

Information Sharing, Scheduling, and Awareness in Community Gardening Collaboration

Xiaolan Wang¹, Ron Wakkary^{1,2}, Carman Neustaedter¹, Audrey Desjardins¹

¹ Simon Fraser University, Surrey, British Columbia, Canada

² Eindhoven University of Technology, Eindhoven, Netherlands

{xiaolanw, rwakkary, carman, adesjard}@sfu.ca

ABSTRACT

Community gardens are places where people, as a collaborative group, grow food for themselves and for others. There is a lack of studies in HCI regarding collaboration in community gardens and considering technologies to support such collaborations. This paper reports on a detailed study of collaboration in community gardens in Greater Vancouver, Canada. The goal of our study is to uncover the unique nature of such collaborative acts. As one might expect, we found considerable differences between community gardening collaboration and workplace collaboration. The contribution is the articulation of key considerations for designing technologies for community gardening collaboration. These include design considerations like *volunteerism, competences and inclusion, synchronicity, and telepresence* as unique aspects of community collaboration in community garden. We also articulate the complexities of community gardening collaboration, which raise issues like *control, shared language, and collective ownership* that exist more as conditions within which to design than “problems” to solve through technologies.

Author Keywords

Community; collaboration; community garden; technology design.

INTRODUCTION

Community gardens are land collectively used by people for planting food in urban areas, typically by residents with restricted access to their own land [26]. Community gardens started at the turn of the 20th century and, because of food shortages, increased in numbers during the World War I and II [1] especially in Europe. People dedicated to family health also show strong interests towards community gardens because of the possibilities of organic gardening [23]. Individuals who have limited access to grocery stores because of inadequate finances or inconvenient transportation can often gain access to community gardens

located within their neighbourhoods [24].

Community gardens are places that foster a strong sense of community collaboration by a local group of volunteers. In community gardens, people tend their gardens in a shared space outdoors and they also work on communal plots in addition to their own space. Along with these activities comes a need to schedule work activities and to present information relevant to the gardeners [9]. We already see the introduction of technology into community garden activities including the use of email and websites [9]. In addition, previous design explorations aimed to embed computational devices into gardening practices [17,19]. As such, it is likely that technology will continue to permeate into the practices of community gardeners regardless of whether they desire such technologies. Thus, the challenge is in understanding when and where technology should be present in community gardening along with how it should be designed to best support the practices and desires of gardeners.

We conducted an observational study of community gardeners and their activities in Greater Vancouver, Canada, along with interviews with ten gardeners who rent plots and routinely work in community gardens. Our results describe how gardeners use digital and non-digital tools to support their community collaboration. In this respect, we contribute descriptions of three collaborative acts: *information and knowledge sharing* through web pages, verbal exchanges and signs; *scheduling work activities* through sign-up schedules, email, and online calendars; *gaining an awareness* of who will be at the garden before going to work there, and the usage of shared tools. We found that the community gardeners in our study use technologies that are already being used in office-based work settings to address similar scheduling and interaction challenges. That is, the gardeners tended to carry over the practices and tools from workplace settings to community gardening collaborations.

For these reasons, throughout our paper, we utilize terminology from research on workplace collaboration to implicitly compare collaboration in workplace settings with that found in community gardens. This comparison highlights the challenges in using digital technologies from the workplace for gardeners’ collaborations. In some cases, suitable technologies do not exist to easily support gardeners’ activities. In other cases, collaboration

technologies from office environments are appropriated with somewhat dismal results. Based on our findings, we address the uniqueness of collaboration in community gardens by identifying design opportunities and challenges. We believe this comparison offers an interesting reference point to understand community gardening collaboration better. Furthermore, it reveals new and interesting insights into collaboration in the context of community gardening.

The contribution of this paper is the identification and articulation of key considerations for designing technologies for community collaboration in community gardens. Considerations like volunteerism, competences and inclusion, synchronicity, and telepresence identify unique aspects of community gardening collaboration for designers to prioritize. We also articulate the complexities of community gardeners' collaboration that raise issues like control, shared language, and collective ownership that exist more as conditions within which to design than "problems" to solve through technologies.

In the following sections, we begin with a literature review of previous research on community gardens and workplace collaboration. Next, we report the design and the findings of our study. We conclude with a discussion of design considerations and challenges with community collaboration in community gardens.

RELATED WORK

Social Issues and Participation in Community Gardens

Studies from outside of HCI have shown that community gardens are often viewed as locations that promote community building in addition to food production [22]. Community gardens provide a place for residents to develop friendships, learn to share, exchange seeds, and help each other maintain individual and communal plant plots [8,20,26]. Other works provide suggestions to encourage people's participation in community gardening [13,21,25]. There is also literature that focuses on topics such as education or health issues associated with community gardens [6,12] as well as the influence of leisure on gender roles and relations [5]. From these studies, we learn that "community building" is an important mission for community gardens. Yet rarely this work explores the specific acts of collaboration in community gardens. As an exception, Power *et al.* [20] describe collaboration in community gardens as a process where gardeners work together to plant crops and eradicate weeds. Our study extends this work by detailing how such acts are scheduled and how knowledge is exchanged between gardeners as a part of these practices.

