

Playing with Rural Design: Design Probe Failure & Community Disconnections

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Abstract

This paper examines the challenges and opportunities of deploying design probes in rural communities to understand Internet connectivity experiences and needs. We share the results of a study in two rural communities in the Midwestern United States where traditional design probes initially failed due to technical barriers, time constraints, and trust issues between researchers and participants. Learning from this failure, we developed a more effective game-based probe that created a time-bounded, collective, and playful experience. This redesigned approach successfully captured nuanced rural connectivity experiences related to community bonds, resource access, and digital infrastructure. The research shares methodological recommendations for how we can adapt design methods for rural contexts, emphasizing co-creation, relationship building, and designing “from the rural” rather than merely for rural people. We contribute to rural computing by advocating for human-centered infrastructure design that recognizes connectivity as contextual, variable, and intertwined with rural identity and community structures, challenging simplistic approaches to addressing the digital divide.

CCS Concepts

- Human-centered computing → Field studies.

Keywords

Rural HCI, Design Probes, Broadband Infrastructure

ACM Reference Format:

Jean Hardy, Megan Gleason, and Ava Francesca Battocchio. 2025. Playing with Rural Design: Design Probe Failure & Community Disconnections. In *12th International Conference on Communities & Technologies (C&T 2025), July 20–23, 2025, Siegen, Germany*. ACM, New York, NY, USA, 17 pages. <https://doi.org/10.1145/3742800.3742830>

1 Introduction

Rural communities in the United States are increasingly central to economic, political, and technological discourse. Take, for example, the numerous journalistic think pieces that popped up in the wake of the 2016 election of Donald Trump that sought to understand the politics of rural America (e.g., [41]). Or efforts by American think



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C&T 2025, Siegen, Germany
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ACM ISBN 979-8-4007-1521-1/25/07
<https://doi.org/10.1145/3742800.3742830>

tanks and policy actors to develop new policies and initiatives to promote economic and community development in rural America in the past decade (e.g., [40]). Or, most prescient for this paper, the massive federal investment made by the United States in the Infrastructure Investment and Jobs Act of 2021 to further develop broadband infrastructure throughout rural America. This interest is present not only in the United States but also worldwide, as many nations struggle with issues of digital development and equity.

A similar trend is happening in the world of computing research. As an oversimplified, but telling, measurement of interest in rural computing, the Association for Computing Machinery’s Digital Library (ACM DL) had 278 entries in it with the word rural in the title from 1908 until 2016. At the time of writing this paper in March 2025, there are already 356 that were published in the ACM DL since 2017. As prior foundational work in rural computing argues [24, 26, 27, 36], rural areas were largely ignored except in fields such as Information & Communication Technology for Development (ICTD). This ignorance to the role that rural places and people play in computing produce key biases in computing research. For example, rural users and rural-originating data are under-represented in some of the most foundational datasets that computational systems are built upon [28, 31, 32, 38, 50]. Existing sociotechnical systems designed for experiences of place are biased towards urban regions or do not reflect rural realities [5, 25, 47, 54]. Lastly, and most importantly for this paper, many of our approaches to design and research have either yet to be rigorously tested in rural communities or need to be modified for use in rural areas [8–10, 20, 49, 56].¹

Taken together, there are many opportunities to understand and intervene in rural computing through understanding user behaviors and the context of use, building new systems to deploy for uniquely rural contexts, and iterating upon and/or developing new research and design methods specifically for rural places. This paper seeks to contribute to these efforts by sharing our experience deploying design probes in a rural region of the Midwestern United States. The design probes were part of a broader study of two digitally disconnected rural communities that also included field-based ethnographic research. The questions guiding the broader research study were: First, what are the localized, and often invisible, connectivity needs of rural people? Second, how do we design infrastructure so it better serves rural connectivity from a rural perspective? In asking these questions, we sought to use human-centered design and ethnographic methods to both understand the

¹While we draw inspiration from rural computing research in HCI that is global in nature, we situate this study primarily in the context of the United States because of our research site and the time at which this research was performed—in 2022 and 2023 when widespread policy efforts around digital equity and broadband infrastructure were being very publicly addressed in the American governmental and media landscape.

digital connectivity needs of these communities, and speculate on potential future infrastructure that might better address the needs of the people in these communities. As we will describe, the design probes did not work as intended due to participant concerns about involvement and insider-outsider dynamics in their communities, leading us to pivot and think differently about design probes as a method in rural communities.

The paper is structured as follows: first, we look to the literature on rural design approaches and design interventions for broadband to situate our deployment of design probes in two rural communities. Second, we describe our fieldsites and the broader project which seeks to reimagine what Internet infrastructure looks like for remote rural communities. Third, we describe the process of developing and deploying our series of design probes, reflecting on our initial failure and lessons learned, and responding to that failure through reformatting our approach to design probes. Finally, we explore how our project helps us understand and learn from failure, and articulate opportunities for rural design.

2 Related Work

2.1 Design research in rural communities

Design research in rural communities has a rich history. In particular, design researchers have sought to recognize the unique challenges and opportunities created by rural contexts for technology deployment, design, and methods. This helps us understand how to better design for rural communities, how we learn and cooperate with them, and how we can build on this work. In particular, we break this research up into two areas: 1) design research to better understand rural contexts, and 2) design research to better understand methods and approaches to design in rural places.

The first group of research emphasizes understanding rural contexts to better align design processes and outcomes with rural values and needs. Crabtree and Chamberlain [9] conducted ethnographic research in rural tourist markets to understand how to support micro-enterprises through design. They found that conventional design approaches often seek scalable solutions that are fundamentally misaligned with rural contexts. Instead, they argue for design opportunities that better reflect rural values and the specific economic realities of small-scale rural businesses. Similarly, Taylor and Cheverst [49] demonstrated the importance of understanding local community dynamics when deploying situated displays in rural villages. Their long-term deployment evolved from a simple photo display to an interactive community information system, highlighting how rural communities construct localized meanings around technology.

Researchers have also explored the need to adapt existing systems for rural contexts, particularly considering infrastructural constraints that impact technology use and adoption. Davies et al. [10] implemented an agile design process for wayfinding systems in rural areas with poor quality cellular connectivity, showing how digital systems can be modified for environments with intermittent infrastructure. Greenhalgh et al. [21] extended this work by examining how to design offline-capable wayfinding tools for rural tourism towns, acknowledging the persistent infrastructural limitations that shape rural technology use. Wyche et al. [56] explore

contextual challenges of rural environments in their study of mobile phone repair practices in rural Kenya, using drawing exercises to elicit how devices could be better designed for contexts with limited infrastructure and different usage patterns. These studies collectively highlight how technological systems designed for urban environments with reliable infrastructure often fail to meet the needs of rural users, necessitating fundamental redesign rather than minor adaptations.

The second group of research focuses on better understanding and/or changing design methods and design approaches to better align with rural places and people. Gorman et al. [20] show how standard usability testing methods required significant adaptation for oral cultures in rural African communities. They found that practices often considered essential to usability testing, such as minimal facilitator intervention and think-aloud protocols, were culturally inappropriate and ineffective in their rural context. This work highlights how fundamental methodological assumptions in design research may need reconsideration in rural settings. Additional research looks at the use of a cultural probe method in rural Kenya [55], combining reflective prompt cards with photo elicitation exercises to inspire speculative design proposals. This approach challenged the pursuit of “a single solution in design” that claims objectivity and generalizability, instead embracing the diversity of rural experiences. Similarly, Wyche et al. [57] documented the process of incorporating local metalworkers into the design of agricultural tools in Kenya, demonstrating how design processes themselves must adapt to rural contexts and knowledge systems.

