

Sonic Technologies of a Queer Breakup

Brian Kinnee
Human Centered Design &
Engineering (HCDE), University of
Washington
bkinnee@uw.edu

Daniela K. Rosner
Human Centered Design &
Engineering (HCDE), University of
Washington
dkrosner@uw.edu

Audrey Desjardins
School of Art + Art History + Design,
University of Washington
adesjard@uw.edu

ABSTRACT

Over the past decade, the growth of voice assistants has presented new challenges within domestic life. Prior research has shown that such technologies affect users unevenly or fail to account for some relationships and domesticities entirely. Our work investigates the under-examined topic of queerness at home. Drawing on the experience of queer breakup, we describe a design inquiry and a first-person research approach exploring two concurrent relationships in separate households both using Alexa. We explore issues of temporality, glitch, and shared accountability. We also ask critical questions with audio experiments, including: How do voice assistants differentiate between queer voices? How should we converse with voice assistants about queerness? And are voice assistants “queer enough”? We contribute a discussion of difference, inclusion, and queer cultures of adversarial use to highlight the limitations of both everyday and professional language for describing and analyzing the particulars of queerness and interaction design.

CCS CONCEPTS

• Human-centered computing; • Interaction design; • Interaction design theory, concepts and paradigms;

KEYWORDS

Design research, first-person research, sound, queerness, voice assistants, domestic devices, IoT, artificial intelligence, machine learning

ACM Reference Format:

Brian Kinnee, Daniela K. Rosner, and Audrey Desjardins. 2022. Sonic Technologies of a Queer Breakup. In *Designing Interactive Systems Conference (DIS '22)*, June 13–17, 2022, Virtual Event, Australia. ACM, New York, NY, USA, 17 pages. <https://doi.org/10.1145/3532106.3533542>

1 INTRODUCTION

Imagine you’re listening to an audio recording. You hear a waffled ringing at two pitches, one low and one high, repeating in quick succession three or four times. Then a middle pitch drops into the mix, looping until the listener begins to feel uncomfortable. A softer voice interjects: “Thanks, Alexa. Alexa- Thanks, Alexa. Alexa-” repeating four or five times until the speed of the ringing increases and then stops. Thanks, Alexa,” the voice states one final time, all on its own.



This work is licensed under a Creative Commons Attribution International 4.0 License.

DIS '22, June 13–17, 2022, Virtual Event, Australia
© 2022 Copyright held by the owner/author(s).
ACM ISBN 978-1-4503-9358-4/22/06.
<https://doi.org/10.1145/3532106.3533542>

Listen closely to this clip and it might sound like a dreamscape: a voice assistant ignoring a user; a voice assistant overpowering a voice command; a background drumbeat for a movie score. A sound clip like this might be compared to noise music, a mode of challenging the musical, stretching what we might hear inside an audio track and characterize as melodious or tuneful. Pay more attention, and it might sound like a scattering of glitches, a mixing together of the left-over audio, the mistakes and defective bits recorded from interactions with a particular smart technology. You may listen to this clip in the supplementary materials in the ACM digital library.

The above sound clip is all those things and more. It’s a remixed version of sound recorded by the Amazon Alexa and labeled “Audio was not intended for Alexa.” A sound clip of someone saying “thanks, Alexa” seems like it would be considered “for” Alexa. But the transcript from Alexa says otherwise—no transcription of the utterance exists. According to Alexa, the “thanks” was not intended for the device. What makes a voice assistant application not recognize a speaker as talking to it? The above sound clip responds to this curiosity by stringing together examples of audio with the same “not intended” label within a single audio file. The resulting remix extenuates the contrasting types of overlooked sounds and allows a close listener to notice the intentionality in the speaker’s voice.

In our project, and in the paper that follows, we use this clip and others like it to explore questions of queerness, ‘smartness,’ and social connection. Our design inquiry involves a process of listening to voice assistant recordings and learning to notice the unintended and under-explored moments they describe. It began with the observation that the Amazon Alexa voice assistant wasn’t able to keep track of queer voices, confusing one voice for another. This simple observation led to a lengthy investigation of what kinds of queer experience the voice assistant does and does not encode through the medium of sound and their consequences for everyday life. Within this inquiry, we explored how using Alexa in queer relationships, across multiple partners and multiple homes, changes what kinds of encounters (practical, emotional, instrumental) the voice assistant opens up and forecloses.

This paper sits at the intersection of several conversations within design research and adjacent fields of human-computer interaction (HCI) and computer supported cooperative work (CSCW). These fields have separately investigated topics of queerness, domesticity, and sound interaction. But they have only begun to examine their intersections—examining the potential of using sound to tell stories about technology that “theorize and produce new knowledge through listening practices,” as Pedro J.S. Vieira de Oliveira explains [77]. Within these developments, HCI researchers face an uphill struggle. Working with sound is challenging; it can be difficult to

analyze collectively; and it can be difficult to represent with text and image. To be sure, you may be experiencing this challenge as a reader of this paper now.

To investigate and further probe the potentials of sound and technology, this paper describes a combined autoethnographic [32, 36] and design inquiry [89] of a queer breakup mediated by two Alexa devices in two homes over nine months. We detail the process of downloading transcripts of Kinnee's two Alexa devices and using dialogical exchange with audio experimentation to analyze Kinnee's data. Informed by and extending prior work [20, 35, 58, 60, 102], we focus on the *sonic*—any phenomena or experiences relating to sound. In particular, we ask: What kinds of sounds aren't noticed by users but are noticed by voice assistants? What kinds of sounds aren't noticed by voice assistants but are noticed by users? How might smart technologies offer an alternative perspective on everyday queer experiences? Like prior work on sonic fiction and design inquiry [77, 98], we're interested in phenomena that other experiential modes of inquiry (ethnographic, participatory, documentary) tend to miss or neglect. The paper that follows begins with these questions to explore what potentials for life, love, and everyday experience voice technologies hold. It does not offer an answer to the questions, nor does it seek to 'improve' the voice assistant interface with universal or design-oriented recommendations. Rather, we theorize technologically-mediated lived experience, and queer lived experience in particular, through the lens of listening.

Our analysis and experimentation make two central contributions to design research. First, we contribute to debates on language within voice assistant design to suggest opportunities for people to reflect on sonic data, label their own experiences, and express varying shades and forms of queerness. This adaptive work involves a process of audio experimentation that uses close listening to investigate domestic technology, especially within some of the most intimate and hard-to-reach spheres of technological life. Second, we expand conversations on culturally-informed voice assistants to consider the heterogeneity of queerness and the impossibility of fully encoding polyvocality. This insight recognizes the design of queerness-informed voice assistants as connected with a process of bounding what it means to be queer. Across this work, we discuss opportunities for design researchers to grasp the particulars of queerness, understand bias in assistance, and comprehend what kinds of futures for domestic technology design are desired and by whom.

2 BACKGROUND & RELATED WORKS

The study of sonic technologies and queer heartbreak comes out of three connected bodies of work at the intersection of digital sound studies, theories of queer temporality, and digitally-mediated intimacies in design and HCI. Below we review each of these areas, with a focus on the particular questions they raise for design research.

2.1 Digital Sound Studies

Sound studies is part of a broader field of sensory studies that emphasizes the entanglement of senses [15, 86]. Research on and through sonic technologies focuses on material engagements with a range of auditory phenomena, from noise and music to stuttering and silence [83–85]. While the visual and discursive have long

dominated social studies of technology, sonic developments mark a turn toward the senses and a wider engagement with practices of listening. As the late Trevor Pinch and Karin Bijsterveld [84] remind science studies scholars, “fax machines, computers, printers, and photocopiers hum and beep; solutions gurgle; tea and coffee bubbles; radios play in the background; and ambient noise is everywhere [...] We who enter the laboratories to observe must also be prepared to listen.”

Understanding sounds as integral to technological developments means examining not only their production and use but also their role in interpretations. Studying the setting of oceanography, for example, scholars follow how sonar, a sound-emitting technology, fundamentally reshapes the analysis of a seascape by introducing new modes of measurement and detection [84, 111]. In computing history, scholars trace the influence of musical keyboards on the design of the computer keyboard and mouse [5, 84] and the influence of stethoscopes on the design of headphones and other contemporary modes of private listening [107]. Sound technologies have subtle but notable impacts our modes of listening and even other sound technologies.

When Murray Schafer first introduced the idea of the soundscape in the 1970s, he argued that “electroacoustically produced sounds” cannot be separated from the particular machines that made them [84, 94]. This link between soundscapes and the technologies that make them possible lives on in the work of HCI. Of late, HCI scholars have explored sound as a means of enhanced sensory engagement and creative expression, expanding tools of civic organizing and embodied performance with a wide-ranging digital implications [18, 40, 49]—from user interface design to machine learning [39].

Across this work, auditory language technologies such as voice assistants present a particularly potent example. Mapping digital encounters that invite close listening, scholars analyze the accent and speed of the chatbot speaker [8, 14, 24, 46, 116]; issues of privacy, trust and surveillance around the gendered, racialized encounter with the voice assistant user [20, 35, 58, 60, 102]; the consequences of voice anthropomorphism on trust, sentiment analysis, and user interpretation [103]; the everyday audio interactions and interjections around voice assisted home life [2, 11, 87]; and the role of speech interfaces in hands-free collaborative practices such as medical surgeries [3, 67].

Responding to this variety of concerns, design researchers and artists have sought to invert and subvert modes of auditory “assistance” by exposing the mechanisms of data extraction they both enable and obscure [17, 22, 23, 26, 61, 68, 75, 80]. Others have drawn a straight line between decolonizing design traditions and emerging forms of sonic fiction [45, 77, 97]. By experimenting with the device's form and situation, they have recorded sounds of infrastructure [31, 113] and exposed the sonic rhythms of translation interfaces [54].

Our work most closely aligns with this latter strand of work in its experimental and critical approach. But where prior work emphasizes speculative design and use, we focus on speculative analysis—imagining new design directions through hermeneutic experimentation. We use lived and experimental encounters with a voice assistant as a means of revising and augmenting our tools of empirical inquiry and interpretation, with particular attention

to important but under-examined questions of queerness within designed interactive systems. In some cases, Kinnee used device encounters to reflect on their everyday lived experiences (e.g. section 4.1). In other cases, they probed the edges of the device through data remixes and imaginative sketching (e.g. section 3.3).

2.2 Queer Temporalities

Our study of queerness and design grows from a particular concern for questions of voice and historicity that undergird the study of sociotechnical phenomena. Extending a strong tradition of queer theory, technology scholars have explored the particular ways queerness operates across temporal registers, connecting the past to the present and the imagined future to the here and now [48, 71, 99]. This work involves a refusal of linear timelines and solutionist narratives [72, 100], but also a consideration of how theorizing itself reflects particular concepts of time [19, 47, 57, 73]. Sometimes timely and other times deferred, queer theorizing has reckoned with its complicity in erasures and struggled with its enmeshment in what has come before.

Within HCI, this reckoning has surfaced in a small but consequential body of work concerned with algorithmic relationships to gender and queerness. Building on feminist HCI scholarship and its attention to embodiment and pluriversal subjectivities [7], scholars study the erasure of queer bodies by airport scanners [21] and ML facial recognition systems [96]. Other work has explored the queering of HCI [30, 105] through projects that center a diversity of queer experience, including coming out narratives [33], the safety of non-binary people of color [106] and the development of trans technology [37]. Across this scholarship, queerness works as an analytic thread for examining how and why technologies so often fail [48] but still contribute (albeit unevenly) to the conditions for queer flourishing [13].

We take particular inspiration from this paradoxical positioning of technological development within queer life. Where existing work has emphasized the widespread societal toll of algorithmically encoded bias on queer subjectivities, we look to their situated and generative potential. We wonder how glitches and oversights might lend themselves to alternative readings of voice assistants and queer life. Examining this potential while recognizing hardship takes exposing some of the most personal and mundane aspects of queerness, beginning with intimate relationships.

2.3 Queer Use and Intimacy by Design

HCI has long grounded the study of intimacy in the development of technology to support human connection—whether by elevating physical contact and care [4, 79] or nurturing emotional expressivity [62]. Early research on technology design and intimacy, such as Strong and Gaver’s Feather, Scent, and Shaker, focuses on measuring feelings of awareness and closeness across remote couples’ interactions and amplifying engagements through tangibility [63, 108] and augmentation [81, 90]. In this work, closeness emerges at the intersection of data records and mundane encounters, suggesting that interpersonal meaning and feelings of intimacy grow not from special events as much as what Lotteridge, et al. call “empty moments” [63].

