Studying the Formation of an Older Adult-Led Makerspace

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ABSTRACT

Makerspaces are being introduced in a wide variety of settings, including community settings such as schools and libraries. Older adults are one group for whom making agendas are being pursued, with envisioned outcomes such as supporting agency and well-being. However, research on making and DIY with older adults typically study individuals who are already engaged in making practices or bring individuals in to a technology environment that has already been created. In this paper, we study the older adult-driven formation of a makerspace in an independent living community. Through an ethnographically-informed approach, we studied the ways that individuals considered appropriate allocation of resources towards a makerspace, scoped activities, evaluated goals, and made trade-offs. Our analysis is centered around describing the way that this makerspace formed as well as three ways that individuals made sense of the makerspace as the planning unfolded: the openness of a space that promises to cater to interests of the population; the promise of a makerspace to involve more residents in technology, but the need to obscure the technology to make it appealing; and a valuation of the return on investment for limited financial and space resources. Our discussion contributes to supporting and studying early adoption of technology by older adults, complicates visions of "making for all," and presents considerations regarding the often under-specified community of a makerspace.

CCS CONCEPTS

• **Human-centered computing**; • **Human-Computer Interaction (HCI); Collaborative and Social; Social and professional topics** → User characteristics; Age; Seniors;

KEYWORDS

Makerspaces, DIY, Maker, Values, Older Adults, Aging, Community

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1 INTRODUCTION

Making, DIY, and hacking are seen as having great potential for wide-ranging social good, from democratizing technology [52] to increasing access to assistive technology [31]. In turn, makerspaces are increasingly seen not only in independent, private organizations [63], but in settings involving wider segments of the community, such as schools and libraries [1, 29, 44].

As makerspaces are being introduced to community settings with a vision of benefiting all citizens, researchers are noting ways in which makerspaces may fall short of providing equitable access and opportunity to all. In particular, makerspaces may be used more often by affluent men with technical backgrounds [12, 18]. Individuals without these characteristics, or those who have other differences may feel a sense of not fitting in or be excluded in subtle ways (e.g., when a child's parents do not speaking English in an English-speaking country [53]). In this paper, we examine an additional dimension – age, which may affect inclusion in makerspace efforts.

Older adults are being swept up into visions of making for all, with research efforts towards making "making" more accessible and approachable [13, 22, 32, 47]. Often, these efforts are framed in terms of benefits that they bring to older adults, such as a greater sense of agency or control [13, 47]. Researchers have argued that aging technology research must be considered in terms of the problematic ways that the HCI literature frames and forms agendas on aging. Critiques include that aging can be framed in terms of problems (e.g., "physical decline") – with technology as the solution [57]. While this savior role of technology is stressed, older adults are frequently framed as passive or unwilling technology users [57]. Perhaps in part due to this presumed passivity, technology environments may not support any deviation from the designer, healthcare professional, or policymaker's vision of how the technology should be used, effectively resulting in coercion [42]. Thus, visions of making for all that strive to include aging individuals cannot be viewed neutrally: they may include tones of technology solutionism and see older adults as technophobic individuals in need of convincing. Refusal may not be included in papers at all

when research only includes those who express interest in a project, and disinterest in technology may not be seen as equally valid and informed as interest.

In this paper, we provide an account of the formation of an older adult-driven makerspace at an independent living community, where we were invited as researchers to observe the process. Through an ethnographic approach to data collection, we were able to observe the ways that individuals made sense of and formed opinions on the makerspace process. In doing so, we were able to analyze the ways that older adults with a stake in executing a vision of making considered appropriate allocation of resources towards a makerspace, scoped activities, evaluated goals, and made tradeoffs. This paper makes two main contributions. Our first contribution is in providing an ethnographically-informed account of older adults' motivations, challenges, and concerns while moving through the adoption process of a new technology environment. Our discussion reflects on these findings in terms of technology adoption by older adults. Our second contribution lies in the ways that the development of this new technology environment is situated within a larger trend in which makerspaces are being developed in a variety of community spaces to engage groups not seen as traditional makers. In analyzing how this space was created and whom it was created by and for, we identify emerging tensions. Our discussion considers the ways in which standard visions of making draw in or break down for different older adults in the context of research directions in aging HCI.

2 RELATED WORK

Below, we describe literature related to the role and purpose of makerspaces, research that reveals the values embedded in making and makerspaces, and past work on making and hacking with older adults.

2.1 Makerspaces

Makerspaces, also referred to as hackerspaces or fablabs, are locations dedicated to supporting people to hack, make, and craft. Often, these sites serve as communal spaces to share equipment such as 3D printers and laser cutters [53] and act as "third places," or public spaces outside of the home for people to gather [6, 41, 53]. Makerspaces are often independent, private organizations made up of like-minded individuals [63], but increasingly, public spaces such as schools and libraries are opening makerspaces [1, 29, 44].

Several considerations to starting a makerspace have been identified in past literature, including finding a site, creating an organization structure, and developing a financially viable model. The physical space influences where the makerspace calls home [39], but also set-up [39], workflow [5], accessibility [1], collaboration, and safety [1, 19]. Organization structure includes considering how decisions are made and conflicts resolved [39, 63]. Another consideration is the development and maintenance of a financially viable model [39, 63]. Though sometimes framed as an investment in the community, the impact of makerspaces can be difficult to measure [53]. In our study, individuals wrestled with whether the makerspace would have an impact worth the investment.

