

Cataloging Augmented, Ambivalent Transgender Futures: Designing Inclusive AR Technologies for Trans Communities Through Speculative, Participatory Zine-Making

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Figure 1: A) Participants in zine-making workshop, B) Various participant zines, and C) Participant using newspaper scraps for collaging

Abstract

Technologies designed to support marginalized communities have often led to unintended harm. This frequently occurs when misaddressing or failing to understand communities' experiences, needs, and desires. User-centered research often focus on needs versus desires (leveraging deficit versus assets-based approaches), which

have been contested in HCI. To promote technology design that better balances the tensions between needs and desires, we contribute participatory zine-making as an effective approach for speculatively designing trans augmented reality (AR) technologies. We facilitated in-person and virtual workshops with trans participants ($n=44$) focused on designing AR technologies, observing participants' zine-making processes and artifacts to gather visual ethnographic data alongside transcripts and facilitator field notes. In participants' zines we identified ambivalence as critical in addressing trans people's needs and desires, and participants conveyed this ambivalence through metaphor and anti-assimilationist aesthetics. Our participatory zine-making approach enabled us to uncover perspectives and design implications crucial to designing trans technologies.

CCS Concepts

• **Human-centered computing** → **Collaborative and social computing design and evaluation methods.**

Keywords

Transgender; Nonbinary; LGBTQ+; Participatory design; Zines; Augmented reality; Anti-assimilationist design; Ambivalence; Trans technology

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1 Introduction

An ever growing priority in HCI has been to design technologies that support marginalized communities—whether through promoting inclusion and safety [10, 30, 53, 54, 56, 76, 77], supporting better access to resources and material conditions [22, 23, 68, 83], or mitigating harms and barriers of structural oppressions [23, 68]. This support for marginalized communities within HCI extends to LGBTQIA2S+¹ communities, with many related works centering on including the experiences of queer, trans, and gender nonconforming (GNC) people [21, 40, 68, 74]. However, it is important for researchers and designers to keep building upon their understandings of queer² and trans communities’³ life experiences because of the profound complexities of them, especially considering a researcher’s positionality in the institute. Academia, computing, and technical spaces have historically upheld structures of oppression that affect people of varying marginalized identities [2, 20, 75], including queer and trans people [45, 48, 50, 62]. These oppressive systems are compounded when considering intersectional identities between race, class, ability, etc. [20, 75, 82]

As a result, the dynamics between researchers, designers, and technologists and the marginalized communities they work with and aim to design for are imbued with power differentials and differences in experience and perspective. Researchers and designers, though often well-intentioned, must be sure to explicitly consider these power dynamics and experiential differences to avoid deep misunderstandings about marginalized communities and their relationships to technology. Such misunderstandings can even perpetuate various harmful design approaches in technology, such as damage-centered design or viewing marginalized groups from a lens of deficit, which in turn can patronize certain groups [81]. On the other end, pluriversal design [52], or a focus on joy facilitation

[78], invites marginalized people to participate in joyful expression. However, joy-focused design may still evoke unintended harm by failing to address obstacles and hardships marginalized communities face—counterintuitively impeding fulfillment and pleasure.

Ultimately, many existing design approaches overlook the tensions between the needs and desires of marginalized groups, the ambivalence emerging from such tension, and the importance of considering ambivalence while designing inclusive technologies. Here, by needs we mean aspects essential to material safety and well-being, which account for the difficulties and challenges that marginalized people face, and by desires we mean expressions of joy, yearning, and creative aspiration. Acknowledging *ambivalence*, or multiple conflicting yet simultaneously true concepts, is critical in addressing desires and needs together, especially in relation to designing technology and studying how marginalized people view and use technology. Prior HCI works that design with ambivalence highlight the ambivalent outcomes and relationships between vulnerable populations and technologies, often citing the oppressive systems and institutes these technologies are derived from as an underlying factor [35, 59, 88].

Our team sees an opportunity for researchers and designers to embrace the inherent complexities and ambivalences that arise when marginalized groups use technology. We chose one context of marginalized users—trans people—and one promising form factor—augmented reality (AR)—to examine how we as researchers and designers can more critically account for a marginalized group’s needs and desires to avoid perpetuating harm when designing technology. The particular relationship between AR technologies and trans communities exemplifies how ambivalent outcomes occur when the complexities of marginalized communities’ needs and desires are not fully considered. In prior HCI research studies, participants often described and envisioned their experiences with queer and trans identity through exploration with AR technology—or technologies alluding to augmented reality (e.g., augmented mirrors and glasses), even if the term AR was not explicitly stated [5, 17, 41]. However, the desire for identity exploration through AR tech is heavily impeded by the harms such technologies can inadvertently produce for trans people, such as misgendering, evoking feelings of dysphoria, and erasing nonbinary experiences [39, 50, 74]. Though AR technologies have potential to accommodate trans people in transformative ways, they are seldom designed with trans communities and the complexities of their needs and desires in mind—resulting in design practices that unintentionally harm trans users.

In pursuit of more inclusive AR technologies, our research seeks to understand trans experiences deeper and more directly. Accordingly, we designed our study to explore potential AR futures by and for trans communities—beginning with involving members of trans communities to participate in the design process. We also sought to have members engage in speculative design [28], as prior HCI work posits speculative design to provide a space for collaboration and resistance that bridges diverse perspectives [55], and considering future technologies that accommodate overlooked communities [10]. Our study required unique forms of data gathering to effectively analyze marginalized communities’ sometimes conflicting needs and desires—considering deficit and assets-based approaches often fall short in addressing ambivalences resulting from such conflicts. Visual ethnographic approaches, such as cultural probes

¹Lesbian, gay, bisexual, transgender and/or gender expansive, queer and/or questioning, intersex, asexual, and two-spirit

²this paper uses “queer” as shorthand for LGBTQIA2S+ communities and groups generally, while acknowledging the limitation that not all LGBTQIA2S+ would use this term for themselves.

³When referencing the “trans community,” we do not imply that there is to be a singular community; in reality, there are many trans communities both online and in physical world that coalesce based on identities, locations, interests, and other factors, and do not have strict boundaries. While trans “population” might be more precise, we keep the language of “community” because community is vital for many trans people.

[36] and participatory crafting [34], have shown success in producing organic and holistic research data that shed light on the complexities of marginalized communities. For this study, we chose zine-making—or sketch/collage—as our visual ethnographic medium, as zines are especially compelling for trans communities to design with given their history within queer cultural and political spaces [27, 32, 64].

Synthesizing our various approaches, we came to our study format of facilitating participatory co-design workshops using zine-making in tandem with group discussion to collect qualitative data about trans experiences. We conducted seven design workshops with a total of 44 participants both in-person in three US cities (Oakland, California, Ann Arbor, Michigan, and Detroit, Michigan) and virtually on Zoom. Participants engaged in group discussion based on our prompts that centered around discussing 1) their experiences with AR technologies in relation to their trans identities, and 2) how AR technologies might support the needs and desires of trans people. We encouraged participants to consider “needs” and “desires” openly and broadly, recognizing that they are interrelated. To guide our findings and analysis and ground them in inclusive AR technology design for trans communities, we developed the following research questions:

- RQ1: How might speculative, participatory zine-making enable us to understand the ambivalences inherent in trans experiences?
- RQ2: What design practices emerge when participants explore trans experiences and AR through speculative, participatory zine-making?
- RQ3: How might speculative, participatory zine-making be used as a unique approach to address ambivalent concepts, and incorporate ambivalence in design to support trans experiences?

Through our study, we found zine-making to be a compelling medium that gave participants an expressive environment to visually think through their design processes. Zines as visual and crafted artifacts also paired well with verbal discussions and interactions to provide rich, multimodal data. Analyzing participants’ zines in addition to our field notes and transcript data allowed us to derive critical interventions of design thinking around trans communities—which include emergent themes around ambivalence. Situating participatory zine-making in a speculative design process for AR designs meant that participants freely designed without worrying about technical and structural limitations of current technologies, and expressed their preferred design practices without needing technical experience (in this case, with AR development specifically).