Sound offers an especially fruitful line of intimate inquiry, opening questions around bodily engagement with and through connected devices. Work by Gopinath Kannabiran, Shaowen Bardzell, Elizabeth Goodman, and others has examined the development and marketing of sex toys [6, 44, 56], with particular attention to the dynamics of arousal, sexual desire, and data privacy mediated by sound-based networked sensors [34, 55, 110]. Technology historian David Serlin, for example, examines the Enby sex toy designed for queer and non-binary users, and people with physical impairments like rheumatoid arthritis [101]. With the Enby, Serlin points to a post-unisex design stance that resists conventional forms of heteronormativity and ablism to emphasize environmental sustainability, flexibility, and unintended use — or *queer* use, to use Sarah Ahmed’s term [1:201].

Queer use presents a potent conceptual anchor for our work. In *What’s the Use* [1], feminist cultural theorist Sarah Ahmed develops queer use as an oblique potential, a chance to explore “how things can be used in ways other than how they were intended to be used or by those other than for whom they were intended” [1:44]. As a mode of reuse or making-strange, it describes a method of working across historical and contemporary timeframes to find unexpected connections, orientations, and perversions—deviating from the “straight path” associated with compulsory heterosexuality and the ableist, gendered, and racializing norms such expectation-setting holds [1:201]. Where design research on intimacy has begun to examine queerness and multi-partner dynamics, scholarship on flexible and queer use has only begun to explore potentials of intimate design. Informed by David Serlin [101], our work on voice assistants in the home connects these two traditions around queerness and intimacy. Aiming to resist a focus on queer-phobic and couple-centric domesticity, we emphasize non-normative family structures and multi-partner communication patterns around sonic technology. We explore how interactions with voice assistants set new design routines in motion, beyond the tactile or visual.

3 METHODS

3.1 First Person Methods and Autoethnography in HCI

This work is grounded in an autoethnographic design inquiry of the first author’s everyday experiences with Alexa over nine months. After conducting an autoethnographic engagement of living with sonic technologies, and alongside dialogues and exchanges between all three authors, we then designed audio experiments as a way to dive into our analysis. This process includes the development of audio experiments as creative entry points into data analysis, which we discuss further in section 3.3 below.

First person methods, like autoethnography [32, 36] and autobiographical design [74], are qualitative research methods that position the researcher as the subject of inquiry. In this case, the researcher is observer, active participant, and at the center of the phenomena studied. Through firsthand experiences, the researcher observes, reflects, and builds insights. By nature, first person methods “*acknowledge and accommodate subjectivity, emotionality, and the researcher’s influence on research, rather than hiding from these matters or assuming they don’t exist,*” according to sociologist and

autobiographer Carolyn Ellis and colleagues [36]. In HCI, the methods have been used to study one's experience of a subculture or group, one's relationship to a technology, as well as one's experience in designing, prototyping and testing new technologies (e.g. [16, 25, 50, 52, 64, 66, 74, 104]). While still new to HCI, first person methods have drawn HCI researchers' attention to an important range of experience, including slow and long-term phenomena, personal and difficult topics, and the researcher's presence, positionality, and presence in a research project. Furthermore, as this approach gains traction, design and HCI scholars have pushed for deeper engagements towards rigor, validity and recognition of the method as a way to respond to the shortcomings of the method (often cited as the small sample size and the challenges around bias). For instance, recent workshops [65], as well as a TOCHI special issue have focused directly on strengthening discussions around the method and establishing best practices [28].

In past HCI works, autoethnography and first person methods have been used to investigate difficult, personal, or taboo topics such as the body [50, 52], (non-binary) gender [104], failure [53], sexual orientation [16], and difficult experiences [29]. Along these lines, first person methods are particularly well suited to study home devices and queerness as they allow for reflections on intimacies with technologies and the self, and are open to long and intertwined temporalities of queer lived experiences.

With first person research roots in the social sciences (with autoethnography), writing has often been a central tool for reporting on first person experiences. Ellis, Adams, and Bochner discuss writing as a tool that “*produces aesthetic and evocative thick descriptions of personal and interpersonal experience*” [36]. As more design and HCI researchers start to take on this methodological stance, new design-oriented ways of engaging with and of reporting on first hand experiences have also recently emerged such as design memoirs [29] and through intersections with speculative design [50] and creative media production [12]. In addition to using writing as a tool, we (the authors of this paper) engage in audio experiments as a way to make sense of Kinnee's data. We detail our audio experiments below in 3.3.

Further developing our methodological approach, our project includes a collaborative engagement between Kinnee and Rosner and Desjardins (the co-authors on this paper). Inspired by some tenets of duoethnography [76, 92], we are interested in using dialogical exchange as a starting point to analyze Kinnee's data. Complementing duoethnography [42], where both researchers use their first-hand experience of the phenomenon, we use first-hand storytelling, collaborative annotations of data, and audio experiments that allow us to discuss the project as a group. Throughout the project, we kept an openness and generosity that supported Kinnee to continue sharing their experiences, following some guiding principles from duoethnography: “*the intent [is] not to profess but rather to learn and change as the result of the conversation*” [93].

Before we detail our process and analysis in 3.3, we first offer some biographical notes about First Author's engagement with Alexa.

3.2 Biographical Notes

Kinnee is a queer, nonbinary person. Kinnee uses the pronouns “he/him” or “they/them,” and often abbreviates their pronouns as “he/they”. Professionally, Kinnee is a PhD Student at the University of Washington in Seattle, WA. Kinnee lived the majority of their life as a cisgendered male, and began living as an “out” queer person in their early adult years. Earlier in life, Kinnee identified as a gay man, but in their early twenties, they began to understand themselves as a member of the Queer, Nonbinary, and Gender Non-Conforming (GNC) communities. As this shift occurred, Kinnee began encountering moments when the designs of interactive systems were or were not sensitive to queerness or queer ways of living.

As Kinnee became further entangled within queer communities, they noticed that many technologies were not designed with aspects of queerness in mind. During the time of the study, Kinnee had relationships with their partner of five years (Warlock) and with a boyfriend of roughly three months (Michael) (we are using pseudonyms for anonymity)¹. Kinnee was in two concurrent, consensual, and separate relationships with both Warlock and Michael [38]. This non-monogamous, queer relationship formation is often referred to as a “Vee” or a “V-shaped” relationship because one person interacts independently with two other people. Both Warlock and Michael consented to be a part of the polyamorous relationship formation, and both were aware that Kinnee was involved in separate, but concurrent relationships with both of them. Warlock and Michael never met each other, and they were never intimately or romantically involved with one another.

Upon beginning their experiments of living with voice assistants in their home, Kinnee felt excluded by the designs of voice assistant technologies that would confuse the voices of queer people. They feared the potential for these technologies to target and/or profile queer people in their own homes. Kinnee also noticed that many domestic technological systems struggled to account for and interact with people with multiple partners—often divulging information to all parties involved, or in some cases the wrong person, when the message was intended to be between just two partners. Therefore, Kinnee's explorations of living with Alexa were largely motivated by concerns over privacy and security around queer people's data in the home.

This paper is specifically looking at Kinnee's interactions with Alexa from May 2021 until December 2021. Kinnee had not lived with an Alexa prior to this study, and installed it in the living room/kitchen of their microstudio apartment in Seattle in early March 2021. In early May 2021, Kinnee experienced a breakup.

3.3 Data Collection, Analysis, and Audio Experiments

By default, Amazon Echo devices keep an ongoing archive of user interactions, including the audio recording of utterances, a transcript of utterances, timestamps, Alexa's response, as well as additional metadata.

¹We note here that while we use the terms partner and boyfriend in this paper as a means to clarify who we are referring to, these labels are not representative of the fullness of the relationships with Kinnee. We interchangeably use partner with Warlock, and boyfriend with Michael.

For this work, we look at data across nine months (April–December 2021) and focus on data from May 2, 2021 to May 26, 2021, as these weeks span the period directly after Kinnee’s breakup. While most of our analytical work focuses on this three-week period, we also weave in salient and important data points from before the breakup and in the long tail of the breakup, until December 2021 (at the moment of writing).

In September 2021, using the Amazon Alexa website, Kinnee manually copy-pasted the recorded transcripts of their interactions with Alexa from early to end of May 2021. Kinnee then pasted the data in a spreadsheet. While other voice assistant systems like Google Assistant allow for easier access to voice data, at the time of the study, Amazon allows users to see their data or listen to it, but doesn’t offer an interface option for downloading all the data easily.

In a collaborative effort, we read through and annotated the spreadsheet. Annotations focused on teasing apart intimacies of a queer break up, through the lens of a voice assistant’s understandings and misunderstandings. We used the shared spreadsheet’s comments as a place for starting discussions, which we often expanded on in our weekly meetings. During our weekly meetings, we often engaged in a storytelling activity where Kinnee recounted an event surrounding a specific data point. We then discussed the story and started to make links and connections with other points of data.

To further our analysis, Kinnee downloaded the audio files from a selection of the most revealing, intriguing and relevant utterances from the spreadsheet. To do so, they followed a process that required using the developer interface to download the .wav files from the Amazon Alexa website [41]. Once downloaded, Kinnee clustered the audio files by theme and linked them on Google slides to share with the team. We used Google Slides because it is an easy, collaborative tool that allows for a form of sketching with sound—sound clips can easily be dragged and dropped onto the slides, could be annotated with text, and could be replayed by anyone in the team as they accessed the slides. We continued our process of commenting and annotation on the google slides, as a place to also reflect on tone, background noise, sonic context, and general atmosphere of the recordings.

Finally, following Ellis’ call to action for mixed genres in autoethnography (such as novel autoethnographic writing) and inspired by Biggs’ ‘making experiments’ in autoethnography [12], we developed creative audio compositions with the .wav files. We experimented with looping (full clips or sections), reversing (listening in reverse certain segments or clips), layering (different parts of a sample, or various clips), and juxtaposing (to compare clips). Making these audio compositions invited us to listen anew, to attune ourselves to the clips and noticing with more precision the voice, tone, intention, or background noises in the clips. The results were often defamiliarizing: the words were often harder to understand, again, inviting a different kind of listening. We each created a set of compositions that we shared at our weekly meeting, spending time listening together. We repeated this activity three times, each time adjusting our choice of initial clips and remix method. We discuss

a few of our audio experiments in the findings below, especially in 4.2.

3.4 Ethical Considerations

Throughout this study, we paid attention to consent, anonymity, and an ethic of care [10, 59] as main guidelines for ethical considerations. Before starting the study, Kinnee talked with both Warlock and Michael to explain their goal of examining questions of voice assistants and queerness, and perhaps interrogate how IoT devices have baked in assumptions about the home, households, and relationships. Warlock and Michael had questions about the Echo Dot’s functionality like ‘is it always listening?’. Kinnee explained that the device would always be on, that it is listening for the wake word and that only the interactions with Alexa are recorded. They also showed them the mute button and said they could unplug the device. Kinnee also showed them the Alexa app which offers a history of the recorded interactions via transcripts and audio files. They tested it to show how it worked. Throughout the study, if Warlock or Michael wanted to review an interaction with Alexa (for instance if something odd or funny had happened), they asked Kinnee and they showed them on the app—this was a necessary step because the Alexa account was just on Kinnee’s name, and while all three were living with the Echo Dot, only Kinnee had access to the app. Both Warlock and Michael understood that the recorded interactions would become part of a data set for the study and consented to this use.

After Kinnee and Michael’s breakup, Michael unplugged the Echo Dot from his apartment and gave it back to Kinnee, as part of the ‘breakup goodie bag’. After processing their breakup for some time, Kinnee didn’t feel comfortable using the recorded Alexa from their shared lives. We chose not to use that data for the study, but Kinnee kept the other Echo Dot connected in their apartment. Simultaneously, the focus of the research inquiry shifted to Kinnee’s break up experience, and the role of Alexa during that time. When reporting on examples throughout this paper, we continue to use pseudonyms to protect Warlock and Michael’s anonymity.

Finally, working through the data analysis meant Kinnee revisited some difficult moments from the past months—at times on their own and at times while recounting specific events to Rosner and Desjardins. As a team, we checked in about the intensity of this work and offered to slow down or pause if needed. We also checked at various times about what parts of this project should be published and what should remain private. We acknowledged that this can change over time and that in the academic publication cycle there will be a few opportunities to revise the manuscript before it is published.

4 FINDINGS

In this section, we offer two main themes for examining the intersections of voice assistant technology, queerness, relationships, breakup, and Kinnee’s lived experience. First, we discuss the various ways Alexa encountered queer break-up and how that intersected with Kinnee’s experience. Second, we unpack how we used sound to understand queer breakup, through a series of listening and remixing exercises.

4.1 How does Alexa experience queer break-up?

A few days after my 2 breakup with Michael, I went back to living full-time in my apartment with Warlock. I had previously been splitting my time between living in my apartment with Warlock mostly during the week, and living with Michael mostly on weekends. While Warlock was excited to have me home again more, I was still going through a breakup, and I was seeking all of the support that I could possibly get. During the pandemic, this was especially difficult to do. In the throes of heartache, I remember thinking to myself:

“This is intense. How long is this going to last? I know that it will take time for me to move past this breakup. . . but I don’t know how long. I wonder if Alexa knows? People go through breakups all the time. I can’t possibly be the only person with this voice assistant going through a breakup. What if I asked Alexa for help?”

