Makers and Quilters: Investigating Opportunities for Improving Gender-Imbalanced Maker Groups

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Recent efforts to diversify participation in STEM (Science, Technology, Engineering & Math) activities through informal learning environments, such as hackathons and makerspaces, confirm a real desire for inclusion among potential female participants. However, understanding factors that may contribute to longer-term, sustainable diversification of such groups remains a challenge. In this paper, we present the results of a mixed-methods study of two microcosms of making: game development, and quilting. Our findings reveal parallel structures within these groups despite being highly skewed towards male or female participation, respectively. Our results shed light on attitudes, behaviours, and experiences indicating that similar desires for wider community support among other factors exist in both groups, but these needs are not satisfied in the STEM context. We conclude by discussing the implications of our findings as opportunities for rethinking how we design the environments that are meant to support design itself, considering the role of technology in these spaces, and prioritizing nurturing the development of the maker *community* beyond the maker *space*.

CCS Concepts: • **Human-centered computing → Human computer interaction (HCI)**; *Collaborative and social computing*; • **Social and professional topics** → *Gender*; Informal education;

Additional Key Words and Phrases: Making; craft; quilting; game development; game jams; gender; feminism; thematic analysis; makerspaces

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1 INTRODUCTION

In his essay *Hackers and Painters* [23], Y-Combinator co-founder Paul Graham positioned an alternative take on making when he asked: "Because hackers are makers rather than scientists, the right place to look for metaphors is not in the sciences, but among other kinds of makers. What else can painting teach us about hacking?" In our work, we retain this spirit of investigating the metaphor, moving on from *Hackers and Painters* to *Makers and Quilters* in order to contribute to the growing research on making in human-computer interaction (HCI). While it is widely accepted that human-computer interaction is a discipline that incorporates research from an abundance of fields, including design, psychology, and computer science, at the heart of the field is the concern for the design of technology and the creation of novel interfaces and interaction techniques. As a result, many HCI labs incorporate a mentality of "making" and frequently house the latest equipment (e.g., "fab labs") and encourage the creation of novel interactive technology, games, interfaces, *et cetera*. Thus, not surprisingly, there has been a recent surge in interest in HCI in game jams [10, 16, 29],

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makerspaces [30, 49] and crafting [20, 38], for their potential for informal learning about issues concerning design, coding and material assembly.

While the focus of "making" is often on the creation of technology for the individual (e.g., games, applications, physical devices, etc.), the communities surrounding the practice are inherently collaborative. As a result, there is a great opportunity to leverage the vast CSCW literature and knowledge to design tools to be used in this practice. However, these emerging spaces where makers gather tend to be predominantly attractive to male participants [58] and afford opportunities to reaffirm masculine stereotypes [19]. Thus, in designing these systems, we must consider the need to encourage female and gender-expansive participation in these events and "making" more broadly. Rosner et al. [50] report that 40% of women come to technology innovation spaces from a background in arts and crafts, rather than engineering. We should, therefore, be inclined to investigate whether familiar community practices from maker groups considered to be in the "arts and crafts" space contribute to a more familiar, and thus more comfortable atmosphere for women who want to explore their identities and build their confidence as makers in a technological context.

More equitable participation not only functions to support growth and long-term attitudes towards involvement in making [12], but can also mitigate the risk of designing technology that excludes the perspectives and experiences of women [64]. The "pipeline theory" describes the trajectory women take from education to a career path, and highlights the 'leaks' along the way—attrition occurs from entry- to mid- and senior- or executive-levels of careers in technology [13, 17]. Maker groups offer an early opportunity to foster an interest and intent to pursue careers in designing technology [18], and because they are still emerging, we can benefit from an understanding of what interventions can support self-determination to foster longer-term engagement, and to potentially engender more inclusive design from such groups.

In our work, in an effort to understand how to potentially diversify such events and to discover opportunities to improve the design of technology used in these spaces, we compare the microcosms of game jams with quilting bees, which are predominantly coded female[1] [26]. We conducted an exploratory mixed-methods study investigating the motivations game jammers and quilters had, respectively, to engage in their events. Over our observations of 334 makers across 7 events, we were specifically interested in the personal values participants assigned to their respective events, how they conceptualized community, and their overall experiences around inclusion and exclusion. In addressing these questions, we provide further insights into how informal learning environments (ILEs) can better cater to more diverse audiences through creating a space where the needs for learning and shared community are equally met.

The contributions of this work are twofold. First, we provide an understanding of both male-dominated and female-dominated groups of makers—their complex relationships, their aspirations, and how they navigate the space afforded to pursue them. Specifically, we identify that, while both jammers and quilters are highly motivated, the nature of support for feelings of autonomy, competence, and relatedness vary drastically between the groups. Second, we discuss opportunities for the design of these events, the design of tools used at such events, and the design of spaces for maker groups more generally. These opportunities build on our findings and provide suggestions for how to foster feelings of self-determination for the purpose of increasing women's participation in the "making" thought to be inherent in the practice of HCI, as well as the digital and CSCW tools used both at the events and in the making community more broadly.

[1]While the paper largely refers to gender as a binary as per self-report of our participants, the authors acknowledge that the spectrum is much broader than might be apparent in our writing.

2 RELATED WORK

In this section, we contextualize recent discourse surrounding maker groups and their perceived benefits. We follow by describing relevant research into the nature of game jams, followed by a discussion of known gender issues in maker groups. We then situate the quilting environment as a maker group, and discuss how the study of craft and game development groups can advance our understanding of what benefits maker groups can potentially offer to a wider set of participants.

In much of the work surveyed, we found that the terms "makerspace", "maker group", and "maker community" were often used without clarification regarding whether the vocabulary was a deliberate choice on the part of the researchers, risking the unintentional conflation of concepts that might otherwise be delineated. Maxigas [36] offers a discussion of the "historical and ideological geneaology" of hacklabs and hackerspaces in an attempt not to lose their distinctive underpinnings to time. The author distinguishes between hacklabs and hackerspaces on notes of, for example, sociocultural attributes such as their attitudes toward accessibility. The focus of this particular study is on *groups* of makers practicing their craft in various spaces. No formally-designated "makerspaces" were observed during this study. Rather, groups of makers assembling in different locations who identified as makers per Toombs et al. [61] and their work on forging maker identities. To this end, we believe that a space is what one makes of it, that is, a space is but a space if not for the presence of makers. We therefore strive to use "maker groups" throughout our work in an attempt to transcend some of the physical constraints imposed by "makerspace", although at times, particularly in reviewing the Related Work, "makerspaces" may be used as a reflection of the previous research on which we build.

Makerspaces. Makerspaces have been popping up around the globe, touted in utopian terms for their ability to democratize technology production, while enabling marginalized groups to participate in innovation [33]. These spaces can be defined as the environments in which "makers" come together to collaborate and learn as they create, invent, and share experiences [30]. Hackerspaces, makerspaces, game jams, and hackathons are all examples of *informal learning environments (ILEs)* [18], which provide contextualized, motivating spaces that facilitate personal meaning. Incorporating making into educational contexts supports the growth and long-term attitudes of students towards science and STEM in general [12, 37, 44, 51, 53]. Therefore, there is increasing support in the public domain for the appropriation of these formats in places like schools, libraries, cities, and museums as "new" approaches to engaging communities [16, 18, 31, 46]. Prior work (e.g., [19]) shows instances of closed maker groups facilitating an environment to explore safely and build makers' confidence, as in the case of women-only hackerspaces. However, a common constraint of the aforementioned sites such as schools, universities, art galleries, and community centres is that, as recipients of public funding, they can *not* be exclusive in the same way as private entities. How, then, might such institutions extend the benefits of making in a manner that is accessible to many? This distinction informed our approach to selecting the contexts explored in this work.