Our results found that many participants speculated and designed around what we later define as *actualizing ambivalence*, or the process of articulating, visualizing, and creatively expressing seemingly ambivalent concepts. Participants expressed how various elements of current technologies create conflicting but simultaneously existent instances of benefits and harms in relation to meeting their needs and desires. In response, participants’ zines reflected specific design practices that attempted to actualize these ambivalent circumstances. Firstly, they implemented multi-meaning visual metaphor as a tool to work through enigmatic thoughts around

their experiences with technology, needs, and desires, as well as make visible those complex relationships. Secondly, participants approached their zines with “anti-assimilationist” design aesthetics, or design that is in the spirit of adversarial design [24] (which is inherently political and disruptive to the status quo) but also encompasses themes of disruption specific to challenging conformity and norms.

In this study, we answer our research questions by using speculative, participatory zine-making workshops as an avenue for trans communities to co-design inclusive AR technologies that better support their needs *and* desires. Using zine-making as a medium specifically led to deep insights into addressing the ambivalence of needs and desires in trans experiences, as participants were able to visually actualize ambivalence through zine-making’s unique affordances. Their designs highlight the importance of addressing ambivalence in their experiences with technology, and the ways participants visually grapple with ambivalence via zine-making provide novel design for designing more inclusive AR technologies. We introduce important design practices that emerged from participants’ creative zine-making and design speculation processes: Addressing complexity through metaphor, and anti-assimilationist design. These practices provide researchers and designers critical insights into trans communities’ values and how these values can be integrated into the AR design process; additionally, these insights yield to technology design for marginalized populations broadly. Since actualizing ambivalence emerges from the material conditions brought on by hegemonic oppression, it exists not only within trans communities, but can extend to additional communities of people with marginalized and multi-marginalized identities.

Previous works have explored the needs and desires of marginalized communities through various lenses, including deficit-based and assets-based research and design [52, 78, 81]. We build on and extend this body of work by centering ambivalence in addressing needs and desires, rather than focusing only on needs or only on desires. We also extend prior work in co-design by synthesizing participatory and speculative design [10, 28, 55] with zine-making [27, 34, 64] to gain insights that can translate to novel design implications for technology. We demonstrate the effectiveness and fruitful contributions of speculative, participatory zine-making as its own approach. In doing so, we highlight ambivalence’s role in participants’ experiences, and what this means for design.

Overall, our paper contributes to understanding both the importance of ambivalence in technology design for trans communities and the efficacy of using participatory, speculative zine-making as a powerful approach for marginalized communities to design and shape their own technological futures. We also invite researchers and designers to consider and embrace ambivalences in their own participatory methods and design approaches.

2 Background

2.1 Trans Technologies

Trans technologies are technologies that help to address needs and challenges that trans people face in the world [40]. HCI researchers have designed and studied a number of trans technologies, including a voice-training app [3], safety apps for trans and queer people [61, 76], a makeup support system [15], a trans-specific social media

site [37], and an app for allies to support trans people while using public restrooms [6]. Though typically focused on needs, trans technologies can also be more playful, such as an educational virtual reality tool that helps people learn about gender and sexuality [60] and a facial prosthetic device that enables the user to have multiple identities on Apple devices [5]. Researchers have also sought to understand how technology can better support trans experiences in the realms of health and well-being [16, 83], gender transition tracking [17], social media [38, 68], art [26], and games [66]. Further research focused on how trans people were involved in technology design processes [41, 87], arguing that technology design processes should, but often only minimally do, involve trans people and communities. We extend this line of prior research and design by envisioning future potential AR technologies with trans communities, taking new perspectives on trans needs and desires using a participatory zine-making approach.

2.2 Solutionist Misinterpretations of Needs

Trends in technologies for marginalized and underserved communities often adhere to solutionist mindsets that seek to solve conceived problems through technology [19]. Solutionism harbors binary and simplistic thinking stemming from its dichotomous pairing of *problem-solution*, and this can enable harmful perspectives towards underserved communities by viewing them and their needs as the *problem* and technology as the *solution* [19, 57]. This approach is also limited when considering the oppressive and colonialist histories that are embedded in current technologies and technical practices [2, 49, 85] and therefore are incompatible with the complex needs of disenfranchised groups [2].

The dichotomous nature of solutionist-oriented approaches also manifests through damage-centered design, by which underserved communities are viewed from the lens of deficit and damage [81]. Beyond designing specifically for marginalized people, damage-centered approaches have a negative impact on technologies as a whole as reflected in insidious narratives around the digital divide [12]. The digital divide is a construct used to describe gaps of technological access that affect marginalized communities—especially those including BIPOC (Black, Indigenous, and people of color) [12, 57]—and from a damage-centered and solutionist perspective, positions marginalized people as technically inept and oppositional to technological progress [12, 57]. Researchers who adopt these narratives ultimately design technologies that are exclusionary and do not properly consider marginalized people's experiences. A few examples include computer vision failing to detect non-white skin tones and bodies [70], data harvesting of vulnerable populations [67], and harmful race and gender biases in artificial intelligence [14] and surveillance technologies [10, 13, 30, 53, 54].

Because solutionist approaches to technology design often exacerbate or create further barriers and difficulties for marginalized people, we look for more complex and community-oriented approaches. We seek to understand and embrace the complexities of trans experiences and design technology outside of simplistic problem/solution and deficit-based frameworks.

2.3 The Limits of Designing for Joy

We noted with interest recent calls in HCI to design for joy and flourishing when working with marginalized communities, rather than or in addition to focusing on needs [78]. Such an approach involves changing researchers' mindsets about the people and communities they work with, and challenging the solutionist-oriented approach [19, 80] common in HCI. This joy-based stance challenges traditional HCI needs-based problem-solving approaches, which sometimes frame marginalized communities from a deficit and damage perspective [78]. While assets-based design work is not necessarily harmful, the limitations of assets-based approaches must be critically examined when considering how design can more holistically center the experiences, needs, and desires of marginalized groups.

Past HCI research has investigated positive design approaches across various user and socio-technical contexts. These works highlight the importance of pleasure in pluriversal design and desire-centered design [52], which invites everyone—especially those from marginalized communities—to express their desires and determine desirable solutions, offering new possibilities for shaping worlds [78]. Such work advocates for design that allows users to transcend oppressive narratives of deficit and exclusion [52]; yet, race, ethnicity—with exception to To [78]—and trans identity are often overlooked in positive design frameworks, warranting further exploration into how a focus on positivity might overlook structural oppressions.

In design work with trans communities, it is essential for researchers to recognize the trauma these communities experience, and the resulting needs and challenges that arise due to systemic transphobia, and other forms of oppression like racism—especially in the current anti-trans political environment. Ignoring these structural barriers invalidates their experiences and falsely places blame on individuals themselves rather than the harmful environments resulting from oppressive structures [75], hindering progress toward equity and justice. Addressing systemic issues rooted in white supremacy, racism, homophobia, transphobia, transmisogyny, and transmisogynoir [51] directly and acknowledging the resulting trauma is crucial in order to not only support their needs but so they can also flourish [4, 76]. Designing with marginalized groups must involve considering both their needs and desires, which can help to address challenges they face [4, 11, 23, 31, 44, 47]. In addition to considering joy and flourishing [78], we must also take seriously the unique challenges marginalized populations face; joy, for instance, is difficult to experience when one does not feel safe. Our research engages actively with structural inequalities and more community-level and individual-level challenges, with a particular focus on addressing the urgent needs of transgender people and other marginalized communities, which has the potential to open up opportunities for joyful design.