HCI, Interaction Design and Community Gardens

In HCI, there is a growing body of work that explores the application of technology into community gardens. Yet this body of work mostly focuses on the individual gardening experience, rather than the aspects of community collaboration, which are the focus of our paper. For

example, Pearce *et al.* [19] introduced an Internet-based application that helps gardeners analyze water amounts in their gardens. Qu [17] developed an interactive installation that augments physical gardens with virtual flowers to explore how the physical environment and digital projection can be naturally merged.

More recently, researchers have focused on urban gardening activities at a community level and proposing design implications for such practices. Bidwell and Browning [2] suggested that technology design in natural places should remain 'natural'; be sensitive to community identity, values and practices; and, not take away people's sense of self-discovery. Heitlinger *et al.* [11] proposed a set of issues that designers should consider when applying ubiquitous computing designs in urban community farm. These included an understanding that not everyone uses a smartphone; efficiency is not always a core value; face-to-face communication is valued; and, farm activities allow people to participate together in joint acts. Odom [15] found that some community gardeners felt that relying on technological systems could limit the growth of gardeners' gardening knowledge. He also found that some participants felt that interactive systems might help new gardeners interact with more experienced gardeners to build relationships amongst them. In Odom's study, community gardeners showed their strong desire for and proposed ideas to broaden the tie between their gardens and the 'outside world.' However, none of the reported technology designs focused on improving community collaborations in community gardens; this is our focus.

Goodman's [9] workshop paper describes how gardeners see their sensory connection to nature as a unique skill that identifies them as a gardener. Gardeners in this study rejected technology that divorced them from the feeling of being connected to nature. Results suggest that designers should avoid breaking the "sensational link" between gardeners and the physical plot of land, echoing some of our own findings. Also related to our work, Goodman reports that gardeners are beginning to use technologies to support information sharing and scheduling around gardening activities. This includes the use of web sites, forums, and podcasts to learn more about gardening, along with email to schedule events and work. However, we do not learn about any details of how these technologies are used or what challenges gardeners face. We build on this work to more deeply explore such issues.

Workplace Collaboration and Awareness

Given that our work focuses on collaborative acts and that community gardeners often turned to digital tools seen in office-based work settings, we also highlight some pertinent concepts from the study of workplace collaboration and awareness. While the contexts of office workplaces and community gardens may seem highly different, as our results reveal, the collaborative acts that occur in both are surprisingly similar. As such, we provide an overview of

research that describes collaboration in office-based workplaces. Throughout the paper, we utilize the terminology from this research.

First, research has shown that *casual interactions* between colleagues form a large portion of collaborative group work [27]. Casual interactions are the frequent and informal conversational exchanges that occur when people run into each other in person or see each other in a common workspace. Casual interactions are often held together by *informal awareness*, a naturally gained understanding of who is around and what they are up to [3,7]. This awareness is used by people to determine the availability and presence of others. In face-to-face situations, people gather informal awareness by simply looking around a shared workspace. When people are separated by distance and not present in the same space, they must rely on technology to provide a proxy for this awareness. As such, researchers have investigated a variety of awareness technologies ranging from instant messaging systems [14] to video-based awareness systems called media spaces [10].

Second, there is also a vast amount of research on the ways in which people and workgroups schedule and plan more formal exchanges of information in the form of meetings and workshops. These include, for example, studies of shared calendars [4,18], email [28] and wiki [16]. Common to most of this research is the fact that users are colleagues in an office-based work setting where system usage is somewhat required. People also typically have training or knowledge in how to use these scheduling tools. As we describe, community gardens make use of similar tools, yet the ability of garden members to use such tools (as well as their desire to do so) heavily varies.

To summarize, our current study explores how the practices of community collaboration emerge in community garden contexts where we build on the terminology presented by studies of collaboration in office-based work settings. This study implicitly sets up a comparison between workplace collaboration and community gardening collaboration. By uncovering the issues within community collaboration in community gardens, we found that despite the similarities of the collaborative acts, the settings are very different and, as such, we found the design approaches should differ as well.

STUDY METHODOLOGY

To understand the collaboration in community gardeners and their use of non-digital and digital tools to support such collaborations, we conducted observations of community garden activities and interviewed community gardeners.

Observational Study

We conducted observation in six community gardens in Greater Vancouver, Canada. These gardens were situated in very different public surroundings. Additionally, due to their differences in size and shape, the physical layout of

plots, notices, and tools and supplies in each community garden varied quite a lot. Garden members included Canadians as well as a large number of immigrants including immigrants from China, Japan, and India. Because of Canada, and specifically the Greater Vancouver area, is remarkably multicultural, not all members spoke English, some spoke English as a second language. The gardens varied in size from only a few plots to gardens with over 100 plots. Each garden was managed by a non-profit society made up of local residents who were members of the garden. Our observations consisted of three activities:

Garden Tours

We took tours of all six gardens with nine different people. Each tour lasted up to 30 minutes. The participants introduced different locations in the garden and described the activities members undertake around these places. During the tour, we asked questions and took notes and pictures.

