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Heterogeneity in making: Findings, approaches, and reflections on inclusivity in making and makerspaces

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Making, that is, the hobbyist and technologically based creation of things, has been associated with many benefits. It is considered to contribute to the development of skills and to enable participation in innovation, and even democracy. At the same time, institutionalized making (in makerspaces, FabLabs) is known to be exclusive as members of such spaces are very often young well-educated white men. This is in contradiction to the promise and self-understanding of the maker culture, which aims to be open and inclusive. In the past 3 years, we, a group of researchers, makers, fablab employees, hackerspace operators, and artists, have engaged with such disparities in a collaborative research project. We inquired into barriers that women* and other underrepresented groups experience, created visions to change the status quo, and implemented smaller and bigger interventions in different spaces (fablab, hackerspace, and makers' homes) to explore their impacts. This article discusses findings, approaches, and foremost, reflections and experiences. In addition to presenting selected insights from our explorations, we pay particular attention to the tensions and challenges that we encountered during our research endeavors. Many of those are rooted in our own roles, perspectives, and backgrounds, which are multiple, sometimes conflicting, troubling, frustrating, yet enriching, and rewarding. In the form of a written conversation among project members, we present those different viewpoints, connect them where possible, and oppose them where needed. We conclude by articulating tensions that we see as characteristic regarding making and the research around it.

KEYWORDS

making, makerspaces, inclusion, diversity, women

Introduction

In the past years, the hobbyist creation of things, also broadly referred to as making, has received increased attention from the public and research. Being considered tremendously promising for democratizing innovation beyond established industries, various makerspaces and FabLabs have been established worldwide—as stand-alone entities, associated with schools, etc. At the same time, making has become a focus in research, which aims to understand the benefits, question the associated promises, and inquire into problems associated with making. For instance, there seem to be disparities between the envisioned potential of making to solve grand societal issues (e.g., climate protection or educational inequalities) and the actual approaches to capitalize on the collective power making could have (Unterfrauner and Voigt, 2017). Furthermore, while making seems to be available to everybody (e.g., makerspaces being presumably open to kids, students, and older adults), it has shown to be not. In Central Europe, where the research took place that we report upon, many makerspaces are inhabited by a very particular group of makers, that is, young well-educated white (cis-)men (e.g., Stelzer and Jafarmadar, 2013). Reasons for other groups not joining such spaces are various, such as not feeling welcome, manifested through a lack of an inclusive atmosphere (Ahmadi et al., 2019), or a primarily “male” culture, one that is “reflected in the interior design of places, or by the language and attitudes of their members” (Eckhardt et al., 2021, p. 1). As a result, several women*¹-only makerspaces or hackerspaces were established (e.g., Fox et al., 2015; Capel et al., 2021) that aim to provide safe and welcoming environments that not just “sprinkle diversity” on top of existing male-dominated spaces (Smit and Fuchsberger, 2020). However, even those spaces are far from safe, as Wuschitz recently described, since they may become the target of attacks and threats of their members through their very nature of being feminist, focusing on “issues of representation and democratic participation in digital media, as well as on ways of reclaiming one’s own body” (Wuschitz, 2022, p. 1). Many further mechanisms why women, queer, non-binary, transgender, or intersex people, kids, or older adults are less represented in makerspaces, have also been identified, such as a lack of self-confidence in regard to making and associated skills (e.g., Campreguer França et al., 2021),

or harmful, learned behavior patterns concerning conflicts, individual differences, or trust (Wuschitz, 2021).