"Every [maker]space is different" [55] – there is no single definition of what it means to be a makerspace [55, 63]. Making activities can mean anything from creating custom hardware [36] to crafting [20, 33]; from biohacking insulin [49] to training job skills [30, 59] and entrepreneurship [30]. In our paper, while the ability to tailor makerspaces to individual contexts is helpful, we find that the purported openness has bounds.

One role that makerspaces take is reaching out to groups often excluded in making initiatives [53]. In HCI research, a number of projects seek to balance the making landscape, which has traditionally catered to able-bodied men [18]. Some research focuses on people with disabilities, creating assistive devices [31, 38] and accessible personalized art pieces [25]. Other work pushes back on the idea that people with disabilities must be brought into making, arguing that researchers have neglected the sophisticated design practices in which individuals are already engaging [8]. A similar pattern has emerged with gender, where researchers are studying how makerspaces can be more inviting to women on the one hand [12, 23], but also noting that women's engineering innovations have been cast as crafts and left out of dominant histories of technical innovation [48]. In centering older adults in this paper, we find a similar need for a nuanced consideration of what inclusion means for this population.

2.2 Diversity of Values and Needs in Making Communities

Makerspaces reflect the values of their community – geographically or based on interest area – leading to a diverse and heterogeneous set of values. As researchers examine practices and attitudes around making in local hackerspaces [54] and across continents [36], they reflect on implicit values to many makerspaces, including adhocism [54] and a distinct hacker ethos (i.e., designing modifiable technology, open sharing of knowledge, peer production) [36, 54]. Even the values identified as implicit are debated, as some see hacking as anti-consumerism [54] while across continents it may be associated with industrial innovation and even commercialization (i.e., from product design to start up initiatives) [36].

Many of the values and benefits associated with making are unique to each community. Toombs [55] noted how makers in an online makerspace listserv struggled to settle on clear guidelines for what belongs in makerspaces, highlighting differences in values despite some predominant maker narratives. A study of women-only makerspaces found a hacker identity around sense of purpose and societal role [23], whereas in traditional maker spaces identity can be built around technical ability [54]. A dominant approach may involve a libertarian set of values [55], in contrast to makerspaces that mark explicit social rules to facilitate discussion of sensitive topics such as gender, identity, and inclusion [23]. Past work on making with children reveals values around inspiring curiosity, playfulness, and building confidence to try new things [4, 37]. And research on values associated with making for older adults [13, 58] identifies caring for one's own health and wellbeing as well as "selflessness and kindness," or making for others in need [58].

It is key to understand the specific needs and preferences of individuals within the community the makerspace will serve, as this plays a role in determining the success of the space. Past work with refugee children indicates that the concept of some makerspace machines was not accessible to the children in this study, who lost

interest due to perceived complexity [50]. This example indicates that individuals make sense of making technologies as to the degree to which they belong in their own lives, and choose to engage accordingly.

2.3 Older Adults and Making in HCI

HCI researchers are calling attention to the role of older adults as actively involved in technology production rather than as passive consumers [9, 47, 60]. Researchers have found psychological and social benefits for older adults producing digital content, including opportunities to reinforce values and identities [9], counter ageist stereotypes [35], and create a sense of community [9, 11]. Beyond social and well-being benefits, older adults may have goals such as learning to create with technology to improve their professional skills [27] or connect with cultural notions of resourcefulness [51]. We extend this past work by uncovering some of the perceived benefits of makerspaces for older adults.

In line with a shift towards viewing older adults as active technology users, studies of making and makerspaces with this population are emerging. Researchers are exploring and adapting toolkits that support older adults in designing their own technologies. These toolkits typically remove technical barriers needed to interact with maker electronics to make them more accessible to novices. In a study of workshops with older adults using one such toolkit, participants were able to easily brainstorm designs of future technology [47]. Craftec [32] and the IoT Un-kit [2] were created specifically to engage older adults in prototyping and design.

Most similar to our own study, Carucci and Toyama set up a makerspace in an older adult long-term care facility, filling it with high-tech (e.g., 3D printing) and low-tech (e.g., button making) stations [13]. The research team chose the equipment, staffed the makerspace, and coordinated with staff to recruit residents. They found that older adults felt empowered to solve everyday problems, such as mending pillowcases and 3D printing home accent pieces. Residents also appeared to experience increased agency, noting how the space helped them to feel in control of their lives. However, despite initial excitement, few people used the space [13], raising questions about whether the individuals who did not engage found value in the activities and equipment [26, 43].

3 METHODS

Below, we describe our data collection process, participants, and approach to analysis.

3.1 Data Collection

In June of 2019, Ora[1] informed us that she was forming a makerspace at her retirement community, Nestern. Nestern is a pseudonym for a retirement community in the Eastern region of the United States that houses almost two hundred residents in independent living. The community also includes assisted living and skilled nursing, though our interactions over the course of the study were with individuals in independent living. We do not have precise financial information about the community, but we learned that while some residents' rents are subsidized, many residents are financially comfortable and some are affluent. Yet it is not a top end, luxurious community.