Team Meeting Observation

We conducted observations at a compost team meeting. Four gardeners, all members of the same community garden, met in one person's home for this meeting. We watched and listened to the discussions and took notes without interjecting in the conversation. We specifically focused on the discussions about the members' experience during collaborative activities and problems they face in these practices. We captured photos of the meeting and audio recorded all conversations. The observation of this team meeting lasted two and a half hours.

Observing Participation in a Workshop

We participated in and observed an allotment design workshop for one of the gardens. Here we collaborated with eight gardeners to create a multi-person gardening plot. We engaged in specific tasks, asked for help and support from others, and completed our plot design together. This observation lasted three hours during an evening and focused on the collaborative practices amongst the gardeners, where and how these were enacted, and what tools were being used.

Semi-Structured Interviews

We recruited 10 gardeners (5 females, 5 males) from the same six community gardens using a snowball sampling technique. We asked our circle of friends who were community gardeners to ask their friends and families, within the garden community, about participation. We also sent emails to the organizers of community gardens. Our participants' ages ranged from 20 to 60 years of age. Six participants had children in their family. Seven were garden committee members who took on a leading organizational role within the gardens. Participants covered a range of gardening experiences: some had only recently started participating in community gardens, some had one or two years of experience, and others had many years of experience.

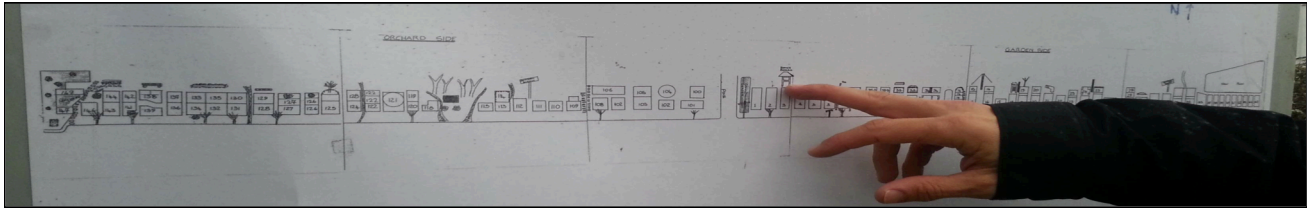


Figure 1. The layout of a long, narrow community garden showing plots in both square and rectangle shapes.

Interviews were all conducted during the sowing season and lasted between 30 and 50 minutes. Prior to the interview, each participant was given an outline of what types of questions to expect and was told that data would remain confidential. Our interview questions asked the participants about their collaborative practices with other gardeners, the ways they collaborate, their motivations for participating in these practices, and their preferences and experiences for using technology during the collaborations. For example, questions included: “*what activities did you do with other gardeners and how did you perform them?*”, “*why did you decide to participate in the activities?*”, and “*how did you inform other gardeners when there was an activity coming up?*”.

Additionally, we had gardeners show us and discuss the digital and non-digital tools that they use to support their practices. This included schedules, meeting records, name lists, and financial records. We also asked participants to tell us about their memorable collaboration experiences. Throughout our interview process, we iteratively refined the focus of interviews as we collected more information. During each interview, a recording pen was used for audio recordings. We transcribed audio recordings and then iteratively reviewed all photos and notes. We organized them into pertinent themes and use those to code all our data.

In the following sections, we describe the results of our observations and interviews. We begin by giving an organizational overview of the community gardens we studied. Following this, we explore various acts of collaboration and the ways in which digital and non-digital tools were used to support them.

ORGANIZATIONAL STRUCTURE AND DUTIES

All of the community gardens we studied were organized and run by an elected board of directors. An Annual General Meeting (AGM), usually happening in March or April, marked the start of the gardening season. The AGM was used to clarify membership, guidelines, policies, and responsibilities. AGMs were held in nearby community centers and all community members were encouraged to attend. This way they could renew their membership, listen to reports of the past year’s activities, be reminded about community policies, vote for a new board of directors, and agree upon a budget and other motions. Members were registered in as volunteers for one year and participate in

activities to ensure and advance the development of the community garden.

At the most basic level, community gardens contained plots of land used by individual members. Plots were selected for individuals on a first come, first served basis. This involved an organizer taking the new members to the garden and showing them the available plots along with a picture of the garden’s layout (Figure 1). The selection of plots was recorded on a garden layout map. Each plot had a number on the map and also at the plot’s physical location.

Throughout the planting and harvesting season, gardeners came and worked on their plots to plant, tend to, and pick their harvests. To build a sense of community and support collaborative garden work, all of the gardens that we looked at created social events and work parties for their members. Work parties were held in different months throughout the year. This was the most common set of community social events and included a diverse set of ‘parties’, such as a ‘clean-up’ party, ‘compost-turning’ party, and a ‘fixing and building’ party. These parties encouraged members to gather in the garden and accomplish tasks collaboratively. In some gardens, it was also considered a requirement of being a community member to attend these parties. Gardeners generally felt involved and engaged in these work parties. In fact, many participants in our interviews told us that their best experiences in the garden were building the garden together with other members during these events.

Within the above observations, our analysis revealed several key activities in relation to community collaboration in the community gardens. These include *information and knowledge sharing, scheduling and assigning work activities, gaining an awareness of gardeners, activities, and shared tools*. We step through each of these to describe the ways in which community gardeners engaged in these acts of collaboration and, how well technology was able to support them.

