"Collective Wisdom": Inquiring into Collective Homes as a Site for HCI Design

Jo Shin, Gabriela Aceves Sepúlveda, William Odom
School of Interactive Arts and Technology
Simon Fraser University,
Surrey, British Columbia, Canada
{jo_shin, gabriela_aceves-sepulveda, wodom}@sfu.ca

ABSTRACT

The home has been a major focus of the HCI community for over two decades. Despite this body of research, nascent works have argued that HCI's characterization of 'the home' remains narrow and requires more diverse accounts of domestic configurations. Our work contributes to this area through a four-month ethnography of three *collective homes* in Vancouver, Canada. Collective homes represent an alternative housing model that offers agency to individual members and the collective group by sharing values, resources, labour, space and memory. Our paper offers two contributions. First, we offer an in-depth design ethnography of three collective homes, attending to the values, ownership models, practices, and everyday interactions observed in the ongoing making of these domestic settings. Second, we interpret and synthesize our findings to provide new opportunities for expanding the way we conceptualize and design for 'the home' in HCI.

CCS CONCEPTS

• Human-centered computing → Empirical studies in HCI

KEYWORDS

Collective Homes; Domestic Computing; Ownership

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1 INTRODUCTION

The home has been a major focus of the HCI community for over two decades. Despite this body of research, recent works have argued that HCI's characterization of 'the home' remains narrow and requires more diverse accounts of domestic configurations (e.g., [11] [12] [19] [23] [32] [43]). Our work contributes to this growing area through an in-depth, design ethnography of three collective households in metropolitan Vancouver, Canada, a city that is well known for its long history of alternative approaches to housing[1,6]. Collective houses are an unconventional model of housing, largely made up of strangers, who form an intentional communal home environment in a single dwelling. These households share more resources, possessions, and places than conventional single-family homes or share houses might. Each of our collective homes represented three different life stages of a collective house; (i) the first year of establishment, (ii) ten years in, and (iii) over forty years later.

Using Gruning and Lindley's domestic ownership spectrum [18], our goal is to explore how collective households uphold or conflict with conventional perspectives of home. By exploring nuanced approaches to sharing and ownership in a collective environment, we highlight implications these cases suggest for the HCI community.

Findings revealed nuanced ways that communal ownership in collective environments support individual agency by considering the varied and changing abilities or senses of its residents. In turn, residents' agency activates the collective house as a site of memory. Our study also revealed how labour added dimensions to domestic ownership, while the house itself becomes an actor in the collective. As an alternate model of mid to long-term housing, our findings illustrate how collective home members cooperate effectively to manage the longevity of their homes internally, despite external pressures and limited social acceptance that threaten their permanence.

Our work helps to extend this nascent and growing area of HCI research by expanding the ownership spectrum to include three additional forms of ownership found in the collective home; in this, we directly build on Gruning and Lindley's determinants of ownership with nuanced approaches to the *origins of belongings*, *designations of location and space*, and introduce the value of *labour* as a determinant of ownership. Based on these expansions of the ownership spectrum, we provide design implications and opportunities for future work in HCI that can support the collective home and help inspire new approaches to the research and design of domestic spaces.

2 BACKGROUND & RELATED WORK

The home has been a major focus of the HCI community. Over the past the past two decades HCI researchers have investigated the domestic domain as a key site for a number of issues including social coordination, communication, everyday practice, and, more generally, the role that smart and ubiquitous technologies might play in enhancing people's everyday lives outside of the office.

In this vast body of work, HCI researchers have also questioned and inquired into the nature of home and technology [26] by investigating the values, social practices and organization of the home's residents [8] [9] [37] [39] [40] [44] while other works have focused on the impacts of domestic ICTs introduced into the home [5] [21] [24] [27]. By gathering a large rich body of knowledge about domestic spaces, HCI researchers are better prepared to interpret the complex relationship between the home, its residents and technology.