So, I turned my head towards the Alexa device on my kitchen countertop and asked, somberly:

Me: *“Alexa, how long does heartache last?”*

Alexa: *“Heartache by ONE OK ROCK is 4 minutes and 24 seconds.”*

Alexa’s response was unexpected to say the least. In that moment, I felt pretty disappointed—all I was looking for was some sort of estimate. At the same time, Alexa’s answer reminded me that I was trying to rationalize a breakup with my question. Alexa’s hyper-literal response intrigued me because it was, in a way, correct. At the same time, I did not receive the information that I was seeking, and I wasn’t sure how else to ask Alexa for it. When conversations around sensitive topics like heartache are machine-interpreted so literally, it can hinder the intent of the original inquiry. At the same time, it can also reveal new meanings and interpretations of the questions that we ask the technologies in our homes. A hyper-literal answer to a metaphorical question might alert us to underlying assumptions in our own inquiries.

As this vignette illustrates, when conversations lack context to inform meaning, they can lead to unexpected outcomes. Below, we discuss how glitches in our interactions with Alexa might reveal some of the assumptions for all conversants involved. We also discuss coterminous temporalities in relationship to Kinnee’s lived experience of their queer personhood.

4.1.1 Heartbreak Glitch. How does Alexa experience queer break-up? Alexa did not explicitly experience or recognize the breakup—it didn’t codify or encode it—but began to engage with the breakup through system errors, or what Legacy Russel [91] might call the glitch—a “built-in technological anxiety of something gone wrong” [91:7]. Many glitches were discovered and encountered over the span of the study. Some were noticed and captured, while others weren’t.

Before the breakup happened, one of the first glitches that I noticed was the (mis)recognizing of voices. Alexa would address me or one of my partners with the other’s name. A few times, this led to some uncomfortable moments in which one partner was mis-recognized as another (ex. Alexa saying *“You’re Warlock, right?”*

to Michael). This made me wonder: What do glitches reveal? As I asked this question, I became more familiar with some of the common glitches that unfolded through our cohabitation. I made a list, inspired by Mimi Onuoha’s Library of Missing Datasets [78], of the seven most common glitches that I lived with over the span of the study. When looking through the transcripts of my interactions, these phrases appeared instead of the expected transcription of my commands or questions to Alexa:

1. No records found
2. No text stored
3. “”
4. “i”
5. Audio could not be understood
6. Audio was not intended for Alexa
7. Not Applicable

When I looked at and listened to my personal data, this list became a way of noticing when things didn’t go as planned in my interactions with Alexa. By examining these points of breakdown, or glitches, I found that some of the most interesting bits of data were hidden behind glitches. For instance, in attuning myself further to the recorded interactions, I learned what kinds of audio were intended for Alexa (6), I learned what kinds of audio could be understood (5), I learned what kinds of records could be retrieved (1), and I learned what kinds of text were stored. Designing with glitches sometimes means playing into their own binary logics to reveal the data that it belies. These technical glitches also include various forms of non-storage (1, 2), empty strings (3), and declarations of what audio is understandable (5) or “intended for” IT. Still other technical glitches, such as a transcription reading “Not Applicable,” provide very little information about what went wrong during the interaction.

In addition to the technical glitches, in which the technology was the source of generative glitching, there were also semantic glitches. Semantic glitches are glitches in which the meanings of an interaction are misread, misunderstood, or taken out of context by the human (myself), the voice assistant, or both of us. Semantic glitches arise when there is a misunderstanding in the meaning, tone, or intent of what is said. For example, Alexa sometimes misheard what I said. When asking a question, it might simply say “sorry, I don’t understand”, but when asking Alexa to record a note, the implications are different as the misunderstanding—the glitch—becomes part of the archive I create for myself using this tool. In one example, Alexa understood:

“it’s hard to move off from bring up swim there are reminders everywhere” [Alexa’s transcription, what it heard]

While I had said:

“It’s hard to move on from break-ups when there are reminders everywhere” [sic, transl.]

When I asked Alexa to “remember” this observation, it transcribed what I said and appended it to a file called “Memories.csv,” which is stored within a directory called “Alerts”. In this directory, there are also .csv files for storing and maintaining lists of Alarms, Notifications, and Mobile Push Notifications. In this example, my queer use of Alexa allowed me to generate a record of my lived

experience in that moment and involved the use of it as a memory device that can be embedded with reminders. However, here, the glitch renders invisible perhaps the most important word of the sentence—“break-ups”—opening questions about what is truly ‘remembered’.

Some interactions with Alexa highlight the ways in which curations from recommender systems can create ableist and insensitive interactions that marginalize queer and disabled people in their own homes. For example, when I confided in Alexa during my breakup, I was disappointed to hear an apology from the voice assistant.

Me: “Alexa my boyfriend just broke up with me”

Alexa: “Sorry to hear that. Talking to a friend, listening to music, or taking a walk may help. I hope you feel better soon.”

Why was the voice assistant saying that it was sorry for me? Alexa didn’t even know me or this person? However, in that moment, I was admittedly desperate. I decided, despite feeling underwhelmed by Alexa’s response, to take the advice. When I did this, I felt better. And so I felt troubled and uncertain about the helpfulness of the voice assistant in my home. Is normative advice better than no advice?

Other interactions, such as seen below, highlight how sensitive questions were mis-parsed by Alexa, sometimes providing comic relief during otherwise heavy or serious personal conversations.

Me: “Alexa can you forget who Michelle² is” [Alexa’s transcription, what it heard]

Alexa: “Sorry, I don’t know that one”

In this case, while I was trying to remove Michael from my Alexa’s notes and memories, Alexa’s misunderstanding of Michael’s name had the effect of re-gendering and/or feminizing Michael’s name. As a glitch, this becomes an interesting observation—seemingly small errors can have a grand impact on people’s sense of self or sense of others. However, when looking deeper, I noticed that I asked Alexa to forget who Michael is in hopes of erasing any memory of him from my Alexa devices. Alexa’s response of “Sorry, I don’t know that one,” seemed to signal to me that Alexa had already forgotten about Michael. It wasn’t until afterwards, when I was reviewing the transcripts, that I realized what had happened: Alexa ‘thought’ I was asking her to forget someone who wasn’t in her memory to begin with.

At the same time, these semantically glitched interactions sometimes invalidated the perspective of the speaker—suggesting that Alexa wasn’t listening, or listening closely, to what was being confided. These moments reveal that voice assistant technologies such as Alexa are not yet designed or optimized for sensitive conversations. Moreover, talking about, and processing over time, our design research team grasped something like a queer breakup as fundamentally multiple. Coupled with a voice assistant, it demands attention to the nuances of people’s lifestyles, relationship formations, and values. A breakup might be a welcome reprieve or it might be devastating at first, and later become a generative, positive life event. Designing with queerness in mind means making

no assumptions and erring on the side of curiosity (e.g. like Eddi in [88]).

For instance, why didn’t Alexa ask me any questions before apologizing to me for my own decision to disclose? Why do all three recommendations make assumptions about my ability (that I can hear, that I can walk, that I can talk?), and why do none of them involve having a fuller conversation with Alexa? What kinds of conversations should we have with voice assistants, and what kinds of conversations should we not have? How might conversations with voice assistants about/around queer breakup illuminate the baked-in values and assumptions of an interactive system?

While Alexa’s recommendations for my queer heartbreak were normative, they still helped me. This complicated my understanding of bias in AI/ML systems: What if a bias that is designed to help an imagined, more normative person ends up also being helpful to an unimagined, queer person? Does this mean that the design was queer, or “queer enough” all along? At what point does a generalized recommendation become heteronormative recommendation? How might we queer interaction design without targeting, profiling, silencing, invisibilizing, or excluding people in the process?

Lastly, my conversations with Alexa often involved the use of humor to avoid grappling with the politics of the glitch/bias that it enacted. Sometimes, the sense of humor arose from awkward pauses or unexpected responses (both good and bad). On one hand, some pre-scripted responses from the voice assistant (ex. Asking Alexa “what are your pronouns?” and hearing “As an AI, I don’t have a gender” in response) are an artifact of developers’ decisions to opt out of charged conversations with a blanket statement. Meanwhile, other responses such as “I don’t know that” may come across as thoughtful or even profound declarations. Designing interactive systems that can externalize what they *don’t* know might allow for greater rapport between people and machines—by furthering our understandings of what’s human, of what’s machine, of what can happen at the human-machine nexus, and of what’s happening during our interactions. Humor is a release from the tensions in my personal data. These tensions were often between what was and what is, or between what was and what could-have-been. Breakups are riddled with expectations versus realities. Queer breakups are riddled with queer expectations versus queer realities *and* queer expectations versus normative realities. I used humor as a way of asking uncomfortable questions and as a way of explicating uncomfortable, paratextual anecdotal data (anecdotal data).

4.1.2 Coterminous Temporalities. In this study, while glitches were one way we observed Alexa experiencing my queer breakup, we also noticed that we formed associations over time with the content, temporality, and context of Alexa use. Content, temporality, and context collapsed into interactions with Alexa, forming another way the device became part of a breakup.

When I plugged my Alexa device back in at the end of summer, after having taken a pause post-breakup, I was not expecting to receive a reminder of my recent breakup. Around this time, I had recently stopped taking a medication (PrEP, or, Pre-Exposure Prophylaxis) that I had been taking during my relationship with Michael—and for a few months afterwards. To me, stopping this medication was another layer of my breakup with Michael—a part

²Michael and Michelle are pseudonyms in this paper. We use Michelle to represent how Alexa mis-parsed Michael’s name.

of the long tail of the breakup. That night, at 9pm, my Alexa device began sounding an alarm and blinking orange lights.

“. . . ### “take my PrEP” . . . ### “take my PrEP” ### . . . “take my PrEP” ### . . .”

I had programmed the Alexa device to announce this reminder in my home every night at 9pm. However, at this time, I had not been taking PrEP for at least a few months. Alexa was reminding me to take a medication that I had stopped taking after the breakup. I speculated about how this situation (i.e. getting an outdated reminder for a former medication) could have been dangerous. This out-of-sync reminder from Alexa could have instructed someone to unknowingly and accidentally mistreat themselves. Furthermore, the reminder could have disclosed my personal, sensitive medical information to the entire captive audience of my home—including my partner or any potential visitors. Regarding PrEP specifically, this out-of-sync reminder could have revealed or suggested a number of things that are often kept private: sexual activity, substance use, and more. This situation reflects the broad stigma surrounding PrEP’s uses and highlights the instrumentation of voice assistant technologies as devices of inquiry for probing the particulars of queer lives.

Moreover, I realized how this particular reminder’s blurring of the private and the public within the home could have caused unwanted conversations for some. I considered how myself, Michael, and Warlock were all aware that I was taking PrEP. However, if this hadn’t been the case, the reminder could have instantiated many unwanted consequences.

I also noticed the many different kinds of information that were encoded in this brief reminder: part my daily routine, part of my medical regimen, which medications I had access to, and multiple personal identifiers surrounding sexuality and sexual activity. I also thought about PrEP’s other use as a protective agent for intravenous drug users. I thought about how PrEP is used by some of the most vulnerable people in the queer community, and how my use of Alexa to offload the labor of remembering to take my PrEP felt subversive. I was also reminded of how PrEP can be taken or not taken at different times in my life, daily or as needed, and how I appreciated having this tool as a protector.

With multitudes of possibilities at multiple intersections of queerness, sex, sexuality, and more encoded in this interaction, I considered how this reminder revealed both a lot of information and very little information at the same time. I decided to leave the reminder as it was to see what might happen if I had this reminder to reflect on every night.

When this reminder first sounded after I had replugged the Alexa device, I was immediately reminded of my breakup—and all of the associations with that time, that person, those places, those things, those sounds, those smells, those sights, and those feelings. I recalled that it was. . .

“Interesting to see how over time I would feel fewer reminders about Michael and more of a sense of curiosity to ask: what would it mean if I had a reminder about this other moment in my life?” Over time, the ghost reminders became less about my time with Michael and instead became more about noticing however I was experiencing queer breakup at the instance of the reminder. The reminder’s use became increasingly about reflection—drawing connections between the person I was when I first set up the reminder, and

the person that I was as I heard it each day. The ghost reminders invited an unbounded speculation of what could have been and of what was. They are artifacts of a zeitgeist that, via the Alexa devices, carried over from before and after my queer breakup. The ghost reminders highlight how Alexa devices, and similar domestic technologies, are optimized to provide timely reminders, but that the designed systems underlying these reminders are perhaps not yet sensitive to degrees of change that accompany relationship dissolution. The infrastructural work necessary for supporting people whose living and life situations change suddenly and unexpectedly is immense. Part of this work might include designing ways of forgetting, or assessing the usefulness of interactions through dynamic frameworks that can account for dual, multiple, and queer use.