INFORMATION AND KNOWLEDGE SHARING

One of the key collaborative acts of community gardens was information and knowledge sharing where garden members used a variety of digital and non-digital tools.

Web Sites

Most of the gardens we studied had their own website where information was posted for gardeners, especially for



Figure 2. A weathered sign next to the compost box.



Figure 3. Notice board for sharing information.

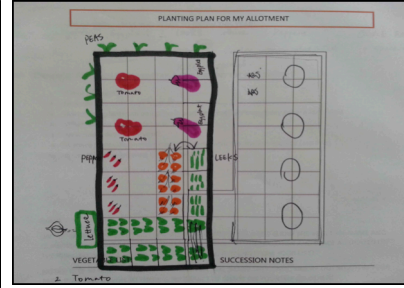


Figure 4. A plan for planting allotment.

those who missed events like the AGM. Members could also use the site to follow news and the process of the garden's activities.

While beneficial, web site information was mostly centrally controlled. That is, the community gardens' administrative team was usually responsible for posting content to it and controlling what information was available for viewing. This meant it was not easy for other community garden members to contribute and share information. The web site was also not often accessible when a person was actually at the garden, unless they carried a mobile device with them.

Signs and Notice Boards

All the community gardens we visited utilized paper signs in various places in the garden for members to exchange information and knowledge asynchronously with others.

We also found that garden members would sometimes create ad-hoc message boards with paper or whiteboard and place these in the garden (e.g. in the tool shed). Community members could use them to write messages for one another on an ongoing basis. In this way, they created an informal messaging system, akin perhaps to the use of instant messaging in office settings for asynchronous communication.

Although signs and message boards were easy to make and could be created and placed by anyone in the garden, they created challenges. First, paper signs were easily weathered even with protective plastic covering or laminate (see Figure 2). They were also prone to being ripped or blown away in the wind. Further, we observed that signs were sometimes hard to read and understand because some people did not speak English well or at all.

Some gardens we visited used a large notice board, such as the one shown in Figure 3. The information usually included the introductory information for the community garden, policies and guidelines, and upcoming events. The board's content was enclosed behind glass and only accessible by the garden's organizers. This meant that the content on it would not be weathered. Yet it also made the boards inaccessible for posting by all community members at all times; thus, it presented a similar problem to the use of a web site. For example, when gardeners would learn

about a discount on fertilizer in the nearby gardening store, they could not directly use the notice board to share the news with the other gardeners. Garden members also told us that they often wanted to record notes on the information posted to the notice board so they would have it available at home. Because it was paper-based, they had to memorize the information or copy it down on other pieces of paper to take with them. Copying information was not always easy: gardeners might be wearing gloves, have 'muddy hands,' or not have paper and a pen ready-at-hand to use.

Casual Interactions In Person

We found that community members actively shared knowledge about best practices for gardening during casual interactions in person. As gardeners worked their plots, they often talked to each other about gardening topics. These casual and informal interactions involved sharing gardening knowledge and planting stories. The following quote describes a member's first hand learning of a situation, which was later shared amongst many gardeners:

"Once there were slugs which are very bad for vegetables in our garden. People cannot use pesticide because we want to keep our food organic. I had heard that slugs don't like to crawl over anything abrasive, so I got to thinking of what I could attach to the wooden border around my plot that might discourage them, and I came up with light wire screen mesh, which I stapled to the border, and it seems to work. I have told many others about this, and many have taken it up." – P3

Of course, the challenge with casual interactions in person is that people must be present together in the same physical space to engage in such serendipitous acts of knowledge sharing. Indeed, the community gardeners in our study often talked about how it was hard to be present at the garden at the same time as others (this is described more in the subsequent sections).

Formal Information Exchanges

Shared knowledge was also provided during more formal in-person group workshops. We learned about two types of workshops during our study, both requiring explicit time scheduling. First, some workshops were held at the garden sites where professionals give talks around the beehives, compost boxes and other topics to gardeners. In these

situations, gardeners would stand together in the garden, listen and talk. These at-the-garden workshops were practical and lively. However, they were easily influenced by the weather and surrounding noise and it was sometimes difficult for people to record information about what they were learning.

Second, participants reported to us and we observed that many workshops occurred away from the garden. For example, the “Allotment Design Workshop” we participated in was held in an activity center building near the garden. During this workshop, the instructor taught garden members about various plants, their growing patterns, and tips for planting. Information was shared on large pieces of paper attached to the walls. Some workshops were also held in meeting rooms of a community center where gardeners were able to use computer-based slides and projectors for showing pictures and text. In addition to the presentation of materials, participants also engaged in hands-on activities in which they planned out their own garden plots (Figure 4). Most participants of the workshop found the information relevant and useful; however, it was often difficult to relate the information obtained in offsite workshops back to the real setting of the community garden because they occurred ‘out of context.’

In summary, the findings above raise many issues that designers could consider when they design for information and knowledge sharing amongst community gardeners. First, gardeners need the information and knowledge sharing to be synchronous and easily accessible in and out of the garden site. Second, information in community gardens is mostly centrally controlled.