Game Jams. Game jams are energized, fast-paced get-togethers of developers and artists to make digital games. These events have emerged as a way to generate and inspire novel game ideas and new ways of thinking [10]. Recent efforts show that while gaming is no longer necessarily a boys' "club house" [53], the continuation of overt discriminatory actions or frequent microaggressions [45] demonstrate a pervasive gendered tint to what community members perceive as being "a maker" or "a gamer" [15]. Game jams can provide benefits that have "intrinsic value" such as making new friends, business partnerships, portfolio pieces, development practice, skill acquisition, and improved confidence in personal abilities [55]. Early positive experiences in gaming environments have been shown by Shaer et al. [53] to relate to higher intention or ideas of continuing in that

field in the future among women. Game jams, as makerspaces and sites of informal learning, can therefore assist with establishing positive self-identity in a field currently suffering from severe lack of diversity in the workforce [43].

Gender Issues in Maker Groups. These ILEs are currently disproportionately attended by men [58]. In their work on gender and hackerspaces, Fox et al. [21] discuss how in practice, hacking practices afford opportunities to reaffirm masculine imagery and identities. Game jams, along with hackathons and makerspaces are becoming "gendered spaces", wherein "the social identities that people create for themselves [...] are cultures made by and for men" [42, p.671]. Furthermore, research on ambient belonging cues demonstrates the negative gendered impact of stereotypical elements being built into an environment on women's participation in computer science [11]. In general, ILEs provide an entrypoint into STEM, but can also be the place where these ambient belonging cues are internalized and a person decides that there is no place for them in this domain in the future [11].

Quilting as Maker Groups. Quilting, because of its association with family and needlework, has in the past been associated secondary status in the production/reproduction hierarchy [26]. Manual labour and feminized craft expertise has traditionally been depicted as menial and less valuable than the masculine, presumably more "sophisticated" cognitive labour of engineering [50]. However, contemporary sociological and cultural studies tend towards an understanding of quilting as an art form, acknowledging how past characterizations of women's art as domestic or quotidian have worked to dismiss its importance in larger conversations about what is and is not considered to be "serious art" [26]. Studies of quilters relate their making activities to feelings of wellbeing, through experiencing flow, satisfaction, mastery, confidence, community, and relationships [9], similar to the overall benefits reported above with respect to making.

Rosner et al. [50] highlight that the worlds of handwork and computing, "or weaving and space travel" (in reference to assembling *core memory*, an information storage method which was woven by hand and used in early NASA projects), are not as separate as once thought. Specifically, the authors focus on the "gendered forms of handwork underlying digital production and their valuation as technical work." Other explorations into quilting in HCI literature involve research through creation [59], and education [56]. Fox et al. [19] focus on how activities within feminist hackerspaces contest and reframe what constitutes hacking and technology development. Despite the relationship between the crafting space and maker groups being surfaced, quilting itself has not been examined in this context.

2.1 Moving Forward

Supporting any creative culture, including making, "entails a serious commitment to understanding its culture, including its cultural contents and their means of production" [1]. For this reason, we took an ethnographic or participatory approach [40] where possible when gathering the data. We additionally set out to practice tenets of HCI feminist methodology, emphasizing empathetic relationships with research participants; co-construction of the research activities and goals; and self-disclosure of researchers' perspectives [53].

In their work, Fox et al. (e.g. [19, 21, 49]) contribute understanding of the qualities of workspaces that support the creative and professional pursuits of women. However, a main feature of the feminist hackerspaces studied was their gender-exclusivity. In the interest of extending the same benefits of participation that these women experienced to *public* venues which can not operate in the same manner due to policy limitations, we study two maker groups that display predominantly male and female participation, respectively, which advertise open participation policies: game jams, and quilting groups.

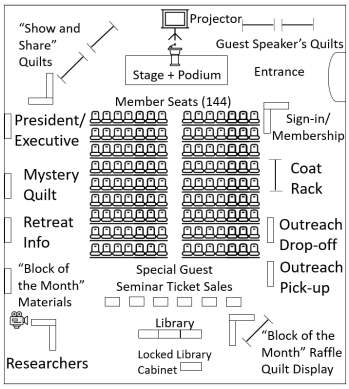
3 STUDY: GENDER-IMBALANCED MAKER GROUPS

Past work has identified that practices around hacking and maker groups are often masculine and tend to be male-dominated, and other work has explored providing female-exclusive spaces to counteract these stereotypes. Our work builds upon this research through an ethnographic approach that examines and contrasts existing female-dominated maker groups (quilters) with male-dominated maker groups (game-makers). Our goal was to develop a deeper understanding of the behaviour, experiences, and attitudes of participants in both groups to help inform the persistent problem of attracting and retaining women in STEM maker environments. We conducted this research through the lens of investigating opportunities for design: design of the events themselves, design of digital tools used at the events (e.g., tools for rapid game development, tools for quilting), and design of spaces for making groups more generally.

3.1 The Jam and the Bee

At first glance and for those unfamiliar with the format(s), quilting groups and game jams may seem unrelated. There is however significant overlap in the two practices, with a noticeable difference being whether they have predominantly female or male participation. A "Quilting Bee" was described by our participants as an ongoing tradition where quilters gather to cooperate on the completion of a quilt during a constrained period of time. Participants reported that "old-fashioned" bees had a goal-oriented focus, such as a community coming together to pitch in to finish a quilt as a gift for a new bride. The Mennonite quilters in our study adopted the term "bee" to apply to any activity that would be difficult to do by oneself, but would benefit the community as a whole: sheep-shearing bee, barn-raising bee, etc. However, in the quilting community at large, more modern twists on the bee format include features such as design challenges that introduce a requirement to include certain thematic or technical elements in the projects, such as the use of certain geometric forms, patterns, or colour palettes. The participants list elements of challenge, friendly competition, social cooperation, and creativity. Since quilting has historically been a feminized activity, quilting bees have offered a space for women to create together and to connect. Today, quilting communities remain strong, and offer numerous ways to engage in the craft along a spectrum between highly collaborative and solitary making conditions: mystery quilts, "block of the month" challenges, workshops, courses, tutorials, online quilt-a-longs, sew socials, quilting retreats, conferences, guild meetings, outreach activities, and, of course, bees.