3 Study Approach

Our team took great care to examine trans needs and desires holistically. Instead of reducing trans experiences to problems for technology to solve, we seriously considered how trans people's challenges, aspirations, and well-being are often intertwined. This entwinement of various factors highlights how emblematic ambivalence

is to trans experiences with technology (something we will further discuss in our Results section). As such, we avoid both purely needs-based *and* purely joy-based design mentalities in order to uphold and reflect on the complexities inherent in trans lives. We also reject solutionist approaches to technology. Such approaches frame our participants as at a deficit. As we engage with technology, our goals are for trans people to feel not only involved, but empowered in envisioning futures that meet their needs and desires. Our design motivations call for a participatory approach to critically analyze current technologies and design approaches. Accordingly, our approach invites trans community members to speculate and ideate on how to align technologies with their communities' values and goals.

3.1 Zines for Visual Power and Empowerment

For our study, we developed and implemented a participatory and visual ethnographic method via participatory zine-making workshops. Zines are independently published, DIY (do-it-yourself) “magazine-like” visual works [27]. As a medium, zines are extremely accessible and affordable to produce and distribute. Historically, zines have been analog print publications, photocopied and locally disseminated; however, zines have the capacity to be made through numerous forms and materialities [8, 27, 34]. We focused on zines as a powerful tool of expression and creation for trans participants because of zines' histories and influences within marginalized communities [27, 34], including alternative, punk, riot grrrl, queer, and trans spaces [27, 46, 64, 69]. “Zining” has historically revolved around building systems and cultures outside of normative, mainstream, and oppressive systems—thus providing an opportunity for marginalized people to express themselves, rebel, and partake in activism [27, 34]. Thus, zines are both a resistant and community-centered technology. Further, zine-making is both a creative and collaborative process. [46]. Participatory design and zine-making effectively complement each other: participatory design democratizes the design process [42] and is meant to include and empower people and communities to develop technologies that account for and accommodate them. Zines also harness the benefits of visual-ethnographic data collection, which leverages multimodal expression from participants and can produce emergent, integral information outside of more traditional forms of data collections (e.g., surveys, interviews) [8, 34, 36].

3.2 Speculating for Trans AR Through Zines

We build upon prior works that identified AR's connection to visual exploration of identity and self-conceptualization among queer, trans, and GNC people [5, 17, 39, 41] and further explore AR through zines to help address trans people's needs and desires. The visual nature of both AR and identity exploration lends itself well to the medium of zine-making, which is highly expressive and visual. Lastly, we prioritized speculation in design workshops because we wanted to empower our participants to freely think through future conceptions of AR technology in a manner unconstrained by present technological and physical constraints [27, 29, 42]. Speculative design, defined as designing for future technologies and techno-realities beyond current traditional design scopes [28, 44], is a compelling method in HCI spaces, especially in research focusing

on designing for and with marginalized populations [10, 44, 55]. Speculative design offers a means to challenge larger systemic powers affecting marginalized populations, lending to generative provocations and possibilities [44]. Participatory design invites stakeholders of communities to meaningfully be involved and engaged in the design process [73], and is especially helpful in tandem with speculative design for marginalized communities to think critically and envision future potential technologies beyond the restrictions and limitations of current technologies [25, 28]. Thus, our study approach combining speculative AR technology design and zine-making provided participants with a visually accessible and familiar technology for ideating on identity exploration.

4 Methods

4.1 Participants and Recruitment

We recruited participants by disseminating study information and a screening survey link on social media (Twitter, Mastodon, Instagram, and Facebook), in trans-focused online communities, among local trans and queer focused organizations, and on a popular trans podcast. To be eligible for the study, participants needed to identify as transgender, nonbinary, and/or gender nonconforming, speak English, and be at least 18 years of age. Participants were not expected to have a certain level of knowledge about AR technologies, ensuring accessibility and preventing exclusion of those with less technological experience. We carefully vetted screening survey responses to ensure participants met eligibility requirements and were not fraudulent by examining IP addresses, locations, open-ended responses, and links to their social media accounts. In an effort to ensure representation across the breadth of the trans community, we used purposive sampling [79], prioritizing the inclusion of individuals who identified as Black, Indigenous, or persons of color. We compensated each participant between \$75–\$100 depending on how much travel reimbursement they needed to attend in-person workshops. Participants could choose to receive payment in the form of a check or electronic gift cards.

Participants lived in 22 cities/towns across seven US states and one Canadian province. Please see Table 1 for participant demographics.

4.2 Study Design and Workshop Format

In our study, we sought to center the voices of trans people to understand how current and future AR technologies relate to their needs and desires. Our focus on AR stemmed from prior work with trans communities, which uncovered AR as a common area in which participants envisioned potential trans technologies [40]. We asked participants about any prior experiences with AR and to explore such technologies through a verbal and visual speculative design process that involved group discussion and creating zines.

We conducted seven design workshops in 2023 with a total of 44 participants. Four workshops were in-person (two in Oakland, California, one in Ann Arbor, Michigan and one Detroit, Michigan) and three were online using Zoom (all virtual participants resided in the US). Each workshop began with providing light refreshments (or mailing refreshments in advance to virtual participants), and a round of introductions with the participants and workshop facilitators. After introductions, we initiated a dialogue about the

Table 1: Participant Demographics

	# of Participants (total $n = 44$)	% of Participants
Gender		
Trans Man and/or Trans masculine	17	38.6%
Trans Woman and/or Trans feminine	8	18.0%
Nonbinary	20	45.5%
Agender	4	9.1%
Genderqueer	2	4.5%
Genderfluid	2	4.5%
Expansive gender identities (incl. demigirl, unlabelled, gender nonconforming, bigender, mixed, butch)	6	13.6%
Transgender (self-identified only as “transgender”)	1	2.3%
Race/Ethnicity		
White	22	50.0%
Black or African American	5	11.4%
Hispanic or Latino	7	15.9%
Asian	10	22.7%
American Indian or Alaska Native	2	4.6%
Multiracial (self identified as “Multiracial,” “Biracial,” or “Mixed”)	5	11.4%
Additional self-reported races/ethnicities (self identified as Ashkenazi, Italian, Moroccan, Indo-Caribbean, and French Canadian.)	6	13.6%
Participant Ages: Mean = 28.75 ($SD = 10.02$, range: 18-63)		
Many participants described their gender and race with multiple identifiers, so percentages add up to greater than 100%.		

rules governing the space. This not only set clear expectations but also provided an opportunity for participants to contribute their own rules, which was intended to ensure that everyone felt valued, respected, and at ease throughout the research process. We then gave an overview of what AR technologies are, a brief history of zines, and an overview of speculative design/futuring. For the next section of the workshop, we opened the floor to discussion (or on zoom, had participants chime in or raise their hand), and asked participants to answer the following questions:

- (1) What personal experience do you have with augmented reality? Was the experience positive, negative, or neutral in relation to your trans identity?
- (2) What do you believe is crucial to validating, uplifting, supporting, or helping meet the needs and desires of trans people and communities? What are those needs or desires specifically?

In the second prompt, we intentionally asked about both *needs* and *desires*, aiming not to sway participants in either direction. Following the third workshop, we refined these questions to make them shorter and easier for participants to process in the hopes of facilitating more focused discussions.

After discussion, we then asked participants to spend 45-60 minutes to sketch, design, or otherwise creatively express their ideas for speculative AR technology in their zines using paper, stationery, stickers, washi tape, glue, newspapers, pens, pencils, and colored pencils at the in-person workshops, and digital zine-making options in the online workshops. Digital zine-making platforms included

Electric Zine Maker, Canva, PicMonkey, Google Docs, and Procreate. Some online participants opted to receive physical zine-making supplies, which we mailed to them prior to the workshop. Participants were encouraged to focus on identity, health, or another topic of their choice (“open futuring / miscellaneous”). We encouraged participants to think outside the box for their zine design process by providing a range of craft materials, allowing participants to use whatever forms of expression they prefer (visual, written, storytelling, abstract, drawn, collaged, etc.) and encouraging that “the only rule in zine-making is that there are no rules.” From our fifth workshop onward, at the end of the zine-making session we showed participants rudimentary designs and prototypes that other participants had drawn, as well as several early prototypes from the research team⁴, to gather preliminary feedback.

