by each of the authors responding to tactile, visual, and textual speculations with bias. In the following section, we describe the prompts as well as the rich set of approaches for slanted speculation that emerged from them. Together, these approaches expose the collective thinking that came from ostensibly individual work.

TACTILE SPECULATIONS

The pieces presented under this rubric use material means –whether fabric, food or found objects– to reflect on encounters with AI and bias. The prompt used for these projects encouraged physical and sensory investigations of machine learning, enabling the authors to think about data in tangible and situated ways. Algorithms function off of invisibility. Their presence is designed to be invisible to the user, and therefore its hardware and labor are also rendered invisible or unobtrusive. The projects in this section engage with the often invisibilized physicality of machine learning labor and infrastructures by turning data into palpable objects and interactions.

VISUAL SPECULATIONS

Visual speculations make use of the graphic possibilities of machine learning: GAN imagery, deep fakes, and other algorithmically generated images. The prompts that guided the projects in this section asked the authors to engage with these visual tools to reinvent artifacts or craft new narratives. The images often speak to the authors' immediate concerns or hidden histories. The projects in this rubric share a sensibility which is anchored in the intimate, the personal and the poetic. These pieces and the conversations that fueled them draw from the authors' identity and experience – starting from individual reflections and developing into a joint language of technological consideration.

TEXTUAL SPECULATIONS

The pieces presented in this section explore the algorithmic manipulation of text. Textual speculations, because of their literal medium, enable the authors to explore their own associations and complicities with AI systems, while remaining probing and interpretative. The projects in this section think of text expansively as a technology of inscription that encodes specific worldviews and particular narratives around gender, social hierarchies, human and non-human value(s) and design paradigms.

TACTILE *speculation*

LIFE MEASURED OUT IN COFFEE SPOONS

Machine learning systems are trained on data but the value or origin of this data remain hidden, obscuring the sometimes poetic and daily rituals that make up data in the first place. In this piece, Anna asks what it feels like to treat mundane waste as vital data. Inspired by the line “I have measured out my life in coffee spoons” from T.S. Eliot’s “The Love Song of J. Alfred Prufrock,” Anna creates material traces of her morning routine over six days. She treats the spoon that she uses to stir her French press as a stamp inked with coffee. Pressing the spoon to paper, she makes one print per day and collects the remaining grounds in a small vial. She then displays the vials in sequence alongside the final collage. “I have always been intrigued by the thought that my coffee consumption communicates an essential aspect of my existence,” she explains. Juxtaposing her six instances of coffee consumption in a single frame exposes how each coffee spoon print transforms based on her movements, which then shift according to her moods and mental state. Data becomes temporal and the embodied record of a mundane ritual.