Situated within these complex entanglements of inclusion and exclusion, spaces, opportunities, and barriers of making, we, a group of researchers, makers, fablab employees, hackerspace operators, and artists, have in the past 3 years raised questions, conducted empirical and design research, and actively intervened. In the form of a nationally funded industry research cooperation, we have collaborated to not only better understand the exclusive nature of making but also to develop interventions that aim to sustainably change the situation. The project, which is called “FEM*mad: female engagements in making—making a difference” has started from the observation that makerspaces seem to be exclusive, discouraging non-male makers to join. To understand what prevents underrepresented groups, and in particular women*, from making use of the vast possibilities of making in such spaces, we have conducted a series of empirical studies, including workshops with experts (Smit and Fuchsberger, 2020), observations in FabLabs and making festivals, interviews with female makers (Campreguer França et al., 2021), a diary study with women* making at home, an online survey targeting makers that are members in makerspaces, and especially those who are not, etc. Building upon the findings, we have created a set of interventions to be applied in the FabLabs and the feminist hackerspace that participate in the project, as well as in makers’ homes. What we call “interventions” are attempts to actively intervene with the current situation through changes in communication (e.g., the fablab’s PR using pictures of female makers in every public appearance), through dedicated activities that strengthen social networks (e.g., a workshop series in the feminist hackerspace that foregrounds female making expertise), or through modifying the physical layout of spaces (e.g., providing exhibition space for women*’s making projects).

In this article, we share findings, approaches, and foremost reflections and experiences by providing a written conversation among project members about heterogeneity in making. Afterward, we discuss the tensions and challenges that we encountered during our research endeavors, many of which are rooted in our own (multiple, conflicting, troubling, frustrating, enriching, and rewarding) roles, perspectives, and backgrounds.

A conversation about heterogeneity in making

Inspired by Leal et al. (2021) who have proposed a critical conversation as a methodological approach to reflect and share experiences, we have collected our individual learnings and viewpoints in the form of reflective narratives. Based on those, we have constructed and curated (i.e., arranged and annotated) a conversation that yields an overview of what we have done, experienced, and learned. This approach is a vehicle for us to

¹ “Being a “woman” or “being a man” is not an essential quality. Using the asterisk* as a typographic interruption, we produce meaning (Tuin and Verhoeff, 2022), one that we focus on in our research as a possible quality of making and makerspaces. Using the asterisk means that we include anyone who identifies as a woman, including those who define themselves as queer, non-binary, transgender, or intersex women. When we talk about men*, we consider anyone who identifies as such, including those who define themselves as queer, non-binary, transgender, or intersex men.

reflect on and share our perspectives beyond reports of findings from particular empirical studies, focusing on challenges and questions that arose during our research.

To start with, Joanna, an employee at the Happylab,² a huge fablab in Vienna, Austria, summarizes their reality of access to making:

Joanna: “FabLabs and makerspaces are super inclusive.”—at least that is the narrative and that is the self-image we have had. Since Happylab was founded, the goal has been to make digital technologies accessible to everyone. But if we have a look at the numbers, we must admit that two thirds of our users are male.

This imbalance results in disadvantages for those not being included. When investigating how making responds to basic psychological needs, we found yet another evidence for this being true, as Cornelia, an HCI researcher, describes:

Cornelia: We learned that some makers suffer from the peculiarities of their lives, trying to satisfy frustrated needs through making; parents who rush through their daily routines find a quiet activity in making; youth who have suffered from isolation during lockdowns because of the pandemic, enjoy the co-making activities in a social context. Individuals try to find something in making and makerspaces they cannot find in other areas of life. Thus, the activity of making has a positive impact on mental health, and accordingly, makerspaces have a supportive function on a societal level.

As a way to explore how spaces can adapt to diverse needs, Happylab brought the “female maker month”, a month-long focus on female* makers in an existing male-dominated makerspace into being:

Joanna: The primary goal of the female maker month was to raise awareness in our community and encourage more women* to get in touch with the possibilities of digital fabrication and technologically-based making. This worked pretty well with women(*)-only workshops that were booked out within days or female role models from our community that presented their projects to a broader public. Within this month we encouraged 40 women* to bring their ideas to life in a makerspace they had not stepped foot in until then. What we didn't expect was the feedback we got from our female* members on how we can improve our shared space and make them feel more comfortable. We didn't expect to start a conversation in other FabLabs about the visibility of female* makers or their female* members. We got invited by international FabLabs to share our experience with them.

It felt like this issue was out there for quite some time and we were the first to address it. Still, it can be frustrating if I check the numbers, and we still haven't reached a 50/50 gender balance in our community.