My experience living and talking with Alexa as a memory device inspired many questions about the relationship between technology and memory. I contemplated what kinds of memories I’d want to store within this sonic recordkeeping device—keeping in mind that I could revisit the audio recording of myself saying it later for more context. This also meant considering what kinds of things I would not wish to remember as well; inviting a more queer modality of memory-making, if one chose to use Alexa as such. I explored queer, conventional, and empirical memory uses of Alexa’s “memories” and reminders. While discussing with Second Author and Third Author, I recalled:

“So, each time I was reminded, I didn’t have control over which ones I was reminded about on any given day; but the same thing being said would feel differently”

While at first it seemed like I was only being reminded of one thing, I discovered that a single reminder actually reminded me of infinitely many things—and that I wasn’t fully in control of which memories would be summoned each time Alexa reminded me to “take my PrEP”. Over time, these interactions start to manifest multiple meanings and associations and became a reminder about other qualities and experiences in my life. These associations built on top of each other to form resonances and meanings that were never intended or imagined by their initial design(ers). When I was reminded to “Take my PrEP”, I was reminded of things like the stigma and fear surrounding HIV/AIDS that queer people live through every day. I was reminded of the asynchronous synchronicity of the language of “being positive” between the HIV/AIDS pandemic and the COVID-19 pandemic. I was reminded of the fear that I’ve lived with regarding HIV/AIDS, of the shift in my perceptions of safety with a pre-exposure prophylactic technology in hand, and of the work that remains to be done to destigmatize HIV/AIDS within and beyond queer communities.

Each time I heard this reminder in my home, my associations changed. However, each time, these associations were also strengthened. Sometimes, the reminder synced all the aforementioned associations with that moment that it was uttered—a kind of updating to morph into the current context. At the same time, over time, the reminder became less jarring and intrusive, less strange, less novel, and became more a part of the everyday soundscapes of my queer home.

In addition to using Alexa for scheduled reminders, as described above, I also used Alexa for its ‘remember’ function. If one asks

Alexa to “Remember BLANK,” then it will record that voice entry and store it within a file called “Memories.csv”. This creates a list of things that Alexa will “remember” for you. For example, early on in my relationship with Michael, I asked Alexa to “Remember that Michael is my friend”. Then, when we became boyfriends, I asked Alexa to “Remember that Michael is my boyfriend”. In response, Alexa said: “Sure, I’ll remember that ‘Michael is my boyfriend,’” which struck me as odd. After this interaction, if I were to ask Alexa to “tell me something about Michael” or ask “what do you remember about Michael?,” then it would say “Brian, this is what I found: From your notes: Michael is my boyfriend.”

In the internal logics of my Alexa device, it wasn’t until after the breakup, when I updated Alexa’s memory of Michael, that Michael wasn’t my boyfriend anymore. The transcripts read as follows:

“Michael is my boyfriend”

April 17th, 2021, 6:18pm

2021-04-17T18:18:56.567Z

“Michael is my friend”

May 6th, 2021, 6:33pm

2021-05-06T18:33:14.013Z

While this interaction may not have been designed with my particular use case in mind, I found this experience to be an interesting way of shifting my own perception of my relationship with/to Michael. It also offloaded some of the weight of the breakup—the Alexa device was a vessel for making sense of my queer breakup. Queering the Alexa device and enrolling it into a queer breakup fostered a subversive exploration of normative domestic tools for queer domestic use. The Alexa device was programmed according to the progression of my queer breakup on my own terms. This form of control over what my household devices do or don’t “remember” meant maintaining an ongoing dialogue with my devices about the people in my life, the kinds of relationships that I have/had with them, and an ongoing archive of my voice commanding Alexa to remember. In asking Alexa to remember relationship statuses across the queer breakup, I enrolled the digital assistant in my relationship sensemaking to record brief notes about the particulars of my relationship status with Michael—from friend, to boyfriend, to friend, to past lover.

Here, I used the Alexa devices as a data collection instrument for capturing information about relationships that was often squishy, difficult to pin down, or couldn’t be located in a particular moment. I wanted to see if logging details on the Alexa devices about my relationships would change what I externalized about the relationships. In the case of Michael and I, the exercise of asking Alexa to remember one another as *something* (i.e. a friend, a boyfriend, a partner, etc.) surfaced conversations around the labels that I used for/with my intimate and romantic partners. When I asked Alexa to remember that “Michael is my boyfriend”, I was logging a moment in our relationship when that term felt like it fit for both of us. By logging this, I did not specify my relationship to Michael, but rather, I logged Michael’s relationship to me at that moment. I then updated this accordingly to “Michael is my friend” when we broke up. Here, Alexa’s memory capacities were explored for their potential to remember particulars of my most intimate relationships. Since the question of “what are we?”, or, of “defining the relationship” is a

question that we all face in our relationships, how might our digital assistants help us in these sometimes-awkward situations, when vulnerability is high and relationships are undergoing definitional work between partners?

4.2 How do we use sound to understand queer breakup?

In the next phase of our study, we explored the use of sound as data to better understand queer breakup. As previously mentioned, Kinnee lived with two different partners and two different Alexa devices in two homes. But this experience also involved two different soundscapes.³ Drawing from this experience, we explore the potential for treating sonic technologies and sounds as rich data for design inquiry. In order to enrich our autoethnographic approach, we listened individually and collectively (as a team of three) to recordings from Kinnee’s interactions with Alexa from the time of the breakup. During this investigation, we selected audio bytes based on our collective data analysis with the transcript. Kinnee flagged recordings that stood out as important for understanding queer breakup and queer space through digital sound. These recordings were then shared with the other two members of the research team. In this process, Alexa’s biases for what kinds of audio were deemed recordable continued to unfold. At the same time, our design research team also reflected on our own biases when investigating personal audio data that has been collected by a commercial voice assistant. For instance, we questioned biases of what we expected to have been captured versus what actually was captured. Our data analysis demonstrates that a multi-media approach to studying interactions with voice assistants—first through direct interaction with voice, then with the machine-generated transcript, and then with the audio—can reveal important context and provide additional information that bring us closer to a glimpse at the lived experience itself.

4.2.1 Attuning to sound. Going into our experiments with audio, we wanted to know: “How do we learn to ‘listen’ or attend or attune closely to the data?”. Our experiments with audio built on our autoethnographic approach by using audio clips from the voice assistant device in Kinnee and Warlock’s apartment and from the voice assistant device in Michael’s apartment. These devices archive interactions by recording the person speaking and generating a machine transcription of what is said by both the device/virtual assistant (Alexa) and what is said by the person using it (Kinnee, Warlock, or Michael). We manipulated these audio clips as part of our design inquiry. In doing so, our analysis shifted away from listening and attuning to the sounds of queer home, and shifted towards attuning through audio experiments and remixes. Working with audio clips that are often less than ten seconds long, we decided to experiment with playing the audio on “loop” (repeating over and over again). When we did this, we noticed changes in our experience of the audio—such as the foreground of the audio gradually becoming less noticeable, the background noises becoming

³Here, we use the term “soundscape” as coined by Michael Southworth and later popularized by R. Murray Schafer [84, 94] to describe acoustic environments in terms of how they are perceived and experienced by humans and machines. Projects such as Schafer’s World Soundscapes Project (WSP) and *The Soundscape of Modernity* by Emily Thompson [112] have provided strong foundations for soundscape studies, or acoustic ecologies, of spaces and places.

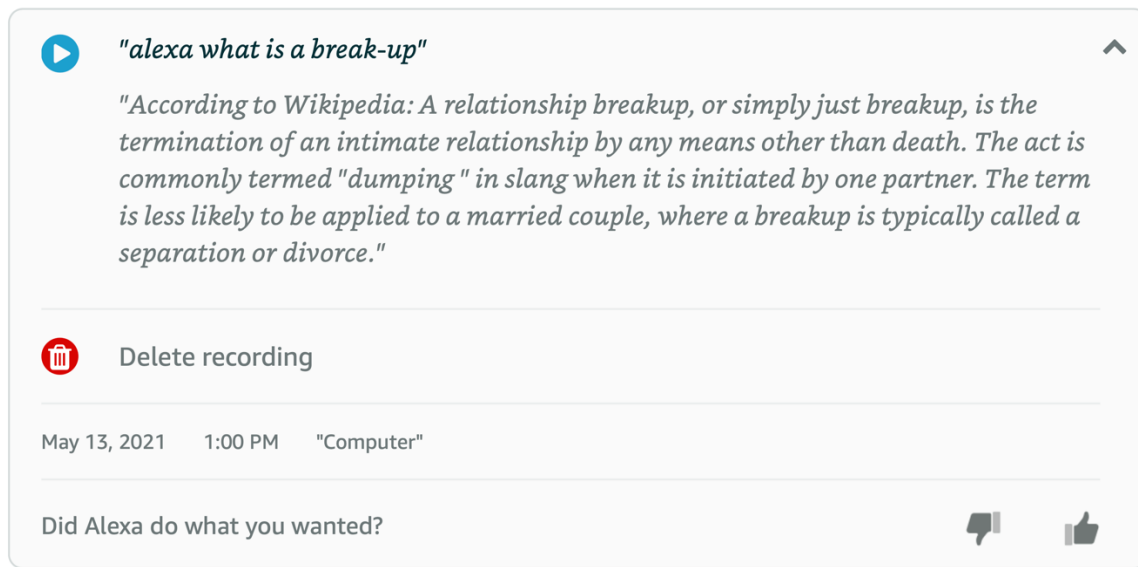


Figure 1: An entry in the "Review Voice History" section of the "Privacy Settings" interface for the Amazon Alexa account and devices. The white arrow within a blue circle plays a recording from the conversation when clicked. A transcription of the speech from the interaction displays the text of the person talking in a black text, and the text from the Alexa device's speech in a lighter gray text. The trash can icon within a red circle, labeled "Delete recording", deletes the recording when clicked. Below, additional metadata from the interaction is listed, including the date, time, and device name. In this case, the Alexa device has been named "Computer".

more noticeable. This encouraged us to listen for sounds that were not described in the transcript and to listen for sounds that were not transcribable. We considered how the Alexa devices capture audio when the wake word is spoken, and yet there is no control over what background noises may be present in the recording [80, 109]. Often, we could hear sounds of the home such as a dishwasher, a noisy television, or a tea kettle.

As we continued our investigations, we found that the background noises often contained glimpses into their domestic environments. This included sounds of other people who were present in the home during the interactions with Alexa—talking at the same time as Alexa (intentionally or unintentionally). While these sounds were recorded by the Echo devices, they were also simultaneously backgrounded and invisibilized by the machine-generated transcript. Our findings suggest that in the case of the Alexa voice assistant and the Echo smart home speakers, machine listening means listening to one person at a time—but still capturing all of the surrounding soundscapes. The design of these devices, as an "always-on" technology with multiple microphones and features such as far-field listening, prioritizes the capturing of audio from domestic environments. To some, these technologies are a source of fear, distrust, and intrusion. To others, these technologies have become normalized and are regarded as mundane—to the point that many people forget they have them (turned on) in their homes.

The home contains coinciding soundscapes of people's everyday lived experience. How might we use these sounds that are otherwise unprioritized, yet still inform lived experiences of home? What if, rather than prioritizing the machine log's data from the

interaction, we instead explored the use of audio "scraps" to inform our understanding of how people use domestic devices and spaces? How might we understand these technological systems in terms of the relationship between intimacy and security? And how might first-person accounts of living with technologies use sonic data and sonic perspectives to further contextualize and center lived experiences in the design of interactive systems?

Furthermore, we discovered that some background noises, such as a news report on the television, could contain details about where we were and when. In our study, Kinnee asked Alexa: "alexa what is a breakup". Alexa read back the Wikipedia entry for "break-up".

In the .wav file of this interaction, a newscaster is speaking about something "...south of Seattle". When a member of the design research team noticed this background sound, they asked Kinnee if they remembered what was playing in the background. Kinnee remembered that they were listening to a local news story about a local LGBTQ+ bar that had recently burned down—with suspicions of arson. Kinnee recounted how the moment of this recording was intensely defined by multitudes of mourning: their own queer breakup and the loss of space for the local LGBTQ+ community. Perhaps counterintuitively, they then used this sound byte along with others—cutting, looping, splicing, and remixing—as a material for designing something from the sounds of queer heartbreak.

Kinnee found that using these sound bytes felt perhaps a bit morbid at first. It was difficult for them to hear themselves at a moment when they were so unhappy and confused—and to hear themselves saying such blunt confessions aloud. However, as more snippets of audio were included in the composition, and as the

sounds became new sounds in combination, the pain they had heard in their voice began to sound harmonic, song-like, and rhythmic. By recombining and manipulating the audio, they discovered that they could alter their relationship to the audio and all of its associations. When the sounds of queer heartbreak were distilled in terms of their background noises, sonic textures previously unheard or unheard became foregrounded. How might this creative process of listening, noticing, and using soundscapes from digital, domestic technologies allow us to texture our lived experiences of spaces? Can we use sound from a queer time and place to reimagine our understandings of what happened to us, around us, and through us?