**“Transforming my morning coffee
into a print led me to consider how
our bodies transform the environment”**

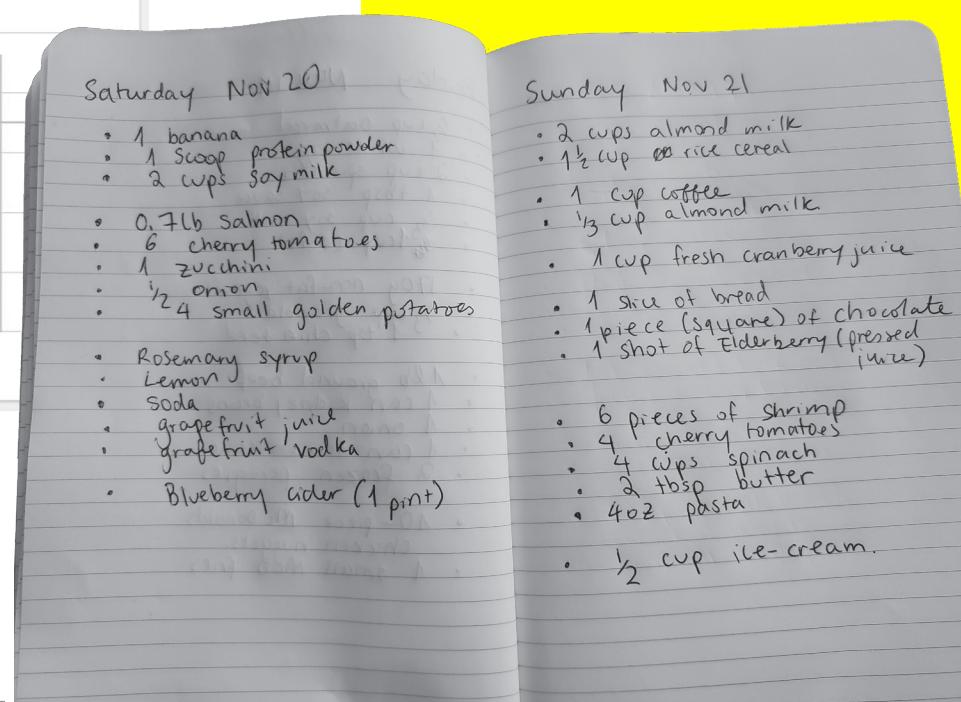
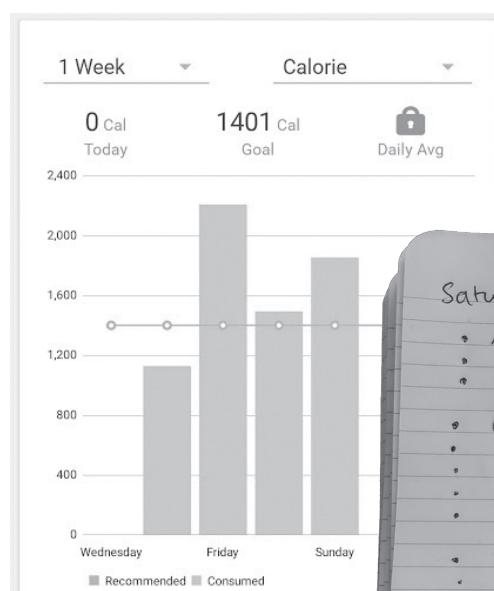
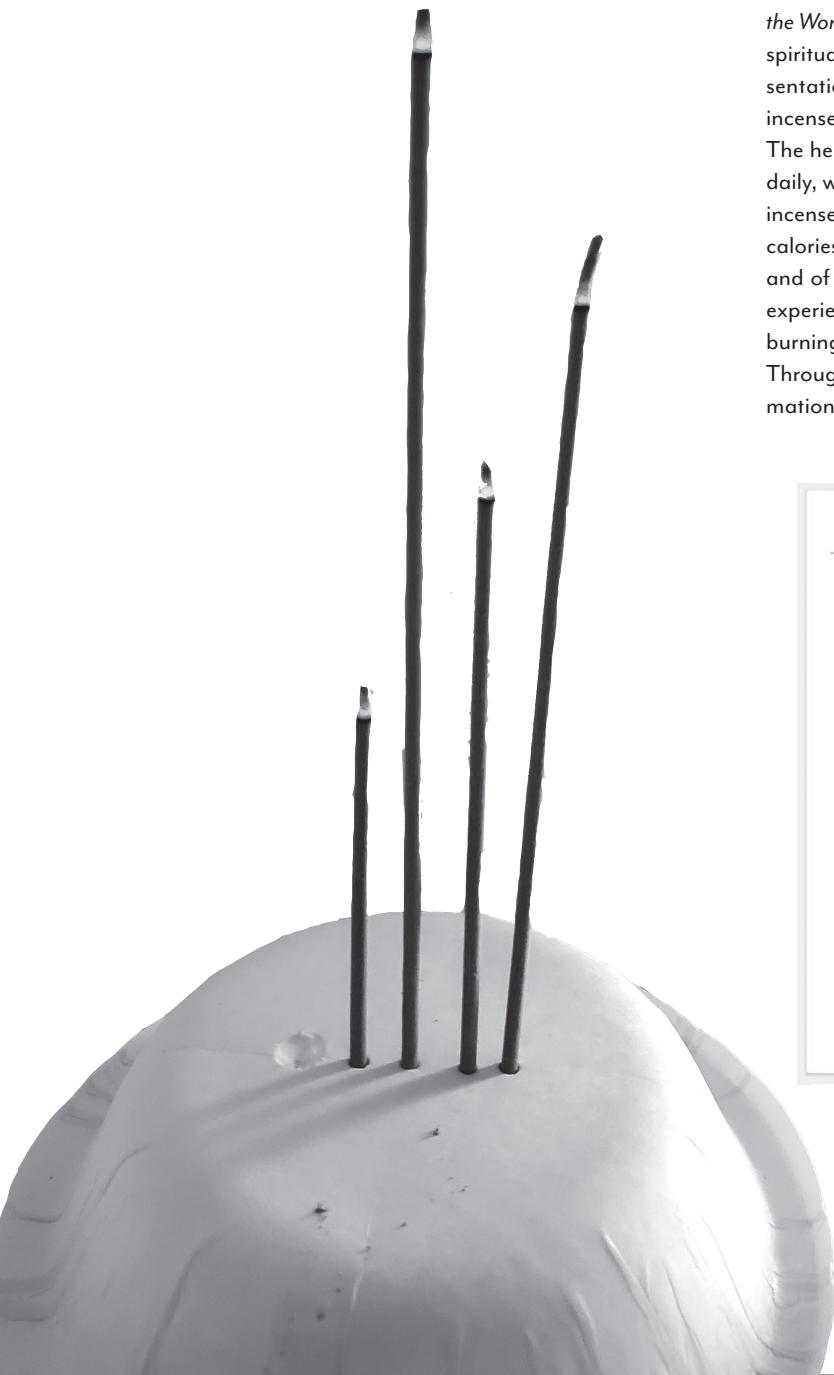
—Anna



TACTILE speculation

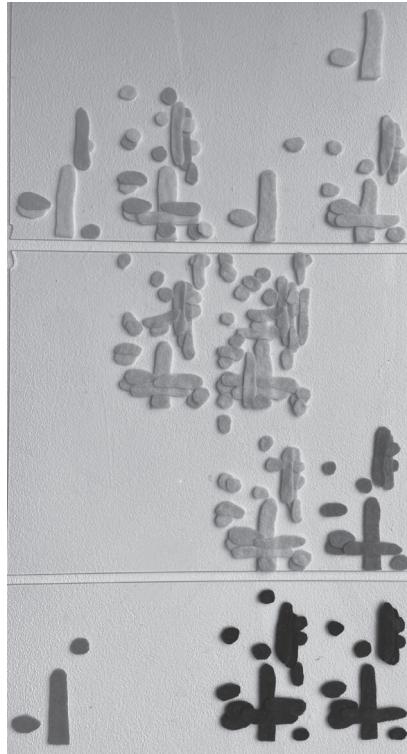
BURNING THE WEIGHT OF THE WORLD

The digital services made possible by machine learning condition bodies and behaviors in both obvious and subtle ways. *Burning the Weight of the World* is an ephemeral installation that links Anh's calorie count to her spiritual practice. Informed by experiments with immersive data representation [19], she develops a three-dimensional bar graph with sticks of incense, placing one stick after another in an upright holder, side by side. The height of the sticks corresponds to the number of calories she burns daily, with the sticks representing distinct, successive days. In the burning incense, she reflects on the layered residues of data collection—loss of the calories, of the incents, of the data materializing calories through matter, and of the lingering smell. "This project gave me a speculative learning experience about being a 20-something woman living, consuming, and burning food in a beauty-obsessed, weight-loss society," she observes. Through burning data and calories, Anh makes entangled data transformations newly accountable to the senses.