Georg, an HCI researcher, describes another finding from the project that exemplifies how multifaceted the problems and potential solutions associated with inclusive making are as follows:

Georg: For me the most interesting finding during the project was one topic that came out of a diary study. It is about the difficulties participants encountered when working with manuals. We identified that many people have an Arduino, Raspberry Pi, Makey Makey or something similar at home that rests unused in a drawer because it was purchased with great expectations and then left unused after some small-scale initial projects or some large ambitious projects that failed. How can we provide challenges / guidelines / tutorials that do not overwhelm the users, provide certain freedom for adaptation and experimentation, and still offer sufficient information for doing the projects? On the one hand, if manuals provide only a step-by-step instruction for a concrete topic this might be too boring or even useless. On the other hand, if people start their own projects from scratch, it might get frustrating soon, because you are missing a certain skill or tool. Or makers need to purchase additional hardware etc. Therefore, we have identified the need for developing better manuals or challenges for motivating people toward making, especially when looking into making with microcontrollers—e.g., Arduino. We aimed to tackle this problem by compiling a collection of manuals inspired by the artworks and artistic tools by women* artists.

However, aiming for potential contributors was more difficult than expected as noticed by Olivia, an artist affiliated with the feminist hackerspace Mz*Baltazar's Laboratory³ She responds by unpacking the interdependencies that a presumably straightforward solution comes with:

Olivia: When looking for female* artists who work in the intersection of art and technology and who could potentially be willing to share their knowledge in a manual, one already encounters several hurdles. First of all, although there are more and more female* artists for whom technology plays a major role in their work, it is still a rather small number (All the more reason to aim for more visibility and work on a community!). In order to make a living from their art, they have to work a lot. In addition, many of them also do care work. Consequently, it is a great effort to fit an additional appointment or an additional task, such as creating a manual,

² https://www.happylab.at/en_vie/

³ <http://www.mzbaltazarlaboratory.org>

into their everyday life. Even if you can inspire an artist to dedicate her rare time to our agenda, sharing knowledge is something very unusual in the (visual) art world and, we encountered both self-insecurity and mistrust.

Georg: As Olivia already mentioned, it was harder than we thought at first to convince artists to share their insights because they were reluctant to share knowledge that they worked hard to obtain, or they considered their work not interesting enough from a technical point of view.

Olivia: Unlike conventional manuals, art manuals are connected to the artistic practice of an artist. Hence they are not only a construction manual but also an interface to a specific artistic work, which gets demystified. The art world is a very competitive one, the value of artworks is argued, if not on the basis of their aura, then at least on the basis of their uniqueness. Sharing knowledge in this context must be unsettling and needs a lot of trust. Working on better manuals does not only address working with technology as a practice, but also sharing. Both need to be practiced, again and again, to find their way into our social and artistic habits.

In contrast to the hesitance that we found, when we invited artists for creating manuals, we generally experienced great generosity of participants in our studies to share their stories with us. This is even more remarkable, as the shared experiences are often characterized by struggles, as Dorothé and Verena, both HCI researchers discuss as follows:

Dorothé: I was moved by the time and effort that so many participants shared with us throughout the project, during interviews, studies, focus groups, workshops, etc. Apart from the time invested by these participants, we should not underestimate the emotion work that is involved when women* share their experiences with exclusion, sexism, and their struggles to “make it” in a world that is dominated by (cis-)men. It is likely that our participants were especially motivated to do so, since they cared about the subject from a personal perspective.

Verena: At the same time, when hearing women* saying that they don’t have the energy to fight any more to make their way into making or particular spaces, or when realizing how many and how bad the experiences were that people, often from marginalized groups or even more so, intersections thereof, made in regards to making, it leaves me with the feeling that there is nothing we can do to make an impact. The sheer ubiquity and extent of problematic situations are overwhelming. For me, working on a project like this is a constant meandering between resigning and hoping, between being optimistic about the infinite opportunities of making and being pessimistic that this fight will never end.