SCHEDULING AND ASSIGNING WORK ACTIVITIES

Scheduling and planning work activities and work parties was a challenging task for all of the community gardens we studied. Time scheduling in the context of community gardens is different from normal meeting and appointment scheduling at work where a company may have access to a shared calendaring system, or where employees have a shared culture of calendar scheduling. Garden organizers have little knowledge of when people are available for work parties. Instead, work party planning involved organizers sending emails to community members to find available dates and times. Despite this, organizers often did not know how many people would show up because not all members would reply to emails and some simply did not read their emails. In a similar fashion, organizers also tried using Google Groups to post information about work parties rather than trying to find a mutually agreeable time amongst community members. This was more convenient for organizers yet some community members did not like the ‘more advanced’ technology because they were not familiar with technology beyond simple emails.

Some community gardens used a scheduling poll through Doodle Poll (<http://doodle.com/>) to see when people were free. In that case, people would select free dates and times

for the work activities, which overcame some of the disadvantages of the emails. However, they often did not find technologies like online scheduling systems appealing. This made organizers feel like the technology was unreliable.

When community members were not consulted about selecting a work party time (or did not check their email), some became upset. Most gardeners had families and worked full time. The restrictions of urban life often took them ‘away’ from the garden. For example, a community garden organizer showed us an email she received from a gardener:

“Work days – they are always scheduled for a Sunday which can be problematic. Perhaps give people the option of a job board... This offers more flexibility which is important to our garden’s demographic of working people.”
– Email excerpt from P6

Work parties were typically structured by organizers who created a list of tasks that needed to be accomplished. Community members would then volunteer for them. Yet community members often had a difficult time clarifying which tasks has been assigned and which tasks still needed people to be done. Some organizers tried to describe tasks in emails but this was still not always clear. Others tried using a shared document with Google Docs in which they would list and assign tasks for work parties:

“I made up a Google doc where we posted jobs and as people volunteer their names was put beside the job.” – P6

However, we observed that such shared documents only listed the title of jobs and people could not clearly understand the skills, estimated time, tools, and specific spaces in the garden that were required for each job. Moreover, there was no way to understand the actual hours a gardener would need to spend on each task. This made it difficult for community members to know if they could attend the work parties or accomplish certain tasks given their existing schedule. As a result of these issues, we were told that work parties often had lower participation than desired by organizers, despite it being a required community member activity. One of our interviewees commented on her confusion over such work party tasks:

“I got informed by mails about some tasks, but I felt that I am uncertain about many of them. Because of not clear about the difficulties of these jobs by email, I was not able to make sure that I am competent to it. That’s why I gave up many opportunities to work in the garden.” - P5

One could conceivably learn the specifics of a work party task when at the garden to complete the task; however, as the quote above shows, community members didn’t always clearly know what tasks they would be doing ahead of time so they could not assess whether it matched their skillset and time schedule.

Some community gardens asked members to sign up for tasks on a sign-up sheet during the AGM. The AGM was selected for such sign-ups since it was the event that most people attended. But, naturally, some people still could not attend it due to personal scheduling conflicts. This made it difficult to include all people into collaborative work.

In summary, scheduling and assigning working tasks amongst community gardeners is not easy. The work of gardeners is voluntary rather than compulsory and online scheduling systems are not widely accepted by them. Gardeners' competences using technology varies. Moreover, gardeners often have low tolerance to new tools and limited desire to learn them. They also lack shared knowledge of gardening terminologies (e.g. those related to certain tasks). In addition, control issues show up again on scheduling and assigning tasks. All these issues cause less community inclusion than expected.

AWARENESS OF PRESENCE AND ACTIVITY

Our analysis revealed that community gardeners tried to maintain an informal awareness of both the presence of others and the activities occurring at the gardens.

Awareness of Garden Members' Presence

Gardeners told us that they liked gardening when there were other gardeners in the garden at the same time. Thus, they wanted to maintain an awareness of the presence of other community gardeners in the garden itself. This allowed them to engage in conversation, discussion, and help, as previously reported. Yet in reality, it was very rare for gardeners to all come to the garden at the same time unless a special work party was scheduled. When new gardeners faced gardening problems (e.g. slugs), this meant they were not able to get help from more experienced gardeners directly. Gardeners sometimes tried to plan when they would go to the garden in order to be there when other more experienced gardeners or gardening friends were present. However, there were no convenient mechanisms for them to check how many gardeners were present at the garden or if they knew the people that were at the garden before leaving their homes.

Awareness of Garden Activities

Many community gardens also had communal plots that multiple garden members were responsible for. Gardeners donated their time and work to these areas and shared the harvest after a season. Members collaboratively managed and shared the harvest from communal plots. Some gardens also donated and delivered food from these plots to neighbors' homes. While beneficial, communal plots caused additional challenges in relation to activity awareness. Gardeners typically did not have shared knowledge of what tasks needed to be done to the communal plots. This often caused problems with a lack of watering or re-watering by garden members.

Collaborations also happened when members were on holiday, or could not come to the garden on a specific day

(even if work needed to get done). Often in the summer months, this meant 'shared watering' amongst plots. To coordinate such efforts, the gardeners we interviewed told us they sent emails to all garden members and also shared their plot numbers through a Google Group. This allowed them to see who was available to help with their plot.