4.2.2 Differentiating between voices. In a third set of experiments, our team explored the potential for Alexa to differentiate between voices. We wondered what conditions might allow Alexa to reliably differentiate between voices; and, conversely, what conditions might curtail or change that differentiation. We also wondered whether Alexa might recognize its own voice. Searching through our archive of recordings, we noticed several examples of recordings made by Alexa of Alexa—typically the last few words from its previous turn in conversation, or the beginning of a new utterance that was quickly cut off in the recording. Other clips recorded the first author without them intending to speak to Alexa. In our sonic experimentation, we began with a clip of Kinnee stating “Alexa, my boyfriend broke up with me” and combined it with a clip of a recording made in error, when Alexa recorded Kinnee saying “Yes!” enthusiastically and without them meaning for Alexa to hear. Listening to the clips in sequence, we noticed a distinct difference in pitch, shifting from the low rumble of the directive to the high timbre of the erroneous recording. We then stretched out the clips, using speed to explore how slowing down the sound might reveal a different rhythm or tonal quality. Instead, we noticed the recognizability of the voice despite the changes. Trying to further obscure this recognition, we reversed the audio clips. Despite no longer understanding the audio, we found Kinnee’s voice recognizable.

One of the questions emerging from our experimentation with speed and direction involved this discernibility of reverse listening. In particular, we asked: If identity is discernible for humans from audio played in reverse, how does this discernibility create friction when going through Alexa’s machine listening processes? During our experiments, we catalogued some of the sorts of questions and answers that Alexa provides. We understood these technologies to contain Machine Learning (ML), Natural Language Processing (NLP), and Artificial Intelligence (AI) technologies. Our investigation probed these technologies for various bits of information that might tell us more about how they work—what sorts of algorithmic biases were present, what the limitations of the hardware and software might be, and what kinds of sources Alexa might be retrieving data from.

Thinking of Alexa and the Echo Dot devices as Natural Language Processing (NLP) technologies, we considered how Alexa was processing information from user-input voice commands and various knowledge bases (Alexa answers, Wikipedia, etc.). NLP is a term that is used to describe both Natural Language Generating (NLG) and Natural Language Understanding (NLU). Our experiment highlighted moments when both the NLU (algorithms for

Alexa’s “understanding” of speech) and the NLG, (algorithms for Alexa’s “generating” of speech), and subsequently the NLP provided unexpected or unwanted interactions. When researching such technologies, it remains difficult to discern precisely which algorithms, sources, and sequences are at play and when.

While we might not know or have access to exactly what is happening at a more granular level within the internal logics and algorithms of the voice assistant devices, we do have a sense of what kinds of algorithmic processes are underway in different phases of voice interactions. First, a wake word algorithm (NLU) recognizes an utterance of the wake word, or a short phrase or name within an ongoing stream of sound. This signifies the beginning of a voice query. For the Alexa devices, the wake word is “Alexa” by default, but it can also be changed to “Computer” or “Echo”. The recorded speech is processed and transcribed by another set of algorithms (NLP) that determine which words and produce a textual transcript from the interaction. Then, a third set of algorithms (NLG) generate a spoken response from the voice assistant device that is also, itself, transcribed. The result is a series of dialogues between people and machines in their homes.

Recalling the PrEP reminder vignette from above, our sonic experimentation with reverse human listening in contrast with machine listening further opened questions of privacy, intimacy, and power. During the NLG process, Alexa’s language (and voice) is generated from a transcript (here “*take my PrEP*”). While these personal, potentially-private reminders from Alexa were intended as a means of medication management for Kinnee, they were still announced from a speaker in their small studio apartment. Private reminders became public in their home, through the NLG process. This meant that people in both households would hear the same reminders every day—even if the reminder wasn’t intended for them. Moreover, because Kinnee had the Amazon account owner, they were the only person who had access to the Alexa devices, settings, notifications, and data via the Alexa mobile app—moving beyond the voice-only interaction modality of the smart speaker. This ownership put them in a position of uneven power and control over the sounds of their shared homes. Sometimes this position meant that information (notifications) was only relayed to Kinnee, and not to anyone else that I lived with. While neither of Kinnee’s partners could control the devices via the mobile app, they could still use voice commands to make some changes. Sometimes, however, Alexa would instruct their partner(s) to access information from their interaction with Alexa via the mobile app—the mobile app that neither Warlock nor Michael had access to! Again, this prompt put Kinnee in a position of gatekeeper to Alexa notifications—a role that they did not ask to play and did not wish to perform. However, there was not an alternative for all three of them to share account(s). Without a shared account, there was no shared accountability: Alexa was fully “Kinnee’s” device, whether they wanted it to be or not.

This set of experiments investigated how Alexa discerns between voices, how multiple layers of NLP technologies underly Alexa’s functionality, and considered how ownership can create an uneven landscape of power, risks, and vulnerabilities. Moreover, matters of ownership, shared accounts, and accountability further texture these domestic power dynamics by limiting access to the sonic record of an entire household to one person.

4.2.3 *What is lost/gained in the translation to transcript?* In a final set of experiments, we noticed how close listening exposed what Alexa simultaneously overlooked and captured. As Alexa transcribes speech to text, the signifiers of voice, tone, and context are flattened—an experience you, as a reader, are likely feeling now. In our data analysis process, we began by exploring the textual transcripts of the interactions with Alexa. As we did this, we highlighted, tagged, and discussed the voice interactions that had been machine-translated to text. Sometimes, we couldn't discern what was being said with just the text alone. Other times, we felt that we could understand what was happening during that interaction based on just the text alone.

As we moved further into analysis, we added in audio from the interactions that we had spent the most time analyzing, or that we were otherwise curious to learn more about. In doing so, we noticed that there was *much* more information contained within the audio clips than the text. We uncovered audio from interactions where no speech was transcribed, but a recording was still captured nonetheless. Recalling the clip when Kinnee heard the faint rumble of a news report in background, we noticed a certain way of concern in the Kinnee's voice that we hadn't heard before, a context around queerness that the Alexa missed but still managed to hold on to. In noises like this, we noticed that things such as tone, sarcasm, and emotion that cannot be described by a literal, direct translation/transcription of speech to text. This engagement meant that sometimes the transcribed text alone was misleading—telling us a different story from what we had understood it to be when we had encountered it as text. We considered what it meant that the device we had used to collect data during our study accurately transcribed some words, but not others. We also distinguished further between the Alexa devices as sonic data collectors, producing recordings from the interactions, and as machine transcribers, producing transcripts from the interactions. Our analysis of both text and audio data from the Alexa devices suggested that listening to the audio data from interactions with Alexa provided a more intimate portrait of the everyday soundscapes within the interactions.

5 DISCUSSION

We have so far explored the range of subtle but notable ways one person's queer heartbreak brings new readings of smartness at home. Using the Alexa voice assistant service across two devices, two homes, and two queer relationships exposes some of the taken-for-granted assumptions built into a smart device. Our analysis and audio experiments help design researchers conceptualize what it means for a voice to be recognizable, for a reminder to permeate distinct spaces and times, and for a device that reinforces heteronormative assumptions to create conditions for imagining a relationship otherwise. Kinnee's domestic life exposes challenges to interpretation, gaps in translation, but also the somatic and often surprising pleasures that come from being with an imperfect NLP service.

Below we reflect on these tensions between queerness and design, encoded harm and encoded possibility, and use our analysis to explore what potentials this study holds for theorizing queer experience with and through interaction design.

5.1 Queering Sonic Technologies

As a first set of concerns, this study foregrounds some of the risks of applying a fixed concept of sexuality or gender to the voice assistant design. Through design inquiry, we noticed that a great risk of sonic technologies in the home is, of course, misuse. Voice assistants are often always plugged in, always on, always "listening," and can be remotely accessed. Moreover, these technologies continue to be developed for greater accuracy at detecting and differentiating between voices. In this study, Kinnee noticed that the Alexa device in their home had trouble differentiating between their own voice and the voices of both of their partners (ex. Alexa saying "You're Warlock, right?" when speaking to Michael)—often mixing them up and mistaking them for one another. Kinnee had a few speculations as to why this might be happening: maybe their voices are too similar, maybe something about their cadence or intonation was too similar, or maybe the voice-recognition algorithm just didn't have enough data yet to make the proper choice? Beyond these possibilities, however, the misreadings prompted Kinnee to notice the ease of reinforcing heteronormative patterns. They considered that the difference between their own voice and their partners' voices was likely less pronounced than, say, between a normative male-female couple. This made them wonder: was Alexa predisposed to assume romantic partnerships with two adults, as opposed to other forms of co-habitation (roommates, co-operative housing, platonic partners, etc.)?

The problem of inclusion in technology design is, to borrow language from HCI scholar Cynthia Bennett, "slippery" at best [9]. On one hand, training Alexa on queer voices from the queer bodies of queer people might, indeed, result in a voice-recognition algorithm that can more adequately distinguish between queer voices. However, do we really want corporations like Amazon to be extracting information from Queer bodies in such a targeted manner—in their own homes no less? Do any queer people *actually* want this? Are any queer people *actually* asking for this? Echoing HCI scholars reflections on facial recognition [9, 95], this study suggests such aspirations may unwittingly reinforce another vein of techno-solutionism. Being included by Alexa may not be, in fact, the preferred future.

With the risks of inclusion in mind, the question then becomes: how might designers queer interaction design without targeting, profiling, silencing, erasing, or excluding people in the process? By investing in categories of social difference, designers simultaneously count some people and label them as "queer," while deciding that still others remain "not queer enough". This approach to queerness precludes the possibilities of people becoming more or less queer across their lifetimes, foregoes all of the context to people's identifiers, and ossifies the individual under a convenient term in an attempt to understand something that is difficult to understand by definition. How our field accomplishes this work without mobilizing the potentially-dangerous language of tokenized inclusion that places people in boxes and renders anyone the least bit divergent as an "other" remains difficult to imagine [51]. It suggests, in line with recent speculative resistance through design [70], that we, as design researchers, liberate our sonic sensitivities for understanding queerness in interaction design, in HCI, and beyond. Following Jordan Wirfs-Brock and colleagues' work with Spotify [118], this work

suggests that voice assistants could use data to encourage reflection on listening practices with something like tone—for example, a device asking, “I can’t quite tell what you mean: did you mean that literally or figuratively?”. Moving beyond predictions and recommendations, devices might support new listening and reflection routines devices that users build into their daily engagements with sonic technologies [27]. But this work might also suggest bringing a more complex reading of sonic data to the regulatory bodies overseeing what data the voice assistant technologies collect and why.

5.2 Towards “Queer Enough” Interaction Design

A corollary to examining the encoding queer experience in sonic devices involves questioning the role of queerness in the wider process of interaction design. This work involves understanding how queerness becomes something to be designed. If we take seriously the idea that queerness exists on a spectrum, then this means that we are *all* affected—in varying shades and degrees—by designs of voice assistants that lack awareness or knowledge of queer ways of living. On the one hand, our study exposes the decision to design voice assistants that are completely unaware of queerness or queer ways of living as queer-phobic. As we saw across multiple engagements, one of the problems with the current state of voice assistant technologies is that they often provide recommendations based on generalizations. But the point when a generalized recommendation becomes a heteronormative recommendation can be hard to pin down. By providing a broad blanket statement that could potentially apply to many people, the recommender algorithms are hedging bets, using a series of concurrent probability calculations, to determine how likely it is or isn’t that a certain phrase or utterance will be appropriate based on the person’s speech input. The problem with this process, however, is that it, again, *assumes that most people are like most other people*. As a result, it is statistically probable that most Alexa responses signal heteronormativity. It is important to remember that some generalizations still *can* apply to queer people. What’s more, hyper-personalization might compel non-normative users to share private information without consent. However, when a generalization takes into account a series of assumptions about how “most” people live, it can very quickly shift from simply generalized advice to generalized *and heteronormative* advice. When we stop to consider the kinds of speech and text that Alexa and other digital assistants are trained on, how could we expect anything different? This research seeks not only to question the apparent heteronormativity of these devices, but rather to experiment with it as unexpected, queer users to further understand how queer personhood is and is not designed for in technological systems of dialogical technologies.

On the other hand, our study has explored the potential limits of smart liberatory design. Like Kinnee, many queer people are likely well-aware of the harmful assumptions built into these systems, the ways in which their queer voices are or aren’t listened to, and the aspects of their lifestyle that won’t and can’t be taken into account by Alexa because they live through and against these assumptions *every day* [43]. Since the logics of voice assistant technologies remain steeped in binaries, perhaps another approach is necessary.