To situate the analysis below, we discuss some of the existing activities and spaces available at Nestern. Before the business center was designated to become the makerspace, it was the main communal space containing technology for resident use. Art activities regularly take place in a separate arts space. Additional spaces where social and recreational activities occur include a resident-run library, chapel, and social spaces (such as clusters of comfortable chairs) throughout the building. Activities are offered regularly, largely organized by management. Most offered are physical activities (e.g., exercise classes) and social activities, but there are also regularly occurring "occupational" activities offered, where residents learn and refine skills.

We started data collection in July 2019 after review and approval from the University of Maryland Institutional Review Board. This was at a point fairly early in the process: a room had already been identified and a committee had been formed, but major decisions, such as which machines to buy or what to name the space, had not yet been made. Our role was mostly as observers: we observed committee planning meetings and spoke to residents. Yet, we also offered to serve an active role in any way that would be helpful for the committee. To this end, we conducted a focus group with residents and delivered a brief summary to the committee, tabulated survey responses, and responded to occasional questions about our perceptions of the process from Ora as well as Tara, a staff member involved in the project. Though we had regular ongoing contact with Ora and Tara and did provide minor forms of assistance, others seemed to see us as an external party to Nestern, which may have led them to more comfortably express doubts or negative views.

In total, our data collection included five observations of committee meetings as well as a two-day planning event; a 90-minute focus group with 5 participants; and 18 semi-structured interviews with 11 unique participants. Each interview was about 30 minutes long. The focus group and interviews centered around participants' reactions to the idea of makerspace, types of equipment or activities they would like to have in the space, desired scaffolding and instructions for those activities, and perceived benefits and concerns. Interviews with committee members involved additional questions around their experience of serving on the committee. Additionally, for the focus group, we showed short videos that depicted makerspaces and making machine capabilities to prompt discussion. Our engagement with this site took place over approximately eight months. When the COVID-19 pandemic affected our region, the committee had been almost ready to open the makerspace but halted as priorities shifted elsewhere. The committee has starting meeting again as of August and are almost ready to open the makerspace to residents.

Table 1 lists participants, demographics, and whether they are residents or staff and on the committee. All committee members have pseudonyms. We use participant IDs for residents who are not committee members as a way for the reader to more easily distinguish the two groups. Towards further anonymization, we give age ranges rather than exact ages. The average age of participants (excluding Tara) is 82.6 years old (range 72 to 97; standard deviation 5.7).

[1] All names in the paper are pseudonyms.

Table 1: Demographics

Pseudonym or PiD	Age Range	Race/Ethnicity	Position
Ora	70-79	White	Committee member (resident)
Tara	20-29	White	Committee member (staff)
Nina	80-89	White	Committee member (resident)
Kevin	70-79	White	Committee member (resident)
Christopher	80-89	White	Committee member (resident)
Xena	80-89	White	Committee member (resident)
Nadia	80-89	White	Committee member (resident)
R1	90-99	White	Resident
R2	80-89	White	Resident
R3	80-89	White	Resident
R4	80-89	White	Resident
R5	Not disclosed	Not disclosed	Resident
R6	80-89	White	Resident
R7	70-79	White	Resident
R8	80-89	Asian / Pacific Islander	Resident
R9	70-79	White	Resident
R10	80-89	Black or African American	Resident
R11	Not disclosed	Not disclosed	Resident

3.2 Data Analysis

Our analysis draws on a constructivist grounded theory approach [14]. The first and second authors were involved at the field site and wrote memos throughout the process, from data collection to analysis. We initially open coded a subset of the interviews. Initial codes included "becoming a part of what might be in a makerspace," "conception of makerspace- can't imagine" and "might result in more social connection." After open coding four transcripts, we shifted to a focused coding approach, and coded the remainder of the transcripts as well as the observation notes, adding new codes as needed. As we coded the transcripts, we revisited and created new memos and theorized amongst our team. Some examples of key themes that formed at this stage include the centrality of technology, crafts, and machines; the perceived openness of the makerspace as being at odds with people's inability to imagine what a makerspace might look like in practice at Nestern; and attitudes towards technology. Two committee members reviewed this paper before publication and responded to questions about minor details as needed (e.g., how many computers had been in the business center).

A constructivist grounded theory approach requires that we consider how our own positionality and worldview affects our findings [14]. We have been influenced by critiques of the ways that older adults are often viewed as homogenous and technophobic [21, 47, 57]. Thus, we came into our research engagement with a hesitance to accept participants' characterizations of other older adults as technophobic (a frequent occurrence in our data collection). At the same time, we are influenced by literature that notes that when older adults do not use technology, they have valid reasons (and that our role as researchers should not simply be to encourage people to use technology) [15, 16, 34, 40]. This stance surely affects the ways that we analyzed our data, in particular the way we worked to make sense of both positive and negative perceptions of the makerspace initiative.

4 FINDINGS

Below, we first provide an overview of the makerspace project. We then describe three central ways that residents, including committee members, made sense of and formed opinions about the makerspace during its formation. The first concerns the openness of a makerspace, where anything is said to be possible, but it can be hard to come up with ideas of what is desired – and the bounds of a makerspace may end up constrained, often invisibly, by the ways that makerspaces are framed. Second, we discuss how residents saw the makerspace as an opportunity to engage others in more technology use – but technology needed to be hidden, or non-technical activities needed to be included, to overcome a perceived resistance. Finally, we discuss considerations of whether a makerspace was a judicious use of resources, with varying perspectives on what would be an appropriate "return on investment" for the community.