The concept of the quilting bee and the community behind it struck a parallel with the game jam format and the groups that organize them, with the caveat invoked by the trope "every space is different" [62]: the comparisons drawn in this study are situated observations that may not reflect how other maker groups are structured. Game Jams and Quilting Bees share the same ideals as they both provide many with the opportunity to learn, challenge themselves, and explore their creativity. Although they are similar in that sense, they have striking gender imbalances (jams being male-dominated and bees being female-dominated). In the game jams studied here, participants were designated a theme to incorporate in to their designs, and completed their games over 48 hours. Some participants worked in teams, others alone. In speaking to organizers of the game jams and stakeholders of the local game development community, major concerns were raised around a number of areas: attrition of female attendees (at the first jam that we observed, 70% of female attendees left by the end of the event), a consistent inability to attract more female participants, and uncertainty around why they had been unable to create a sense of community buy-in or how to create a sustainable community of novices and experts, including both hobbyists and professionals going forward. Given the benefits associated with quilting [8] and those associated with making more generally (e.g., [39, 60]), we felt that a deeper understanding of both spaces could lead to



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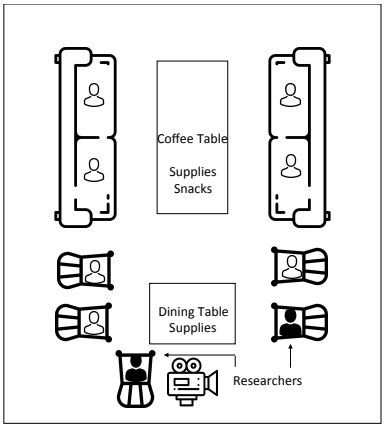

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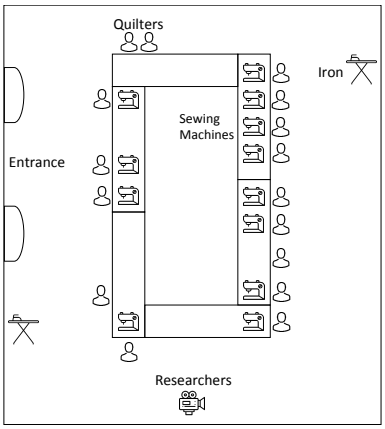

(e)

(f)

Fig. 1. Quilt Guild meeting overhead view (a) and photograph (b), Home-based quilting group configuration (c) and the members (d), Sew Social room layout (e) and participating quilters (f).

Table 1. Summary of Events and Participants in the Study

Group	*Event Attended*	*Attendees Observed*	*Gender*		*Group Labels*
			F	*M*	
Quilting	Home Quilting Group	7	7	0	QH
	Quilt Guild Meeting	144	144	0	QG
	Guild Sew Social	16	16	0	QS
	Mennonite Quilting Bee	12	12	0	QM
Total	*4 events*	*179*	*179*	*0*	
Games	Local Game Jam	91	25	66	GL
	Game Development Club Meeting	16	3	13	GC
	Global Game Jam	48	1	47	GG
Total	*3 events*	*155*	*29*	*126*	

opportunities for improving the design of the events themselves, the tools used for making, and the spaces used by maker groups more generally.

3.2 Methods

3.2.1 Overview. To investigate our research agenda, we took a qualitative, ethnographic approach, in total observing 334 makers across 7 different events; the breakdown of these events can be seen in Table 1. In September of 2017, we began observation and interviews at a local Game Jam event. These Game Jams are hosted three times per year on the local university campus, and are open to high school and post-secondary students, professionals, hobbyists, and anyone from the public with an interest in participating. We observed members' practices in their own environment over the 48-hour duration of the jam, and documented them through drawings, field notes, photographs, and video recording (Figure 2, Figure 3). Unless specified otherwise, it is this combination of documentation methods implied when referring to "observation" for the duration of this paper. We followed up on this fieldwork with interviews in the week following the jam with three participants. Following from this experience, we refined our approach. In November of 2017, we took the same steps of an initial investigation with a seven-member home-based quilting group (Figure 1d). These participants represented one of many ways that quilters self-organize, and through a group interview they provided an introduction to the domain of quilting as they see and experience it, as well as the complexity of the relationships formed around their shared passion for the activity.

3.2.2 Field Sites. Following the first game jam and quilting group, we visited other sites in order to ensure exposure to different approaches of quilting. Between January and May of 2018 we also observed a 2.5-hour Quilt Guild meeting (Figure 1b), a 9-hour Sew Social event hosted by the Guild (Figure 1f), and an all-day Quilting Bee among Mennonite participants. We interviewed 12 quilters across the two Guild events including the guild president. We modified our procedure taking into consideration the values of the Mennonite community (e.g., privacy and independence from the use of non labour-related technologies) and took a more informal approach to interviewing one organizer of the Bee and the Bee participants while they worked, focusing on note-taking and observation, with limited use of recording technology. We observed and recorded a Game Development Club meeting at the local university which took place directly before the Global Game Jam in January 2018, where participants met to find potential teammates, brainstorm ideas, and ask questions of more experienced *jammers* (the name given to game jam participants). Finally, we conducted our research at the 2018 Global Game Jam host site at a local university, where we

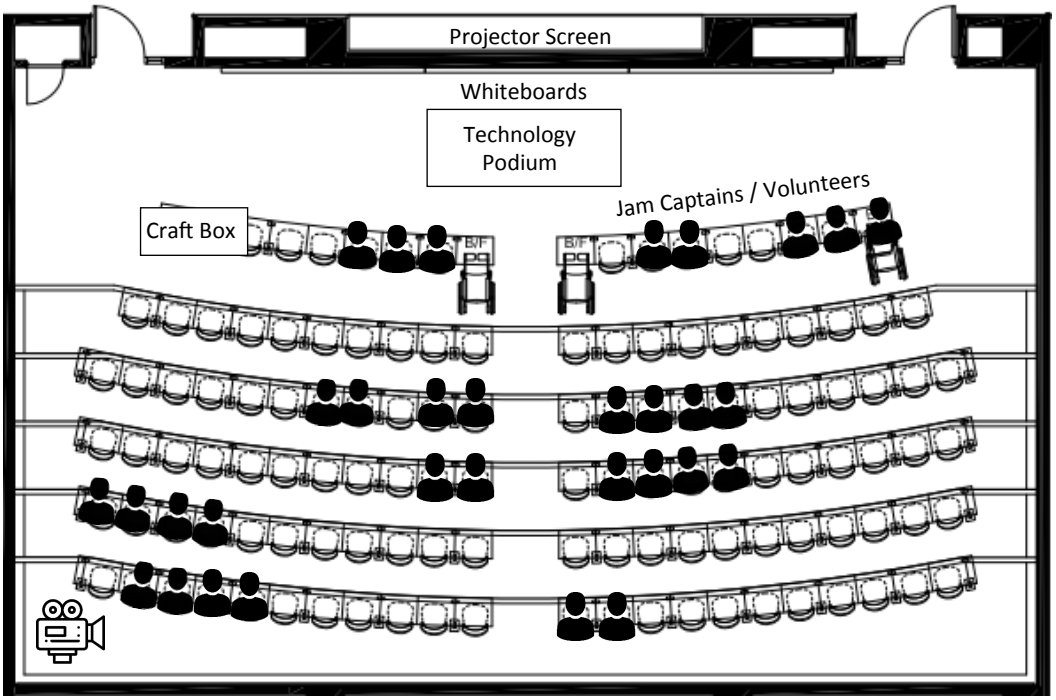

Fig. 2. Overhead impression of Game Jam location

continued our pattern of observations and conducted interviews with 10 attendees. Participants at all events had the opportunity to complete an Intrinsic Motivation Inventory questionnaire to complement the qualitative data collected. Table 1 shows the events visited and number of makers observed. In contrast to the definition of "makerspace" defined by Sleigh et al. [54] which rests on the availability of a workshop with tools or equipment provided by some source, we studied these groups of makers making use of what they had available: schools, community centres, and a small museum. Despite a lack of ownership, these constituted "both a community space and a space for communities" [63], a concept which will emerge concomitantly through our analysis.