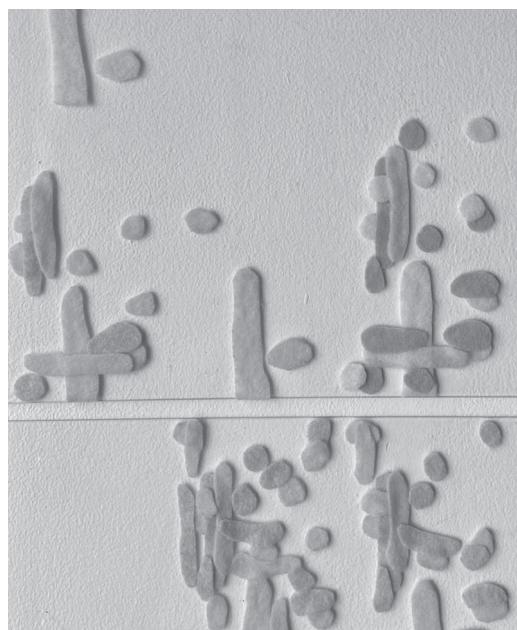
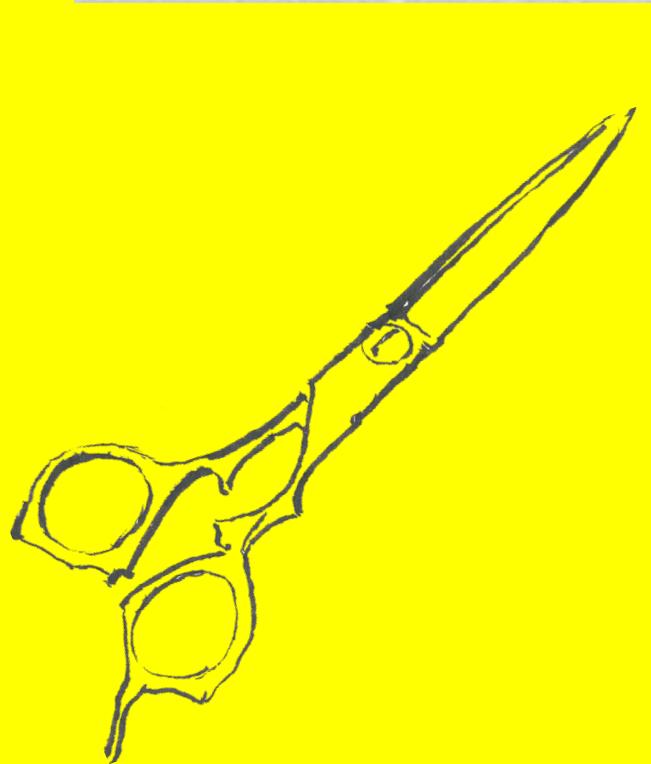
"The language of dieting centers around the image of 'burning'—'burn fat,' 'burn calories'—as though food is something to destroy as soon as we consume it for survival."

—Anh



“Movement and physicality can affect how we receive and interpret information.”

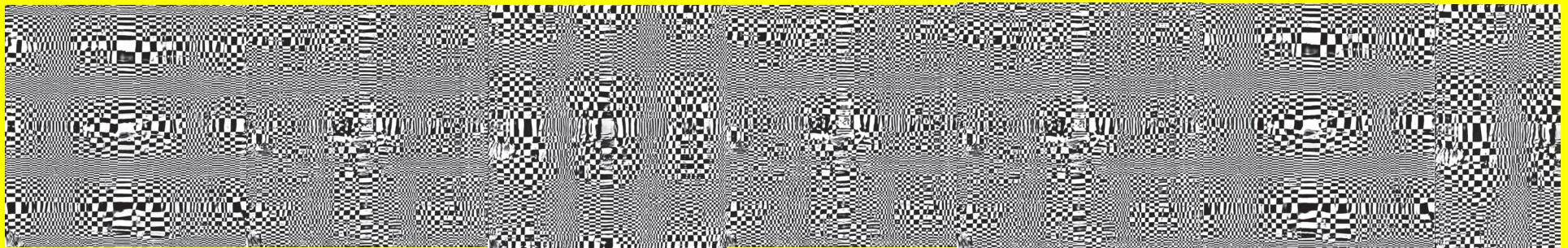
-Kathryn



TACTILE *speculation*

TOUCH

Touch is a soft materialization of smartphone use data. Engagement with social media and use of digital services start with the small flick of a thumb: the swipe. In this piece, Kathryn explores the physical origin of much bias in AI. Taking data recorded by the Screen Time feature on iOS devices, Kathryn materializes each instance of unlocking an iPhone. Cut felt visualizes the small gestures of fingers navigating a digital space through the phone screen. Kathryn recalls, “Collecting this data and materializing it made me reflect on movement between virtual and actual space, noticing the differences in my inhabitation of each, and the constant of my bodily presence in both. Virtual and actual space could find more ways to be present in each other; we know they don’t exist exclusively, yet their relationship is often felt as dichotomous as an implication of the tracelessness of our interactions.” By materializing encounters with the device, Kathryn reckons with the idea of how movement and physicality can affect how we receive and interpret information—and possibly generate or encounter bias.