Research on the appropriation and use of sociotechnical systems in rural environments also informs changes in views on traditional design methods. Dix et al. [12] examined the deployment and appropriation of a low-cost, multi-touch table in a rural island community, finding that the system was repurposed in ways that reflected local priorities rather than designer intentions. Taylor and Cheverst [49] similarly observed how rural communities collectively engaged with and transformed technology “seeds” (e.g., abstract exploratory prototypes that were intentionally simple and flexible) over extended periods, resulting in systems that reflected community values and practices.

Collectively, this literature emphasizes that rural design research requires approaches that are sensitive to the unique infrastructural, social, and cultural contexts of rural communities. Both the methods employed and the resulting designs must adapt to rural realities rather than attempting to transplant urban approaches. This understanding informs our own deployment of design probes in rural Midwestern communities, where we seek to develop methodological approaches that resonate with rural experiences of connectivity and infrastructure.

2.2 Design interventions for broadband

Despite massive investment in recent years to decrease geographic disparities in basic Internet infrastructure, rural areas still continually lag behind in urban areas. In the American context, many of the nation’s largest Internet Service Providers have avoided expansion of their market into rural areas. While cooperative and municipal ISPs sometimes step up to close this gap, or work-arounds are achieved using alternative Internet infrastructure such as fixed

wireless or satellite, rural areas in the United States continue to be both underserved and receive lower quality service [3, 53]. To address these issues, and the problems caused by poor reporting and data from the FCC in their Form 477 process, some groups and communities deploy surveys and other data collection practices to address digital disconnectedness (e.g., [14]). Yet these methods for engaging communities on Internet infrastructure still largely focus on simple binary methods for determining digital connectivity: is there wired Internet infrastructure, and if so, is a household a subscriber? Despite a growing understanding of the digital divide that accounts for a wide spectrum of influence, including accessibility, socioeconomic, geography, technology maintenance, and general technological access [11, 19, 23, 43], infrastructural solutions to address digital inequality are still largely one size fits all and operate within a connected-disconnected binary. In doing so, normative approaches to infrastructural connectivity - always connected on one side, always disconnected on the other side - permeate our research, influencing not only how we frame issues of digital equity, but what we see as possible through Internet access. This binary, we argue, at best limits our understanding of rural connectivity needs and, at worst, results in misguided policy and infrastructural investment that assumes rural connectivity needs and the infrastructure that serves those needs, look the same as urban needs and infrastructure.

There is extensive work in computing that has sought to develop community-centered approaches to Internet infrastructure, mostly in remote and rural communities. This includes research that works towards building and understanding broadband and community networks [4, 30, 34, 42, 45]. For example, Nicola Bidwell has done extensive work with communities developing community networks, including recent work [30] on how community networks and the applications developed to support them are the embodiment and materialization of the people who build them. Researchers have also sought to develop applications and data infrastructure for low-signal and community network environments [13, 14, 44, 51, 52]. For example, Morgan Vigil-Hayes and colleagues [52] experimented with using LoRa (long-range open radio frequencies) to develop a low-power network architecture that could ensure low-speed Internet access in remote, rural environments in times when high-speed networks fail. There is also quite a bit of work in HCI on understanding the everyday impacts of, and methodologies in studying, broadband access in communities [13, 37, 42]. For example, Melvin and Bunt [37] researched the challenges of using the Internet for work in rural and remote communities, identifying common issues around signal access and stability in an increasingly geographically distributed work environment in rural areas where travel is difficult.

For the purposes of this paper, we pay closer attention to the work at the intersection of design research and broadband [2, 4, 14, 22, 34, 42, 44]. Some of this work has focused primarily on using design research or outcomes to understand and address rural connectivity challenges. Ali and Heimerl [2] outlined key design considerations for sustainable cellular infrastructure in rural areas, emphasizing the need for solutions that account for local environmental conditions and maintenance capacities. Several studies have employed participatory and speculative design methods to engage communities in broadband infrastructure development.

Bagalkot et al. [4] used speculative design and design fictions to help communities articulate their needs regarding the sustainability and resilience of community networks, while Duval et al. [14] co-designed location-based mobile games that enabled community members to contribute to wireless speed data collection efforts. These participatory approaches acknowledge that successful rural connectivity solutions must be developed with, rather than for, rural communities. Work in this space has been around for over a decade, with Rey-Moreno and colleagues advocating for co-design methods as early as 2013 [42] in the deployment of community-based WiFi networks, identifying design considerations related to local resources and cultural contexts that influence network adoption and sustainability (not dissimilar to [2]).

Other researchers have explored how design interventions can mediate people's relationships with and understandings of digital infrastructure. Grönvall et al. [22] created sensor-based probes that allowed participants to "sense" wireless signals in their environment, providing a more embodied understanding of the invisible infrastructures that shape connectivity experiences. In a less embodied fashion but still related to values and experiences of place, Loh Chee Wyai et al. [34] employed cultural probes to explore community values in rural Malaysia prior to deploying community networks, ensuring the resulting infrastructure aligned with local needs and practices. Similarly, Sankar [44] combined co-design and speculative design to develop culturally situated applications specifically for community networks. While this body of work offers valuable insights into designing with, for, and from rural communities [26], there remains a significant opportunity to deploy design probes that specifically investigate the everyday lived experiences of broadband infrastructure and its intermittent nature in rural contexts. Such probes could help overcome the binary connected/disconnected framework that dominates current infrastructure planning, revealing the nuanced ways rural residents navigate, experience, and make meaning of varying connectivity levels that characterize their digital experiences.

The literature above demonstrates key themes across rural contexts such as tight local networks, infrastructural constraints, and the need for methodological adaptation. It is important to acknowledge that rural experiences vary significantly across global contexts. The rural Midwestern United States, the focus of our study, differs markedly from rural Kenya or other international rural settings in several key ways. Rural American communities often have greater baseline infrastructure (roads, electricity, basic telecommunications) and higher individual economic resources, even when underserved relative to urban areas. In contrast, rural communities in Global South contexts may face more fundamental infrastructure gaps and operate within different economic, political, and social systems.

However, the methodological insights from this literature remain valuable precisely because they reveal common challenges: the mismatch between urban-designed methods and rural realities, the importance of understanding local social dynamics, and the need to adapt rather than transplant design approaches. Whether focusing on oral cultures in rural Ghana [20] or community values in rural Borneo [34], the underlying principle remains consistent: rural design requires approaches that are sensitive to local contexts rather than applying universal solutions. Our work builds on this foundation while recognizing that the specific manifestations of

rural connectivity challenges in the American Midwest represent just one variation of a broader global phenomenon.

3 Human-Centered Infrastructure Design – Field and Approach

This study is part of a broader project, called the Human-Centered Infrastructure Design Project, that sought to answer the following: First, what are the localized, and often invisible, connectivity needs of rural people? Second, how do we design infrastructure so it better serves rural connectivity from a rural perspective? For purposes of this paper, we focus primarily on the first question as it relates to ethnographic and design research performed from 2022 to 2024. Our approach involves combining ethnographic methods that seek to understand the cultural and lived experience of digital connectivity on the ground with design methods (i.e., design probes) that seek to understand how infrastructure could be designed differently if we centered rural connectivity needs from the beginning of the design process.

The data that we present in this paper is centered around two deployments of design probes [16, 18, 55] that sought to collect data that addresses: 1) individuals' daily experiences with technology, and 2) the different types of connectivity and infrastructure that are essential to rural life. The deployment was inspired and complemented by ongoing ethnographic research in the rural communities where probes were deployed. The ethnographic research included qualitative interviews with community members, in-person observations at community or municipal events, and monthly fieldwork trips to the two communities over the course of 12 months. While the design probes were inspired by the ethnographic research, and we used our ethnographic interlocutors as research participants for our initial wave of probe deployment, we do not report results of the ethnographic data in this paper.