What if, instead of categorizing interactions as “heteronormative” or “homonormative,” design researchers use other, more precise language to get at the particulars of queerness and to celebrate its multiplicity? For instance, many interactions from our study were rendered through the lens of polyamory to account for that particular form of Kinnee’s queerness. Moreover, Kinnee could have also explored their interactions through their identity as a young non-binary person or as someone living with multiple disabilities. As other HCI scholars have shown [117] voice assistants could be designed to give people opportunities to label their own experiences with their own language—to build a shared vocabulary along with the human and voice assistant. Until designers and researchers find tactful and dialogical ways of building and accounting for these varying shades and forms of queerness across people’s lifetimes, the problem of mistrust with domestic voice technologies may only persist or grow more volatile. By amplifying our attention to nuance and sharing more stories of how these technologies intersect with queer lives through first-person use, our field might get closer to rich descriptions of exactly how these technologies work (or fail to work) at the registers of micro-aggression and fundamental misunderstandings.

5.3 Queer Use and Domestic Technology

Alongside understanding the encoding of queerness in design features and approaches, our work points to the particular potentials that come from queering engagements with smart devices. Historically, queer people have been barred from participation in cultures of domesticity [69, 114, 115] as non-normative people and non-normative families living non-normative lives. In the context of North America, the Cold War-era fable of the white picket fence, neatly trimmed lawn, and a traditional nuclear family once rose to a level of prevalence that we might now consider to be a monoculture. Around the world, local cultures provide nuanced and encoded scripts that suggest a certain way or ways of living.

Today, while this image remains prevalent, our conversations about personhood, home, and family are evolving to consider a broader range of the social, cultural, and socioeconomic factors that influence where one lives, in what kinds of dwelling(s) one lives, how one lives, and with whom one lives. Queerness and queer culture remain sensitive topics that elude study by definition. The encroachment of voice assistants on queer spaces means a compromise of this secrecy, and perhaps subsequently, a compromise on the ways in which queerness is allowed to manifest itself within interactive domestic sociotechnical systems.

A voice assistant might not be queer, but what comes from a queer person using the technology? Sarah Ahmed reminds that queer use might grow from using a technology in ways or to ends that it was never designed or imagined to be used [1]. In our study, the queer use of the Alexa devices in two queer homes and within two queer relationships provided a series of redundancies and samenesses throughout the system. We saw how the subversive nature of queer use created a strong platform for experimenting with our experiences using sonic technologies. Using the Alexa device in an environment that it wasn’t designed for and in relationships that it wasn’t designed for allowed us to unearth built-in assumptions in the system that might otherwise remain invisible. How

could we design culturally-informed voice assistants when there is no *one* culture? How could we design queerness-informed voice assistants when there is no *one* way to be queer? The heterogeneity of queerness is often lost or misunderstood, and despite the declaration of the LGBTQIA2S+ acronym, designing technologies that paint across all experiences with a broad brush occludes the possibility that there is variation within and between the people whose queerness is tied to their sexuality and/or gender identity. Queerness can refer to the sameness across these experiences, and “queer” itself is an identifier that is a queer use; an appropriation and reclaiming of what was and sometimes still is a queer-phobic slur. Being “queer” signals an identification, solidarity, and realization that there are many other people in this world who don’t neatly fit into the dominant culture around them. Centering queerness and queer culture is fraught when it always is, always was, and always will be at the margins.

5.4 Bias in Assistance

In a final set of concerns, this study exposes some of the tensions around exposing bias around queerness, but also using that bias toward new and unexpected ends. Across our engagements, we noticed that Alexa’s advice mobilized assumptions about Kinnee’s body and ability, social networks, and hearing ability *during* the time of their queer breakup—a time when culturally-informed, particular forms of care are of heightened importance and sensitivity. The harmful assumptions baked into digital assistants, voice assistants, and recommender systems, and other technologies of capture such as camera and film have been well-documented [8, 60, 61, 82]. Routinely, these biases function under a set of assumptions about a “normative” user. But what if a bias that is designed to help an imagined, more normative person ends up also being helpful to an unimagined, queer person? Does this mean that the design was already queer, or “queer enough” all along?

In the case of Kinnee’s queer breakup, the bias was audible when they were instructed by Alexa to “go for a walk, talk to a friend, or listen to music”. Despite feeling like the advice from Alexa wasn’t really “for them” during their queer breakup, Kinnee’s choice to suspend judgment and follow this advice led to some relief from their heartache. This complicated the research team’s idea of bias; we considered how an encoded misunderstanding or erasure might sometimes help the people who are most often excluded, invisibilized, or dehumanized by digital assistants. The queer use of advice from voice assistants like Alexa might mean following the script that is given, and then seeing how, when, or if it holds up to the particulars of a queer person’s lived experience. The moments of breakdown—when the advice is no longer relevant to the queer person or people involved—further confirm that these systems invisibilize queer lives in nontrivial and non-deterministic ways. A device’s misreading of queer lives will never fully determine queer experience.

6 CONCLUSION

In this paper, we presented a combined autoethnographic and design inquiry into domestic sonic technologies and queer experience. By following one person’s experiences across two homes, two Alexa devices, and two queer relationships, we explored the contours of

encoding queerness (and/or queer phobia) in voice assistant devices, design approaches, and designed interactions. Across nine months of use and after processing three weeks of sonic breakup data from Amazon’s Alexa, we learned that glitches and voice assistant pre-scripts are interwoven with the soundscapes of everyday life, and that Alexa’s recordings can challenge a sense of non-normative time through reminders and memories. Our sonic experimentation led to further insights about the richness of the voice assistant recordings, how Alexa’s system differentiates across voices, and how its processes of translation and transcription reveal opportunities for countering queer erasure. We end with potential strategies for design researchers to bring more nuance and complexity to the limitations wrought by binary and queerphobic logics, bringing new attention to the forms of queer resistance inherent in everyday lived experience with smartness at home.

ACKNOWLEDGMENTS

We deeply appreciate the generous feedback and suggestions from our research community. First, we would like to thank James Pierce and the members of the Tactile and Tactical Design Lab (TAT Lab) for sharing their thoughts on this work throughout its development. Next, we thank Noura Howell, Jordan Wirfs-Brock, and Brianna Dym for their precise and incisive feedback in later stages of writing. Additionally, we thank Michael Brown and Larry Knopp for their support and mentorship in researching queerness and space. Finally, we thank Warlock and Michael for their open-mindedness and sincerity in sharing their experiences of queerness while using sonic technologies at home. This work was supported by NSF Grant 1947696.

REFERENCES

- [1] Sara Ahmed. 2019. *What’s the Use?: On the Uses of Use*. Duke University Press Books.
- [2] Tawfiq Ammari, Jofish Kaye, Janice Y. Tsai, and Frank Bentley. 2019. Music, Search, and IoT: How People (Really) Use Voice Assistants. *ACM Transactions on Computer-Human Interaction* 26, 3: 1–28. <https://doi.org/10.1145/3311956>
- [3] Jonas Austerjost, Marc Porr, Noah Riedel, Dominik Geier, Thomas Becker, Thomas Scheper, Daniel Marquard, Patrick Lindner, and Sascha Beutel. 2018. Introducing a Virtual Assistant to the Lab: A Voice User Interface for the Intuitive Control of Laboratory Instruments. *SLAS TECHNOLOGY: Translating Life Sciences Innovation* 23, 5: 476–482. <https://doi.org/10.1177/2472630318788040>
- [4] Uddipana Baishya and Carman Neustaedter. 2017. In Your Eyes: Anytime, Anywhere Video and Audio Streaming for Couples. In *Proceedings of the 2017 ACM Conference on Computer Supported Cooperative Work and Social Computing (CSCW ’17)*, 84–97. <https://doi.org/10.1145/2998181.2998200>
- [5] Thierry Bardini. 2000. *Bootstrapping: Douglas Engelbart, Coevolution, and the Origins of Personal Computing*. Stanford University Press, Stanford.
- [6] Jeffrey Bardzell and Shaowen Bardzell. 2011. Pleasure is your birthright: digitally enabled designer sex toys as a case of third-wave HCI. In *Proceedings of the SIGCHI Conference on Human Factors in Computing Systems (CHI ’11)*, 257–266. <https://doi.org/10.1145/1978942.1978979>
- [7] Shaowen Bardzell. 2010. Feminist HCI: Taking Stock and Outlining an Agenda for Design. In *Proceedings of the SIGCHI Conference on Human Factors in Computing Systems (CHI ’10)*, 1301–1310. <https://doi.org/10.1145/1753326.1753521>
- [8] Ruha Benjamin. 2019. *Race After Technology: Abolitionist Tools for the New Jim Code*. Polity, Medford, MA.
- [9] Cynthia L. Bennett, Cole Gleason, Morgan Klaus Scheuerman, Jeffrey P. Bigham, Anhong Guo, and Alexandra To. 2021. “It’s Complicated”: Negotiating Accessibility and (Mis)Representation in Image Descriptions of Race, Gender, and Disability. In *Proceedings of the 2021 CHI Conference on Human Factors in Computing Systems (CHI ’21)*, 1–19. <https://doi.org/10.1145/3411764.3445498>
- [10] Cynthia L. Bennett, Daniela K. Rosner, and Alex S. Taylor. 2020. The Care Work of Access. In *Proceedings of the 2020 CHI Conference on Human Factors in Computing Systems*. Association for Computing Machinery, New York, NY, USA, 1–15. Retrieved February 15, 2022 from <http://doi.org/10.1145/3313831.3376568>