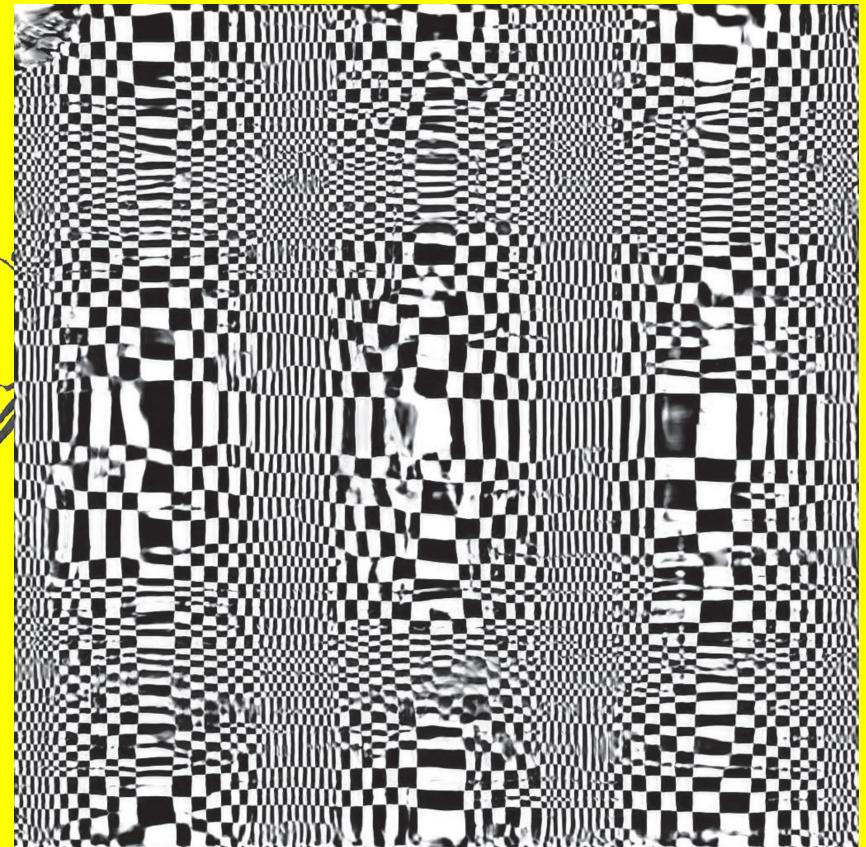
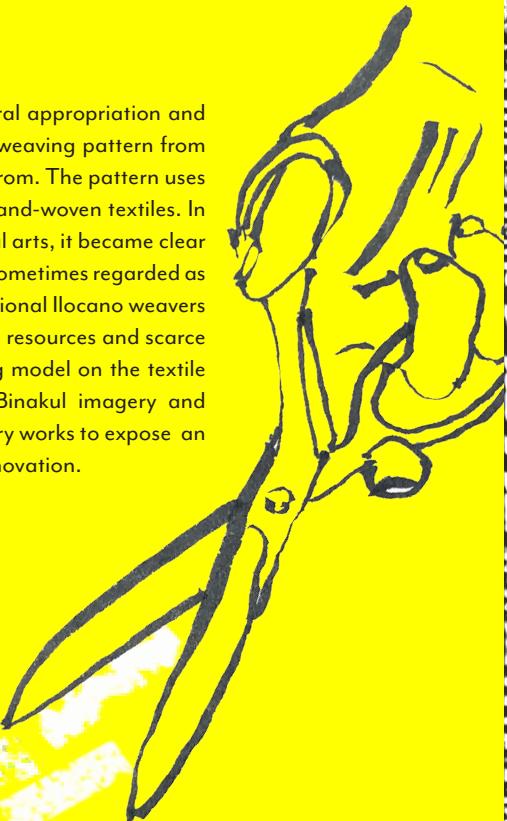
VISUAL *speculation*

WARP

Warp uses ML techniques to explore the contours of cultural appropriation and erasure. Kathryn was inspired by Binakul, an Indigenous weaving pattern from the Philippines' Ilocos and Abra region where her family is from. The pattern uses math and repetition to create an illusion of curvature on hand-woven textiles. In trying to collect data and learn more about these traditional arts, it became clear that this certain textile pattern was often compared to and sometimes regarded as modern, Western art, 1960s Op Art. "The heritage of traditional Ilocano weavers are continuously threatened by dwindling access to natural resources and scarce documentation," she opines. "Training a machine learning model on the textile images, I produced a set of algorithmically-generated Binakul imagery and projected them on the wall." The ML-generated wall imagery works to expose an under-recognized history of aesthetic and mathematical innovation.

"Bias in archives and cultural documentation are constantly threatening to create illusions in history."

-Kathryn



“I wanted to create something that would be reflective of my own culture, but also highlight the preexisting technology within it. I am also holding space for the dichotomy between modern society’s demonization of black hair expression and its simultaneous appropriation of the same expression. This project attempts to reinvent, or imagine the art of black hair retrospectively.”