4.1 Origin Story

The room that was designated for the makerspace was originally a multi-purpose room which included a business area with two computers and a printer, as well as a more recreational area with a pool table. Ora[2] described the origin of the makerspace initiative as follows. As a leader in the resident association, she had formed a space committee that was determining how to best use resident space at Nestern. Over time and through discussion, it was decided that the multi-purpose room could become a technology center.

Ora had an academic background in a discipline in which makerspaces are seen as ways to engage communities (e.g., in libraries). Her own motivations included widening residents' interests, and

[2]Committee members are referred to with pseudonyms. Residents who are not committee members are referred to with participant IDs.

she came up with the idea that the tech center could become a makerspace, ensuring that they could "claim" the entire room that was up for discussion. As this conversation was taking place, the resident association had identified money that needed to be spent for tax purposes. The conversation of how to spend that money originally centered around updating the business center equipment with new computers and printers, and the costs associated with the makerspace came under this umbrella.

Ora had originally selected people with technological expertise for the space committee, as they had the knowledge necessary to update the computers. As the committee evolved into a makerspace committee, individuals who represented interests in crafts and art were brought in. Ora invited individuals based on her assessment of their potential interest, as well as their expressed interest, solicited through a survey. Beyond the committee, some residents supported the makerspace initiative through donations (jewelry supplies, fabric) or expertise (e.g., the wife of a committee member contributed her assessment of what needed to be purchased related to sewing). Tara, a staff member, played a central role on the committee which included but extended beyond representing committee interests to management. Her fit on the committee came from one of her main jobs at the community, which was supporting wellness. A second staff member, who provided resident technical support, was also a part of the committee. The committee met monthly and was involved in decision-making around many aspects of the makerspace, including the name.

Ora welcomed us to these committee meetings, and for the most part, our research team played an observing role, attending meetings and interviewing individual residents. Two efforts to understand preferences of the community included us more directly: we provided assistance in tabulating a survey that was offered to all residents and sent the PDF of results to the committee, and we also led a focus group and reported a brief summary back to the committee.

4.2 The Indeterminate Openness Of A Makerspace

Ora intentionally left the determination of exactly what would go on inside of the Nestern makerspace open, so that it could be most interesting and useful for residents. As the makerspace formation process went along, the committee worked to find out what was interesting to people and plan machine purchases and support needs accordingly. These efforts were often simultaneously attempts to garner interest in the space. Ora and Tara hosted a series of demo-type sessions where residents were exposed to the concept of a makerspace and the equipment within. For example, Tara organized a three-hour long card making activity to demonstrate the programmable cutting machine (Cricut [64]) to a large group. She walked individual residents through how to use a button maker. Other sessions brought in external parties, such as a two-hour long 3D printing demo by a local library's technology truck. In some cases, the efforts of the committee to understand resident preferences led to the identification of areas that appeared to be of great interest, such as jewelry making and sewing (sewing was well received as it met the needs of those with restricted apartment space).

For Ora, what was to go on inside the makerspace was fluid and emerged in response to community interest. A virtual reality demo had received popular interest – the following is an excerpt from our interview:

> Researcher: Going back to the VR for a second. Do you see that as being a [makerspace] thing, the VR, then?
>
> Ora: Not especially, but I don't care.
>
> Researcher: You don't care?
>
> Ora: I don't really care what's in this room as long as it brings together people to do things that are interesting to them. That's the part I'm still waiting to find out, is what would be interesting to people.

Along with the committee, we learned about the ways that residents tried to envision how they might use the makerspace. Activities that were seen as exciting spanned many areas, from opportunities for more social connection to making useful items such as Christmas cards. Learning was a major draw, for its own merit and also as a way to distract from what some residents perceived to be negative aspects associated with aging. In particular, learning new technology-related skills was appealing, with R7 stating her main interest in the makerspace as a way to learn about coding.

But even as some described potential benefits that they could envision, there was a distinct sense of uncertainty about what could be in the space aside from what was shown in demos (where 3D printing and button making in particular captured people's attention). This made it difficult for the committee and for us as researchers to gather individuals' preferences for the space. The focus group, intended to gather these interests, was mostly spent on residents asking what a makerspace was for. This emerged in interviews as well. When we asked R7 what she would be interested in aside from coding, she said "that's why I'm not that keen on it, because I don't know enough to imagine something." When asked what classes he would like to take in the makerspace, R9 said, "I can't think of a thing."

For some residents, however, the very openness and indeterminateness of the space that made imagining its contents difficult was seen as exciting. During the focus group, R3 explained that she was drawn to the makerspace because "I'm curious. Still curious at my age. So, curiosity is one of the things that I like about this makerspace, to learn about it." This openness was similarly appealing for committee members such as Xena, who described the excitement of the early stages on the committee: "we're all learning and throwing out ideas, and talking back and forth about what might go and what might not go." Nadia was drawn to serving on the committee because the new, forming space contrasted so sharply with many other activities that, "I won't say set in stone, but were well established when I got here."