Following each workshop, the study team took 15-20 minutes to debrief and discuss the session. The team consisted of two to three of our graduate student and postdoc authors who facilitated a workshop—the first author helped facilitate all workshops except for the final workshop. The team met weekly to discuss how the workshops they facilitated were going and areas to improve. We each wrote field notes for each workshop we attended, recalling our observations and thoughts. These notes enabled us to document our mindsets going into, during, and following each workshop. We accounted for and wrote about our moods, positionality, and anything that seemed particularly notable that might not otherwise be apparent in our audio and visual data. In our field notes, we also

⁴Zines and prototypes by the research team were not included in our analysis.

documented challenging moments, points to improve on, and our perspectives on any notable interactions.

4.3 Data Analysis

Study data consisted of 14 hours of audio, workshop transcripts, researcher field notes, and 42 zines. Two participants from virtual workshops did not submit their zines, and did not respond to follow-up emails soliciting their submission. In late 2023, we separately inductively open-coded [18] transcripts of discussions from two workshops, to establish recurring codes and initial patterns in the data. Then, our team used Miro (an online visual workspace) to group codes together into broad categories, discussing and reflecting on what the code groups might have in common. Next, we collaboratively translated those code-groups into a code book, moved that code data into our qualitative coding software (Atlas.ti Cloud), and then reviewed the initially-coded transcripts again to further refine codes. In early 2024, the majority of authors then coded the remaining transcripts and further refined the codes and themes. Four authors categorized each zine as either focused on needs/challenges, joy/desires, or both. The authors determined the category of the zines through collaboratively analyzing how participant's described their zines/what story or themes they were conveying and the visual elements of the zines. Finally, five authors collaboratively coded photos of all zines (each accompanied by that participant's demographic info and a transcription of their own descriptions of their work) in a Miro board.



Figure 2: Participants from first Oakland workshop.

Our approach to data analysis drew in part from reflexive thematic analysis [9], and was primarily inductive [9], meaning that we derived codes and themes from the content of the data. We prioritized understanding participants' experiences, needs, and desires, steering away from imposing preconceived notions on the content or limiting the analysis to literal descriptions. The thematic analysis adhered to an interpretivist (constructionist) perspective [71], where we conceptualized themes collaboratively based on our analysis of what participants said and drew. This approach emphasized capturing the complex meanings and interpretations embedded in participants' experiences. We knew that our future work would move toward designing prototypes from the speculative AR technologies that participants described and depicted in

their zines, which informed some of the themes that we later identified in our data. These themes stemming from a more deductive approach included what participants identified as the positive and negative aspects of AR, challenges that trans people face (whether directly related to technology or not), participants' ideas for new AR technologies, and participants' desired technological and interface features. In this paper, we focus on two main inductive themes from our data analysis: actualizing ambivalence and ambivalent design patterns.

4.4 Reflexivity and Researcher Positionality

Reflexivity involves engaging in critical reflection on both the researcher's role and the practice and process of research itself [72]. Subjectivity lies at the core of reflexive thematic analysis, particularly within the qualitative paradigm. As researchers, our subjectivity encompasses various aspects, including personal identities, values, and disciplinary perspectives, making us integral instruments for analysis [58]. In our study, it was not only crucial to embrace subjectivity but also to actively interrogate it. Reflection on our assumptions, expectations, choices, and actions throughout the research process was paramount [33]. This reflective process aimed to scrutinize how our standpoint and choices as researchers might enable, exclude, or limit perspectives [84]. Reflexivity is an ongoing journey rather than a final destination [33]. The researcher's subjectivity is not a hindrance to be removed or minimized but a valuable resource to be consciously and actively utilized. It was essential for us to incorporate a range of perspectives and voices, ensuring that the study is inclusive and representative of the complexity inherent in trans experiences. For this reason, we intentionally centered BIPOC voices within the study in our study recruitment and workshop facilitation.

With this in mind, we considered our power dynamics in research. It was crucial for us to be aware of our positions of power and the potential impact on participants, particularly as we collaborated closely with them on creating zines. Our approach was centered on minimizing any tendency to dominate the conversation, impose our ideas, or steer the direction of their zine-making process. By navigating and critically assessing these power relations, we aimed to ensure a research environment that prioritized fairness, respect, and a genuine acknowledgment of the influence researchers wield in the participant-researcher relationship.

Our study team is made up primarily of trans scholars, *representing a wide range of trans and nonbinary gender identities*. Six research team members are people of color and two are white. At least two and as many as four members of the research team attended each workshop and sat interspersed with participants, conversing with them and working on our own zines alongside them. During workshop discussions, some researchers shared experiences regarding their own identities—including race, ethnicity, transness, sexuality, Dis/ability, and class—to help encourage open conversation and a safe atmosphere for disclosure. We viewed this as important, as it helped to establish trust with participants and lent insight into our varied, subjective positions as researchers. In this way, we also worked to establish trust and rapport with participants. Speaking with and working creatively with participants was part of our understanding that as researchers, we co-construct

data with participants and are situated in this data production process with them rather than observing our participants in a neutral and objective setting [54]. We believe this is especially vital when working with a marginalized group (that many of us are members of) and furthers our reflexive process.

4.5 Limitations

As scholars located in the United States, we acknowledge that our sample population overrepresents North American English-speaking trans individuals with reliable internet access. Further, our workshops were available only to those with time to attend. We also acknowledge that 50% of our participants were white, and a large proportion were trans masculine (38.6%) and/or nonbinary (45.5%). These demographics and our privileges as researchers mean that we cannot account for all the diverse ethnic and cultural experiences of marginalized people, particularly trans people of color, nor is there a singular BIPOC experience. We also recognize ethnographic differences between virtual workshop facilitation and in-person engagement, with limitations and benefits of both. Offering virtual options was intentional to increase accessibility for participants who may not be able to attend otherwise. Notably, the virtual workshops had a higher proportion of participants who were BIPOC, disabled, and/or neurodivergent. We would encourage future studies to further engage with diverse trans populations and better account for the lived experiences of trans people of color and trans individuals outside the US and Canada.

Lastly, we acknowledge that many of the technologies participants designed, as will be described in the following Results section, will be beyond the scope of technological capacity. However, such speculative technologies help us understand truths about trans populations, such as the need and desire for more agency in healthcare and physical transition, and also serve as building blocks to imagine different futures where these technologies might be possible. We draw inspiration from these hopeful alternative worlds, pushing our design practice towards not only speculation but also liberation.

5 Results

We begin chronicling our results by describing how participants combined two seemingly contradictory orientations—needs and desires—to exist simultaneously in many of their zines. Needs-oriented zines included images and text specifically geared toward a trans need, such as P13’s zine about access to trans healthcare, which included medical clip-art images such as a stethoscope (Fig. 3A). Joy-oriented zines used cheerful comics or drawings, stickers with positive phrases like “grow your own way” (Fig. 11B), and pictures of objects like flowers, animals, and fruit. Of the 42 zines in our dataset, 17 zines were primarily desire-oriented, 11 were primarily needs-oriented, and 14 included substantial elements of both needs and desires. Throughout the process of coding the zines, we began to grasp the complexity inherent in trying to separate needs from desires; often the boundaries were unclear, and even a small element like a smile on a drawn figure’s face signaled that a zine might represent joy rather than, or even within, a challenge (Fig. 7c). We lean into this complexity in our results and describe how participants expressed such complexities through the various ways

they reconciled with ambivalent circumstances via their participatory zine-making experiences (RQ1) as well as the design practices they yielded for complex expression (RQ2). Our results illustrate how acknowledging ambivalences—and offering a space to think through them—is important because it recognizes that marginalized groups’ needs and desires are varied, complex, and overlapping.