"Last year, there were six of us who shared watering, like people who were on vacation, someone sent email, saying does anyone want to be a part of watering circle, so I said yeah. So then there were six people who responded and said yes. So whenever one of those six was going away and sent an email to other five says can someone water for my garden. And someone would say 'yes, I could do these days', the other 'I could do these days', so it is covered. Actually, I really like that. That is to be a part of community, too. You know, help each other a lot." – P7

In addition to looking after plots, some gardeners took pictures of other people's plots with their phones and sent them to the holder of the plots over email when they were on vacation. This helped owners get a periodic understanding of what was happening at their plot. Overall, this highlights the desire by gardeners to use technology to share awareness information.

Awareness of Shared Tools

We also found that community gardeners had to maintain an awareness of the shared tools or other resources that were used as part of their activities. All of the community gardens we observed had communal sheds that members could use. The shed was a small structure that gardeners kept tools in for shared usage and each garden had a set of shed guidelines. For example, the gardener who was the last or only one using the tools was required to return the tools and ensure that the shed was locked. All gardeners were responsible for maintaining the garden's shed, including keeping it clean inside and around the shed, returning tools where others could find them easily, and contacting organizers when the lock was broken or tools were lost.

In all of the gardens we looked at, the act of sharing tools was not an easy process. We were told that it was common for tools to be broken or lost. Gardeners also frequently brought in their own private tools for this reason and placed them in the shed. This sometimes brought up issues over which tools were communal, which were privately owned, and what tools a person could or could not use. Moreover, not all gardeners followed the guidelines to clean and return the tools after they used them. Therefore, effective management of the tools in the shed was a challenge for gardeners. Some gardens created a paper-based list that showed which tools were available for usage; however, these were only useful for gardeners to check and did not easily support the recording of new information about the tools. Thus, the system saw breakdowns when tools were lost and the list was no longer accurate.

From the analysis, we can see the desire of community gardeners to “see” the current state of their gardens when they are away. They want to know who is present at the garden as well as the situation of gardening plots. Given the nature of shared ownership, gardeners face difficulties in managing the activities on communal plots and tracking the tools usage.

DISCUSSION: DESIGN CONSIDERATIONS AND CHALLENGES

Our study has described the collaborative practices of community gardeners. We now turn to the discussion of these acts and the opportunities for technology design.

Collaborative Acts in Community Gardens

Community gardeners in our study were engaged in a variety of collaborative acts. On the surface, these collaborative acts are similar to those that occur in office-based work settings where co-workers schedule meetings, engage in casual interactions with one another to share knowledge, and use an awareness of presence and activities to move into these interactions [7, 27]. It is also likely that community gardeners who work in office settings carry over the technology from these environments because they see the need to solve similar problems that they face at work.

Yet the reality is that community gardens are very different settings than office workplaces. Office settings are often very utilitarian in nature with a drive for efficiency and productivity. On the other hand, we have seen that community gardens focus on ‘helping out’, volunteering one’s time, and trying to form and maintain a sense of community. Community gardens also have a diverse mixture of people. In the community gardens we studied, this included various language abilities, technological literacy, and access to technology. This means that it is not simply the case that office-based tools can easily migrate into community gardens *as is*. The context and culture of the place presents its own needs for collaboration tools. This suggests that designs that support community collaboration in community gardens need to focus beyond efficiency and functionality. This is consistent with the issues Heitlinger *et al.* proposed [11], as presented in our related works section.

Based on these understandings, we now articulate the uniqueness of community collaboration in community garden in terms of design considerations and challenges. Specifically, generated from our findings and analysis, two categories of themes about these differences are described in the following parts: 1) *considerations* for designing to support community collaboration in community gardens; 2) *challenges* in designing for community collaboration in community gardens. The first category leverages opportunities that emerged in the findings; the second identifies challenging problems or much more intractable concerns and issues that emerged from the study.

Design Considerations to Support Community Collaboration in Community Gardens

In this section, we discuss how findings from our study can be leveraged into design considerations. This category of themes includes considerations related to *Volunteerism*, *Competences*, *Synchronicity*, and *Telepresence*. These issues articulate the different nature of community gardening collaboration from workplace collaboration and therefore a different set of emphases and priorities for designers.

Volunteerism

Community collaborations in community gardens are largely based on volunteerism rather than compulsory or for financial gain. In this sense, any effort on behalf of the gardener including the use of technologies should strongly map to the motivation behind the volunteerism, such as gardening, meeting their neighbors, belonging to a social group, and enjoying growing your own food. In designing technologies for collaboration, a key consideration and priority is the immediacy to which tools and technologies align to the motivations of a volunteer. This consideration suggests that technology design should be “natural” to the gardening group, which is also suggested in Bidwell and Browning’s work [2]. With this in mind, it is not the technologies that are important, rather it is the proximity of the use of the technologies to the motivations that are important. For example, emails to organize and coordinate watering circles to maintain plots when the gardeners are away worked well while Google Docs used at home for scheduling and assigning work tasks did not work well. Therefore, when designing for community collaboration in community gardens, which are based on volunteering, we believe that designed technologies more closely linked to personal motivations will be more successful.