3.2.3 Recruitment & Procedure. We recruited participants by contacting quilting guilds in the region through their publicly available websites. For the first game jam event, the first author was an event captain, which contributed insights to this work through personal experience and deeper involvement in the community. They therefore recused themselves from research commitments to prevent a conflict of interest at this particular event, and other authors conducted the research. For the second game jam, we contacted the organizers of the event for their consent to study the jam. In all cases, gatekeepers/organizers would decide whether we would be welcomed into the space. Gatekeepers would make participants aware of the researchers' presence and agenda before arriving, and upon arrival, and they were notified of how they could be exempt from photo or video recording, as well as how they could opt-in to interviews and surveys. Once on-site, we were able to introduce ourselves and explain our purposes, and be clear about the voluntary nature of the study. We embedded ourselves in the environment, having casual and non-intrusive discussions with participants throughout their activities. At a time that they felt comfortable, the participants

Fig. 3. Participants in action during a Game Jam

retrieved an Intrinsic Motivation Inventory (IMI) survey, and after completing it, participated in a 15-30 minute semi-structured interview in a private space away from the main group.

This research received clearance from the institutional ethics board, and participants that completed the interview and survey were compensated $10 for their time.

3.2.4 Participants. We conducted one group (7 people) and 25 individual interviews, for a total of 32 participants. Of these, 10 self-identified as male (all jammers) and 22 self-identified as female (3 jammers, 19 quilters). The participants ranged in age from 13 to 89 years old. Our sample, while not representative of the general population, is consistent with published representations of game jam participants [58] and quilters [34]. We made observations of all attendees at the quilting and game development events, summarized in Table 1.

3.2.5 Interview Structure. Interviews followed a semi-structured format. Following the pilot study, we found improved uptake and more vivid reflections on participants' experiences were provided when interviews were conducted at their convenience during the quilting or gaming event. Participants were asked about a range of topics: demographics (e.g., their educational and career background or trajectory, their history with the craft including when they started and why they joined this particular group or event, the typical context in which they engage in making); group relations (e.g., experiences and feelings toward collaboration, group dynamics, community or social structures such as tacit knowledge of social codes or expressions of social capital); reflections (e.g., perceptions of barriers, advice for newcomers); techniques (e.g., use of tools, problem solving); and

more. We thank Shaer et al. [53] for providing their instrument used in *Understanding Gaming Perceptions and Experiences in a Women's College Community*, which helped to inform the development of our interview questions.

3.2.6 Survey Instrument. The Intrinsic Motivation Inventory (IMI) [52] questionnaire was used in both the quilting and game development groups to assess attendees' subjective experiences and their motivations for participating in the activity. While completing the survey, participants use a seven-point Likert scale ranging from 1 (meaning "Not at all true") to 7 ("Very true") when evaluating whether each statement feels true to them.

The IMI instrument assesses participants on subscales of interest/enjoyment (IE), perceived competence (PCo), effort/importance (EI), value/usefulness (VU), felt pressure and tension (FPT), relatedness (R), and perceived choice (PCh) while performing an activity [14]. The interest/enjoyment subscale (IE) is most related to intrinsic motivation in itself [14], however, the other subscales are included as positive predictors for motivation (PCo, PCh), negative predictors (FPT), related concepts (EI), to understand whether participants are internalizing and becoming self-regulating with activities they find valuable for themselves (VU), and to understand situations involving interpersonal interactions and friendship formation (R).

Participants completed the survey ahead of their interviews, which prompted reflection on their personal experiences and motivations. We contextualize the use of this measure throughout our presentation of both our analysis and results.

3.2.7 Goals. The goals of our analysis, after identifying these male- and female-dominated maker communities, were to generate new insights through contrast and comparison of the group members' relationships with the activity, the space, and each other. With the game jam and the quilting bee serving as conceptual groundwork for both groups to come together, we aimed to capture behaviours, experiences, and attitudes of both sets of participants that could shed light from a different angle on the persistent problems faced in the STEM maker environment: in particular, the difficulty of attracting and retaining female participants, and whether this relates to any wider issues in organizational philosophy.

3.3 Data Analysis

In conducting our analysis, we analyzed the IMI questionnaire's reliability and responses using the IBM SPSS statistical analysis tool. For this data, we had a sample size of ten jammers and sixteen quilters. To analyze our interview data, we followed the Braun and Clarke [6] approach to Thematic Analysis when analyzing the semi-structured interviews. This method involved engaging with our data in six prescribed stages, briefly: (1) familiarization through immersion, (2) generation of initial codes, (3) developing candidate themes, (4) reviewing the patterns created by further refined themes, (5) defining and naming themes while beginning to develop sub-themes, and finally, (6) adding the context and evidence for the themes to cohere in a narrative illustration of the issues investigated.

4 RESULTS

In this section we present the results of our statistical questionnaire and thematic interview analyses. Limited availability of existing research on intrinsic motivation in maker groups [27] and game jams [29] show a focus on the motivations of the "typical" (male) participant in those spaces. We were not able to find any similar work describing needs-satisfaction in predominantly female maker groups, and thus we contribute an improved understanding of what both jammers and quilters seek to gain from their engagement. A meta-analysis of previous work in self-determination theory (SDT) in exercise behaviour [25] reports consistency across (binary) gender in how men and women value

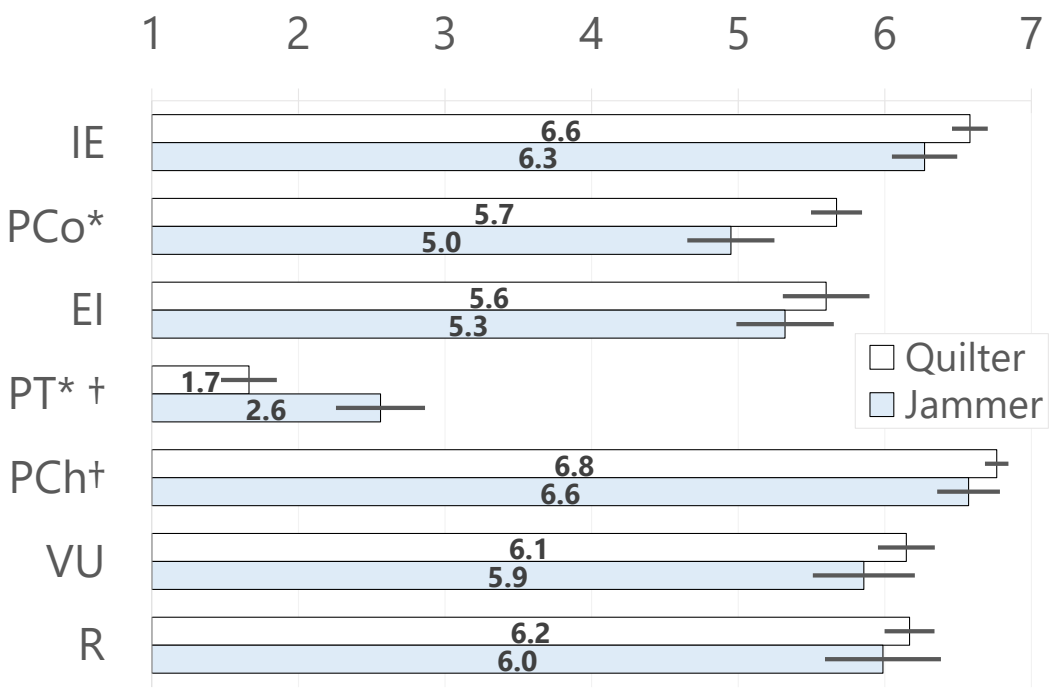

Fig. 4. Mean Responses per Jam and Quilt Groups across Intrinsic Motivation Inventory Subscales. $*$ = significant at $p < .05$, † = subscale unreliable for quilters ($\alpha < .70$), error bars represent standard error (SE).