We conducted this research in two communities in a very remote and rural region of the Upper Midwestern United States. The first community, Forest Township (a pseudonym), is home to about 2,500 residents spread across nearly 600 square miles. Almost 25% of the residents live below the poverty line, twice the state and national averages [6]. The local economy is driven by tourism, along with healthcare, municipal, and manufacturing jobs. There is a small city with a population of approximately 13,000 people about an hour drive away, while the closest metropolitan area is a four-hour drive. This fieldsite had extraordinary resource gaps when it came to digital connectivity. Nearly 60% of residents are considered unserved or underserved per the Federal Communications Commission (FCC).² Residents are very dependent on cell phone hotspots in the unserved and underserved regions of the Township, though cell phone service is also similarly poor.

The second community, Island Township (a pseudonym), has under 1,000 full-time residents, though it is a popular destination for summer or second homes. Permanent residents face a poverty rate slightly higher than average state and national levels [6]. There is quite a wealth gap between permanent residents and seasonal

residents, reflected in the fact that taxable properties in Island Township account for 10% of the entire county's total property value. Island residents face similar travel distances to urban areas as those in Forest Township, though this is exacerbated by the need to use a ferry to leave the island. This fieldsite had even more intense resource gaps when it came to digital connectivity, with 90% of the island considered unserved or underserved per the FCC. While many residents and businesses turned to satellite services like Starlink to fill in the gaps, at the time of research, some households were waiting an entire year for service due to network constraints. Residents are similarly dependent on cell phone hotspots for connectivity, though cell service remains an issue in many parts of the island.

All three authors of this work had prior connections to or experience with the study region. The first author was born in the region, lived in a different area of the region than our fieldsites as late as 2019, and has been conducting ethnographic research in a variety of settings of the region since 2014. The second author's family has a remote cabin in the island study site and had spent summers on the island since childhood. The third author had traveled extensively throughout the region and previously conducted ethnographic research in similar regions in the Upper Midwest. Given the multiple stages of research and the interconnected nature of the design probe process, we largely retain methodological details about each step of our process within the description of the work itself. Here we share a timeline that provides a high-level overview of the project and how it progressed from one stage to another.

4 The First Probes

4.1 Creating the Probes

The first and second authors began working on the initial design probes in Fall 2022. We started this research from the standpoint that current methods for understanding Internet infrastructure in rural communities relied largely on simple binary methods for determining digital connectivity: Is there wired or reliable wireless Internet infrastructure? If yes, is a household a subscriber? This, to us, was a dissatisfying understanding of infrastructure that didn't reflect many of the complex ways scholars have come to think of the role of infrastructure in day-to-day life [46]. In particular, there's a growing understanding of the digital divide that goes beyond basic Internet connection and includes access, socioeconomics, geography, maintenance, accessibility, and other factors [11, 19, 23, 43]. Despite this, infrastructural solutions to the digital divide still rely on that connected-disconnected binary, which is limiting when we consider that for many rural people, connection is intermittent and influenced by a variety of factors.

Taking this as our launching off point, we sought to develop design probes that would help us understand the day-to-day lived experience of infrastructure from people living in remote and disconnected rural communities. We purposefully framed our approach to design probes as an approach to understanding connectivity more broadly rather than just Internet infrastructure. This approach, we believed, would generate a more foundational understanding of connectivity and situate Internet within that understanding. While design probes are often deployed as an alternative for more culturally situated and time and resource-intensive field-based research

²The Federal Communications Commission denotes a household "unserved" if it either has no Internet access or has Internet access that is at or below 25/3 Mbps (25 Mbps download, 3 Mbps upload). A household is considered underserved if it has Internet access that is at or below 100/20 Mbps.

Timeline

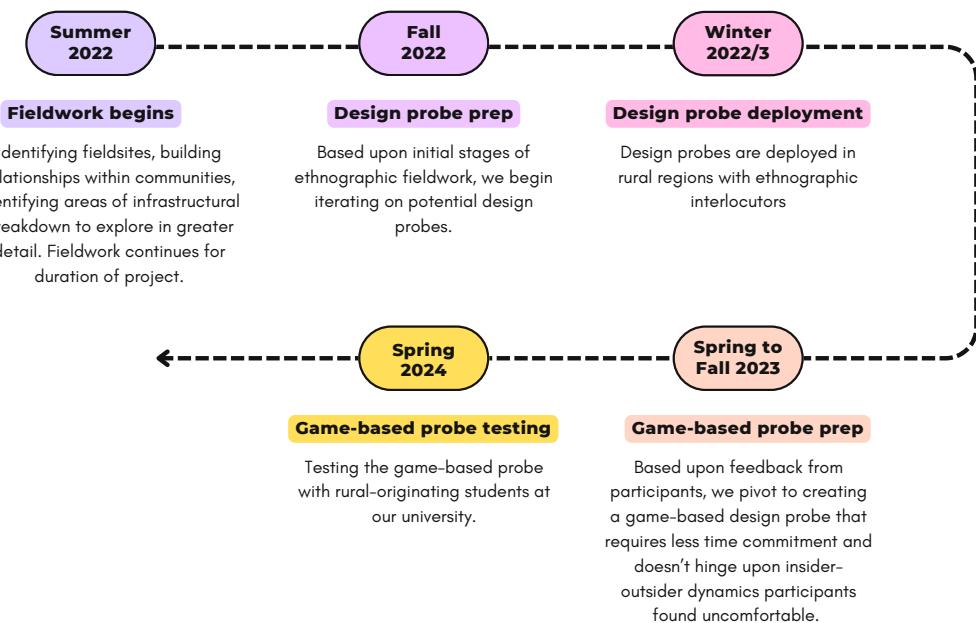


Figure 1: An image of our research timeline

[16], we chose to deploy design probes alongside conducting ethnographic research in the same sites. This, we believed, would allow us to better culturally situate our design probes and better ensure buy-in when we deployed them.

Based on extensive experience conducting ethnographic research in the rural Midwestern United States and preliminary results from the first three months of ethnographic research, we held brainstorming meetings with the entire team in November 2022 where we identified potential themes and/or ideas that could be generative for probe construction. These included:

- Capturing how people construct cultural difference attributed to geographic difference (e.g., the urban vs rural divide; an us vs them mentality).
- What is special about rural places? What makes them unique?
- Personal experiences of rural place—what does rural mean to you?
- Broader infrastructural experiences
- Experiences of disconnectedness and connectedness
- Connectedness as both communal and technological
- Motivation for and feelings about living on an island, especially in relationship to connectivity (i.e., the ferry)
- Relationships to tourism

With these potential themes, we began generating as many potential design probe ideas as possible. The second author iterated on these initial themes to generate a list of feasible design probe activities (see Table 1). With this list in mind, the team prioritized the four probe ideas that were most aligned with the intent of the research (marked with an asterisk in Table 1) and that we believed combined designerly activities with potential output that would be helpful for future speculative design activities with the results. The first and second authors iterated on versions of these four probes, detailed below, with the consultation of the third author who was able to better understand how they might work in the field.