- [11] Frank Bentley, Chris Luvogt, Max Silverman, Rushani Wirasinghe, Brooke White, and Danielle Lottridge. 2018. Understanding the Long-Term Use of Smart Speaker Assistants. *Proceedings of the ACM on Interactive, Mobile, Wearable and Ubiquitous Technologies* 2, 3: 1–24. <https://doi.org/10.1145/3264901>
- [12] Heidi R. Biggs, Jeffrey Bardzell, and Shaowen Bardzell. 2021. Watching Myself Watching Birds: Abjection, Ecological Thinking, and Posthuman Design. In *Proceedings of the 2021 CHI Conference on Human Factors in Computing Systems*. Association for Computing Machinery, New York, NY, USA, 1–16. Retrieved January 12, 2022 from <http://doi.org/10.1145/3411764.3445329>
- [13] Edna Bonhomme. 2021. Imperial Fevers, Invisible Lives. Retrieved from <https://drive.google.com/file/d/1QSDQqEHgEkk1EMmKRUWAphixqhD1T4H/view>
- [14] Danielle Bragg, Katharina Reinecke, and Richard E. Ladner. 2021. Expanding a Large Inclusive Study of Human Listening Rates. *ACM Transactions on Accessible Computing* 14, 3: 12:1–12:26. <https://doi.org/10.1145/3461700>
- [15] David Le Breton. 2017. *Sensing the World*. Routledge, London; New York, NY.
- [16] Curtis C. Cain and Eileen Trauth. 2017. Black Men in IT: Theorizing an Autoethnography of a Black Man's Journey into IT Within the United States of America. *SIGMIS Database* 48, 2: 35–51. <https://doi.org/10.1145/3084179.3084184>
- [17] Julia Cambre, Samantha Reig, Queenie Kravitz, and Chinmay Kulkarni. 2020. "All Rise for the AI Director": Eliciting Possible Futures of Voice Technology through Story Completion. In *Proceedings of the 2020 ACM Designing Interactive Systems Conference*. Association for Computing Machinery, New York, NY, USA, 2051–2064. Retrieved January 25, 2021 from <http://doi.org/10.1145/3357236.3395479>
- [18] Alan Chamberlain, Mads Bødker, Adrian Hazzard, David McGookin, David De Roure, Pip Willcox, and Konstantinos Papangelis. 2017. Audio Technology and Mobile Human Computer Interaction: From Space and Place, to Social Media, Music, Composition and Creation. *International Journal of Mobile Human Computer Interaction* 9, 4: 25–40. <https://doi.org/10.4018/IJMHCI.2017100103>
- [19] Joshua Chambers-Letson. 2018. *After the Party: A Manifesto for Queer of Color Life*. NYU Press, New York.
- [20] Eugene Cho. 2019. Hey Google, Can I Ask You Something in Private? In *Proceedings of the 2019 CHI Conference on Human Factors in Computing Systems* (CHI '19), 1–9. <https://doi.org/10.1145/3290605.3300488>
- [21] Sasha Costanza-Chock. 2020. *Design Justice: Community-Led Practices to Build the Worlds We Need*. The MIT Press. <https://doi.org/10.7551/mitpress/12255.001.0001>
- [22] Kate Crawford. 2021. *Atlas of AI: Power, Politics, and the Planetary Costs of Artificial Intelligence*. Yale University Press, New Haven.
- [23] Kate Crawford and Vladan Joler. 2018. Anatomy of an AI System. *Anatomy of an AI System*. Retrieved February 21, 2021 from <http://www.anatomyof.ai>
- [24] Paul R. Daugherty, H. James Wilson, and Roman Chowdhury. 2019. Using Artificial Intelligence to Promote Diversity. *MIT Sloan Management Review* 60, no. 2. Retrieved from <https://sloanreview.mit.edu/article/using-artificial-intelligence-to-promote-diversity/>
- [25] Audrey Desjardins and Aubree Ball. 2018. Revealing Tensions in Autobiographical Design in HCI. In *Proceedings of the 2018 Designing Interactive Systems Conference* (DIS '18), 753–764. <https://doi.org/10.1145/3196709.3196781>
- [26] Audrey Desjardins, Afrodit Psarra, and Bonnie A. Whiting. 2021. Voices and Voids: Subverting Voice Assistant Systems through Performative Experiments. In *Creativity and Cognition* (C&C '21), 1–10. <https://doi.org/10.1145/3450741.3466807>
- [27] Audrey Desjardins and Timea Tihanyi. 2019. ListeningCups: A Case of Data Tacitly and Data Stories. In *Proceedings of the 2019 on Designing Interactive Systems Conference* (DIS '19), 147–160. <https://doi.org/10.1145/3322276.3323694>
- [28] Audrey Desjardins, Oscar Tomico, Andrés Lucero, Marta E. Cecchinato, and Carman Neustaedter. 2021. Introduction to the Special Issue on First-Person Methods in HCI. *ACM Transactions on Computer-Human Interaction* 28, 6: 37:1–37:12. <https://doi.org/10.1145/3492342>
- [29] Laura Devendorf, Kristina Andersen, and Aisling Kelliher. 2020. Making Design Memoirs: Understanding and Honoring Difficult Experiences. In *Proceedings of the 2020 CHI Conference on Human Factors in Computing Systems* (CHI '20), 1–12. <https://doi.org/10.1145/3313831.3376345>
- [30] Michael A. DeVito, Ashley Marie Walker, Caitlin Lustig, Amy J. Ko, Katta Spiel, Alex A. Ahmed, Kimberley Allison, Morgan Scheuerman, Briana Dym, Jed R. Brubaker, Ellen Simpson, Naveen Bagalkot, Noopur Raval, Michael Muller, Jennifer Rode, and Mary L. Gray. 2020. Queer in HCI: Supporting LGBTQIA+ Researchers and Research Across Domains. In *Extended Abstracts of the 2020 CHI Conference on Human Factors in Computing Systems* (CHI EA '20), 1–4. <https://doi.org/10.1145/3334480.3381058>
- [31] Graham Dove. 2021. Graham Dove – SONYC. SONYC. *Sounds of New York City*. Retrieved February 10, 2022 from <https://wp.nyu.edu/sonyc/author/gd64/>
- [32] Margot Duncan. 2008. Autoethnography: Critical appreciation of an emerging art. *International Journal of Qualitative Methods* 3, 4: 28–39.
- [33] Brianna Dym, Jed R. Brubaker, Casey Fiesler, and Bryan Semaan. 2019. "Coming Out Okay": Community Narratives for LGBTQ Identity Recovery Work. *Proceedings of the ACM on Human-Computer Interaction* 3, CSCW: 154:1–154:28. <https://doi.org/10.1145/3359256>
- [34] Anna Eaglin and Shaowen Bardzell. 2011. Sex toys and designing for sexual wellness. In *CHI '11 Extended Abstracts on Human Factors in Computing Systems* (CHI EA '11), 1837–1842. <https://doi.org/10.1145/1979742.1979879>
- [35] Justin Edwards and Elahel Sanoubari. 2019. A need for trust in conversational interface research. In *Proceedings of the 1st International Conference on Conversational User Interfaces* (CUI '19), 1–3. <https://doi.org/10.1145/3342775.3342809>
- [36] Carolyn Ellis, Tony E. Adams, and Arthur P. Bochner. 2010. Autoethnography: An Overview. *Forum Qualitative Sozialforschung / Forum: Qualitative Social Research* 12, 1. Retrieved October 31, 2014 from <http://www.qualitative-research.net/index.php/fqs/article/view/1589>
- [37] Sarah Elwood. 2021. Digital geographies, feminist relationality, Black and queer code studies: Thriving otherwise. *Progress in Human Geography* 45, 2: 209–228. <https://doi.org/10.1177/0309132519899733>
- [38] Jessica Fern, Eve Rickert, and Nora Samaran. 2020. *Polysecure: Attachment, Trauma and Consensual Nonmonogamy*. Thorntree Press, Portland.
- [39] Rebecca Fiebrink and Laetitia Sonami. 2020. Reflections on Eight Years of Instrument Creation with Machine Learning. Retrieved February 10, 2022 from <https://nime2020.bcu.ac.uk/>
- [40] Lesley Fosh, Steve Benford, Stuart Reeves, Boriana Koleva, and Patrick Brundell. 2013. see me, feel me, touch me, hear me: trajectories and interpretation in a sculpture garden. In *Proceedings of the SIGCHI Conference on Human Factors in Computing Systems* (CHI '13), 149–158. <https://doi.org/10.1145/2470654.2470675>
- [41] Futu-Tech. 2019. *Download Alexa voice files/recordings*. Retrieved February 17, 2022 from <https://www.youtube.com/watch?v=Z7yBxj3AFU>
- [42] Patricia Garcia and Marika Cifor. 2019. Expanding Our Reflexive Toolbox: Collaborative Possibilities for Examining Socio-Technical Systems Using Duoethnography. *Proceedings of the ACM on Human-Computer Interaction* 3, CSCW: 190:1–190:23. <https://doi.org/10.1145/3359292>
- [43] Salomé Gómez-Upegui. 2021. The Future of Digital Assistants Is Queer. *Wired*. Retrieved February 18, 2022 from <https://www.wired.com/story/digital-assistant-smart-device-gender-identity/>
- [44] Elizabeth Goodman and Janet Vertesi. 2012. Design for X? distribution choices and ethical design. In *CHI '12 Extended Abstracts on Human Factors in Computing Systems* (CHI EA '12), 81–90. <https://doi.org/10.1145/2212776.2212786>
- [45] Steve Goodman. 2009. *Sonic Warfare: Sound, Affect, and the Ecology of Fear*. MIT Press, Cambridge, MA, USA.
- [46] Anhong Guo, Ece Kamar, Jennifer Wortman Vaughan, Hanna Wallach, and Meredith Ringel Morris. 2020. Toward fairness in AI for people with disabilities SBG@a research roadmap. *ACM SIGACCESS Accessibility and Computing*, 125: 2:1. <https://doi.org/10.1145/3386296.3386298>
- [47] J. Jack Halberstam. 2005. *In a Queer Time and Place: Transgender Bodies, Subcultural Lives*. NYU Press, New York.
- [48] Jack Halberstam. 2011. *The Queer Art of Failure*. Duke University Press Books, Durham.
- [49] Adrian Hazzard, Steve Benford, and Gary Burnett. 2015. Sculpting a Mobile Musical Soundtrack. In *Proceedings of the 33rd Annual ACM Conference on Human Factors in Computing Systems* (CHI '15), 387–396. <https://doi.org/10.1145/2702123.2702236>
- [50] Karey Helms. 2021. Entangled Reflections on Designing with Leaky Breastfeeding Bodies. In *Designing Interactive Systems Conference 2021*. Association for Computing Machinery, New York, NY, USA, 1998–2012. Retrieved January 12, 2022 from <http://doi.org/10.1145/3461778.3462048>
- [51] Anna Lauren Hoffmann. 2021. Terms of inclusion: Data, discourse, violence. *New Media & Society* 23, 12: 3539–3556. <https://doi.org/10.1177/146144820958725>
- [52] Sarah Homewood, Amanda Karlsson, and Anna Vallgård. 2020. Removal as a Method: A Fourth Wave HCI Approach to Understanding the Experience of Self-Tracking. In *Proceedings of the 2020 ACM Designing Interactive Systems Conference* (DIS '20), 1779–1791. <https://doi.org/10.1145/3357236.3395425>
- [53] Noura Howell, Audrey Desjardins, and Sarah Fox. 2021. Cracks in the Success Narrative: Rethinking Failure in Design Research through a Retrospective Trioethnography. *ACM Transactions on Computer-Human Interaction* 28, 6: 42:1–42:31. <https://doi.org/10.1145/3462447>
- [54] Bettina Judd. 2019. Glossolalia: Lucille Clifton's Creative Technologies of Becoming. In *Black Bodies and Transhuman Realities: Scientifically Modifying the Black Body in Posthuman Literature and Culture*, Melvin G. Hill (ed.). Rowman & Littlefield.
- [55] Gopinath Kannabiran, Alex A. Ahmed, Matthew Wood, Madeline Balaam, Theresa Jean Tanenbaum, Shaowen Bardzell, and Jeffrey Bardzell. 2018. Design for Sexual Wellbeing in HCI. In *Extended Abstracts of the 2018 CHI Conference on Human Factors in Computing Systems* (CHI EA '18), 1–7. <https://doi.org/10.1145/3170427.3170639>
- [56] Gopinath Kannabiran, Jeffrey Bardzell, and Shaowen Bardzell. 2011. How HCI Talks About Sexuality: Discursive Strategies, Blind Spots, and Opportunities for Future Research. In *Proceedings of the SIGCHI Conference on Human Factors in Computing Systems* (CHI '11), 695–704. <https://doi.org/10.1145/1978942.1979043>
- [57] Kara Keeling. 2014. Queer OS. *Cinema Journal* 53, 2: 152–157. <https://doi.org/10.1353/cj.2014.0004>
- [58] Jenny Kennedy and Yolande Strengers. 2020. *The Smart Wife: Why Siri, Alexa, and Other Smart Home Devices Need a Feminist Reboot*. MIT Press.