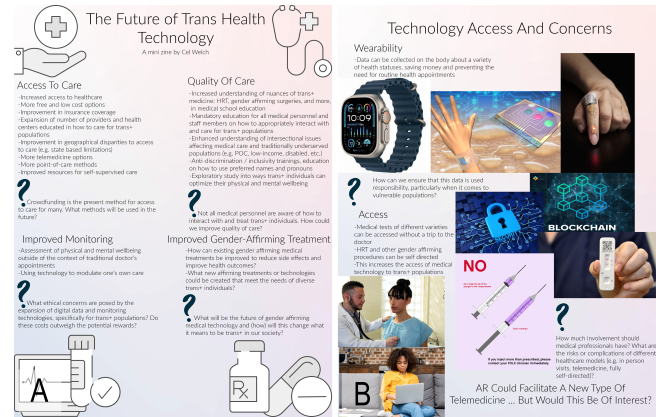


Figure 3: P13’s digital zine A) Front page. B) Back page.

5.1 Confronting Ambivalence with Zines

We found that zines were an explorative and effective way of working through ambivalent ideas for participants, or instances where they could identify a desire, but found it difficult to reconcile that desire with a seemingly conflicting need. These ambivalent needs and desires manifested for our participants in several ways including: 1) Desires for the materially impossible (e.g., instant body changing technologies or frictionless AR to edit physical world space/sound), and 2) Desiring the potentially unsafe or unethical (e.g., increased visibility or data gathering necessarily/potentially exposing people to unsafe situations). Through creative visual expression, participants could think through and confront these ambivalences and consider their relationship to needs and desires in new ways.

For example, P36 designed a solution around her personal desire to have increased access to community, which was at odds with a broader need for safety. The design (Fig. 4) included a drawing of a map that could identify and geolocate trans community spaces nearby, tagging them with broader concepts of safety such as “[community] movement, euphoria, etc.” P36 articulated verbally that such a map and its “visible networks” would be “a double-edged sword” however. She wrote in her zine, “How can we leave our traces, to mark where we build community... How do we make ourselves more visible to each other... and less visible to those that do not accept us?” Yet, P36 was able to articulate and visualize the opposing forces that arise from sharing resources and informational networks against the possibility of harm (Fig. 4). This speaks to the anticipation of harm even in efforts meant to alleviate/mitigate such negative effects, a common and ambivalent sentiment participants broadly held as well.

P24 used their zine to work through being safely perceived in society and presenting their identity authentically—something they

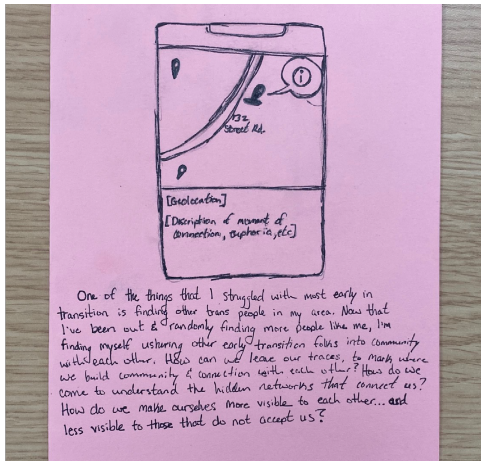


Figure 4: Close-up on front page of P36's zine.

simultaneously wanted and questioned. They identified a possible desire to appear however they wanted to others across different social, temporal, and spatial contexts; “to change from day to day” by using futuristic holographic AR technology. In turn, they channeled ambivalence to pair this desire with their discomfort around what they considered to be the potentially unethical consequences of changing the physical world in such a way. They illustrated their desire to use AR to appear differently in physical spaces (Fig. 5), then in turn recognizing the ethical pitfalls of such a technology, writing: “Is it ethical to mess with others’ perceptions of reality? People ask this about trans folks already. But whose reality are we talking about? Is it fair to force others to have the same perceptions that I do? ...Will I ever feel safe?” These interconnected needs and desires—the need for safety and the desire to be affirmed—seemed to conflict with the ethics of “mess[ing] with others’ perceptions of reality” (P24).

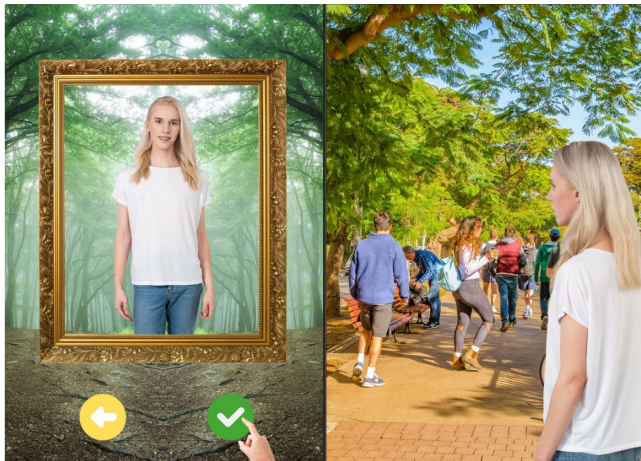


Figure 5: P24's digital zine.

As in, ways of reconciling with both their needs and safety brought upon other issues and layers of ambivalent situations for them to work through. Their zine makes these complex feelings

visible, enabling P24 to think through them on a deeper level, even if those complex emotions cannot be readily resolved.



Figure 6: P11's zine.

Participants also used zines to illustrate their desire for an immediate, almost magical transition while also acknowledging that such physical transformations were not materially feasible. Many zines included magical imagery, such as potions and “magic” mirrors, to explore the space between what is and is not possible. P11 illustrated their desire for a “body shop,” where individuals could easily swap body parts out for others (Fig. 6). Although it would be materially impossible to swap out body parts in this fashion, P11's zine creates a world where it would be possible. P24, too, explored their ambivalence for such an idea, writing, “If I could customize myself daily, hourly, instantaneously, with no surgery, no pain, no unwanted side effects, would I be happy to have a body?” Rather than working through a material impossibility towards a solution, P11 and P24 used their zines to deeply consider their conflicting desires for instantaneous changes to the body, need for well-being, and desire to avoid pain and surgical complications—along with the added complexity that such desires may be physically impossible.

By confronting ambivalence rather than focusing on general or universal solutions, conflicting attitudes are made visible and can enable open discussion to serve as a catalyst or framework for expansive design practices. Such practices were demonstrated by how participants designed with ambivalence accounted for, which we describe next.

5.2 Ambivalent Design Practices

Two overarching design practices emerged in our findings that were commonly explored in participants' zines as they worked through ambivalent concepts: 1) addressing the complexity of desires and needs through metaphor, and 2) anti-assimilationist design, or design that is adversarial [24] and challenging of conformity and strict hegemonies. These practices were not always separate in their employment, however, and often overlapped and/or extended one another. Further, the sentiments of these zines, especially when

addressing struggles and challenges in their communities, often skewed positive and imbued hope–orientations that on the surface seem contradictory but in practice demonstrate reconciling with ambivalence.

5.2.1 Addressing Complexities Through Metaphor. Participants often used zines to visualize expansive, expressive possibilities for gender presentation (far beyond binary gender categories) by frequently employing metaphor using natural imagery, mysticism, or nonhuman elements. These metaphors expanded upon participants' verbal sentiments and showed how they used visual complexity to work through their ideas. P35 verbally described the need for “society [...] to start restructuring the way that we think and teach people about gender,” explaining that:

[Though] saying that someone is neither male nor female has gotten a modicum of understanding in society, people are starting to see people who don't conform to one binary gender as having a third gender, when that's not the point. [Gender] is supposed to be like a spectrum... but people are like, “there's male, female, and nonbinary.” I'm like, “that's not how it works.”

P35 verbally criticized how social attitudes simplify all genders outside of the male/female binary into a singular “nonbinary” or “third gender” category, challenging how mainstream society understands gender complexity. Instead, in many participants' views, the rigidity of categorization itself was at the heart of the problem—and thus, adding nonbinary as another “category” was no solution. As a response, P35's zine depicted their desire to “pick and choose” different metaphorical qualities related to their gender expression (Fig. 7B), rather than being confined to only traditional and literal forms of masculine or feminine aspects. P35 wrote a passage about “blooming the way they want to.” Their inclusion of animals, flowers, and hearts not only visually addresses ideas of gender expression outside the gender binary in their verbal comment but it also frames it in a more fantastical context that extends beyond what they could verbally express around the complexity of gender.