4.1.1 Message in a bottle. This probe activity had two points of initial inspiration: 1) capturing the experience of waiting for and on the ferry that connected our island fieldsite to the mainland; 2) exploring perceptions of a rural-urban cultural divide by having participants write postcards to imagined urban pen pals about what life was like in a remote rural community. In Island Township, the ferry was probably the most important piece of infrastructure for our research participants. In interviews, many participants talked about how they structured their lives and their families around the ferry schedule. We wanted to be able to capture those mundane, in the moment experiences of life when reliant on this particular piece of connectivity infrastructure. We initially conceptualized

Theme	Design probe idea
Experiences of rural life & place	<ul style="list-style-type: none"> A "message in a bottle" where participants would write messages to an imagined urban audience about what it was like to live in a rural community.* A photography activity inspired by "Flat Stanley" [1] where participants would take pictures at their most important places in their community and reflect on why it was important to them.* An emergency preparedness kit where participants would write down the things that are most important.
Rural vs urban	<ul style="list-style-type: none"> A board game in the style of Monopoly where players had to take opposing urban vs rural side. Physical emojis in the shape of angels and devils (i.e., the angel and devil on the shoulder metaphor) where participants would write about the positives and negatives of urban and rural life.
Experiences of infrastructure	<ul style="list-style-type: none"> A physical "WiFi" symbol where participants would shade in how connected or disconnected they feel at a particular moment, reflecting on what is making them feel that way.* A map of the participant's area where they would map out experiences of where infrastructure (widely defined) breaks down.
Relationships to tourism	<ul style="list-style-type: none"> A tourism pamphlet with activities that participants would use to generate personas of the typical tourist in their community.*
Durability & longevity	<ul style="list-style-type: none"> Writing letters about family heirlooms and/or items that are important to their daily life that document why they are important to them.

Table 1: Our initial design themes and potential probe ideas. Those ideas that we prioritized are marked with an asterisk

this probe as a little box that would sit on someone's car dashboard where they could capture their thoughts and feelings in the moment while sitting in their car on the ferry or waiting in line to board the ferry. Given constraints on the number of probes we could deploy, we decided to combine this activity with another initial idea where we wanted people to write letters to urban pen pals explaining their experiences of rural life. Rather than letters, we opted to create a kind of "message in a bottle" activity that captured elements of both probe activities. This resulted in a glass jar, with a hand-sewn sleeve attached that held a pen and notecards that participants could use to write on (see Figure 2). We provided participants with an instruction sheet that asked them to write a short message, once a day or more, to a stranger about what it's like to live where they lived. We requested that they put the piece of paper in the jar as if they were sending a message in a bottle.

4.1.2 Photo deer. This probe activity was inspired by "The Flat Stanley Project," as well as many standard photo diary probes that have been deployed historically [1]. The Flat Stanley Project was a children's literacy initiative where children would take a cut-out of a fictional children's book character named Stanley, mail it to friends

and family around the world, who would "document" his adventures through pictures and stories before mailing it back. The project was meant to promote storytelling and creativity among children. This probe activity is also similar to standard photo diary probes that have historically been deployed in many design probe activities, where designers ask participants to take photos of their day-to-day life and/or provide specific prompts to guide the photography. For example, Wyche [55] paired cards asking participants in rural Kenya to reflect on their own personal experiences with photo elicitation exercises as design probes to inspire speculative design proposals. To better focus the results of the activity, we opted for specific photo prompts rather than an open-ended request. In particular, we wanted to use this activity to get a more distinct interpretation of our participants' experiences as it related to community and connectedness. We asked people to take pictures of: 1) Your favorite place in your community, 2) Your favorite place at home, 3) The most "disconnected" place you are on a regular basis, 4) The most "connected" place you are on a regular basis, 5) The most rural place in your community, and 6) The most urban place in your community. We provided participants with a laser cut, wooden white tail deer (see Figure 3) with instructions glued to it and a QR



Figure 2: Our “Message in a Bottle” probe

code linking to a Google Form where they could submit their digital photos and a brief explanation on why the photo fit the prompt. The deer motif was chosen as deer hunting is popular in the region and wood was used so that participants could easily modify and draw on the deer if they so desired (i.e., in the style of the “Flat Stanley” paper dolls).

4.1.3 Measuring connectedness. Our third probe activity was created to directly measure our participants’ feelings related to connectedness. As is apparent in the photo probe, we are interested in people’s place-based experiences of connectedness, broadly defined, but we are also interested in how people feel about being connected or disconnected. We crafted physical Wi-Fi symbols (see Figure 4) using cardboard and construction paper. The symbols were three-dimensional, in that as the signal got “stronger,” the cardboard was stacked to offer some dimension and difference in feeling. We provided participants with three symbols each and asked them to color in the Wi-Fi symbol when they were feeling particularly connected or disconnected to correspond to that feeling. We then asked them to briefly reflect on the back of the probe why they were feeling that way.

4.1.4 The tourism pamphlet. Our last probe activity was inspired by the socioeconomic reality of the region we were doing work in, which is reliant on the tourism industry as one of, if not the most important industry in the region. We created this probe because we wanted to better capture insider-outsider dynamics in our fieldsites. This was especially the case in our island fieldsite, where much of

the property is second-family homes used as summer or holiday residences, and where there is long-term tension between people who live in the community full-time and summer visitors. This probe took the form of a tri-fold tourism pamphlet, called “An Insider’s Guide to [Township Name]” (see Figure 5). The pamphlet was inspired by tourism pamphlets we used on road trips as children that had activities in them related to the place we were traveling through. The pamphlet asked participants to share their favorite things about their community, to draw a map or picture of a place that they didn’t want to become a tourist hotspot, to answer some questions about the impact of tourism on their community, and to “Build a Tourist” through a drawing exercise.

4.2 Deploying the probes: Issues and incompletes

In January 2023, the first and third authors delivered nine sets of probes in our two fieldsites: Island Township received six sets of probes and Forest Township received three sets of probes. The probes were delivered to people the third author had established a connection with over the previous six months of the project. Each participant received verbal and written instructions, alongside an orientation for the probes and their purpose. They were able to ask questions during this time and were advised that they would have a month to complete the probes. The third author would return at the end of February, and if participants had any questions, they were provided with contact information for both the first and third authors.

A week prior to the return trip to collect the probes, the third author made contact via email, text, phone call, or direct message with all but one probe recipient. At the time, we reminded the participants to complete the probes if they hadn’t already and scheduled a time to pick them up that would work best for the participant. For the one person we couldn’t reach directly, the third author dropped in at the beginning of the next fieldsite visit to schedule a pickup time for later that week.

Of the nine deployed probes, seven were not completed at all, and two were partially completed. We choose not to share the results of the partially completed probes, as those results are spurious at best due to the extensive issues and concerns our participants had with completing the probes. Instead, we share the issues that participants had with completing the probes and resulting concerns from some of the probe activities. In other words, here we share our “lessons learned” from our first probe deployment that we later took into account when developing the second version of our rural design probe.

4.2.1 Tech issues. Although our probes featured low-fidelity design elements to anticipate technical challenges, participant feedback revealed that we may have overestimated their digital skills. Several participants encountered difficulties with the probes’ digital elements. Two participants who only partially completed their probes reported confusion regarding QR codes and the Google Form used for uploading photos. As workarounds for these challenges, one participant received a personalized, step-by-step demonstration on their phone, which included setting up a clickable link as an alternative to the QR code for their Photo Deer submission. Meanwhile, the other participant chose to send their Photo Deer submissions



Figure 3: Our “Photo Deer” probe

and completed the tourism pamphlet via text message to the third author after multiple unsuccessful attempts with the Google Form. While participants had written and verbal instructions and contact info for the third and first author, participants did not reach out to request clarification or tech support. In retrospect, the tendency to avoid seeking help reflects a broader culture of self-reliance, which often discourages people from asking for assistance.