However, this touted unconstrained openness of a makerspace had limits when it came to what ideas were picked up and moved forward, and often, what ideas were offered as possibilities. Specifically, most activities voiced as options had to do with technology or arts/crafts. Though some of these seemed tailored to the community (such as requesting the teaching of basic technology skills), activities generally fell into those traditionally viewed as belonging to a makerspace. We saw how some interests were seen as outside

of the makerspace purview in our interviews with Nadia, who had tried to get other people interested in the makerspace despite not seeing any benefits for herself, and eventually left the committee when she felt she had served her part. In our first interview, she said, "I'm more of a head worker than a hand worker... the idea of science, and space, and all these things that are coming at us are just outside of my interest. Give me a good book." When we discussed other things she was interested in after she had left the committee, she spoke of presentations from residents who had lived historically impressive lives and visiting academics, as well as civic engagement (writing letters, organizing trips to the city council). When we asked, she acknowledged that these activities "could be" part of a makerspace – but did not take it further than that acknowledgement.

The invisible constraints of a makerspace came up even when it came to technology. 3D printers and other makerspace machines are often described as having endless application, from printing guns to prosthetics (both of which were brought up by residents). But when a man asked in detail about making his own shoes on a 3D printer at a community-wide information session, this was brought up later as a sign of someone who did not quite understand what was possible within a makerspace. Another resident had asked about self-publishing books in both the information session and our focus group. Even though writing represented a common interest at Nestern, nobody in the committee brought up self-publishing in committee meetings as an activity to plan for, and we did not include it in the summary of the focus group that we gave to the committee (that we had inadvertently seen it as out of the bounds of a makerspace became clear only at later stages of our data analysis process).

Makerspaces are often described as entirely open and forming based on member interests, and Ora's intention was to cater the makerspace to the interests of people living in Nestern. Yet the above anecdotes show how people come in to discussions of makerspaces with an inability to imagine or a narrowed set of possibilities. It is likely that the demos and ways the makerspace was framed had to do with this, but also from research residents conducted in their own time. R7 told us that she had looked up makerspaces after we had sent her a recruitment email to participate in an interview. She shared that in her search, she learned that one of the local makerspaces, "had a class in coding for teenage girls. Coding is something that I'm very interested in." Individual interests in the makerspace are shaped in part by what have already been framed as makerspace activities.

4.3 People Here Fear Technology, But We Can Change That!

As described above, some residents envisioned benefits to themselves from using the technology in the makerspace, such as learning to code. Even more frequent than envisioning technology-related benefits for themselves was envisioning these benefits for others. Participants told us that many Nestern residents feared or were disinterested in technology. Anecdotes were shared of eyes rolling at cellphone use at dinner. Multiple informants mentioned the phenomenon of adult children gifting their parents at Nestern technologies, such as iPads, that were swiftly abandoned. The makerspace represented an opportunity to combat this perceived anti-technology sentiment. Xena said the makerspace could result in, "them maybe learning how important technology is. . . and maybe they would take their iPad back... I am hoping that sort of thing will happen, that eyes will be opened."

In interviews, residents saw technology as a promising avenue to engagement and connection for others at Nestern. R9 said that technology, "opens up a new world for you." She explained, "I've got a couple of friends who refuse [to use technology]. . . they could reach out and do other things, and find out about other things, if they would learn computers and learn to be down there (in the makerspace)." Nadia explained how the makerspace represented a community-wide effort that could help people stay on top of technology changes: "I think it's consciousness raising about technology because the changes come so thick and fast." Being more in touch with technology could help residents "be more in tune with the rest of the world" [R7].

Even as technology came up again and again as something Nestern residents needed to be pushed towards, there was a recognition that care needed to be taken given the perceived disinterest. As a result, less technological approaches were seen as useful for generating initial interest in the makerspace. Ora explained that they were featuring the button maker because, "it doesn't require a computer... when they saw the Cricut (programmable cutting machine), what they said is, 'Oh, you have to use the computer."'

The addition of more craft activities, such as knitting, seemed to have increased interest for some. Christopher discussed how he went through a shift in terms of seeing far more potential in the makerspace than he had originally. This shift occurred in part from seeing residents express interest, such as in using the Cricut for scrapbooking purposes. He brought up jewelry making as a particularly compelling activity for residents, saying: "A lot of people have shown interest in that. That's not anything technical. That's strictly going to be physically."

Another strategy was devised to balance the advantages of newer technology with the ways that it repelled some individuals. R9 was not on the committee but was assisting with the selection of the materials needed for sewing in the space. She shared that they had decided to purchase a self-threading machine, which provided a clever way to accommodate the dexterity and vision changes that many residents experienced that had made threading a needle possible "only for people with good eyes." However, all of the self-threading machines came with more advanced features, such as screens with computer-controlled settings. She noted that,

> I don't think if you wanted to come down and repair clothing you would want to learn this new computer-controlled sewing machine. Because I would say over half the people here are not computer literate and they are a little bit afraid of computers and touch screens and that kind of thing.

The approach she and the committee came up with was to purchase two self-threading machines. One machine would be for individuals who felt more comfortable with technology. For the other, "we found one that's just slightly high tech, and we thought that we could put a sign on it that says, 'leave on straight stitch, if you want anything fancy move on to the next sewing machine."'

In doing so, the appearance of technological complexity of the machine could be reduced.