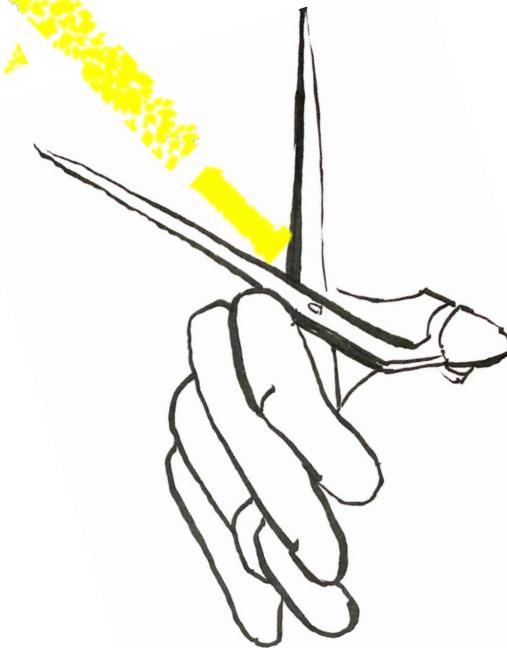
—Chariell

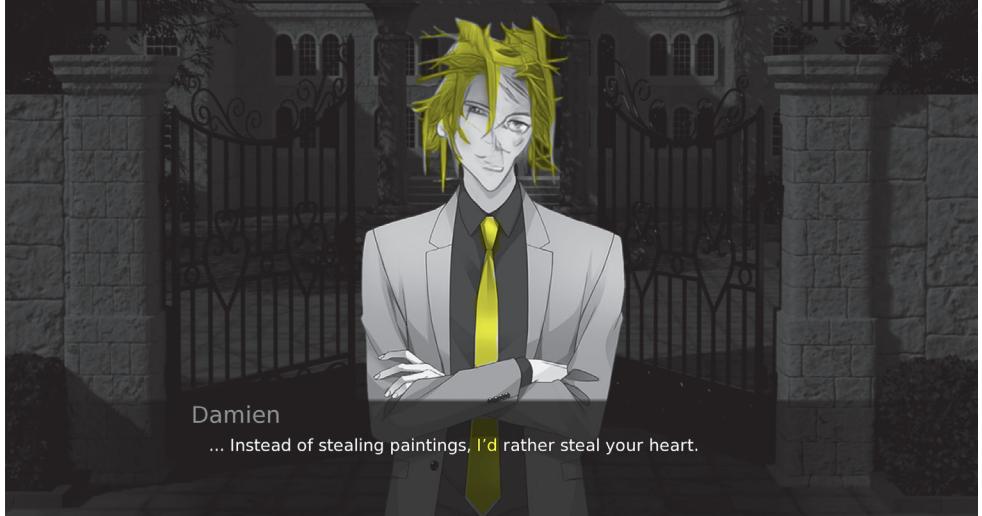
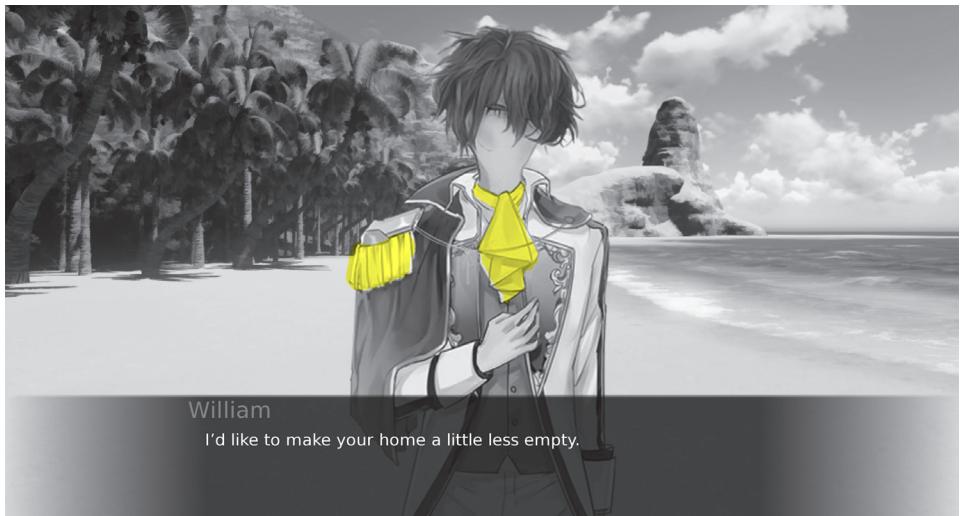
VISUAL speculation

HAIRSTYLEGAN

HairStyleGAN is an experimental encoding of text in algorithmically generated photographs of braided hair. The algorithm takes in a short to medium phrase as input, and “translates” it into a seed. Seeds are internal coordinates within a StyleGan2 vector that allows for the discrete location of a particulate section within the model. The resulting image encrypts a representation of a cultural artifact.

In the images presented here, Chariell hides excerpts from Audre Lorde’s poem “A Woman Speaks” in views from the back of a person’s head. The stanza “I do not mix / love with pity / nor hate with scorn” appears below an image of several twisted coils meeting at the center. The braided head rests above an impossibly wilting neck, one of the only visible traces of algorithmic sorcery. To create the imagery, Chariell trained a model that would generate new braiding hairstyles, based on a dataset of unique braided hairstyles. “I trained a model for a total of 5,000 steps, and determined that it was effectively creating unique variations. After I achieved this I wanted to operationalize the model through a system, to revisit the function of language in traditional hair braiding technology.” These explorations grow from their reflections on Generative Fiction and how language models get built. Left in black and white, the synthetic photographs are sensual and arresting. They push the viewer to look closer rather than recoil from the erasure of Blackness, as Audre Lorde’s excerpt describes.