4.2.2 Life issues. Participants, regardless of completion status, reported significant time constraints impacting their ability to complete probes. Many participants were involved in public-facing organizations and took on multiple roles in their communities – running small businesses, working in health and human services, balancing family responsibilities, and engaging in civic or volunteer leadership. This was especially evident in Forest Township, where the population is predominantly older, resulting in fewer residents shouldering a disproportionate amount of community work. As a result, juggling various civic and leadership roles alongside career and home life made it exceptionally challenging to manage additional tasks like the probes. For several participants, their already packed schedules were further complicated by emergencies, illness, travel, and seasonal work obligations (e.g., winter tourism and tax season). These events further constrained participation, even when there was high interest.

4.2.3 Relationship issues. Participants noted their unfamiliarity with the first author, who accompanied the third author to explain the probes. For some, this was their second encounter, while for others it was their first. The third author clarified during fieldwork that the project has two parts, with distinct roles for the first and third authors. This information was integrated into discussions

to help participants feel comfortable before the first author’s introduction of the probes. However, due to the constant influx of tourists, community members are cautious in their interactions, needing time to build trust, which can erode with new arrivals. The third author found that it typically took three visits for members to open up. Openness was more restrained when the first author accompanied the third author, reflecting earlier interactions. Many participants viewed the probes as requiring emotional vulnerability, which was challenging due to their limited relationship with the first author. One participant called the probes “a little woo-woo,” and another, who initially agreed to participate, handed off her probes to her “touchy-feely” co-worker. Later, participants told the third author they agreed to participate mainly due to a sense of obligation to their relationship.

Participants voiced concerns about potentially misrepresenting their experiences, which could harm the community, despite guarantees of confidentiality. This anxiety manifested in two ways. Firstly, their dependence on tourism influenced the process of the tourism pamphlet probe. Many participants feared that negative portrayals could damage local tourism and relationships with others in the industry. One participant focused solely on the ‘good.’ These apprehensions resulted in incomplete or selective feedback. Secondly, concerns about misrepresentation stemmed from rural consciousness. Residents in rural areas are cognizant of how media, academic research, and political discussions portray their lives. They are often cautious about how researchers and journalists, particularly outsiders, may contribute to reductive or harmful depictions.³ After the probe project concluded, the third author established stronger

³This is most evident in recent books such as *Hillbilly Elegy* and *White Rural Rage*.



Figure 4: Our Wi-Fi symbol probe

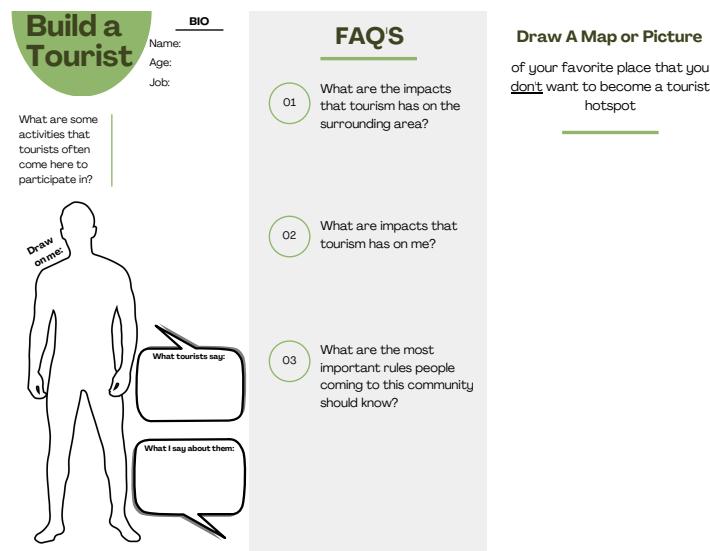


Figure 5: Part of our “tourism pamphlet”

connections with participants over an additional 16 months of field-work. Participants began openly discussing the various inaccuracies

of media representations of rural areas, especially following the 2016 election. They conveyed that their limited involvement in the

probes was intensified by concerns that misrepresentation would strengthen negative stereotypes. They suggested they might have been more inclined to engage if the probes had started more than six months after the project commenced, allowing for greater trust in the researchers.

4.3 Reflections and recommendations

Reflection on the probe creation and deployment processes as well as the factors that contributed to several missed opportunities, led us to several recommendations for future work in rural communities. These recommendations, which center on logistical, relational, and design elements, also incorporate recommendations based on the third author's ongoing work in the communities.

4.3.1 Logistical.

- *Transition to an 'ala carte' approach:* In retrospect, four probes might have been too many probes at once. Instead of providing a four-probe packet that requires completion of all probes, let participants choose possible options. For better selection, it may be more effective to categorize probes by a more clearly articulated estimated time commitment (e.g., light: 1 hour, moderate: 3-5 hours, extended: 1x/day for 7 days). It might also be useful to align incentives with effort, offering higher rewards for more time-intensive tasks. This would enhance flexibility, allowing participants to choose activities that fit their schedule.
- *Increase incentives and provide at the activity completion level:* We offered an incentive for the completion of the entire packet, though it may be more effective to offer incentives for completed activities instead of full probe packets. This could encourage the completion of fewer activities entirely rather than more partially completed activities. Participants can take on additional probes if time allows, without penalties for partial engagement.
- *Implement flexible timelines and rolling participation:* Establish flexible completion timelines, enabling earlier deployment while maintaining the original deadline. Implement phased participation based on seasonal work and collaborate with community members to account for seasonal constraints.
- *Incorporate recruiting participants for probes rather than relying on existing relationships:* This may seem counterintuitive, but it might be best to use traditional recruiting methods to find participants with little connection to researchers. While we initially thought this might lead to little participation, the disconnection may create a buffer between researchers and participants, encouraging some individuals to share more openly.

4.3.2 Relational.

- *Foster a more unified presentation of the project avoiding researcher segmentation:* Maintain a distinct sense of the team of researchers involved in the project, even when they aren't present. Doing this leading up to deployment, while minimizing the visible divisions or roles and tasks, may result in more familiarity with the team. When possible, create more opportunities for other members of the research team

to interface with community members directly to improve familiarity and relationship building.

- *Tailor probe introduction based on community dynamics:* While the first and third authors introduced the probes together, as the first author was leading the design component, we realized it may have been more effective to have the third author be the primary point of contact for the field deployment, leaving the first author out of the picture. This approach leverages established relationships and trust, allowing residents to maintain communication practices and comfort with asking questions, especially in closed communities. Integrating roles and tasks can help community members feel more at ease, reducing the need to restart the trust-building process. When possible, delay probe deployment to strengthen relationships.
- *Recognize rural consciousness, rural narrative fatigue, and the harm of misrepresentation with compassionate curiosity:* Whenever possible, and without compromising rigor, aim for radical honesty and transparency about the goals of your research, how data will be used, and the narratives involved. Stress that the purpose of research is to accurately capture lived experiences and reveal insights that are both truthful and impartial. It's essential to convey that your research arises from a genuine desire to understand their views, conducted with respect for their dignity, the intricacies of their experiences, and their voices. Make sure you uphold this commitment. Collectively recognizing and addressing these issues helps build trust.

4.3.3 Design.

- *Co-create probes with participants:* One of our major mistakes was a mismatch between probe design and participants' technological skills or daily rhythms. To foster ongoing discussions to discover activities that align with participants' lifestyles and tech comfort levels, we should have considered co-creating the probes with participants[35]. This may involve posing guiding questions to residents, encouraging them to adopt the perspective of researchers. For instance, *if you were to visit a community like yours, aiming to gain insight into residents' experiences with technology, connectivity, and the community's dynamics, what activities would you design to enable residents to share their experiences in more detail? Feel free to be as creative as you like; this could encompass written or artistic expressions, including photography, or creating interactive opportunities. Considering what you know about yourself and your neighbors, which activities do you think would be most effective? What topics or activities would you prefer to avoid, and why?* The goal is to collaborate with residents to create probes that identify challenges and sensitive topics, ensuring research objectives are met in a safe, open environment.
- *Leverage co-creation to develop a community-informed FAQ:* Create a FAQ document to include in probe packets based on questions or concerns identified by participants during the collaborative development process. These might include items that fall outside the purview of probe instructions but that collaborators identify as aspects that participants

like them, may have questions about. Proactively providing support serves to minimize barriers to participation and completion, particularly in communities where residents may be hesitant to ask for help based on local cultural norms.