Thus, researching such a topic not only affects those being researched but also those doing the research:

Dorothé: I concur with Howard and Irani (2019), that the researcher’s role is to manage the relationship with the participants, and the emotions the participants experience while partaking in a study. Doing research with participants is a reciprocal process. The researchers who perform these activities—e.g., interviewing a maker, or analyzing data from a diary study—might be confronted with personal memories, vulnerabilities, and feelings. From an ethical standpoint, the researchers are concerned with the effect that a study might have on participants, but often much less focused on the emotional labor that is connected to doing that research, especially research that is emotionally laden for the researcher, due to own life experiences, personal identity, or other reasons.

HCI researchers, Emma and Dorothé, describe the struggles of multiple roles as a search for harmony and balance, which are influenced by the expertise of the researcher, emotional involvements, and project realities alike:

Emma: From my rookie-perspective as contributor who joined the project toward the end, I agree with the others that there is a personal connection between most of us and the activities and topics that are a part of the project. We influence- and are also influenced by- working on this project. I experienced this while I conducted a workshop around a maker scavenger hunt for children to explore ways in which children can be engaged in making and taught making skills that might help reduce the gender gap in makerspaces in the future. I found myself taking on various roles throughout the study, from researching legal information on data processing to taking on many organizational tasks. Due to unplanned circumstances, I had to take on the double role of researcher and expert helper; balancing the roles was challenging. I was able to do so because of my own background and experience with making as a designer, it made it easier to slip into this double role. Having a double role may make the researcher more engaged by providing with first-hand insight into the participants’ process but, having multiple roles also affects the researchers’ ability to remain detached and observing. In addition to that, helping participants takes time and attention away from the researcher and may cause certain data to be overlooked and unreported. I believe it is important to be aware of this duality (or multiplicity), avoid it if possible, or plan for it prospectively.

Dorothé: Being able to balance between a neutral outsider during research activities, an expert, and engaging with the emotional labor that was naturally involved, was facilitated by the trust among the researchers in the project, and the possibility to discuss experiences, frustrations, and emotions openly in the low-risk environment of the consortium. Unfortunately, this kind of labor cannot easily

be captured in time sheets, financial reports, or project milestones, and therefore remains an unseen part of doing research in emotionally-laden contexts.

Balancing roles also requires individual reflexivity, as Nathalia, also an HCI researcher, adds:

Nathalia: Thinking about how our backgrounds influence our perspectives in the project has not only been a topic in workshops with experts, interviews with participants and conversations among our team but it was also stated in the papers we wrote. The first paper I published within the project was the first time I had to define my background into actual words, so it was urgent that I understood mine. I am a Latin American immigrant living, studying, and working in Central Europe for the past 4 years. Interestingly, I would probably not have explicitly called myself an immigrant or Latin American if there weren't situations of discrimination that evidenced it. I come from a working class background but still have a privileged position in my home country. In Europe, however, I do not have access to the same privileges as a native. It feels that the identity I had built my whole life has suddenly been put to question. In one side, there is the privileged one coming from the same white, westernized standpoint widespread in research. The other one comes with the background of "breaking through", carrying this responsibility to advocate, so others like me can have the same opportunity—a heavy (yet rewarding) role. The more I have time to learn and process, I understand that I can't be without either. There is no one generalized view of a researcher's background, as there is no generalized view of the background of an immigrant, and the same applies to our study participants.

Starting from the grand ideal of facilitating access to making for everyone, this conversation shows it is not only a matter of finding solutions but also of understanding the problem with all its interdependencies, including those that come with researching it. As a project team, we have gained a variety of insights and created several interventions attempting to interfere with the status quo, all while finding ourselves interwoven with the multiple realities of making, makers, and makerspaces. In other words, we have come to grip with our own vulnerabilities, privileges, and involvement along with the realization that we cannot succinctly distinguish between those whom we research (the makers), what we research (making), and ourselves, who are makers, women*, immigrants, learners, and pioneers, as well.