Figure 7: P35's zine. A) front page, B) pages 1-2, and C) back page.

Other participants engaged in multimodal methods of metaphor to convey complex sentiments within their personal experiences and explorations of identity. P30 expressed the necessity of multimodal approaches in tandem with expressive visual storytelling in design and how we can incorporate this in technologies:

Talking about the face filters earlier, the ones that I am drawn towards, it's much more the ones that play with

lighting or the ones that will play with colors, and not so much trying to emulate a particular human appearance. Or even just ones that turn you into lemons, things like that. Things that are completely not human-related are the ones that I find myself gravitating towards the most.



Figure 8: P16's zine.

P16 also highlighted multiple avenues of desire in his zine, depicting sexual, medical, and embodied self-conceptualizing through visual iconography that can be interpreted in multiple ways (Fig. 8). Such iconography includes scissors, where in the context of the composition they could allude to medical procedures (a common topic when discussing gender-affirming care) but might also illustrate explorations of sexuality, calling forth the queer and sexual imagery of scissors. The double meaning conveyed by these scissors shows both medical anxiety and sensual pleasure, two conflicting emotions that are yet simultaneously expressed visually here. P16 employed more conflicting imagery, using aesthetically pleasing images of ripe and colorful fruit in contrast with ants placed in a compositionally pleasurable way. These examples show how participants used visual metaphors and ambiguous imagery, or images that hold multiple meanings and even forms, as an important way to express the complexities of their experiences and feelings related to gender and trans identity.

5.2.2 Anti-Assimilationist Design. An overarching design practice we identified in participants' zines was their anti-assimilationist nature; zines did not conform to conventional aesthetics, materiality, and form. We defined these design aesthetics as “**anti-assimilationist design**” which extends from adversarial design, or a design that incorporates the use of provocative imagery or language to convey political concepts and ideas [24]. However, an explicit theme we found in participants' zines which extends anti-assimilationist design beyond adversarial design was resisting assimilation, or explicitly challenging conforming to traditional and normative systems and aesthetics. The pressures and oppression of normative systems has been significant in queer history/discourse, and this spirit to challenge assimilation showed through in participants' zine aesthetics, often being explicitly confrontational or critical of certain socio-political strife trans people are challenged

with. Participants expressively challenged the bounds of how they could speculatively design technology, using the affordances of zine-making as a powerful tool of expression untethered by convention and normative design practices. Participants were able to express critical yet joyfully tongue-in-cheek elements or images with multiple, potentially contradictory, meanings, often to express and analyze their desires to transcend normative systems.



Figure 9: P2's zine. A) front page, and B) pages 1-2.

For example, P2's zine reflected a socio-political critique participants frequently brought up: Bureaucratic systems mishandling gender. Participants described misgendering as a common and harmful experience for trans people, occurring in many contexts including healthcare systems, workplaces, etc. P2 centered misgendering experiences as the focus of critique in their zine, opening with the assertive title, "My Name is: *MINE* My Pronouns are: *PAY ATTENTION*" (Fig. 9A). This is particularly powerful as an assertion of their identity and ownership of self-demanding acknowledgment and care in the ways they need. P2 also included in their zine both visual and written explanations about gender misconceptions, how to consider gender in healthcare spaces and suggestions for better conceptualizing gender and etiquette with trans patients (Fig. 9B). The visuals of P2's zine depicts the assertive and messy nature of the matter of trans patient etiquette—not being particularly pleasurable in tone and aesthetics, but anti-assimilationist instead to bring more urgency to their feelings in order to bring attention to their suggestions.

Other participants played with the zine materials as a multimodal means of expression, such as using textures as interactive storytelling. P30 played with form through materiality in their zine, adding texture with various craft objects and manipulating them (ripping, folding, etc.). This creative use of materials demonstrated multimodal and tactile interaction within the zine itself (Fig. 10). Further, P30 highlighted aspects of intersectionality within their zine, describing how these multimodal forms and materials correlate to how they interact with the world as an autistic person as well as how that is inexplicably tied to how they experience gender. P30 also emphasized the term "autigender" (Fig. 10D) to name this relationship between their autism and gender. This exploration of intersectional expression is also anti-assimilationist in nature as it went beyond the conventional uses of materials to express ambiguous sentiments transcending language and neurotypical perspectives.

Intersectionality was key in many participants' conversations as well, with discussions of how intersectionality can make needs and desires more complex. Many participants brought up sentiments around assimilation specifically and the tensions that arise when trans experiences across varying, multiple marginalized identities meet normative systems and societal values. For example, P25 expressed:

I think some people also have this impression about the queer community, this fight for gay marriage, whereas trans Black women are like, "I'm dying. I don't care about gay marriage." And cis white gays are like, "Gay marriage is everything. We have rights." ... I think that for certain parts of the trans population, particularly for white people, there can be this argument that's like, we're just like everybody else. Because again, there's this fight against otherness. And also white trans people, depending on their marginalizations and experiences, may not be marginalized in any other way besides their transness.



Figure 10: P30's zine. A) front and back cover, B) pages 1-2, C) pages 3-4, and D) pages 5-6.

P25 pointed out that the relationship to mainstream acceptance among various parts of queer communities informs how certain desires in the communities conflict with one another—*"I think, again, just reiterating this idea of the depth and complexity of all the things that are at play."* Many BIPOC participants reflected similar attitudes toward AR technology trends catering to white, Western, and Eurocentric hegemony/norms (white-washing skin tones, euro-centric ideas of "female" and "male" physical attributes, etc.).

Anti-assimilationism is bound up with the complexities of trans people's needs and desires. Thus, in participants' zines, they reflected these complexities through nonconformist, adversarial, and multimodal aesthetics. Further, intersectionality pervades trans people's experiences, and plays an important role in anti-assimilationist design and its multi-meaning and multimodal elements.

5.2.3 Contradictory Joy. Lastly, we found a prevailing theme within anti-assimilationist design that pervaded in participants' design practices. We define this as contradictory joy, where participants' verbally-expressed ideas often differed from the ideas depicted visually within their zines, in a way that followed a pattern. Verbal discussions were frequently critical and needs-based, describing the kinds of obstacles and socio-political challenges trans people experience in society. In contrast, we found that ideas participants explored in their zines skewed in a more hopeful, whimsical, desires-based direction, often emphasizing themes of positivity and affirmation.



Figure 11: P17's zine. A) front and back page, B) pages 1-2, C) pages 3-4, and D) pages 5-6.

For example, when asked to identify pressing needs and desires in the trans community, P17 stated:

Money. Many trans and nonbinary people have to pay for hormones, surgeries, new wardrobes, makeup, legal name and document changes, etc., in ways that cis people do not have to. On top of that, many trans people are unemployed or underemployed, discriminated against in employment, housing, etc.—and all of these compound, so trans and nonbinary people may have higher costs of living, lower salaries, and less access to healthcare benefits through employers.

P17 verbally focused on trans people's needs and material struggles, critically examining trans people's outside burdens in healthcare and transition-related costs and access and employment and housing discrimination. In contrast, P17's zine took a more positive, desires-based tone, with imagery and text snippets emphasizing bodily autonomy, nonlinear growth, and trans affirmation (Fig. 11). Imagery included a picture of a pink, white, and blue (the colors of the trans flag) city skyline, which P17 used to depict "a place where trans people just have everything they want and need, to do whatever they want. To have the bodies and lives they want, all of the food and the things they need." In comparison to discussing unfulfilled trans needs, P17's zine used metaphor to envision the joys of having one's needs and desires fulfilled in an imaginative way. However, they also conveyed that one cannot get to a state where they can

fully dream or enact their desires until their safety/material needs are met.

Even in instances where participants' zines directly focused on trans needs rather than desires, zines often took on a more positive or hopeful tone than participants' verbal comments. Similar to P17 and P35, P4 shared a needs-based verbal comment on mental health-related needs and challenges faced by trans people:

Something that's also not really addressed in our community is that most of us have experienced a lot of trauma. The problem with people who are experiencing trauma is when they get [emotionally] closer [to each other], they don't negate [each other's] trauma. It increases. You start picking up on their trauma, they pick up on yours, and it makes it very difficult for us to work with each other.