- *Provide tech alternatives for response submission:* Build in and preemptively offer flexible submission options for participants. We offered other opportunities for submission as problems arose, but it would have been better to have these from the beginning. Preemptive offering can eliminate perceived tech barriers that may prevent the participant from initiating the task. Examples of this include allowing photo or activity submission via text message to a research team member in addition to utilizing a Google Form, or for participants who do not have a smartphone and instead take photos with a camera, providing reimbursement for photo printing or providing disposable cameras specifically for the activity which the research team will develop.

5 The Second Probe: The Game of Rural Life

Following the failed probe deployment, the research team met together in March 2023 to determine next steps. We discussed the third author's recommendations and reflection on the failures of the design probes and sought to carve out a path forward that would retain the intent of design probes (e.g., a more creative activity that would capture nuances of participants' lived experience), while also respecting participant concerns around ability to participate, trust, tech issues, and timing. We went back to our initial brainstorm of potential design probes and focused on ideas that might best be deployed in a single session. In other words, we wanted a probe that could be deployed in one moment with the research team present, rather than over the course of a week or month. This, we hoped, would remedy some of the commitment and relationship issues that arose from the first deployment, and also allow for us to be more directly involved in data collection. This approach veers away from standard design and cultural probe methodology, which values a longer-term participation without researchers present. Yet we felt like we did not have a choice given the concerns from both of our fieldsites about the time commitment and ability to complete the probes as deployed. We ultimately settled on developing a board game. We believed that a board game would retain the fun and creativity of a typical design probe deployment, while also allowing participants to engage in it at a set time and place, and with other people in their community. This approach is in line with prior work in HCI that explores board games as a research tool [39].

5.1 Creating the second probe

Rather than creating a game from the ground up, we chose a classic American board game, *Life*, as our inspiration due to its focus on typical experiences across the lifespan. *Life* tasks players with navigating from college to retirement while accumulating wealth (and debt), career achievements, and family milestones. Players spin a wheel to determine movement, make key life decisions at various crossroads, and compete with others to finish the game (i.e., retire) with the most money. The game is simple, lends itself well to creative re-imaginings of components and mechanics, and

is a game that many Americans are familiar with, meaning lower barriers to entry, even those who had never played *Life* before.

Given the original intent of the project, understanding people's lived experience of connectivity in their rural communities, we sought to remix the game to create new components and mechanics that would center experiences of infrastructure, especially infrastructure that is important for connectivity (e.g., Internet, roads). We decided to refer to the game as *The Game of Rural Life*. Our changes included doing some simple things, like replacing basic event spaces that players have to engage in when landed upon, to reflect various life events and experiences of our rural fieldsites (e.g., hunting, fishing, county fairs) and unexpected costs (e.g., car repairs, gas and grocery prices going up). It also included altering broader game mechanics to reflect key experiences of infrastructure. This included at the time early in the game where players had to buy a house, keeping it secret that one of the two houses available did not have Internet, which would impact many of their abilities throughout the remainder of the game. The consequences of not having Internet were designed into the game in a way that players were frequently reminded of the importance of Internet connectivity for modern life, including in ways such as:

- If players lost their job over the course of the game, they would lose a turn to file unemployment because they needed to file in person rather than using an online portal.
- Investment opportunities or side hustles were made available to players with Internet to earn extra money.
- At a certain moment in the game, players were given the opportunity to reskill to a better paying job. If they didn't have Internet, they had fewer options than those who did, and those options paid less.

We also included new types of spaces on the board that we referred to on the team as "infrastructural breakdown spaces" where players had to draw a card at random that would interrupt their gameplay with a particular experience of infrastructural breakdown (e.g., rivers flooding and taking out bridges, blizzards, schools shutting down).

We did not come to all of these components organically of course. We went through two major iterations of the game. The first version we developed using cardboard, construction paper, and post-it notes (see Figure 6). This version was a simple first step in remixing the game where we kept all of the original game mechanics while changing basic event spaces to reflect rural life and the housing and reskilling triggers to reflect disparities in broadband access. This game was refined over the course of summer and fall 2023 through multiple gameplays with two groups: 1) members of our research lab who were from and/or conducting research in rural areas to ensure that our portrayal of rural experiences would appropriately capture some of the issues with infrastructural breakdown and digital connectivity; and 2) colleagues who were game designers to ensure that the game mechanics were translating well and appropriately structured to achieve our desired goals.

At this point, we developed a second version of the game in Adobe Illustrator based on testing feedback, where we refined the visuals of the game and included more elements and experiences of infrastructural breakdown (see Figure 7). In particular, through



Figure 6: The first prototype of our Game of Rural Life probe

gameplay in our first round of testing, we realized that the negative experiences of the game were largely falling on those players without Internet. While this was partially intentional, we didn't want it to be so uneven that those players without Internet didn't have fun with the game. We remedied this by introducing the universal "infrastructural breakdown spaces" to ensure that all players experienced it at some point. Though, we continued to retain an imbalance where players without Internet still had the bulk of these experiences to replicate the reality of the digital divide. We also created custom components for jobs, houses, and money to reflect the broader visual design of the game.

5.2 Deploying the Game of Rural Life

In Spring 2024, the first and second authors ran a pilot study with the second iteration of The Game of Rural Life. We were unable to travel for this pilot, so we chose to recruit rural-originating college students at our suburban university. Our university has a large agricultural component and there are many student groups related to agriculture, livestock, and other activities that would be more likely to attract students that come from rural communities. We sent out recruitment messages to 10 student organizations and advertised the research participation opportunity in two large lecture classes in our department. We asked for students who currently or

previously lived in rural communities (self-defined) to participate in testing a board game on the theme of rural life. We shared that the board game sought to understand how people interpret experiences of rural life through playful design. Prospective participants were told sessions would take 75 minutes and they'd receive a \$25 Amazon gift card for their participation.

Our participants included eight students who took part in four playthroughs of the game (i.e., two in each session). All students self-identified as currently or previously living in a rural community. Seven students lived in a rural community in the United States, one lived in a rural community in China. All students were undergraduates ranging from age 18 to 23. We did not collect other specific demographic information from our participants, though the sample was racially and gender diverse. While this participant group is different than our sample for the initial design probe study (i.e., people who lived in two digitally disconnected communities), as we will demonstrate later, every single one of the students was clearly able to articulate experiences related to digital disconnectedness in the rural communities they came from and how it impacted them and the people around them.

For each playthrough of the game, we had a facilitator and an observer. The facilitator was the first author and PI of the project, who is also a professor at the university where the participants attend and who grew up and currently lives in a rural community.