While these studies have contributed to what is now the canon of domestic space research in HCI, recent works have argued that these inquiries, while important, have been limited in their perspectives of 'the home'. Desjardins et al [12] synthesized 121 home and domestic space publications from twenty-five years into seven genres and two dominant perspectives based on epistemological commitments. In addition to Desjardins et al, other works in recent years have also followed similar epistemological lines of inquiry about the home; questioning homogenous interpretations of the home [1] [3], its material boundaries [4], social configurations from single-person domestic living situations to children of divorced parents residing in multiple homes [28] [31], as well as structural forms of living in vans to co-housing communities [1] [19] [20] [46]. Each of these works have demonstrated the need for domestic spaces research to expand its notion of 'home' and to develop further inclusive perspectives of domestic *life* in order to better understand the rich design possibilities and disruptions within 'the home'. Our work helps expand this nascent and growing area of research by offering an in-depth exploration of three collective homes. We analyze the values, ownership models, practices, and interactions that guide these heterogeneous homes and to expand how the HCI community might approach researching and designing for 'the home'.

2.1 Collective Houses

Historically, collective houses in the global north refer to a communal housing model traced back to the Swedish *kollektivhus* and the Danish *bofaellesskab*, influenced by American and Nordic utopianism [42]. Today, collective houses are an alternative form of housing in which multiple members, largely strangers, come together to form an intentional communal home environment in a single dwelling. These households are often medium to long-term living arrangements that offer agency to individual members and the collective group, challenging normative definitions of "home" and homogenous assumptions of domestic technology users. While similar in their community values approach to the shared community model of co-houses in Atlanta, USA [19] [20], collective houses in Vancouver accommodate unconventional social configurations of related and unrelated residents (sometimes including children and people with different intellectual and physical abilities) who all share one dwelling, its limited living spaces, resources, labour and practices by design.

Collective houses are not unique to Vancouver; however, Vancouver represents a unique site to focus our research for two important reasons. First, it has a diversity of housing models that have emerged both organically and structurally with the support of all levels of government. From conventional single-dwelling family homes to tiny homes, vehicle living and single-resident social housing, as well as collectives and larger co-operative co-housing, it is home to many forms of dwellings [22] [36] [35]. Second, Vancouver currently suffers from an affordable housing shortage [6] [7] [33] despite its international reputation as one of the most livable cities in the world [17] [47] [48]. Collective living is an affordable model of housing in a city where affordable housing is increasingly challenged by population density and a shortage of affordable stock [2] [49]. The intersection of these incongruous circumstances makes collective houses in metropolitan Vancouver an important and unique site to study the unremarkable, mundane and densely nuanced

ways in which the home operates as a site of interaction between the dwelling, its residents and technology.

3 METHODS

Our ethnography focuses on a small selection of three collective households and ten participants to gain a rich, descriptive understanding of the collective home environment. Our work is an initial qualitative investigation into these unfamiliar domestic configurations and informs what might be salient issues for future research and practice.

3.1 Participant Recruitment

Participating collective houses and their members were selected for inclusion in our study based on their current residence in a self-identified collective household located in metropolitan Vancouver, ability to complete an interview in conversational English and availability to provide a walkthrough of their home. A combination of snowball sampling and social media outreach were used to recruit participating houses. We reached out to contacts known to the collective housing community in Vancouver; a personal contact of one of the researchers living in a collective house and the Collective Housing Society of Greater Vancouver, a local non-profit housing collective resource, both were provided with study information to share with potential participants to ensure consistent and accurate study information. Both informants informally vetted potential participating houses for characteristic diversity and representation of collective houses. While two collective houses were recruited through informants, one of the houses were recruited through social media during a call for participants on Facebook.

The particular collective households recruited in this study offer insight into how different collective households share similarities but also differ from one another, while their distinct life stages inspire how long-term alternative domestic living configurations could function. Each of the three participating collective households represent a different life stage of a collective house; (i) the beginning; first year of establishment, (ii) ten years in sustaining a collective, and (iii) at maturity over forty years later. We found three houses would be an adequate start to explore collective homes in Vancouver considering the very limited knowledge about these domestic environments within the HCI community.