“My visual novel explores a critical stance to infrastructures of algorithmically-mediated forms of technology, intimacy, and personalization through the topic of subscription services.”

—Neilly

VISUAL *speculation*

DATING SIMULATION

Dating SIMulation is a playable, interactive visual novel where users can date characters from GAN-generated deep fakes. Neilly created the deep fakes from a dataset of characters from “otome games” dating sims. Otome games are video games that allow users to play through different romance scenarios where the goal is to date or develop a relationship with one of several characters. “My visual novel explores a critical stance to infrastructures of algorithmically-mediated forms of technology, intimacy, and personalization through the topic of subscription services,” says Neilly. She develops the storyline around a (fake) new system called the Amazon Echo Companion, which is a subscription service for an all-in-one virtual assistant and romantic partner. The user is given \$20 of free trial money to explore dating each of these bachelors, being able to only access certain ‘childhood memories’ or romantic exchanges if they pay a certain fee. “This experience helped me to engage more deeply with questions around decontextualization and consent,” Neilly observes. Through the process of training a deep fake dataset alongside human faces, she sees visual bias as a prompt for reflection on larger landscapes of technological development and the racial capitalist imagination.

“Satellite images from tools like Google Earth illustrate the progression of the linguicide and historicide happening in communities. It is made visibly quantifiable by the number of speed boats, resort buildings, and golf courses that are increasingly visible in the satellite images.”

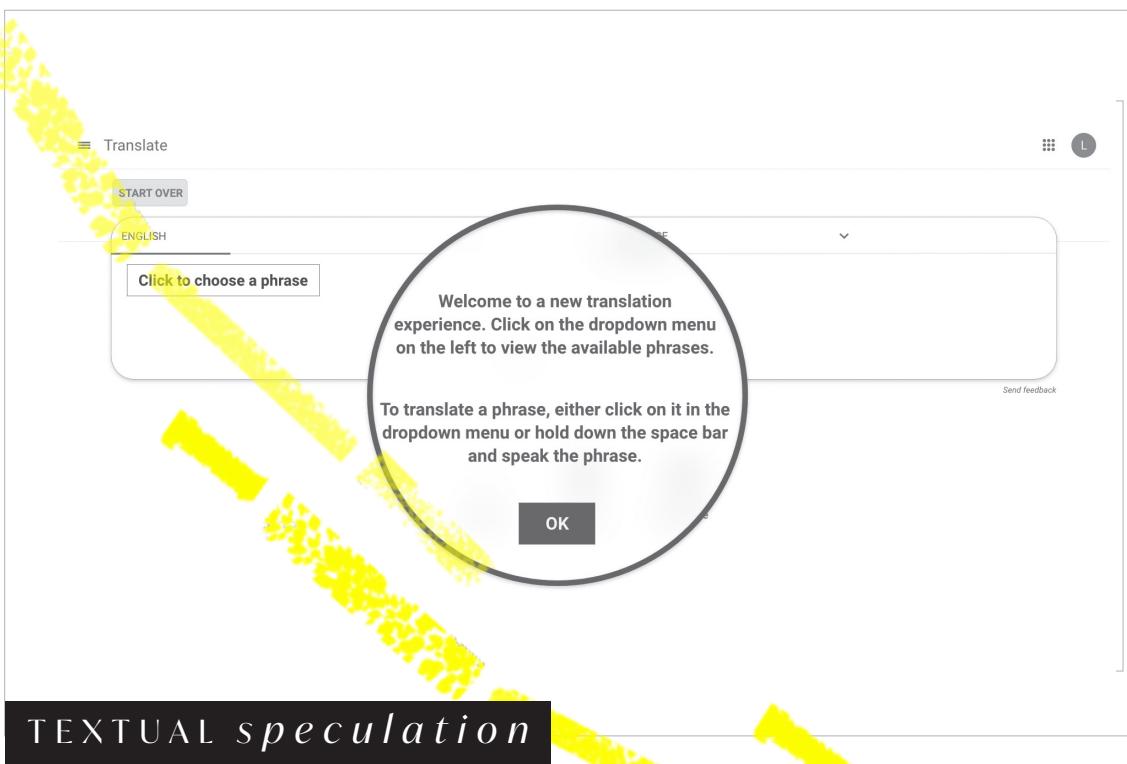
—Chariell

VISUAL *speculation*

SPECULATIVE LANDSCAPES

Speculative Landscapes is an ongoing artwork that explores historically black landscapes along with the cultural progression of the communities tied to the land. The project began with the Gullah people, a group of descendants of West and Central Africa who purchased land, and built a sustained community in Carolinas. However, as the property values went up, real estate capitalists found loopholes that allowed for the slow erosion of the communally held Gullah land. Today, where there was once Gullah farms, churches, schools, and graveyards, there are vacation resorts and golf courses. Maps are often tied to colonialist ideas of ownership, boundaries, and territories. They also create documented versions of a reality that are assumed to be true. With this mapping in mind, Chariell created a “deepfake” version of an area where a historical grave site was being encroached upon by a vacation resort. Using segmentation, they removed all of the buildings, speedboats, and signs of disturbance around the cemetery site as a restorative speculative gesture. The resulting documentary begs the question of what is truly the deepfake in this situation, the alternative reality, the truth?