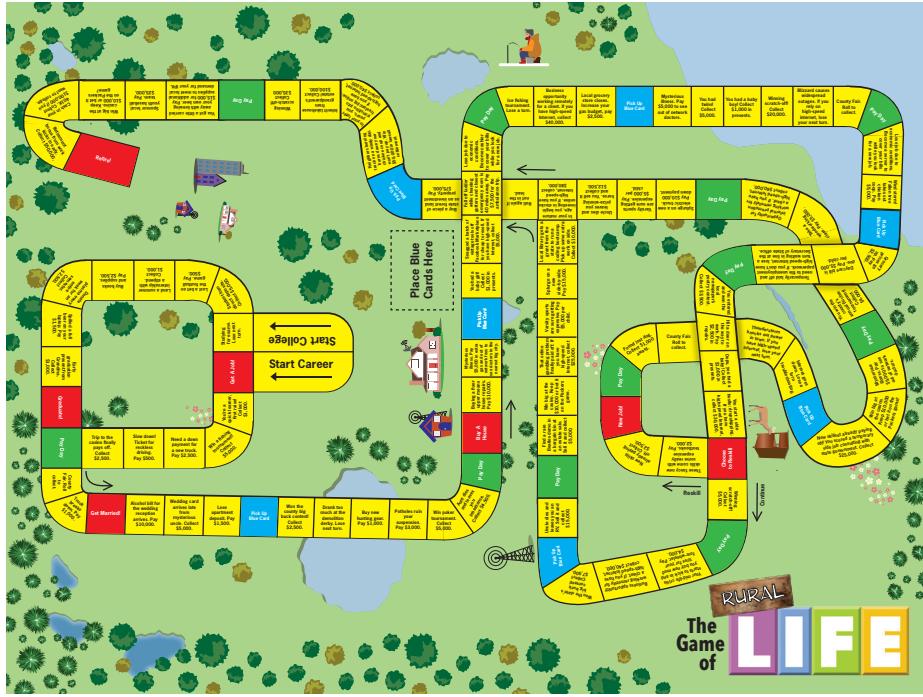


Figure 7: The final prototype of our Game of Rural Life probe

The observer was the second author, an undergraduate research assistant on the project who grew up in a rural community. The facilitator acted as the “game master,” going over instructions, asking questions at various points in the game, and reminding players of certain game elements or rules. The observer took notes throughout gameplay, including what choices the players made, how they responded to elements of the game, how players interacted with each other, and how players responded to experiences of infrastructural breakdown. At the mid-point of the game, the facilitator conducted a check-in with players, asking how they thought they were doing, how they felt about their life prospects, and if there was anything of interest noticeable in the game play. At the end of the game, participants were asked a series of questions as a group about why they made the choices they did during the game (e.g., why they went to college, why they chose to reskill), if they thought the game was fair, their perceptions of the role of Internet in the game, how they would play differently if they were to play it again, and general feedback about the game (e.g., pace, content, instructions, ability to capture rural life).

Each game session was recorded, transcribed using an automated transcription service, and checked for accuracy. Notes from the game and quotes from the transcriptions were coded using an open coding process (Emerson et al., 2011) to identify themes related to infrastructure, place, geographic difference, and opportunity. While the results we present here are based on a pilot study, our intent was to capture our participants’ place-based experiences of connectivity, which we believe this game does successfully. The structure of the game and the guided conversation at the end of the game resulted in participants sharing their own experiences, as

well as their family’s experiences, of living in rural communities and how that was reflected in the game. In particular, here we briefly look at participants’ experiences as it relates to three types of connectivity: sense of community, resource access, and experiences of the Internet.

5.2.1 Sense of Community. Based on our pilot study, participants noted that rural communities foster a unique sense of connectedness characterized by strong interpersonal bonds. As one participant said, they are a place where, “a lot of people know and can help each other,” which create networks of mutual support. Rural communities thrive on regular social interaction, with residents “getting together for events and constantly visiting each other’s homes.” Participants noted that community gathering points like churches, schools, and bars serve as vital connectivity infrastructure, while community events like county fairs, one participant noted, bring “the whole community together.” The familiarity of rural connectedness extends to everyday encounters where, “you go to the gas station and see a familiar face.” However, this connectedness has notable drawbacks. Some participants expressed a desire to “be apart” from the interdependence of rural life “built upon trust and surviving off each other,” suggesting potential feelings of social obligation or lack of privacy. Additionally, one participant noted that when they left the rural community they grew up in that, “There was no remaining infrastructure to stay connected when I left,” highlighting the geographical limitations of rural social networks. This contrasts with cities that participants described as being lonely, full of people stuck in their homes and not knowing their neighbors, revealing how the physical and social structures of rural places fundamentally shape experiences of connectivity.

5.2.2 Resource access. Our participants revealed complex experiences with resource access that significantly impacted their connectivity and quality of life. Physical isolation in rural communities creates tangible barriers to essential services, with one participant noting that, “the closest grocery store is 25 miles [away],” reflecting an experience they had in the game when the grocery store closed during gameplay. Another participant noted that when you live far away from the city, you are also “far from good health care in town when you are [at] retirement age.” This geographic disconnection extends to digital resources, which we will go into in greater detail in the next section, but isn’t only limited to the Internet as infrastructure. As one participant acknowledged, “being in the country, I won’t have high speed internet or near to a hospital.” Infrastructure limitations further compound these challenges, with residents recalling when storms hit in their communities that trees would block roads and that the local schools had a bus driver shortage which made it difficult for kids who lived out in the country to get to school. Educational resources emerged as a critical pathway for rural connectivity, with many viewing education as essential for economic mobility. As one participant shared, “since I got a scholarship, I went to college because it was the only way out of a life of poverty.” This opportunity often necessitates physical disconnection from rural communities. Rural brain drain was a real experience for these students, who were themselves a part of it. As one participant said, “all the young people leave, because there’s not a lot of opportunity,” with another reporting, “I left my town to get an education and look at things differently.” These experiences highlight how resource access fundamentally shapes both the physical and social connectivity of rural residents to broader opportunities and support systems.

5.2.3 Experiences of the Internet. Participants shared many of their own experiences of Internet access, inspired by their experiences in the game. Some participants shared about being completely disconnected at times, “My house doesn’t have Internet, we don’t have WiFi, we never have.” One participant who lived with his grandmother in her rural village in China mentioned, “In my grandma’s village, there was no Internet so you couldn’t do anything there.” This was comparable to how participants discussed the disadvantages of Internet access in the game, “I kept getting [penalized] because I didn’t have Internet.” Another participant noted, “The lack of Internet in the game impacted my outcome because I kept losing out on things [that other players didn’t].” People’s experiences of Internet connectivity growing up also influenced their behavior and perceptions of the broader world. One participant noted that she always used the data on her phone rather than WiFi, despite being on a campus with universally accessible free WiFi, because “that’s what I’ve always done.” Another participant mentioned having to travel to her grandmother’s house who did have Internet in order to use it when their satellite Internet wasn’t working. As one participant noted, these disadvantages can leave rural people behind: “Technological advancement happens so fast, it takes a while to come to somewhere where I live.”

5.3 Outcomes of the probes

Returning to the research question that drove the deployment of the probes, what are the localized, and often invisible, connectivity needs of rural people? Based on our pilot deployment of our

design probe, we understand that the connectivity needs of rural people encompass both physical and digital infrastructure that supports holistic community engagement. Digital connectivity represents a critical need, with inadequate or nonexistent Internet access creating cascading disadvantages cross education, employment, and social participation—forcing our participants to engage in workarounds like traveling to other places or relying on mobile data. Community infrastructure that facilitates social connectivity is also essential, with churches, schools, and local gathering spaces serving as vital nodes in our participants’ networks. Given our focus on college students, educational resources emerged as particularly crucial connectivity lifelines, providing pathways to opportunity that ironically often necessitate physical disconnection from rural communities, contributing to brain drain. The tension between the positive aspects of tight-knit rural communities and their limitations highlights the need for connectivity solutions that preserve community closeness while reducing isolation. These multifaceted connectivity needs remain largely invisible to policymakers and technology developers who primarily design for urban contexts, yet addressing them is essential for rural residents to maintain meaningful connections to both their local communities and broader society. While these findings are largely confirmatory, they do tell us something about our design probes. That is, our design probe helps us capture lived experiences of connectivity, especially as it relates to infrastructure and urban-rural divides.