4.4 Determining the Judiciousness Of Resource Allocations

Despite the enthusiasm and efforts of Ora, Tara, and the committee, skeptical or negative reactions to the concept of a makerspace arose across Nestern – including on the committee itself. A major component of this resistance could be attributed to how residents lived in a space where they did not have control over much resource allocation. Several residents brought up management expenditures that they had perceived as mismanaged, such as replacing a working audio system. The makerspace had a costly appearance to many residents. In the focus group, after people were shown a video of a makerspace to prompt conversation, an initial reaction was "That's a very expensive space, I would say." Nadia said "I don't use a computer, but I know they cost a lot." She shared that even though the information session listed expenses at $5000, "I think here it's going to be a lot higher and that worries me a little bit, because we try to be prudent with the money that we have. Every year the rates go up..." The makerspace initiative was compared to other needs that might deserve more priority, such as a new bus or roof. This question of the judicious use of resources was a source of frustration for staff member Tara, as it had been made clear to residents that the money was coming from the extra funds of the resident community. At the same time, she understood residents' frustrations at seeing rents rise.

Whether the cost of the space was acceptable to residents linked to whether it was seen as a judicious use of resources. R8 captured this sentiment with his initial impression of the makerspace, which was wondering, "Will there be a return in investment money?" Return on investment did not necessarily mean a large number of residents would use the space. R9 explained that success for an activity at Nestern was different than what she was used to before living there, and even having a couple people engaged was enough: "as you get to be our age, I think anything that gets you interested in getting up in the morning and getting out and going some place rather than staying in, I think they consider that a success."

Resistance existed not only around the allocation of financial resources, but also regarding the use of space, which is at a premium at Nestern. Residents expressed a sense of powerlessness at times when management made decisions about their space, and were invested in having space used in ways that met their needs. We heard of a decision management made to reallocate a social space to instead be a recreational exercise space, which churned up widespread resistance.

In considering what made a makerspace worth the resources invested, functionality or usefulness was brought up often. Certain components of the makerspace were seen as more functional than others, such as praising the idea of having computers, but questioning the utility of a 3D printer. When thinking of how she might use the space, R9 said she could imagine taking advantage of the sewing space to make draperies and pillows for people in the connected nursing home. Thinking about other activities at the community, including in a makerspace, she said: "I came here to serve, not to be served... I don't want to be entertained, I don't want a nice little life, I don't want to fill my days with stuff. If it's not meaningful and it doesn't serve somebody then it doesn't seem to have value for me" [R9].

Others expressed similar sentiments in terms of thinking of some activities a makerspace might have as frivolous, and others as useful and important. This response emerged in reaction to Ora and Tara's approach of showing people possibilities by bringing in things that had been made in other makerspaces. Tara shared one experience where:

> I brought in some figurines from the [nearby] library, from the 3D printer. . .I showed one resident. . . a ballerina bookmark that I made. And I said, "See, I made this and I'm excited because I'm going to a workshop today. . . with the bigger 3D printers..." And I told this resident this, she said, "Oh, so you can make a bigger bookmark?"

Residents raised concerns about the utility of the objects that were presented as produced in a makerspace. R10 had attended a demo session where when residents asked what could be done with the 3D printer, the presenters said "Buttons." She recounted the exchange that followed: "So the ladies here say, 'Yeah? So what am I going to do with buttons?' Then they (the presenters) said, 'Well, we can make all kinds of little things."' In response to this notion, R10 said, "I'm still getting rid of stuff, you know?" In the focus group, one participant saw the makerspace as a way for young people to learn the skills "that we would have done by hand. . . they've put [them] on a computer setting." While she saw benefits to learning basic technology skills for her generation, she did not see utility to making technologies, as she had already taken "home-ec[onomics]": "It's an arts and crafts situation, is what it is, really, basically. And that's moved it up into their (younger people's) level of functioning, which is more the computer."

Utility was also linked to cost. Ora would sometimes wear her 3D printed earrings as examples of what could be made with 3D printers. But given cheap commercial manufacturing, the cost of machines was held against what could be made. Christopher said "You can make earrings or necklaces or whatever, but you could probably go to Walmart and buy them cheaper." He was drawn to the Cricut, on the other hand, because residents could use it to make personalized scrapbooks. The complexity of makerspace machines made the contrast stark: "Here's a 3D printer that I know it can do massive amounts of intricate things and whatever, but we're talking about (pin-on) buttons and earrings" [R7]. R7 explained, "I just thought that was a big expense for making jewelry." When asked what would be more appropriate uses for a 3D printer, R7 mentioned prosthetics and dentures.

Yet, this emphasis on utility was not shared by all residents, and some spoke of the satisfaction of creating something even if it could be purchased for a lower cost. R8 said that people who made comments about how something would be cheaper to buy at Walmart, "miss the whole point. . . The satisfaction of knowing that I made this... That's what the attitude should be about this space." He continued, "reasons like peace of mind, satisfaction. . . personal accomplishment. Those mean more to me than just ordinary stuff."

Some individuals saw no benefits in the space for themselves or other residents currently living at Nestern, but were open to

the idea because they saw it as a way to address the many open and unrented units which affected the overall financial health of the community. Across our data, individuals raised the idea that regardless of whether they or other existing residents would use the space or not, the makerspace could be a marketing tool to draw in new residents. A participant in the focus group described the people currently wanting to move into independent living communities as "younger and a little bit more affiliated with the world as it is now." Nadia said this younger generation of older adults "may be looking for things like makerspace and we want to be ready when they do." Tara contextualized this with a trend in independent living communities, where "five years ago it was does your community have wifi and common areas.' And now it's 'what speed is it?"'