the SDT constructs of autonomy, competence, and relatedness. However, through the qualitative aspect of our investigation into male- and female-dominated maker groups, our findings suggest differences both in the *ways* participants' diverse needs are being *expressed*, and how they are or are not being *met* in their respective contexts. As will be discussed, when these factors remain unchecked, they lead to gendered inequalities in who benefits from engagement in making and who is compelled to stay engaged.

4.1 Statistical Analyses

Tests for reliability using Cronbach's α confirm that the Intrinsic Motivation Inventory (IMI) questionnaire was reliable for game jammers across all subscales, and for quilters across all subscales except for Pressure/Tension and Perceived Choice. Levene's test confirmed homogeneity of variance for both groups across all subscales. Finally, an independent samples t-test compared the means on IMI subscales between the quilting and jamming groups. The Quilt and Game Jam groups were found to differ in their responses on the subscales for Perceived Competence ($t_{PC} = 2.2, p < .05$) and Pressure/Tension ($t_{PT} = -2.6, p < .05$). In these cases, the Jammers rated their Perceived Competence on average to be lower than the Quilters ($M_J = 5.0, M_Q = 5.7$), and rated higher Pressure/Tension ($M_J = 2.6, M_Q = 1.7$).

While we computed adequate reliability, our analysis revealed noise around specific questions and we do not consider the IMI results to be a major contributor to this study. Rather, it is supplementary information in the company of our much richer qualitative data. We share some insights and challenges faced while using the IMI in 4.1.1 and 5.2.

4.1.1 Context and Value of Excluded IMI Responses. Since the home-based quilting group was considered part of the pilot study, they completed the IMI surveys after the research team had left. When receiving the IMI surveys back from the group, we were made aware that they had completed and discussed it as a group, as they said they needed to explain the questions aloud to one partially blind participant with signs of dementia who found the wording "tricky" (and who was ultimately unable to complete the survey). We therefore excluded their responses from the overall analysis as all future participants were administered the IMI in a consistent manner, completing it individually. However, qualitatively, the group's responses tell a story reflective of what we came to realize throughout our time with them.

This group, shown in Figure 1d, was tightly bonded and, unlike the other groups visited, stated that they had decided membership was *closed* because they were too intimately connected, and it would be too strange to bring in someone new. The first members in the group had been there for 40 years, the newest member having joined 18 years ago. More than once, the women were brought to tears over how much their bond meant to them. They somewhat jokingly referred to their group as "Therapy Wednesdays", and described supporting each other through welcoming new babies, losing children, losing husbands, surviving cancer, and more. They "share a lot more than just quilting", and also noted that they firmly do not gossip outside of what is shared in the group, creating a safe space for everyone to know they will be supported: members said that they prioritize the group over doctor's appointments and all other commitments. Following the interview, they sent a note thanking us for the opportunity to pause and look back on their history together, since each week that they met they were usually occupied with catching up.

The IMI results show that with this group of older participants (aged $72 - 89$, $M = 79$), questions that required a reversal during analysis that had corresponding positively-worded questions elsewhere in the questionnaire created confusion. The IMI produced reliable results for Perceived Competence and Value/Usefulness for this group. Most notably, but perhaps not surprisingly, we were not able to compute any data regarding the Relatedness subscale for the IMI, because every participant gave the maximum score on each of these questions related to trust, closeness, and wishes to stay together in the future.

This environment, complete with tea and bundt cake, may seem a planet away from the harried atmosphere of a game jam, but these women were collaborating and making design choices to achieve one final product, describing steps and challenges along the way that we also heard from game jammers. However, their values, priorities, and relationship to the space made a world of difference on their way to achieving that shared goal. In the following sections, we will delve into these items in more detail.

4.2 Thematic Analysis

We analyzed our interview data using the Braun & Clarke [6] method. We collected Intrinsic Motivation Inventory responses as a means of determining whether the maker groups had comparable feelings while engaging in their activities, and with the intention to investigate whether survey data would corroborate what we heard from participants. We did not impose any groupings or labels while developing the themes. However, once themes had developed from the analysis and we moved into the final stage of contextualizing these results, a narrative emerged surrounding the personal and collective benefits associated with participating in the game jams and quilting groups. This narrative repeatedly returned to commentary on participants' satisfaction with respect to their autonomy, competence, and relatedness. We therefore use these components of self-determination theory [47] as a lens and as groupings for the presentation of the thematic analysis.

4.3 Relatedness

4.3.1 Contextualizing Relationships. Fox et al. [21] refer to a use of language among members of a feminist hackerspace describing a particularly prominent aspect of membership: being "companionable". In their research, the discourse of companionship came to both define and support feelings of *confidence* for members of that space. When quilters were asked what qualities or characteristics describe their group, their answers revolved around the same concept.

> We're friendly, we learn from each other, it's very social, you get good ideas, and it just creates a great environment for you to enjoy quilting. (QS3)

Despite the larger size of the quilting guild (200 members) compared to the at-home quilting group (7), participants still described a tight-knit connection to the group that extended beyond mere acquaintance.

> I would tell [a prospective member] it's great companionship and it's also a support group because whatever goes on in your life someone will be there and try to make it better. It's great support. (QS10)

The word "family" was used more than once to describe both the immediate group, and a feeling of belonging to a larger network: "There's a whole quilting family that's across the country" (QS7).

In contrast, one game jammer described the tentative nature of others in the room:

> Don't be afraid to be social, everyone's sitting in the room wanting someone to talk to and start a conversation. (GG1)

Other jammers described their uncertainty and hesitation around how to interact with other participants, navigating a tension between delivering feedback to achieve effective collaboration, but not wanting to risk damaging the relationship going forward:

> I wouldn't go full-on criticism because I don't really know [my teammates]. [My friend], I feel a little less bad critiquing just because, I don't know, we're a bit closer than the other guys. (GG1)

This does not mean however that the social environment of quilting was utopian compared to jamming. In fact, they also reported constraints imposed by how they felt they needed to act: holding in their opinions about design choices (one participant made everything purple, another said it reminded her of "the inside of a coffin"), and saying that they steer clear of political topics. They, too, share an awkward relationship with feedback or critique:

> Positive feedback is what most of us strive for. So we might... I can't say that we critique each other's work but we give each other positive feedback and what works and maybe possibly subtly what's not working if that's what the person wants but mostly we just encourage each other...I don't think anybody gives negative feedback. (QS3)

While the quilters were consistent to report unspoken social codes around the delivery of critique or feedback, the lack of a mutual understanding in the game development space inhibited both the ability to grow closer to one's teammates as well as satisfaction with the final product.