Discussion

We have touched upon many issues and struggles in our conversation that have been mentioned by others already, such as how making is not yet inclusive (e.g., Pederson, 2016;

Eckhardt et al., 2021), how female* makers are discriminated (e.g., Wuschitz, 2022), and how such sensible topics require researchers and participants to perform emotion work (e.g., Balaam et al., 2019). Considering our conversation, we add to the notion of emotion work that it may be even more challenging if emotion work is not only required inter-individually (between participants and researchers) but also intra-individually (within researchers) when researchers take over different roles. For instance, being a researcher and expert maker, as Emma described, or having experienced both privileges and discrimination oneself, as mentioned by Nathalia, add another layer to emotion work. One that requires additional reflection, sensibilities, and practices that go beyond stating positionality in publications but which urges us to continuously question—and articulate—how we create knowledge and apply methods, and what our own roles were therein.

What we also add through our conversation is how it points to tensions that affect making and makers, and which require attention in research and practice. Articulated in a positive way, we may call them ideals, openness, richness of resources, and belonging; and articulated in a negative way, we may talk about difficult realities, exclusion, reluctance, and fighting.

Ideals or realities

Making is inherently associated with the ideals of being inclusive; in the “dominant discourses about maker culture [...] gender equity, making, knowledge, and entrepreneurship are routinely aligned terms” (Pederson, 2016). However, realities differ. The imbalance of gender that Joanna described in a fablab is just one of many empirical proofs of that continuous skewness. Cornelia talked about how making could serve to meet social and individual needs, yet it remains unclear how everyone can benefit from those.

Openness or exclusion

The realities show that the challenges associated with making are far from being solved and that they require more than one solution. In other words, a one-fits-all approach will not suffice. The question of whether spaces need to be exclusive or inclusive remains unanswered. Maybe we need both, inclusive spaces that host everybody, and dedicated, safe spaces for particular groups of makers, depending on who they are and how likely it is that they will experience (further) harm through being exposed to a heterogeneous group of people.

Richness of resources or reluctances

As we have outlined earlier, the idea of creating manuals to share knowledge among makers turned out to be only

conceptually feasible but not practically. When inviting artists, we found restraints in regard to sharing knowledge, which, as Georg and Olivia speculated, may have various underlying reasons, ranging from lacking time and uncertainties about the value of the knowledge, to yet-to-be-developed common practices.

Belonging or fighting

The ideal for everyone being a part of the maker community is (too) often not met. Throughout our project, it was striking how often women* talked about how they need to fight for being included, as Verena briefly mentioned, and how they are tired of doing so. Dorothé mentioned how many female* makers were willing to share their stories with us, so there seems to be hope that it is still worth investing efforts in. The question is, though, whose (intersectional) perspectives we have already lost.

Conclusion

This article only shows a small subset of struggles we, as a project team, came across during the past 3 years. They—again—show that making faces grand challenges when it comes to opening up, and being truly democratic and inclusive. We were aiming to unveil the dynamics and mechanisms of exclusion and change them for the better, yet while we did that, we encountered even more of these mechanisms. Is it worth the effort then, you ask? It is, or at least it was for us. We have evidenced a variety of positive changes, induced by our raising questions, implementing strategies and activities in the fablab and hackerspace, sharing our experiences, and reflecting on our own roles. Our conclusions are that our actions in this project, small or big in scale (from changing the language to being more inclusive in online tutorials to organizing a month-long event that celebrates women* in making), can have an effect. We might not solve all the big issues and fight all the important fights at once, but using the tools that we *do* have, we can achieve considerable positive change.

Data availability statement

The original contributions presented in the study are included in the article, further inquiries can be directed to the corresponding author.

Ethics statement

Ethical review and approval was not required for the study on human participants in accordance with the local

legislation and institutional requirements. The participants provided their written informed consent to participate in this study. Written informed consent for the publication of potentially identifiable data was not required as the participants are all listed as authors and they all approved the final version of the article.

Author contributions

VF created the initial draft. VF, DS, NC, CG, OJ, JK, GR, and ER contributed their individual narratives and iterated the draft until completion. All authors contributed to the article and approved the submitted version.

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Conflict of interest

JK was employed by the company HappyLab. CG and GR were employed by AIT Austrian Institute of Technology GmbH.

The remaining authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

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