Finally, management seemed to see a benefit of this space in terms of fundraising (some Nestern programs relied on donations) and making a name for the community. Ora explained Nestern management was dedicated to being leaders in technology, and the makerspace was seen as one initiative to demonstrate this tech forwardness. The development team tasked staff member Tara with creating decorations for their gala. Tara said, "they want to be able to say, 'look at this cool new cutting-edge thing that we're doing."' Nadia shared this view: "somebody might invent something that would actually be a success, and it would go out to the wider world and that would recommend Nestern.".

As described above, envisioned benefits varied widely. Across the considerations of whether the makerspace was an appropriate use of resources, even when asked about their own envisioned use, individuals considered the return on investment for their community.

5 DISCUSSION

Over eight months, we interviewed and observed Nestern community members during the formation of a makerspace in their independent living community. Participants grappled with notions of makerspaces that were too wide or too narrow, as well as how to create an inclusive space where all residents, even those perceived as technophobes, would feel comfortable creating. Individuals debated and justified the expense and space resources taken to initiate a makerspace, prioritizing a return on investment for their community (though varying on what was considered a suitable return on investment). Here, we reflect on these findings by discussing technology adoption by older adults, the ways in which standard visions of making draw in or break down for different older adults, and what a community means in the context of a makerspace.

5.1 Technology Adoption

In studying the planning stages of a makerspace, we observed older adults' motivations, challenges, and concerns while moving through the adoption process of a new technology environment. Our analysis yields several considerations for early technology adoption by older adults.

Different Adoption Points Our work provides some ways that older adults uninterested in high tech options can still be introduced to technologies and tools that they may find useful. Our recommendations align with Carucci and Toyama's work stressing the need for low tech tools (e.g., jewelry making) as well as high tech (e.g., 3D printing) [13]. We offer two additional considerations to support adoption. First, researchers can recognize that there are different entry points or "on ramps" to a makerspace – in our study these included button makers, sewing machines, and basic technology courses. Scrapbooking, card making, and jewelry making were seen as especially appealing – centering crafts may be a way of reaching this population (as in past work with older adults [32] and other groups [10, 45]).

A second consideration is that for some individuals, reducing technological complexity is key to keep useful technologies accessible. Revisiting the sewing machine purchases, the self-threading capabilities of newer machines were optimal for accessibility, but posed the risk of alienating individuals who were not interested in the touchscreen interaction the system required. The subsequent decision to purchase two self-threading machines, placing a sign on one to prevent changing settings, was a way the community was able to allow for high and low-tech use while retaining the benefits (in this case, physical and visual accessibility) of a new technology. Researchers can explore similar approaches, including bringing features to operate machines such as the Cricut off of a screen (e.g., via digital pen/paper).

Motivations for Technology Adoption The literature highlights that older adults are motivated to adopt technologies that are beneficial to them [15, 40, 56] – in some cases, a lack of adoption is as simple as a technology not meeting any needs of the intended recipient. Our study provides several dimensions of usefulness which may be illuminating for future research investigating technology provision and adoptions for older adults. First, *space constraints* tied to evaluations of benefit, both in terms of whether a makerspace was the best use for a room, but also whether the technology environment could allow residents to engage in activities that they were interested in but could not participate in due to the constraints of their personal living spaces (e.g., a large table to cut cloth). In a community with large apartments or for those with less space-imposing hobbies, usefulness would likely be evaluated differently. A second consideration is *the benefiting audience*. For some, learning something new was seen as useful. Others only considered a makerspace beneficial if they could make something for close loved ones (e.g., holiday cards) or benefit others (e.g., making draperies for nursing home residents). This motivation may drive researchers to expand their view of older adults as the sole recipients of the benefits technologies bring. Finally, individuals had different assessments of the *value of handiwork*. Some saw things that they themselves made as inherently more valuable, while others did not see value when something could be purchased in less time for less money.

Even with the different notions of usefulness that we uncovered, there was considerable sensemaking that needed to take place for individuals to answer our questions, and it was often difficult to form and share perceptions about the makerspace. We link this to the indeterminate openness of maker technologies. The discourse of the makerspace is open – shaped around the interests of members [55, 63], providing the capability to create and customize nearly anything. Yet, to answer questions about their preferences for a makerspace, participants had to first form a sense of what a makerspace is or is not for. We see a parallel in user-centered design

research, where researchers often present a topic and ask individuals to ideate with few or no stated limits: this may be at odds with an environment where people can meaningfully state their preferences and researchers can take them in. A better path may be to first understand individuals' attitudes and experience with the topic of interest and then provide information and scaffolding to guide the participant through sharing their ideas within the bounds of the research and technical constraints of the project.

5.2 Complicating the Vision Of Makerspaces For All

Though above we provide ways that older adults can be embraced in a makerspace movement, here we contribute to a body of research that has raised issues with a utopian vision of the makerspace movement. Yet, with each of the points below, our data indicates that a solely critical pushback cannot account for many of the positions in our data. Thus, we share critical reflections on visions of making for older adults, but also show the limits of our own critiques.

First, researchers have noted ways that concepts in and presentations of makerspaces can be exclusionary [12, 23, 38]. In our work, we identify an additional dimension of makerspaces that may be exclusionary to some groups: youthfulness. This attribute emerged throughout our data, sometimes used synonymously with technology but also myriad other ways, such as a participant's view of a makerspace as home economics for a younger generation and how another searched online to find more information on makerspaces and learned about a coding program for girls, spurring her interest in coding in the makerspace. Yet, as the latter case hints, the solution is not as simple as removing all traces of youthfulness from a makerspace program for older adults: this attribute which repelled some was precisely the draw for others, who looked forward to opportunities including engaging in innovation, "keeping up with the world," and attracting younger older adults to Nestern.