4.3.2 Balancing Social and Creative Needs. The ability to feel closer to one's companions in a maker group is moderated by how participants perceive of their own reasons for being there, and whether the events facilitate reaching their goals. Participants expressed what they felt were the implied goals of participating in the jam or bee: the quilting groups emphasized participation and effort to contribute over one's actual skill level, whereas the game jam was seen to have a focus on producing a final product, even though many members' personal goals ran counter to that—in both groups, members were highly interested in learning and developing their skills. As such, the

jam environment did not provide the appropriate context to support relatedness, even though both game jammers and quilters valued this similarly in their surveys.

The following quote illustrates just how important the game jam is as a creative outlet to this individual:

> It's really the only kind of art or creative thing I'm good at, so if I want to express myself artistically then game making is really the only thing that feels accessible to me. (GG7)

Later, in 4.4.1 and 4.4.3 we will hear more from this same participant about how they were not fully able to reach their goals due to the constraints that they placed on themselves after deciding that they did not feel adequately confident to join a team, instead sacrificing the opportunity for social relatedness by choosing to work alone.

The feminist hackerspaces studied by Fox et al. [21] had a closed membership process and thorough vetting for new members, in stark contrast to the openness of the quilting guild, which welcomed everyone with an interest in quilting within the limits of fire codes for their building (200 members). Both place high value on companionship over production or skill. When new members arrived, they accepted a Code of Conduct or set of bylaws that assured them of a shared set of community values. Game jammers recounted not being sure if they would be welcomed or accepted on account of their individual differences or their skill level, and the mere act of showing up was taking a leap of faith. One participant even promoted the idea of keeping communication within their own team in fear of appearing as though they would be "vulturing" ideas off of the other participants (GG2). Additionally, an obstacle to communication between participants concerning the use of space emerged. When asked how the Global Game Jam was different or similar to other events, one participant expressed a lack of mobility (see Figure 2):

> There's more space in the other game jams so we have more room to walk around... it's easier if you want to stand up and go, 'Hey, how's it going?' So it's not possible in this room so this is a big problem. (GG9)

A public maker group such as a game jam can improve upon the feelings of relatedness that form the foundations for community, by considering how they frame participation and success, and whether these framings are concomitant with the community's longer-term goal or vision.

4.4 Competence

4.4.1 Opportunities to Learn. The game jams and game development club that we observed marketed the jam as a time to "learn, make, and play." A majority of the jammers interviewed stated that they wanted to make use of the time to learn or improve their skills and techniques (for example, with Unity, Blender, or Node.JS). During game jams, though, existing skills need to be applied efficiently, so there is limited time for personal learning to occur. What can be observed instead is a gendered division of labour [48].

Even in the case of a female participant working alone, and therefore freed from the pressures of contributing to a team, she felt that ending the jam without a finished game would be a failure, and therefore did not pursue the new skills she was interested in learning:

> I've only ever made 2D games before, so I was thinking it would be interesting to make a 3D game in Unity and Blender. ... I got nervous and checked out of forming a team. So yeah, I just sort of made another 2D game that's in the style of what I usually make. I wouldn't say I picked up any new skills or anything. (GG7)

This jammer expressed an underlying goal of learning a new skill that was superseded by the fear of failure. This fear was still present even though the atmospheric nature of the jam was to learn over having a final product. This goal displacement may have been due to the perception of an absence of support that we found was afforded to the quilters, where the nature and variety of their events fostered a variety of opportunities to learn and try new things.

The quilting guild not only offered the groundwork for companionship similar to that found in the feminist hackerspaces, but also offered different formats for learning so that participants could have room for experimentation and failure: experiences which can dramatically affect women's feelings of self-efficacy when working with software [2, 7]. The guild provided venues including courses, workshops, retreats, sew socials, trips to quilt shows, a dedicated library, and invited speakers—in addition to the collaborative activities they engaged in that *do* have similar pressures to a jam, which prompted our initial desire to understand the contrasts between the maker groups.

At this stage in our analysis, the importance of an overarching organization involved in the administration of the maker groups began to emerge. The game jam format thwarts participants' feelings of competence, and does not offer alternative ways to engage with game development, which stands in the way of the organizers' desire to grow and sustain the local game development community by nurturing the seeds of potential in jammers. One possible explanation of the difference in organization and the ability to cater to the group's longer-term development is the relative maturity of the contexts studied. The game jam group is more experimental and fluid in how it self-organizes, and its high proportion of students leads to a rotation of membership, although it does have a mixture of life stages involved. The jam and Game Development Club are both sponsored by a research institute that has longer-term engagement, with graduate students, staff, faculty, and industry partners. The quilters are not working on any sort of terms, thus enjoying relative stability. We therefore recommend more diversity in the stakeholders to avoid the "student government problem," that is, a revolving door of membership causing instability and an inability to work consistently towards larger goals of inclusion.

4.4.2 Competitive Orientation of Makers. Despite an emphasis from organizers and volunteers to have fun and set personal milestones over aiming to have "the best" game, our data confirms that jammers still viewed the event as competitive, even if they themselves said they attended for other reasons, such as networking or learning:

> [I would tell a new jammer] don't aim for some award like first place. ... It's not really about getting the prize or something. (GG4)

Notably, prizes based on performance were never explicitly advertised as part of the event. Rather, during the kick-off, the tradition of giving out literal jars of jam as honourable mentions or recognitions on a spectrum of seriousness was announced to the whole group. This game jam was the above jammer's first time participating and it is interesting how he still came to the assumption it was a competitive environment despite all messaging to the contrary. On the other hand, veterans of the jam event were more aware that organizers would provide these randomly drawn prizes and 'joke' prizes that were determined during the event based on participants' efforts. For example, during the 2018 Global Game Jam with the theme *transmission*, the organizers bestowed a prize called "The Longest Transmission" to recognize a participant (GG9) who made a game through communicating via Skype with his teammates in Sweden and Germany. This had nothing to do with the game, but rather the team's tenacity, and to highlight this unusual collaboration.

While quilters were focused on their own projects, with one participant even asking about an IMI question since she did not compare herself to others, they still did report instances of feeling inadequate when seeing others' accomplishments (QG1). However, this participant acknowledged

that since they had access to so many opportunities to "find out what I'm good at" through the guild, they did not dwell on it or consider themselves inferior.

4.4.3 Performance Anxiety. Male and female jammers alike were frank about the role confidence in one's own abilities played in to their approach to the activity. On the one hand, we heard from a male jammer that "you have to be confident in what [you're] good at and be, idea-wise and design-wise, just flexible but you should generally know what you're good at" (GG1). On the other hand, a female jammer reported that "... the main thing is feeling like you don't have enough experience to participate, even though there [are] a lot of people who [don't] have experience with game development" (GG7).