Figure 12: P4's zine.

P4's verbal comment critically addressed struggles many trans people experience; in this case, how mental health struggles and trauma can negatively impact relationships with similar others. Though P4's zine addressed the same themes as her verbal comment, her zine took a more humorous, playful approach. For example, P4 included a satirical illustration of conservative U.S. politician Rudy Giuliani expressing distress at the concept of "trans mental health" (Fig. 12). P4 explained that she depicted Giuliani saying "oh! no!" at the idea of trans people's mental wellness "because he doesn't want [trans people] to be mentally well," and because trans people are "a threat to [conservatives' and transphobic elites'] overlord-ness." Unlike P17 and P35's zines, P4's zine was less focused on desire or joy, instead addressing the same needs that she described in her verbal comment in a comical and satirical fashion. However, even while not joyful, P4's zine expressed her ideas related to trans mental health in a more positive and empowering way.

Overall, we found that participants' zines acted as a vehicle for hope, affirmation, envisioning futures, and expressing satire and

humor. These zines took on playful and positive tones even while addressing challenges and struggles faced by trans people. It is worth noting that the selection of available stickers and other supplies might have influenced more positive overtones of participants' zines. Available stickers often portrayed animals, fruits, flowers, and positive phrases and leaned toward colors that may be interpreted as joyful. Though this was considered a limitation, participants were able to creatively re-appropriate this joyful imagery and use them toward expressing ambivalence, such as contradictory joy, to promote empowerment and hope in spite of and simultaneously acknowledging the strife and obstacles trans people face.

6 Discussion

In our study, we triangulated participants' discussions, zines, and interactions in the expressive environments of our participatory workshops. We found how ambivalence plays important roles to how participants understand and navigate their trans experiences, and that zines were a particularly powerful vehicle to express and work through participants' ambivalent feelings. Analyzing how participants speculatively designed AR by reconciling with these ambivalent feelings through zines helped answer our research questions on how speculative, participatory zine-making enables us to understand ambivalences inherent in trans experiences (RQ1), and the design practices that emerge while exploring trans experiences and AR through speculative, participatory zine-making (RQ2). In our discussion, we draw from our results to discuss how speculative, participatory zine-making is used as a unique approach to address ambivalent concepts through design, and to incorporate ambivalence in inclusive technology design (RQ3). We first discuss the design practices derived from participants' zines and zine-making process—addressing complexities through metaphor, and anti-assimilationist design—and how they are critical for supporting trans complexity. We then discuss design implications for how AR technology could better support trans people through adopting these design practices, and provide an example of how they can be applied in an inclusive trans AR technology.

6.1 Design Practices for Trans Complexity

In our results, we found that participants took on two main design practices to work through and express the complexities of their experiences: 1) anti-assimilationist design and 2) using visual metaphor to express complexities. In their zines, participants highlighted the tensions and complex relationships between their needs and desires. While our results showed that zines were often based on *desires*, participants verbally emphasized more about the *needs* of trans communities. The design value of anti-assimilationist design helped participants embrace the contention between expressively creating toward desires while communicating and venting needs. Again, we use the term anti-assimilationist design to describe designs that are adversarial [24] to reject restrictive and normative societal expectations. Further, participants often used visual metaphors to explore and express the tensions between needs and desires; multimodal storytelling and imagery enabled them to visualize multiplicity and express complexity, especially as it related to their transness.

We also identified how the zine-making materials themselves may have influenced or even impeded participant expressions, as many of the materials that were available for us to purchase for design workshops were positive and normative in nature. Participants' more positive expressions through zines may have been influenced by the optimistic nature of the stickers and other supplies we provided. Some of the paper materials for zine page backgrounds involved patterns and colors that would generally be read as joyful. The joyful default in our zine-making supplies demonstrates how pervasive normative aesthetics can be, and the importance of highlighting the implications of this pervasiveness. In considering anti-assimilationist design practices as a means to express transness, it is important to mitigate barriers that impede non-normative and adversarial expression. Still, because zines are malleable in form and allow for robust expression and storytelling, participants were able to creatively re-appropriate the positive-leaning materials to convey more complex emotions around transness—using identified design practices like 5.2.3. In spite of the conventional materials, unconventional expression was fundamental for participants to explore, work out, and convey the complexities of their trans experiences and identities. To mitigate potentially suppressing more authentic expression, designers should think about the aesthetics and materials of their designs to afford anti-assimilationist aesthetics; they can use visual elements that enable multi-layered metaphor to broaden expression of trans complexity.

Participants deeply engaged with speculative, participatory zine-making because of its compelling affordances to explore and visually communicate trans complexity. Participants wielded these affordances through anti-assimilationist designs and complex, multi-meaning metaphor in order to challenge hegemony (such as P2's zine critiquing the mishandling of gender in bureaucratic and healthcare contexts). Our work thus demonstrates how the design practices derived from speculative, participatory zine-making are critical to supporting trans complexity. These design practices in turn inform how to design technology beyond normative forms and modalities to accommodate and uplift trans complexity.

6.2 Importance of Designing Around Ambivalence

Initially, we anticipated participants would offer clear ideas and designs towards speculative AR technologies that tend to the needs and desires of trans people. In practice, however, participants' contributions revealed attitudes that were much more varied, and expressed a spectrum of ambivalent sentiments about technology and trans needs and desires. They used their zines, and accompanying discussions, to visualize and describe their ambivalence about visibility, safety, community, barriers to medical transition, identity affirmation, binary gender norms, and more. These expressions of ambivalence are vital to understanding the complexities and intersections inherent in designing for trans experiences. Further, we argue that it is important to embrace these ambivalent expressions not as problems to reconcile, but as simultaneous truths.

Fore-fronting ambivalence in design acknowledges the ever shifting relationships marginalized folk have with technology, especially technologies that track, store, and recall sensitive information [7, 13, 35]. As the interconnected relationship between people

and computers has solidified and persisted, more literature has tended to ambivalence in design [35, 59, 88]. Through these literatures, we understand ambivalence might be read as an “either/or” in design—similar to prior works in deficit vs. assets-based design [43]—where one is either empowered by design, or resigned to be disempowered. In reality, it is more complex, including for queer and trans experiences. For example, prior literature that identifies the ambivalence felt by queer communities around reporting hate crimes proposes that design must account for complex notions of vulnerability, “resist[ing] static narratives about... participant identities” [35]. We extend prior research by accounting for the simultaneous possibility of empowerment and disempowerment when designing AR technologies for trans communities, as well as designing technologies for marginalized communities broadly.

6.2.1 Actualizing Ambivalence. We define *actualizing ambivalence* as the process in which people visually confront and articulate ambivalence through design. Our results included many examples that show how actualizing ambivalence through exploratory, participatory zine-making can provide a deeper understanding of a community’s complex feelings regarding their identities and materialities. Participants’ zines and verbal descriptions demonstrate a spectrum of simultaneous but conflicting needs and desires, ranging from safety and visibility to a desire to be recognized and affirmed in multiple gender presentations. It is important to recognize that actualizing ambivalence does not aim to resolve these conflicts; rather, it acknowledges the contradictions and tensions inherent in the experiences of marginalized communities.

Our concept of actualizing ambivalence also extends critical and speculative design research, offering further opportunities for reflection and possibility when many seemingly conflicting things can be true at once [10, 24, 28, 86]. Where prior research [86] has similarly framed normative systems and background infrastructures in different socio-political contexts, our work extends zines to function as an anti-assimilationist technology that directly challenges cisheteronormative structures/systems. Moreover, visualizing and expressing ambivalence through zine-making can offer such possibilities by voicing concerns for “worst case scenarios” while also recognizing the desire for things to be different. This includes and supports concepts like *dark design*, where negativity is used to “draw attention to a scary possibility in the form of a cautionary tale” [28]. In this way, actualizing ambivalence can serve as a guide to sharpen critical discussions that open up design explorations of what is real and what *might be* real.