Second, some individuals exhibited disinterest in the makerspace project that appears to be nearly inverse to the excitement that makerspaces carry in the media and public interest. In many research projects, and in the way that we frame points in section 5.1, this kind of disinterest is characterized as technophobia [21, 57]. Yet, there are cogent reasons for this disinterest that appear in our data, such as discussions of downsizing ("I'm still getting rid of stuff") or a thrift sensibility. These findings indicate that while makerspaces represent opportunities for creativity and a return to skilled production for some, this view should not be considered to be timeless, but rather, tethered to a particular time in history and likely more salient to certain generations. Instead of focusing on what disinterested older adults may lack (e.g., motivation, knowledge, ability), we can shift to questioning the charisma of certain technology initiatives and ask why so much excitement and funding has coalesced around makerspace projects [3]. And yet, we do not believe this critical examination and accounting of resident pushback means that the Nestern makerspace is as an inadvisable effort. Removing the political lens for a moment shows the makerspace comparable to other clubs and groups at this community, such as Tai Chi and religious groups, that exist and utilize resources even without benefiting each resident.

5.2.1 Probing the Concept of Community. Makerspaces are often described as tailored to the community [23, 37, 53]. Additionally, an emphasis on community is becoming increasingly relevant to studies of aging [17, 46]. In studying the formation of a makerspace by older adults, we identify three key questions for researchers:

Who is "the community"? Similar to past work, the makerspace formed with the intention of benefiting the community. Yet there is complexity to who participants believed constitutes this community. We highlight the imagined others who appear in our data as important figures to consider. One such figure is the "imagined, disinterested others". The disinterested others are technophobic and uninterested older adults. For these individuals, non-technical approaches are seen as the best route: technology must be obscured. This figure calls to mind an imagined other that appears frequently in research as a way that older adults distance themselves from interventions targeted towards the frail elderly ("not for me") [26, 43, 61]. Yet, rather than being seen as a more appropriate target for a technology, in this study, individuals were working to figure out how these imagined others might use the makerspace. The second group is the "imagined interested others," the younger generation that will move in to a tech-forward community. At times, personally appealing ideas were seen as an inappropriate resource use due to predicted disinterest from imagined others (and vice versa). Understanding that individuals may be speaking for others makes it key to unravel who is speaking for whom and to determine whether these imagined others indeed exist and have interests as predicted.

What gets counted as success for this community? Past work has noted the difficulty in measuring makerspace outcomes [53]. Here, we note the nuance to determining what a successful outcome even means for a makerspace. Unlike other populations, a space in which to tinker or learn from trial and error [4, 7] was not necessarily seen as an end goal. Beyond the conception of the makerspace as potentially supporting the health and wellness of the community [13, 58], different members of the community described success differently. And, residents had widely varying perceptions of what a successful return on investment would mean from each other and management. From these different valuations, we argue it is key to *consider the range of stakeholders to determine what success means for different subgroups.*

Who are the leaders of introducing new technologies or initiatives and how are they perceived? Ora spearheaded the makerspace initiative at Nestern, recruiting older adults to serve on a committee and make key decisions. Although the process that we describe is older-adult driven, staff and management played a key role, for example, making the final decision on space allocation. Having a staff member in the committee helped with some aspects, such as hosting demos, but was sometimes viewed with light skepticism or even resistance when residents described management decisions with which they disagreed. It is key to understand the histories of the community we study, and to *consider the decision-makers and how they are perceived.* If management had total control over the process, both the makerspace and reactions to it would likely look very different. Uncovering the skepticism that arose at times in reaction to management may explain past work which identifies the importance of community champions in makerspaces

[23] and of older adults teaching others skills in their communities [24, 62].

Not all studies have the resources to answer the questions we pose above through an ethnographic approach. In these cases, we recommend devising study protocols that cast a wide enough net to attend to these dynamics, carefully attending to discussions of past initiatives and attitudes towards others' attitudes towards technology, and soliciting perspectives by asking research questions such as "Who do you think will use this space?" Although one practice (that we have done many times) is to simply come into a community space and proceed with a research project on aging, it is key to spend some time in advance understanding a community's history and some of the politics around resource allocation. As is made clear in work by Harrington et al. [28], histories and context matter, and the approach of limitless possibilities that designers may bring into their projects is not always sensible. In community living spaces such as Nestern, deciding to adopt a technology may mean to a resident that another initiative – a bus, a new roof – may be compromised, or that rents will go up to compensate. Individuals, sensibly, may want to see a path to a return on investment before committing valuable space, money, or time to a new technology.

6 CONCLUSION

Our study of Nestern highlights the sensemaking and complex decision-making processes involved in forming a community-based makerspace by older adults – a group often neglected in visions of making [13, 32, 51]. Whereas past work has investigated how people with technical backgrounds create a community around well-defined makerspaces, we found tensions that arose as older adults attempted to define a makerspace that is welcoming to the needs and interests of the community while grappling with concerns around resource allocation. As the HCI community develops tools to engage older adults in making, we argue that an understanding of community histories, politics, and the diversity of perspectives within is key.

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