All female jammers interviewed expressed that they only felt comfortable attending with someone they already knew:

> I always feel like since I don't code that well they might be like 'well you're a dead weight' or something. But I don't feel that way when I'm with [my partner]. (GL1)

One female jammer with advanced game development skills said:

> I sort of feel out of place a lot of the time ... [and] I worry about having that sort of feeling when I join a team with a bunch of people that I don't know. (GG7)

This anxiety contributed to thwarting the jammers' desires for improving their competence and feeling connected to the game development community. In contrast, a male jammer with no game development experience described a much different view of his prospects at his first-ever game jam:

> We're all very good ... we've all played enough and know enough and are going through engineering programs that are all about usability and user design, so we are all confident enough in that ability. (GG1)

Overall, our results showed that the perceived competence of jammers was significantly lower than that of the quilters when surveyed. This returns to the variety of opportunities afforded in both the quilting and feminist hackerspaces to explore one's own identity as a maker, which has positive effects on confidence [21].

4.5 Autonomy

4.5.1 Gender Stereotypes and Representation. One of our female participants (GL1) reported being mistaken for a game jam volunteer just because she presented as a woman, which she found discouraging. She problematized the fact that while many women were public faces of the game jam, the fact that they were organizing rather than participating reinforced technical skill biases.

A frequent joke among quilters was how it was their "expensive hobby" (QS7, QS4). More than one quilter referred to their equipment as "toys": at one point while explaining that sewing machines could cost anywhere into the thousands of dollars, a participant said "*these* are *girl* toys" (QH2), intentionally foregrounding and reversing the trope of housewives being expected to accept and move on when their husbands come home with expensive but unnecessary "toys" with which to perform masculinity. It emphasized that they felt just as entitled to spending on themselves, but this use of language, categorizing complex machinery—that is not easy to learn nor to operate—as a toy and therefore a frivolity, simultaneously downplays the stature of the art, and the significance of their work. In most cases, the quilters we observed not only quilted as a hobby but for the purpose of commission:

> All my quilts I post when I finish them. They all go on Facebook. That's how I've gotten so many more customers... people coming in and wanting me to commission them. (QS7)

In game jam groups, participants side-stepped questions of gender, one participant saying that he thought women would "definitely not" feel excluded, because "it's a pretty game-focused environment [so] there's not much polarizing about it" (GG2). Assumptions of gender-neutrality often obscure a bias towards default male preference [5, 64], and from what we heard from the female jam participants above, they had a different experience where gendered expectations hindered their feelings of autonomy.

While feminist hackerspaces are positioned as a material response to masculine technoculture [21], quilting groups express a material response to an oppressive social culture. Within the quilting group, participants surface and play with feminine stereotypes as a form of asserting control over their identities as makers and as individuals bound by commitments to their communities, jobs, and families. However, in the jamming group, burying such issues makes it much more difficult for them to be addressed.

4.5.2 Creating space. The spaces in which we observed making activities served to help or hinder participants' ability to achieve their goals. There was an aspect of fluidity and comfort with the quilting spaces (Figure 1) that contrasted with the rigidity of the jamming space (Figure 2). With the exception of the home-based quilting group, none of the groups observed had ownership over the space they occupied. However, the guild quilters intimately knew their stomping grounds in the local community centre: at the Sew Social, they warned which outlets were connected to which fuses, so that we knew where to set up our equipment so as to not interrupt power to their irons and sewing machines.

The sense of comfort with the space shown by the quilters allowed them to feel as though they belonged, whereas a lack of ambient belonging cues in the jam environment created uncertainty about who could be there and what they could do. As well as in feminist hackerspaces [21], environmental cues in the physical space affected feelings of autonomy. However, we saw as the guild moved between spaces that the higher concept of the community bound them together regardless of the venue that they occupied.

5 DISCUSSION

Through our analysis, we found that pleasures and pains experienced by makers in all the spaces studied were related at a higher level to the self-determination theory constructs of autonomy, competence, and relatedness. Participants in gaming and quilting environments displayed a variety of personal needs and desires that we envision on a spectrum: a common desire for relatedness, which can be achieved by working alone among a group, or by directly collaborating with others; wanting to learn and grow, from one's peers or by individual experimentation; and a genuine interest in the creative activity, whether they took pleasure from the process of making it or from the satisfaction of seeing the end result. In Toombs et al. [61] we were introduced to a rich set of values determined by a study of an all-male group of makers. Among these were the ideas of building confidence and adhocism. Given what is known regarding gendered differences in self-efficacy [2, 4] and tinkering behaviour [3], we felt it was important to corroborate those done with different demographics. There is no one-size-fits-all solution to designing conditions for successful diversification of a maker group, but we offer some initial thoughts based on the reported themes, separated into three higher-level shifts in thinking that could help maker groups move towards fulfilling a broader set of needs. Following this, we discuss opportunities for designers of maker tools and spaces (5.1).

5.0.1 Redefining Belonging. While quilters felt that true membership in the group came with continued participation as opposed to simply paying the membership fee, game jammers felt their involvement began and ended with the jam event. We provide evidence for the diversity in how relatedness is satisfied in different ways for different people, from working alone in the presence of others to directly collaborating with them. For organizers trying to create a lasting sense of community, we suggest evaluating how current events are both structured *and* perceived by participants, and whether they afford opportunities for participants with different needs to feel a sense of belonging to the group.

5.0.2 Reframing Failure. The game jams provide one way to fail: openly (unless people decided to leave to avoid this, leading to the very attrition we seek to reduce). This raises gendered issues in willingness to participate and to innovate. We argue that a confident community stems from feeling safe with various opportunities in venues to explore and to fail, and this is supported by investigations of groups like the Failure Club [49] which has been designed for women only. Our quilters laughed at and celebrated their unfinished projects, calling them "UFOs" (UnFinished Objects). As was discussed in 4.4.1, a maker's personal goals (e.g., learning a new tool) may be thwarted by what they perceive to be the objective of participating in the group (e.g., finishing a game in 48 hours). The game jams that we observed deliberately offered recognition via jam jars for achievements like taking risks, but we found that the predominant culture still conveyed an impression to participants that there was a competition to be won. As maker groups are important to learning and developing one's confidence as a maker, the reframing of failure is central to promoting more willingness to remain involved, even if things are not going as planned.

5.0.3 Renegotiating Space. As the gaming environment can display hostility to women [53], it can be tempting to redefine the bounds of the game jam. However, existing members are attached to them for a reason, and the existing communities must be respected, not displaced to accommodate another group [1]. Maker groups provide sites for members to negotiate their identities [12, 21, 61], and our evidence shows that a strong sense of community can help makers overcome limitations of the physical space as well. As was shown in our analyses, a desire to create underlined a high level of motivation among the participants. The space, over which they have less control, is the environment created collectively, based on the shared drive and attitudes of the participants.

5.1 Opportunities for Design

The presentation of our data has highlighted the rich experiences of individuals during the process of making throughout this study. To move forward, we discuss a number of design opportunities that could promote more satisfying experiences for participants in various maker groups by addressing the three facets of self-determination through design: specifically, how makers interface with their tools, with each other, and with the space.

5.1.1 Relatedness. There is a large opportunity to leverage the wealth of knowledge in the CSCW community regarding the use and adoption of collaborative tools, in order to support relatedness. In 4.4.1 we discussed opportunities for learning: in the quilting environment, learning from peers was a regularly expected experience, whereas in the game jam environment there were concerns about interrupting, as well as not knowing who to ask about what, and a hindrance caused by the physical space as well as the time constraint (4.5.2). To overcome this, game jammers took to the chat tool Discord to communicate with teammates and to put questions out into the void in the hopes that someone could help them. However, this creates an inequitable situation where more experienced jammers are unable to achieve *their* goals if they spend too much time teaching: a problem well-documented in the CSCW literature [24]. There is an opportunity to research the

nature of the communication *between* participants to understand where breakdowns occur, what reoccurring problems arise, and how tools could be designed better to facilitate activities of this nature.