3.2 Data Collection

During the course of our study we visited a total of three collective households over the period of four months. Our approach primarily involved semi-structured contextual interviews with each household that were audio recorded, each lasting approximately an hour and a half in length. Following the interviews, observations were made in the form of field notes and photography during in-home walkthroughs of the home, led by one or more collective members. 'Deep hanging out' [34] [44] was a secondary form of data collection we employed when we spent open-ended free time with participants by participating in collective meals and hanging out in collective spaces. Each household self-determined the style and number of participants to be interviewed which resulted in two one-on-one interviews with a member of the Union Collective (including a revisit), one focus group style interview with all members of Club 16, and a dinner focus group style interview with all members of the Mountainview Collective. Enabling each household to shape their interview format allowed participants to build their own rapport with the interviewer. The visits resulted in a total of four interviews with ten individual participants and three walkthroughs. All participants were asked to nominate pseudonyms for themselves and their collective houses.

3.3 Analysis

After each interview was conducted, each audio recording was transcribed and shared with the participating collective household to ensure data integrity and their contributions. At the end of the data collection period, interview transcripts were imported into NVivo 12 qualitative data analysis software and coded for emergent themes.

An inductive-deductive logic was applied to data analysis. Transcripts were first coded by low-level inference for "ownership" and "sharing", as well as other patterns. As nuanced forms of ownership and sharing emerged, we undertook an axial coding approach to the transcript. All primary and secondary data collected (i.e. transcript-based data, observations, photographic images and researcher notes) were then redistributed in an affinity clustering exercise from which emerged our three major themes and their sub-themes. From the 154 pages of transcription and 335 images from on-site walkthroughs gathered, three major themes each with an additional three sub-themes were identified.

Figure 1. Union Collective from the backyard (left), inside Club 16's living area (center) and Mountainview Collective (right).

3.4 Background and Overview of our Collective Households

Home to Canada's third largest population, Vancouver currently outpaces other Canadian cities when it comes to population growth [35]. The area's growing population density, relative high cost of living, as well as other socio-political and economic factors have resulted in fewer affordable housing options for people living here. Our city is also a geographically unique port city exposed to many international influences and yet, it is limited by its borders; with the Pacific Ocean and archipelagos to the west, the Cascadian and Coastal mountain ranges to the north and east, and a shared border with the United States to the south. Together, these issues of density, affordability and limited geographic space have motivated a history of different models of housing in the region. Collective homes found in Vancouver are an alternative response to these environmental pressures, making them an ideal site to explore heterogeneous forms of domestic living.

Going into the field, we expected a certain degree of diversity and unconventional domestic living practices based on previous work [[19][19], [32] and our own personal shared living experiences in this city. We visited three different collective households during our fieldwork: the Union Collective to the east of our city, Club 16 to the south-east and Mountainview Collective to the west. Each collective house is distinctive in its membership, circumstances and household lifecycle. Our participants are notably diverse yet provide a foundational understanding of the shared similarities between collectives over time. Next, we offer brief overviews of each collective household.

3.4.1 Union Collective

At just over a year into its establishment, the Union Collective is our youngest collective house; this collective of five was predominantly led by a single member, An-Albert. For An-Albert, a collective house is about "*people living together and making things work together and being there for each other*". Having lived in collective environments since her childhood, deciding to set up a new collective house came naturally to An-Albert who was dissatisfied by the leadership structure in her previous collective house.

Members of the Union Collective consisted of An-Albert, an accessibility consultant in the arts sector; her four-year-old son, Lou, who lives with her part-time; Ed, An-Albert's housemate from a previous collective household; Peter, a twenty-seven-year-old Deaf man with an intellectual disability under An-Albert's care; and Megan, the newest member to join. All members of Union Collective live in a small two-storey five bedroom detached rental house. While An-Albert did not consider the collective a "hardcore" collective, she stated it was made unique by Peter's presence. For the collective, living with a Deaf person with an intellectual disability means having greater flexibility, patience and strategies beyond that found in most shared domestic or even collective home environments. For Peter to be included in the collective and to have his needs met, the household provided additional social supports, including the introduction of American Sign Language (ASL) in addition to spoken English and Flemish in the household.