To work toward more just forms of design for trans communities, following these prior works, we also find that it is then necessary to account for conflicting attitudes and to authentically address and design for them. Our concept of actualizing ambivalence takes prior researchers’ arguments a step further by leaning into marginalized groups’ ambivalences and using multimodal expression like zine-making and discussion to enable them to visually and verbally express conflicting concepts, thus embracing ambivalence rather than trying to reconcile its conflicting facets. Our critical approaches to design are especially important in community-based design for marginalized groups generally, where negative design (or in the trans context, “anti-trans technologies” [40]) can go beyond negative feelings or discomfort and expose individuals to physical

harm and violence [65]. Instead of focusing on direct and clean solutions, designing for ambivalence accounts for the inherently messy realities that often pervade trans lives and upholds and includes them in shaping technology design.

6.3 Implications for Design

6.3.1 Design Approaches for Ambivalence. When considering ambivalence through a design lens, design practices that we as designers and researchers wish to prioritize (such as those we described in 6.1 and 6.2) may run counter to sleek and modern perspectives on mainstream technology design. We can think of ambivalence, in its anti-assimilationist nature, as resisting clean, polished designs and challenging conventions of streamlined efficiency—which reinforce entrenched societal power structures by excluding marginalized communities in their design. Additionally, rather than prioritizing efficiency and ideas of “universal design,” which view users’ interactions with technology as a monolithic experience (and failing to acknowledge differing relationships with technology shaped by power and marginalization), we can instead center context. Context here refers to the complexities within a community and honoring the variance of experiences. Sometimes, centering context and ambivalence can manifest as design that is messy. In ambivalent approaches to design, we can push back on the idea that an interface or design object must always be aesthetically pleasing and clean. In allowing for messiness in design, we can then also push the boundaries of functionality and usability. A system can be breakable but not broken; it may include elements such as scuffed designs, blurred constraints on interactions. It may also prioritize adaptability and change within the user interface. Such breakable systems have their roots in queer and trans tech as well [38, 63], especially in the context of glitching technologies [63].

In terms of the design practices around complexities through metaphor and anti-assimilationist design, we can think about design and interaction more expansively. For instance, design may not need to focus on only “pleasurable” experiences and interactions; instead, we can remain open to aesthetics that allude to monstrosity (a major theme in trans studies [1]), or expansive visualizations of how we can imagine ourselves and experiences beyond normativity, or affordances that intentionally include friction [37]. Further, implementing anti-assimilationist design in multimodal technologies, we can experiment with UX elements such as haptics that are *unpleasurable* or have friction for the user. We can also explore UX that evokes more ambiguous feelings and can accommodate the contradictory nature of joy along with struggle, as portrayed in various participant zines. In accepting and exploring the ambivalent design practices we discovered through co-designing with trans communities, we can experiment with radical design possibilities to shape technologies that better encompass the complexities of trans experiences—and all human experiences.

6.3.2 An Example of Applying Ambivalent Design Approaches. After our design workshops concluded, we began to create AR prototypes that incorporate the design practices participants’ expressed when actualizing ambivalence in their zines. Accordingly, these prototypes, including a face filter app, manifest complex and sometimes conflicting needs and desires through design. Our face filter prototype includes both realistic and fantastical markers for

gender, foregrounding what is vital for agency in gendered presentation while also including expansive elements. These options include realistic elements like making subtle adjustments to one's face (e.g., squarer jaws, higher cheekbones, wider noses) or adding adornments (i.e. piercings, tattoos, etc. (Fig. 13) to offer avenues for various—including nonconformist—expressions. Further, we reject “whitewashing” effects that participants noted in other existing apps, ensuring that their original skin tone remains consistent. These design elements are crucial to address participants’ needs for control over their own appearance, decide their gender presentation for themselves, and resist perpetuating racist and/or conformist standards of beauty.

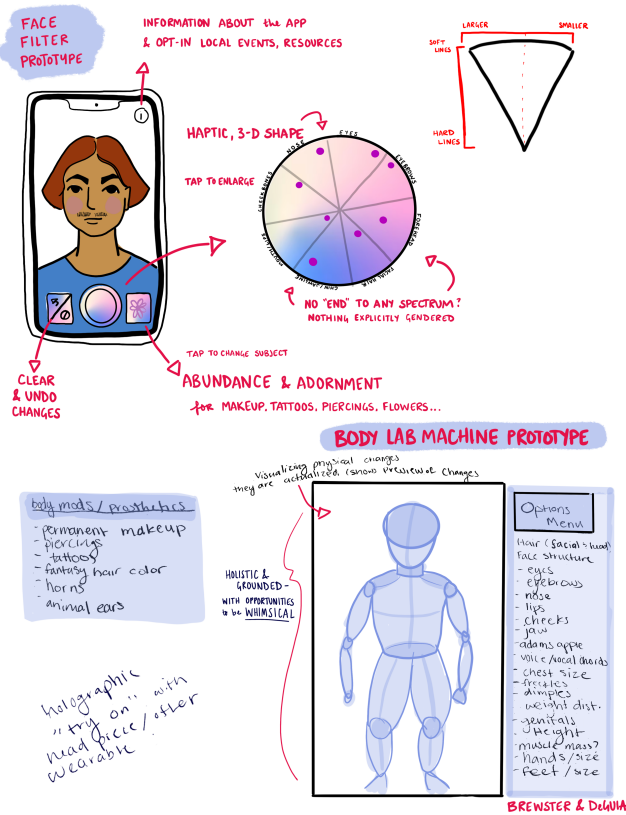


Figure 13: Early fidelity mock ups of future AR technology prototypes.

In tandem with more realistic options—which are important for exploring physical changes that might actually occur as part of gender transition—we also opted to include more fantastical appearance options (e.g., angel wings). These elements may not actually be feasible or even truly desired, but serve as a tool to ambivalently explore identity through visual metaphor. Lastly, not only do our designs integrate anti-assimilationist expression through these expansive elements, we also design interactions that resist communicating conformist and binary sentiments. For example, we ensure that the user interface interactions for facial adjustment and appearance customization avoid implying that one’s appearance has

an “end result” or that changes are on a binary spectrum by offering circles and spheres as input controls instead of sliders (Fig. 13). Our future directions in designing trans technologies will involve our continued development of gender-affirming AR technologies that are inclusive of complex genders and expansive gender expressions. To do so, we will continue to draw from participants’ drawings, sketches, and ideas from both their zines and their discussion.

7 Conclusion

Our work thoroughly demonstrates and examines the potential of participatory, speculative zine-making as a radical approach to designing trans AR technologies by helping integrate trans people’s complex and ambivalent perspectives, needs, and desires into applicable design practices. Our method rejects purely needs-based and joy-based design approaches, giving serious consideration to the holistic experiences of trans people. We found that zines are a creative medium for participants to work through and address the ambivalent circumstances of their experiences in relation to current technologies and their socio-political environments. We were also deeply informed by the design patterns analyzed in our participants’ zine designs when working through and actualizing ambivalence. These design patterns included anti-assimilationist expressions through ambivalent forms, such as using multimodal aesthetics and formats, and using multi-meaning, visual metaphors to illustrate the complexities and tensions between needs and desires. Anti-assimilationist expression and visual metaphors were particularly prevalent in zines that skewed in a desires-based and positive direction, even when addressing significant struggles faced by trans people—showcasing novel forms of joy facilitation that still encompassed the material and emotional challenges trans communities face. Ambivalent design practices provide important insights for designing more inclusive trans technologies that address complex trans experiences and can reflect greater implication on how ambivalence can be accounted for when designing inclusive tech broadly. We hope to continue these fruitful explorations in trans technology by incorporating design practices which meaningfully address and support ambivalence. Accordingly, our future directions will implement the important design implications our insights have lent us to actualize the trans AR technologies our participants envision. We also invite others to embrace and explore speculative, participatory zine-making and ambivalent design practices to design toward more inclusive technologies.

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