6 Discussion

6.1 Learning from failure

In the process of developing and deploying the first probes, we considered existing infrastructure, the economic-industrial base of the region, what seemed feasible given known constraints, and establishing relationships with participants before deployment. Our approach to design probes was primarily researcher-led, meaning we didn’t directly consider our participant’s perspectives in the creation of the probes. If we had taken a more participatory approach [35], the initial probe deployment may have been more successful. Despite our best intent to create design probes that were culturally responsive and situated to the communities that we deployed them in, our initial probes were a failure. While failure was never meant to be a central takeaway or theme from this research, we learned much about failure and how to respond in the process of conducting this research. Prior work in HCI has engaged quite critically with failure. This includes work that looks at the failure of designed objects, such as robots, and how users respond to that failure [7, 33, 48]. More importantly for our experience of failure is prior research that’s sought to understand what we learn from the failure of our research projects and objectives [15, 17, 29]. Like Gaver and colleagues in a deployment of a home health information system [17], our initial design probe deployment resulted in limited or fleeting engagement with the vast majority of our design probes. Drawing from a Feminist STS and HCI tradition, Howell and colleagues [29] advocate for a perspective on failure that goes beyond “success/failure binaries,” embracing the messiness of failure as an opportunity to reflect on what often gets left out of typical narratives of design success.

The “results” of our failure resonate extraordinarily well with what Howell et al. [29] deem the “labor and burden of participation.” In our own reflection on failure, we came to understand that what we thought of as simple participation was indeed not simple, not easy, and butt up against many of the everyday experiences that we were trying to capture through our initial probes. In other words, rather than begin well-aligned with the ability to capture rural experience, our probes in some ways exacerbated and reminded our participants of the frustrations of rural life. Take for example the tourism pamphlet that we deployed in order to capture the insider-outsider dynamics of life in a region dominated by tourism and the service economy. Participants were reticent to do activities with our probe that might shine a negative light on tourism, despite the fact that they were very open to discussing these issues with the third author during their fieldwork. In responding to this failure, rather than taking it as truly a failure, we treated it as an opportunity to learn, resulting in many recommendations for design probe deployment summarized above.

6.2 Playing with rural design

The research on rural design emphasizes a methodological approach and sensitivity that understands the infrastructural, social, economic, and cultural contexts of rural communities. As that research shows, designers and researchers must adapt methods and designs to rural realities rather than attempting to transplant urban approaches. Echoing prior research that focused on rural values and experiences [9, 55] and community dynamics [49, 57], our research sought to respond to the rural values and needs from the start, though learned rather quickly that we needed to be more agile and responsive through our extended design probe process. We developed an orientation to our fieldwork and design probes that conceptualized experiences of connectivity and infrastructure in a particular way [10, 21] and quickly learned what was going to work and what wasn’t going to work when our first design probes failed.

In response to this initial failure, we persisted in a focus on a probe-like intervention, drawing on the reflections and experiences of the participants. In doing so, our second probe emphasizes the following:

- *Playfulness*: to counteract the often-serious nature of rural disconnectivity and its downstream effects.
- *Time-boundedness*: to alleviate concerns about the types of commitments participants had to make when they have many demands on their time.
- *Collective experiences*: to emphasize an experience of design probes that is group-based rather than one that is largely done alone. This would allow us to re-emphasize the collective nature of rural experiences and the relationships between rural community members, rather than the relationship between researcher and participant that led to uncertain dynamics in our initial probe deployment.

We would not pretend to think that these takeaways are universally applicable to rural areas, or those who are considering deploying design probes in rural communities. In fact, as prior research in rural design has shown, these places are highly contextualized and need unique attention (e.g., [55]). Rather, we offer these as an example of

us as a research team learning to design “from the rural” [26], rather than designing with rural people in mind. By responding to the concerns of our research participants, our orientation moved from one that was broadly with rural people, yet still bound to particular approaches to design probes that are relatively typical in our field. In our response, we opened ourselves up to different interpretations of what designerly activities could look like that responded to concerns that emerged from our fieldsites. While this designerly activity took the form of a board game, our work currently has limitations in how we situate our results within the research on board games, and serious games more broadly, as research tools [39]. Future work should consider bringing together research on design probes and research on board games as data collection tools to better understand how these methodological orientations converge and diverge in their intent and practice.

While our primary contribution is methodological, as outlined above, we believe that our research has contributions for how we understand rural people’s relationship to Internet infrastructure in HCI. In particular, our research is firmly situated within broader research in HCI that focuses on developing community-centered approaches to Internet infrastructure, mostly in remote and rural communities. As noted in our Related Work, probe-based research in this area has largely focused on designing potential solutions to localized network-based needs, rather than using probes to investigate the everyday lived experiences of broadband infrastructure and its intermittent nature in rural contexts. Our work sought to explore this space using design probes as a generative opportunity to understand whether it would yield “useful” results for further contextualizing these types of lived experiences.

Our work addresses a significant gap identified in an understanding of broadband access, which is often characterized through a reductive binary of connected versus disconnected. Similar to how Melvin and Bunt [37] revealed the complexity of rural work experiences amidst intermittent connectivity, our probe-based approach illuminates the rich spectrum of connectivity experiences that shape rural life. Through our game-based probe in particular, we were able to have our rural players articulate and respond to an ecosystem of variable connectivity that impacts education, employment, social cohesion, and mobility in ways that traditional infrastructure assessment methods fail to detect. By eliciting these lived experiences through playful design, we begin to show how to explore connectivity not merely a technical state of being “online” or “offline,” but rather a complex sociotechnical condition that rural residents actively negotiate. This nuanced understanding challenges infrastructural solutions based on simple presence or absence of broadband, suggesting instead the need for human-centered infrastructure design that recognizes connectivity as contextual, variable, and deeply intertwined with rural identity and community structures. In moving beyond the connected/disconnected binary, researchers, policymakers, and designers can develop more responsive approaches to rural connectivity that address not just the physical presence of infrastructure, but the meaningful forms of connection that rural residents actually seek and value in their everyday lives.

7 Conclusion

This paper documents our journey of developing, deploying, adapting, and learning from design probes in rural communities to better understand connectivity experiences beyond simplistic binary frameworks. Our initial probe deployment failure, rather than representing a methodological dead-end, became an opportunity to examine our own assumptions about rural participation and design research. By reframing our approach through a time-bounded, collective, and playful game-based probe, we created a more suitable intervention that honored rural participants' realities while still capturing many of the nuanced experiences of digital and physical connectivity that define rural life.

While our game-based probe succeeded in ways that our original probes did not, we also provide recommendations for ways to deploy more typical design probes in rural communities. Rural design requires flexible approaches, strong community relationships, transparent communication about research goals, and willingness to go even deeper to co-create research instruments with participants themselves—acknowledging their expertise related to their own community and connectivity experiences. This work contributes to the growing field of rural computing by demonstrating how traditional design methods must evolve when deployed in rural contexts. By designing “from the rural” rather than merely with rural people in mind, researchers can develop methodologies that better capture the complex interplay between infrastructure, community, and connectivity. As policies and technologies are increasingly developed to address rural connectivity, our research underscores the necessity of human-centered infrastructure design that moves beyond simplistic connected/disconnected frameworks to embrace the rich, contextual nature of rural connectivity experiences.

Acknowledgments

We would like to thank the Merit Network and the Quello Center for the research funds that made this work possible. We would also like to thank our participants for their insights and Casey O’Donnell and Figgins for their feedback on early iterations of the game.

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