Competences and Inclusion

Related to motivations of volunteerism, we can see there is a low threshold or tolerance for learning new communication tools or any tools that are not directly and immediately relatable to a gardeners’ motivation. For example, many gardeners did not like online scheduling systems or have interests in learning how to use them. Different from the workplace, part of the measurement of a successful collaboration in community gardens is community inclusion, as illustrated in the Scheduling and Assigning Work Activities result section. The priority of inclusion is beyond task accomplishment in this context. As a consequence, successful tools for scheduling or information sharing that are mapped to existing competences where no new competences need to be learned work best, and those tools that are simplest or aimed at the lowest common denominator for competences are the most inclusive. In our study, we found that scheduling tools were a challenge to many and it could be argued that such tools were as a result exclusionary. This lack of control over one’s involvement in community garden activities created frustration.

Synchronicity

Supporting face-to-face or on site collaboration and communication is a very important issue designers could consider. This theme relates to what Goodman [9] referred to as the “sensational link” between gardeners and their garden. As a result, community gardeners largely prefer collaboration on site rather than talking about gardening away from the site. Context and immersion is highly valued in community gardens, which is not surprising given the embodied nature of gardening. On site casual and formal interactions were seen as more valuable than off-site interactions since they are in context and allow for embodied participation and exchanges. Signs and notices on site are valuable since they are in context and synchronous with gardening and being with people. Designing for synchronous collaborations and interactions on site would be a key starting point for any design considerations. This involves rethinking the priorities of distributed work and asynchronous collaborations of the workplace with collaborative tools.

Telepresence

Related to the theme of synchronicity, telepresence technologies of the workplace emphasizing distributed work would not, based on our study, work well in community gardens. We feel that virtual technologies that take gardeners away from the community would not be widely accepted, but virtual technologies that bring gardeners to the garden could be successful. Virtual tools that bring the gardens closer when a gardener is away are keen design opportunities, for example knowing who is present at any given time or having photos of your garden sent to you while on holidays.

Challenges in Designing for Community Collaboration in Community Garden

In this section, we identify and articulate hard problems or intractable concerns and issues that emerged from the study. We see these as issues not for technologies to “solve,” rather they are part of the complexities and conflicts within community gardening collaboration design situations. Issues include *Control*, *Shared Language*, and *Collective ownership*.

Control

As we discussed earlier, organizational structures of community gardens are minimally hierarchical and very flat, reflecting the underlying volunteerism of such groups. We also highlighted how information sharing amongst community members is critical. However, in community gardens, information is mostly controlled by, for example, notice boards covered by glass for reasons of weather resistance; and websites centrally controlled to ensure clarity and accuracy of information, as we revealed in the Information and Knowledge Sharing section. Thus information sharing and community ethos are often in conflict. Gardeners’ desire for synchronicity can compound this problem since some of the most equal exchanges of information are the casual interactions on site. Yet these are

not shared with other gardeners. Controlled scheduling conflicts with the volunteer motivations to pick the days gardeners desire to be on site rather than mandating them. For example, as our findings showed, gardeners want workdays to be flexibly scheduled rather than on Sundays, yet fairness and shared workload dictate a degree of mandated scheduling. Control issues in a community setting pose a fundamental challenge to most considerations of technologies, particularly with complex matters like information sharing and scheduling.

Shared Language

Related to volunteerism, there is limited desire on the part of gardeners to invest the time and preparation to acquire and become fluent in a shared language (e.g. detailed knowledge of certain tasks and the related terminology), unlike in the workplace where this is a necessity. As a consequence, managing and assigning work tasks can be challenging and further, a lack of understanding of what is involved may make participation more intimidating. In this case, the problem of shared language is a complex situation and difficult to resolve, thus becoming part of and often beyond design or technology considerations.

Collective Ownership

Community collaboration in our gardens involved shared ownership of tools rather than management owned resources of the workplace. Managing accountability and responsibilities of the maintenance and tracking of collectively owned tools (or resources) is complex in community gardening collaboration. It is also difficult to resolve. Hence, design and technologies alone are limited in addressing the social complexities of shared ownership.

To conclude, in this section, we propose a set of considerations when designing for community collaboration in community gardens. Generally, the issues we raise reflect the differences with collaboration in the workplace and help to articulate the community collaboration in gardens. Key among this community gardening collaboration is the underlying volunteerism in community gardening. As a result, efforts and tools need to be closely mapped to the motivations of the gardeners; meaning new tools that go beyond existing competences are less tolerated. Further, inclusivity is central and such tools can be viewed as exclusionary if not designed well. The embodied practices of gardening and motivations of community gardeners privilege synchronicity and on-site interactions, such that telepresence tools that bring gardeners closer to the site have potential for success. We also highlighted the complexities of community collaboration in community gardens that raises issues like *control*, *shared language*, and *collective ownership* that exist more as conditions within which to design than “problems” to solve through technologies.