Quilters reported a knowledge of implicit social codes (4.3.1), and previous work reports explicit social codes contributing to a stronger sense of shared community [21]. We therefore raise a need for wider adoption of Codes of Conduct, as they not only assist with overcoming the social tensions (4.3.1) reported over how, when, and whether to provide feedback or criticism, but can foster a baseline sense of community before makers even arrive at the group, through knowledge of a shared understanding of acceptable behaviour. While Codes of Conduct have increasingly been adopted in the HCI world, for example at its flagship conferences, it is not well understood at this stage what would constitute a healthy and productive code in the context of maker groups.

5.1.2 Autonomy. While performance anxiety was discussed in the context of feelings of competence (4.4.3), this was also a major barrier to women's autonomy as makers, as they reported a number of concerns about working with people with whom they have no prior relationship. For example:

> Part of the reason why I didn't join a team this time, there's a few reasons, but one of them is that I don't feel like I'd be a great teammate. Like I said, I'm very picky about how the final product turns out, so when I work on group projects it usually leads to me not liking how it's going, but I'm too anxious to say anything, or I kind of, like, start nitpicking about things and annoy everybody. (GG7)

The perceived emphasis on performance in the game jam lends to this unease, whereas quilters were more likely to show up to an event alone, because they knew they shared a common bond with everyone over the love of quilting. Besides de-emphasizing the performance angle, there is an opportunity to circumvent the temporal constraint of team-building in maker groups through design of matchmaking tools to help participants find others with complementary attributes in advance. Such advances have already begun in this community through explorations of algorithmic team formation [32], the effect of team-building activities and composition on outcomes [28], and how methods such as "team dating" can help determine if participants would like to work together for a longer period [35]. Further exploration in this area would additionally help to level the playing field between those who have pre-existing relationships with other makers, and those who are making the brave step to join on their own. The design of such a tool could draw on further empirical data gathered through this study about what characteristics or attributes makers deem as important to success—keeping in mind that success, throughout this work, has been shown to be a relative term.

Although we highlight the importance of collaborative and communication tools above (5.1.1), we recognize that the existing tensions between the demands of novices and the availability of experts can be exacerbated in such an environment. Novices may be acutely aware of this, and turn to lurking as a result of not feeling adequate enough to contribute, or not wanting to 'bother' others on the platform. Contrastingly, some makers may be loath to speak up in a shared collaborative tool, for fear of the lurkers laughing at them, inducing comment anxiety. Previous work in the CSCW space has elucidated a number of insights about the lurker [22, 41], which can be leveraged in the design of a tool that acknowledges these potential barriers and recognizes the potential contributions of such participants to a vibrant group environment.

5.1.3 Competence. A repeated message from game jammers was that there was a perceived hierarchy of tools to be used in development, which lent to feelings of legitimacy in the final product. This sense of legitimacy feeds into feelings of competence. For example, when a jammer

was asked what skills or characteristics would lead someone to success in a game jam group, they responded:

> For this one it's definitely more technical skills, people who are good at programming, Javascript, someone who's good at programming for the blockchain is definitely useful. (GG5)

Other jammers repeatedly nodded to Unity as the tool that would unlock the ability to jam (despite a number of tools being used), with one participant saying: "If you're great at Unity, you can be a part of any game jam since you already have the main tool" (GG2). Meanwhile, in 4.4.3, a female jammer expressed her fear of being a "dead weight" if her tool competence was not meeting expectations, which lead her to work only with someone she knew.

Among the quilters, there was more acceptance that a person's method was their own preference, and those differences were celebrated. To enable those new to making to achieve their goals, we do not recommend the creation of custom tools that would stand in opposition to those perceived as 'legitimate' (Unity, Unreal Engine), as there is a saturated market of such software: this would further contribute to feelings of being "less than." Instead, we encourage explorations of how the existing tools can be modified to be more useable or accessible, to grow confidence while using the tool through methods such as plug-ins, tooltip overlays, or step-by-step revealing of more complex features to reduce feelings of being overwhelmed.

Representation is important to helping makers feel as though they, too, can handle the activity. However, in designing a maker group, one should make conscious decisions about representation. In 4.5.1 we heard from a woman who was mistaken for a volunteer at the game jam, because there was a high proportion of female organizers, but the same was not true among the jammers themselves. There should be adequate representation at all levels to reduce the risk that participants perceive tokenization over genuine diversity in the group.

5.2 Limitations

The at-home quilting group's confusion with the IMI survey reveals a limitation of using such questionnaires, which may bias younger participants in their construction [57]. The intersection of age and gender leads to a broader limitation of the intersectionality of this study.

We chose to study the game jam and quilting groups due to the similarities in how they operated and their very skewed gender membership despite the difference in medium. However, based on the diversity of our sample, we would be remiss to assume the generalizability of our recommendations to equally benefit *all* marginalized groups, should maker groups implement our recommendations. At the quilting groups, various forms of disability had been accommodated to serve aging participants. Other forms of structural or institutional exclusion were left unsaid: most participants were educated and affluent, and no gender nonconforming or people of colour were present. The factors that make white women feel comfortable and welcome in a space are not universal and should not be taken as such. Instead, this research should add to the growing body of work addressing and understanding the diverse experiences of marginalized peoples and how we might create more open and welcoming environments for all.

The maturity of the game jam and quilting groups may lend to the differences in how well-developed they are (that is, how they might have adapted to accommodate others, how they organize events); the groups investigated had not been in existence for the same amount of time. As discussed in 4.4.1, overarching organization emerged as an important factor to ensure longer-term health of the group. Given the different life stages of our participants and the maturity of the groups, this had become established among the quilters but remains an opportunity that we recommend for sustainability and growth of the game jams.

Finally, given the immense diversity of maker environments, it stands to reason that the contexts studied here are not representative of the breadth of maker groups, and that the groups studied here may not be representative of their respective maker cultures. Community-based research has an inherent trade-off between its generalizability and specificity. Given the parallels that emerged between ours and similar work in this space however, we are encouraged by these findings and look forward to future work exploring additional metaphors which could triangulate insights and increase confidence among interested adopters of the recommendations. We also view opportunities for future work in further analysis of the data collected here, focussing on each context in and of itself through the use of the substantial data collected, and/or exploring the use of different angles of analysis.

6 CONCLUSION

In this work, we investigated crafting spaces as an extension of existing work on maker groups, focusing on female-dominated quilting groups in comparison to the masculine culture of game jams. Through fieldwork and thematic analysis as well as questionnaire data on intrinsic motivation, we found that participants' feelings of autonomy, competence, and relatedness were satisfied in different ways across the quilting group, and that the STEM-oriented game jam failed to provide opportunities to engage a more diverse group of people. We offer a number of recommendations to consider how game jams, and by extension, maker groups might be reimagined, boiling down to a shift in focus: Instead of focusing on specific goals to achieve, organizers could put their efforts into fostering longer-lasting community ties through satisfaction of needs.

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