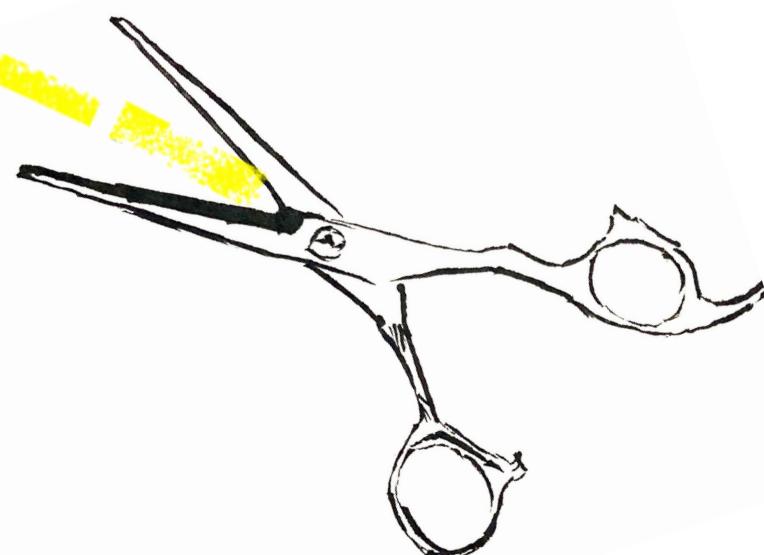
TEXTUAL speculation

(DE)CONTEXTUALIZING LANGUAGE THROUGH GOOGLE TRANSLATE

While learning Korean, Lacey inputs the phrase “Do you like that guy?” into Google Translate and receives the result “그 남자 좋아해?” Unlike the ~~나 ending, the resulting Google Translate ending makes assumptions about the sexuality and gender of the person spoken to (in this case, a heterosexual female). Flipping the script, Lacey then tries the “gender-neutral” language Bahasa Indonesian with the phrase “Dia seorang presiden,” which translates to “They are president.” The Google Translate result shows “He is president” instead. Inspired by the gendered assumptions built into the tool, Lacey builds *(De)Contextualizing Language*, a prototype system that translates English (voice and text) into Japanese and then asks the user for highly specific, contextual data that may alter the translation. She draws examples from academic papers studying politeness levels in Japanese; when the system shows a user the updated translation, they hear the text from the relevant academic paper. She chose to focus on politeness levels because they are both embodied and grounded, reflecting the speaker’s and listener’s ages, job titles, and relationship; the environment in which they’re speaking; and the mood of the conversation. With this system, she seeks to complicate questions of language as data: when does data work as context? And when does context work as bias? Which voices inform translation, and which voices are left out? Finally, given the complexity of language, what constitutes “enough” data? By paying attention to gendered assumptions built into the tool, the system offers a performance of ML bias—showing what bodies and algorithms produce in tandem.

“Google Translate takes a scientific approach to language, assuming that language can be broken down to its key components and stripped of context – history, politics, gender. However, its knowledge is generated entirely from “real world” language data.”