CONCLUSION

This paper has presented a detailed study of collaboration in community gardens. We described three collaborative acts:

information and knowledge sharing; scheduling work activities; and, gaining awareness of other gardeners, activities, and shared tools. By comparing workplace collaboration and community gardening collaboration, our work identifies opportunities and challenges related to the design of technologies for community gardens. The contribution of our work is the articulation of the key considerations embedded in community collaboration in the context of community gardens, which include *volunteerism, competences and inclusion, synchronicity, telepresence, control, shared language, and collective ownership.*

ACKNOWLEDGMENTS

We thank all our participants. We also thank Chinese Scholarship Council (CSC) for financial support of this study.

REFERENCES

1. Armstrong, D. A survey of community gardens in upstate New York: Implications for health promotion and community development. *Health & Place*, 6(4), 2000, 319-327.
2. Bidwell, N. J., Browning, D. Pursuing genius loci: interaction design and natural places. *Personal and Ubiquitous Computing*, 14(1), 2010, 15-30.
3. Bly, S. A., Harrison, S. R., & Irwin, S. Media spaces: bringing people together in a video, audio, and computing environment. *Communications of the ACM*, 36(1), 1993, 38-46.
4. Brzozowski, M., Carattini, K., Klemmer, S. R., Mihelich, P., Hu, J., & Ng, A. Y.. groupTime: preference based group scheduling. In *Proc. CHI 2006*, ACM Press (2006), 1047-1056.
5. Diana, C. P., Glover, T. D. and Kimberly, J. S. 'Mary, mary quite contrary, how does your garden grow? Examining gender roles and relations in community gardens. *Leisure studies*, 24(2), 2005, 177-192.
6. Doyle, R., Krasny, M. Participatory rural appraisal as an approach to environmental education in urban community gardens. *Environmental Education Research*, 9(1), 2003, 91-115.
7. Fish, R. S., Kraut, R. E., & Chalfonte, B. L. The VideoWindow system in informal communication. In *Proc. CSCW 1990*. ACM Press (1990), 1-11.
8. Glover, T. D. Social capital in the lived experiences of community gardeners. *Leisure Sciences*, 26(2), 2004, 143-162.
9. Goodman, E. Learning in Nature: Reflection as Means and Motivation. *Designing for Reflection on Experience*, Lancaster University, 2009.
10. Harrison, S. Media Space: 20+ Years of Mediated Life, Springer, 2009.
11. Heitlinger, S., Bryan-Kinns, N., Jefferies, J. UbiComp for Grassroots Urban Food-growing Communities. In *Proc. UbiComp '13*. ACM Press (2013), 589-594.
12. Labonte, R. Social inequality and healthy public policy. *Health Promotion International*, 1(3), 1986, 341-351.
13. Naimark, S. *A handbook of community gardening*. Macmillan Reference USA, 1982.
14. Nardi, B., Whittaker, S., and Bradner, E. Interaction and Outeraction: Instant Messaging in Action, In *Proc. CSCW 2000*, ACM Press (2000), 79-88.
15. Odom, W. Mate, we don't need a chip to tell us the soil's dry: opportunities for designing interactive systems to support urban food production. In *Proc. CHI 2010*, ACM Press (2010), 232-235.
16. Osama Mansour, Mustafa Abusalah, and Linda Askenäs. 2011. Wiki-based community collaboration in organizations. In *Proc. C&T '11*. ACM Press (2011), 79-87.
17. Qu, J. Jing Hua: interacting with virtual flowers in a physical garden. In *Proc. TEI 2012*, ACM Press (2012), 391-392.
18. Palen, L. Social, Individual, and Technological Issues for Groupware Calendar Systems, In *Proc. CHI 1999*, ACM Press (1999), 17-24.
19. Pearce, J., Murphy, J. and Smith, W. Supporting gardeners to plan domestic watering: a case study of designing an 'everyday simulation'. In *Proc. OZCHI 2008*, ACM Press (2008), 227-230.
20. Power, E. R. Human-nature relations in suburban gardens. *Australian Geographer*, 36(1), 2005, 39-53.
21. Reynolds, R. On guerilla gardening: A handbook for gardening without boundaries. Bloomsbury, 2008.
22. Saldivar-Tanaka, L., Krasny, M. E. Culturing community development, neighborhood open space, and civic agriculture: The case of Latino community gardens in New York City. *Agriculture and human values*, 21(4), 2004, 399-412.
23. Schukoske, J. E. Community development through gardening: state and local policies transforming urban open space. *NYUJ Legis. & Pub. Pol'y*, 3, 1999, 351.
24. Shinew, K. J., Glover, T. D. and Parry, D. C. Leisure spaces as potential sites for interracial interaction: community gardens in urban areas. *Journal of leisure research*, 2004.
25. Surls, R., Director, U. C. Community garden start-up guide. *Los Angeles: University of California Cooperative Extension*, 2001
26. Wals, A. E. (Ed.). *Social learning towards a sustainable world: Principles, perspectives, and praxis*. Wageningen Academic Pub, 2007.
27. Whittaker, S., Frohlich, D., and Daly-Jones, O. Informal workplace communication: What is it like and how might we support it? In *Proc. CHI*, ACM Press (1994), 131-137.
28. Whittaker, S., & Sidner, C. Email overload: exploring personal information management of email. In *Proc. CHI 1996*, ACM Press (1996), 276-283.