- [59] Cayla Key, Fiona Browne, Nick Taylor, and Jon Rogers. 2021. Proceed with Care: Reimagining Home IoT Through a Care Perspective. In *Proceedings of the 2021 CHI Conference on Human Factors in Computing Systems*, 1–15. <https://doi.org/10.1145/3411764.3445602>
- [60] Josephine Lau, Benjamin Zimmerman, and Florian Schaub. 2018. Alexa, Are You Listening? Privacy Perceptions, Concerns and Privacy-seeking Behaviors with Smart Speakers. *Proceedings of the ACM on Human-Computer Interaction* 2, CSCW: 102:1-102:31. <https://doi.org/10.1145/3274371>
- [61] Minha Lee, Renee Noortman, Cristina Zaga, Alain Starke, Gijs Huisman, and Kristina Andersen. 2021. Conversational Futures: Emancipating Conversational Interactions for Futures Worth Wanting. In *Proceedings of the 2021 CHI Conference on Human Factors in Computing Systems*, 1–13. <https://doi.org/10.1145/3411764.3445244>
- [62] Danielle Lottridge, Mark Chignell, and Aleksandra Jovicic. 2011. Affective Interaction: Understanding, Evaluating, and Designing for Human Emotion. *Reviews of Human Factors and Ergonomics* 7, 1: 197–217. <https://doi.org/10.1177/1557234X11410385>
- [63] Danielle Lottridge, Nicolas Masson, and Wendy Mackay. 2009. Sharing empty moments: design for remote couples. In *Proceedings of the SIGCHI Conference on Human Factors in Computing Systems (CHI '09)*, 2329–2338. <https://doi.org/10.1145/1518701.1519058>
- [64] Andrés Lucero. 2018. Living Without a Mobile Phone: An Autoethnography. In *Proceedings of the 2018 Designing Interactive Systems Conference (DIS '18)*, 765–776. <https://doi.org/10.1145/3196709.3196731>
- [65] Andrés Lucero, Audrey Desjardins, Carman Neustaedter, Kristina Höök, Marc Hassenzahl, and Marta E. Cecchinato. 2019. A Sample of One: First-Person Research Methods in HCI. In *Companion Publication of the 2019 on Designing Interactive Systems Conference 2019 Companion (DIS '19 Companion)*, 385–388. <https://doi.org/10.1145/3301019.3319996>
- [66] Angella Mackey, Ron Wakkary, Stephan Wensveen, and Oscar Tomico. 2017. “Can I Wear This?” Blending Clothing and Digital Expression by Wearing Dynamic Fabric. 11, 3: 15.
- [67] C. Massaroni, F. Giurazza, M. Tesei, E. Schena, F. Corvino, M. Meneo, L. Corletti, R. Niola, and R. Setola. 2018. A Touchless system for image visualization during surgery: preliminary experience in clinical settings. In *2018 40th Annual International Conference of the IEEE Engineering in Medicine and Biology Society (EMBC)*, 5794–5797. <https://doi.org/10.1109/EMBC.2018.8513631>
- [68] Lauren Lee McCarthy. SOMEONE — Lauren Lee McCarthy. Retrieved February 9, 2021 from <https://lauren-mccarthy.com/SOMEONE>
- [69] Tara McDowell. 2019. *The Householders: Robert Duncan and Jess*. The MIT Press, Cambridge, Massachusetts.
- [70] Rubez Chong Lu Ming. 2020. Speculative Design As Resistance In The Age Of Surveillance Capitalism. MASSACHUSETTS INSTITUTE OF TECHNOLOGY, Boston, Massachusetts, United States. Retrieved from <https://dam-prod.media.mit.edu/x/2021/03/16/RubezChongLuMing-SM-MAS-2020.pdf>
- [71] José Esteban Muñoz. 1996. Ephemera as Evidence: Introductory Notes to Queer Acts. *Women & Performance: a journal of feminist theory* 8, 2: 5–16. <https://doi.org/10.1080/07407709608571228>
- [72] José Esteban Muñoz. 2009. *Cruising Utopia: The Then and There of Queer Futurity*. NYU Press, New York.
- [73] José Esteban Muñoz. 2020. Editors’ Introduction. The Aesthetic Resonance of Brown Joshua Chambers-Letson and Tavia Nyong’o. In *Editors’ Introduction. The Aesthetic Resonance of Brown Joshua Chambers-Letson and Tavia Nyong’o*. Duke University Press, ix–xxxiv. <https://doi.org/10.1515/9781478012566-002>
- [74] Carman Neustaedter and Phoebe Sengers. 2012. Autobiographical Design in HCI Research: Designing and Learning Through Use-it-yourself. In *Proceedings of the Designing Interactive Systems Conference (DIS '12)*, 514–523. <https://doi.org/10.1145/2317956.2318034>
- [75] Johanna Nicenboim, Elisa Giaccardi, Marie Louise Juul Søndergaard, Anuradha Venugopal Reddy, Yolande Strengers, James Pierce, and Johan Redström. 2020. More-Than-Human Design and AI: In Conversation with Agents. In *Companion Publication of the 2020 ACM Designing Interactive Systems Conference (DIS '20 Companion)*, 397–400. <https://doi.org/10.1145/3393914.3395912>
- [76] Joe Norris, Richard D Sawyer, and Darren Lund (eds.). 2016. *Duoethnography: Dialogic Methods for Social, Health, and Educational Research*. Routledge. <https://doi.org/10.4324/9781315430058>
- [77] Pedro JS Vieira de Oliveira. 2016. Design at the Earview: Decolonizing Speculative Design through Sonic Fiction. *Design Issues* 32: 43–52. https://doi.org/10.1162/DESI_a_00381
- [78] Mimi Onuoha. 2016. The Library of Missing Datasets — MIMI ONUOHA. MIMI ONUOHA. Retrieved February 13, 2022 from <https://mimionuoha.com/the-library-of-missing-datasets>
- [79] Rui Pan, Samarth Singhal, Bernhard E. Riecke, Emily Cramer, and Carman Neustaedter. 2017. “MyEyes”: The Design and Evaluation of First Person View Video Streaming for Long-Distance Couples. In *Proceedings of the 2017 Conference on Designing Interactive Systems (DIS '17)*, 135–146. <https://doi.org/10.1145/3064663.3064671>
- [80] Emmi Parviainen and Marie Louise Juul Søndergaard. 2020. Experiential Qualities of Whispering with Voice Assistants. In *Proceedings of the 2020 CHI Conference on Human Factors in Computing Systems*. Association for Computing Machinery, New York, NY, USA, 1–13. Retrieved January 25, 2021 from <http://doi.org/10.1145/3313831.3376187>
- [81] Hannah Perner-Wilson and Mika Satomi. 2009. DIY Wearable Technology ISEA 2009 Wearable Materialities Panel.
- [82] Thao Phan. 2019. Amazon Echo and the Aesthetics of Whiteness. *Catalyst: Feminism, Theory, Technoscience* 5, 1: 1–38. <https://doi.org/10.28968/cft.v5i1.29586>
- [83] Trevor Pinch. 2008. Technology and Institutions: Living in a Material World. *Theory and Society* 37, 5: 461–483.
- [84] Trevor Pinch and Karin Bijsterveld. 2004. Sound Studies: New Technologies and Music. *Social Studies of Science* 34, 5: 635–648. <https://doi.org/10.1177/0306312704047615>
- [85] Trevor Pinch and Karin Bijsterveld (eds.). 2011. *The Oxford Handbook of Sound Studies*. Oxford University Press. <https://doi.org/10.1093/oxfordhb/9780195388947.001.0001>
- [86] Sarah Pink. 2009. *Doing Sensory Ethnography*. SAGE Publications Ltd, London; Thousand Oaks, CA.
- [87] Martin Porcheron, Joel E. Fischer, Stuart Reeves, and Sarah Sharples. 2018. Voice Interfaces in Everyday Life. In *Proceedings of the 2018 CHI Conference on Human Factors in Computing Systems (CHI '18)*, 1–12. <https://doi.org/10.1145/3173574.3174214>
- [88] Jon Rogers, Loraine Clarke, Martin Skelly, Nick Taylor, Pete Thomas, Michelle Thorne, Solana Larsen, Katarzyna Odrozek, Julia Kloiber, Peter Bihr, Anab Jain, Jon Arden, and Max von Grafenstein. 2019. Our Friends Electric: Reflections on Advocacy and Design Research for the Voice Enabled Internet. In *Proceedings of the 2019 CHI Conference on Human Factors in Computing Systems (CHI '19)*, 114:1-114:13. <https://doi.org/10.1145/3290605.3300344>
- [89] Daniela K. Rosner. 2018. Approaching Design as Inquiry: Magic, Myth, and Metaphor in Digital Fabrication. In *The Routledge Companion to Media Studies and Digital Humanities*. Routledge.
- [90] Daniela K. Rosner and Kimiko Ryokai. 2010. Spyn: augmenting the creative and communicative potential of craft. In *Proceedings of the SIGCHI Conference on Human Factors in Computing Systems (CHI '10)*, 2407–2416. <https://doi.org/10.1145/1753326.1753691>
- [91] Legacy Russell. 2020. *Glitch Feminism: A Manifesto*. Verso, London; New York.
- [92] Richard D Sawyer and Joe Norris. 2012. *Duoethnography*. Oxford University Press, Oxford, New York.
- [93] Richard Sawyer and Joe Norris. 2015. Duoethnography: A Retrospective 10 Years After. *International Review of Qualitative Research* 8, 1: 1–4. <https://doi.org/10.1525/irqr.2015.8.1.1>
- [94] R. Murray Schafer. 1993. *The Soundscape: Our Sonic Environment and the Tuning of the World*. Destiny Books.
- [95] Morgan Klaus Scheuerman, Jacob M. Paul, and Jed R. Brubaker. 2019. How Computers See Gender: An Evaluation of Gender Classification in Commercial Facial Analysis Services. *Proceedings of the ACM on Human-Computer Interaction* 3, CSCW: 144:1-144:33. <https://doi.org/10.1145/3359246>
- [96] Morgan Klaus Scheuerman, Kandra Wade, Caitlin Lustig, and Jed R. Brubaker. 2020. How We’ve Taught Algorithms to See Identity: Constructing Race and Gender in Image Databases for Facial Analysis. *Proceedings of the ACM on Human-Computer Interaction* 4, CSCW1: 058:1-058:35. <https://doi.org/10.1145/3392866>
- [97] Holger Schulze. 2013. Adventures in Sonic Fiction: A Heuristic for Sound Studies. *Journal of Sonic Studies* 3, 4.
- [98] Holger Schulze. 2020. *Sonic Fiction*. Bloomsbury Academic, New York.
- [99] Eve Kosofsky Sedgwick. 1993. *Queer and Now*. In *Tendencies*. Duke University Press. Retrieved February 7, 2022 from <https://read.dukeupress.edu/books/book/591/chapter/126855/Queer-and-Now>
- [100] Eve Kosofsky Sedgwick. 1993. *Tendencies*. Duke University Press Books, Durham.
- [101] David Serlin. Forthcoming. The Politics of Friction: Designing a Sex Toy for Every Body. In *Design for One: Post-Universal Design and the New Normal*, Elizabeth Guffey (ed.). Bloomsbury Academic, New York and London.
- [102] William Seymour. 2018. How loyal is your Alexa? Imagining a Respectful Smart Assistant. In *Extended Abstracts of the 2018 CHI Conference on Human Factors in Computing Systems (CHI EA '18)*, 1–6. <https://doi.org/10.1145/3170427.3180289>
- [103] William Seymour and Max Van Kleek. 2020. Does Siri Have a Soul? Exploring Voice Assistants Through Shinto Design Fictions. In *Extended Abstracts of the 2020 CHI Conference on Human Factors in Computing Systems (CHI EA '20)*, 1–12. <https://doi.org/10.1145/3334480.3381809>
- [104] Katta Spiel. 2021. “Why are they all obsessed with Gender?” — (Non)binary Navigations through Technological Infrastructures. In *Designing Interactive Systems Conference 2021 (DIS '21)*, 478–494. <https://doi.org/10.1145/3461778.3462033>
- [105] Katta Spiel, Os Keyes, Ashley Marie Walker, Michael A. DeVito, Jeremy Birnholtz, Emeline Brulé, Ann Light, Pinar Barlas, Jean Hardy, Alex Ahmed, Jennifer A. Rode, Jed R. Brubaker, and Gopinath Kannabiran. 2019. Queer(ing) HCI: Moving Forward in Theory and Practice. In *Extended Abstracts of the 2019*

- CHI Conference on Human Factors in Computing Systems (CHI EA '19)*, 1–4. <https://doi.org/10.1145/3290607.3311750>
- [106] Denny L. Starks, Tawanna Dillahunt, and Oliver L. Haimson. 2019. Designing Technology to Support Safety for Transgender Women & Non-Binary People of Color. In *Companion Publication of the 2019 on Designing Interactive Systems Conference 2019 Companion (DIS '19 Companion)*, 289–294. <https://doi.org/10.1145/3301019.3323898>
- [107] Jonathan Sterne. 2003. *The Audible Past: Cultural Origins of Sound Reproduction*. Duke University Press Books, Durham.
- [108] Rob Strong and Bill Gaver. 1996. Feather, Scent, and Shaker: Supporting Simple Intimacy. In *Proceedings of CSCW*.
- [109] Neilly Herrera Tan, Brian Kinnee, Dana Langseth, Sean A. Munson, and Audrey Desjardins. 2022. Critical-Playful Speculations with Cameras in the Home. In *Proceedings of the 2022 CHI Conference on Human Factors in Computing Systems (CHI '22)*.
- [110] Theresa Jean Tanenbaum and Karen Tanenbaum. 2018. Steampunk, Survivalism and Sex Toys: An Exploration of How and Why HCI Studies Peripheral Practices. In *New Directions in Third Wave Human-Computer Interaction: Volume 2 - Methodologies*, Michael Filimowicz and Veronika Tzankova (eds.). Springer International Publishing, Cham, 11–24. https://doi.org/10.1007/978-3-319-73374-6_2
- [111] Emily Thompson. 1995. Machines, Music, and the Quest for Fidelity: Marketing the Edison Phonograph in America, 1877–1925. *The Musical Quarterly* 79, 1: 131–171.
- [112] Emily Thompson. 2004. *The Soundscape of Modernity: Architectural Acoustics and the Culture of Listening in America, 1900–1933*. The MIT Press, Cambridge, Mass.
- [113] Emily Thompson. The Roaring Twenties - an interactive exploration of the historical soundscape of New York City. *Vectors Journal*: Retrieved February 7, 2022 from <http://vectors.usc.edu/projects/index.php?project=98&thread=EditorIntroduction>
- [114] Stephen Vider. 2020. Domesticity. In *The Routledge History of American Sexuality*. Routledge.
- [115] Stephen Vider. 2022. *The Queerness of Home: Gender, Sexuality, and the Politics of Domesticity after World War II*. University of Chicago Press, Chicago.
- [116] Meredith Whittaker, Meryl Alper, Olin College, Liz Kaziunas, and Meredith Ringel Morris. 2019. Disability, Bias, and AI. *AI Now Institute*: 32.
- [117] Jordan Wirfs-Brock. 2021. Learning to Listen to Data: Voice Interaction, Sonification, and Narrative. In *Companion Publication of the 2021 ACM Designing Interactive Systems Conference (DIS '21 Companion)*, 7–10. <https://doi.org/10.1145/3468002.3468231>
- [118] Jordan Wirfs-Brock, Sarah Mennicken, and Jennifer Thom. 2020. Giving Voice to Silent Data: Designing with Personal Music Listening History. In *Proceedings of the 2020 CHI Conference on Human Factors in Computing Systems (CHI '20)*, 1–11. <https://doi.org/10.1145/3313831.3376493>