–Lacey



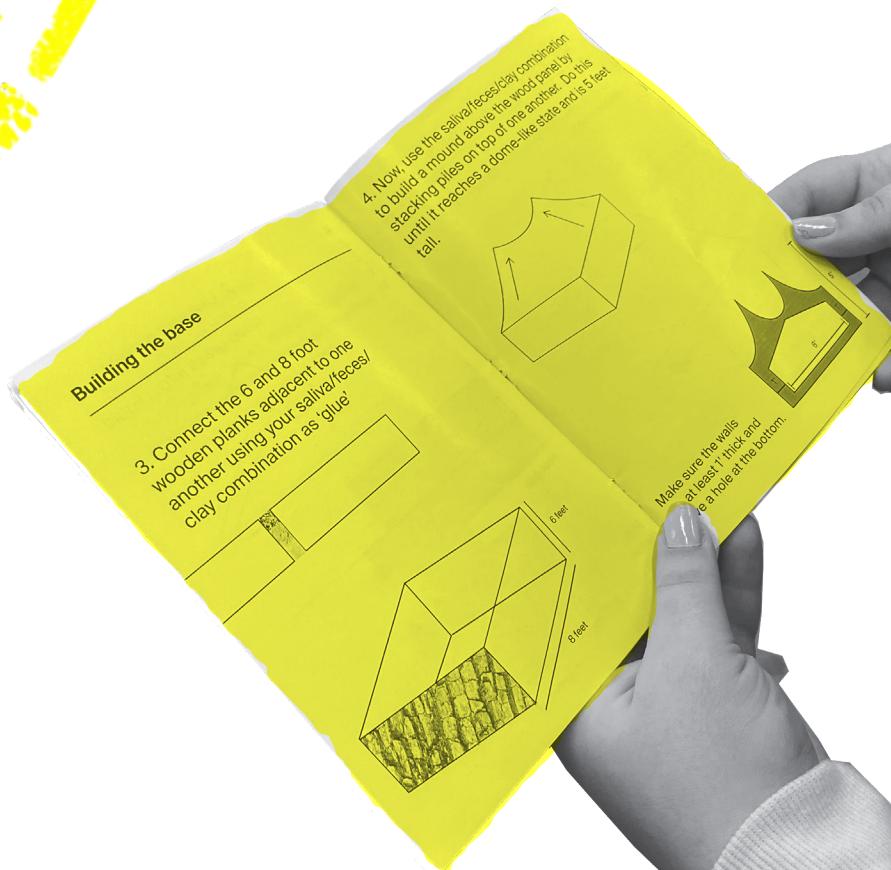
TEXTUAL *speculation*

TERMITOMYCES BED

Deeply entrenched AI bias shapes not just digital systems and online interactions but our built environment as well. *Termitomyces Bed* is a speculative manual for growing furniture the way termites grow timber-based habitats. Inspired by the Silk Pavilion and other works by Neri Oxman [40], Ashten explores the relationship between the built, natural, and biological environments. “This came from my interest in animal architecture and how insects such as termites build compounds with more advanced structures than our own based on instinct and collective effort,” she explains. By merging termite technology with conventional bed construction, she imagines what it would be like to treat evolution as the standard for advancement over industrialization. “We can start to see how far the built structures we know today have strayed from natural forms.” The speculative equivalent of IKEA assembly instructions, *Termitomyces Bed* highlights how ingrained worldviews live in the most prosaic documents—and how these documents can also hold space for alternate visions.

“**By merging termite technology with how we typically view the process of building a bed, we start to see how far the built structures we know today have strayed from natural forms.**”

—Ashten



THREE STRATEGIES FOR MATERIAL ENGAGEMENT

Across each project, authors engaged with a variety of topics such as data labor, the anatomy of AI systems, data representation and the relationship between algorithmically created content and reality. These works reflect a shared sensibility towards algorithmic bias—a sensibility that weaves the personal and the formal and adopts a poetic slant towards AI systems rather than an empirical or technical one. Perhaps more importantly, these interventions do not seek to redesign AI systems; they do not offer recommendations on how to make systems less biased. Rather, they work *with* bias to imagine fairer encounters, ones that reorient the aim of everyday algorithmic technologies and expose the entanglement of our lives with these systems. As such, they echo and expand on other design approaches for recasting narratives, imagining alternative presents, and inquiring through material means [2,11,46,49]. Building on this work and on the projects presented in this pictorial, we identified three types of strategies for slanted speculation—material and conceptual tools for engaging with AI systems. These strategies are ellipses, knots, and folds.

FOLDS

The first orientation visible in these works is towards the authors themselves, their lives and daily encounters with digital technologies. Like Höök's somaesthetic design [30], this is not a solipsistic orientation but rather a self-reflexive move through which these designers locate themselves within the very thrust and sweep of these systems. Through the collection of their own data—sleep patterns, consumption habits, physical interactions with technology—and the narratives they choose to highlight or examine, the authors do not expose bias so much as fold it upon itself—piling up layers of technical, material, and critical accounts of AI systems. Kathryn's *Warp*, for instance, highlights the entanglement of material, cultural and personal narratives and the way they can be re-imagined with algorithms. Similarly, Chariell's *Speculative Landscapes* uses machine learning to wrap a particular colonial narrative within a re-fictionalization of the landscape, calling attention to the ways documents create reality.

ELLIPSES

The second orientation is towards gaps and context rather than complete or definite accounts. Echoing tactics in ineffable design [7] and fabulations [46], ellipses are omissions from speech (or writing) of a word or part of phrase that can be understood from contextual clues. Like Chariell's braided poetry, Neilly's *Dating SIMulation*, and Lacey's experiments in translations, expressiveness comes just as much from the interventions themselves than from what they leave out: the silencing of braided hair as a technology; the histories of connections and longing in virtual spaces; the context that is abstracted in the algorithmic manipulation of language. By being freed from the demands of producing exhaustive accounts of their encounters with biased systems, and of the harms they (can) produce, the authors were able to express inclinations and affiliations with their algorithmic landscape that would have otherwise gone unnoticed.

KNOTS

Following this positioning, the third orientation is towards knots: the associations and re-arrangements of the threads that run from machine learning systems to their micro and macro effects. Building on Wakkary's repertoires [49], knots tie together the various strands—political, material, social, personal, technical—that make up the designer's experience with everyday algorithms. Through this orientation, the authors were able to make connections between seemingly disparate aspects of their involvement in machine learning systems. Whether it's Anh's calories incense sticks, which lace together cultural and physical concerns with the stabilizing effect of algorithmic tracking, or Ashten's thermocytes bed manual, which knits together the natural and the manufactured, many projects displayed an inclination towards the compound rather than neat lines. The knots they tie do not only bring together the strands of their experience with machine learning but also pull the audience into their engagement, inspiring association and connivance rather than blame.

CONCLUSION

In this pictorial, we presented nine projects that engage speculatively and materially with topics of algorithmic bias. We reflected on these projects and identified strategies for slanted speculation, an approach that treats AI bias as a tool for tilting conventional encounters with machine learning. We described folds that layer personal experiences with AI, knots that tie together the narratives and stakeholders of these experiences, and ellipses that leverage context and gaps in the process of making sense of data. These tactics participate to broaden the approaches to AI bias in computational and interaction design—encouraging the use of speculative and material techniques alongside the empirical, technical and critical perspectives already operative in the field. These projects were developed over the course of a few weeks and yet offer interesting insights into the rewards of using bias as a material technique rather than an issue to solve at all cost. Moving away from the urge to frame interactions and systems as problems to fix, slanted speculation retains the “problem” in bias—not resolving it but rather tilting it so that it can cast a different light, generate different encounters. There is still much to explore in this regard and we hope that these projects encourage designers to consider the bias of machine learning as another possible instrument to investigate not only what AI systems could be, but also reformulate what they already are.

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