3.4.2 Club 16

Four members in their 20s–30s lived in Club 16, which they characterized as an "unstructured collective" that has become a "clubhouse" for current and past members. Having been established nine years ago and still

functioning as a collective house, Club 16 approached collective living with a dedicated sense of social and environmental responsibility. Club 16 was located in a two-level rental house separated into two units; its four members were distributed across its four-bedrooms in one of the units. Its members consisted of Boomer, a graduate student; Patricia, a non-profit professional, and a romantic couple, Chris A., an engineer and Todd, a beer brewer. All house occupants, including the neighbours, shared a laundry room, garage and yards.

3.4.3 Mountainview Collective

The Mountainview Collective is just over 45 years old making it one of the oldest collective houses in the city. Its six members work together to continuously determine the nature of the collective house and encourage a sense of community in it.

Mountainview Collective is located in a two-storey rental house. Five adults, one child and a seeing-eye dog share the five-bedroom dwelling. The two newest members were Julie, a spiritual healer, and Joey, a health supplements consultant, who had lived in the house nine months each. For Joey, this was the third time living in Mountainview Collective; cumulatively, he has lived over four years there. Other members included George, a school teacher, Melissa a musician, and Chris B. a community consultant, respectively. Chris B. is also a blind person who is married to Melissa. The couple have lived in the house the longest, raising their child, Frankie, there. As one of the most established collective houses in our city, the collective hosted regular community events to further foster a collective community within the city.

3.4.4 Collective Home Culture: Understanding What it's all about

All three collective houses approached the making of home life with a distinct intentionality. Each were invested in maintaining and improving their physical house, as well as the collectivist social structure of their home. As Melissa, one of the Mountainview Collective members, describes: "*…a collective house should have some defined shared property, some shared values and some defined social structures that sort of encourage a sense of community*".

Home culture across all houses embraced inclusive political views, DIY culture and sustainability. Home culture was reinforced by the members willing to "work" through cooperation and collaboration to keep the house "going" even if it meant the collective might one day relocate to a new dwelling.

In the following section, we discuss three major themes that help better characterize the commonalities and diversity across our study of collective households, these include: the house as a site for ownership, agency and history; sharing and ownership practices; and maintenance and upkeep of household longevity. Our goal is to demonstrate how collective households uphold or conflict with conventional perspectives of home, and to reflect on the implications these cases suggest for the HCI community.

4 FINDINGS

4.1 The House as the Site for Ownership, Agency, & Memory

In our study of collective houses, a focus on intentionally creating a culture of sharing as a "community" facilitated the home as a site of ownership, agency and history. A defining feature of collective houses is their approach to ownership, which in turn enables greater agency. Greater agency among collective members contributes to the history of the house.

4.1.1 Ownership

In many ways, ownership in our collective homes were not dissimilar from ownership models found in conventional homes. Like other Eurocentric global-north families, our collective households had separate rooms for each individual member or couple unit. Communal spaces (e.g., living rooms, kitchens, laundries and green spaces) were shared among residents and each member owned personal possessions (e.g., clothes, bathroom affects, photographs, ornaments, some furniture). Uniquely, the members of these collective households pooled individual financial resources to communally own food, belongings, appliances and other resources such as the internet, electricity and water.

Communal ownership enabled members with access to more resources than individually possible; providing a greater quality of life and a higher potential for improved resources. As described by Chris B. of Mountainview Collective:

> "I think one of the core parts that matters to me is the idea of shared communally owned property and communally owned culture… or way of doing stuff. And… that in part of sharing stuff together as a collective, that it expands my resources, my capacity to do things and to have things and to be a part of things that I could never have living as an individual."

Across all participating houses, members were satisfied with the amount of space they could access and felt they could collectively invest more money on more reliable or elaborate appliances or furniture.

For communal ownership to work well, members emphasised the importance of their relationships to one another. Communication, trust and accountability were fundamental to these relationships which enabled collaboration and cooperation within the home.

4.1.2 Agency

Communal ownership afforded members an increased sense of agency individually and as a group. Collective resources provided material and immaterial benefits, including cost and time saving, as well as greater social agency.

Social agency was an immaterial benefit we observed most profoundly in the cases of Chris B. (Mountainview Collective) and Peter (Union Collective). These households approached members' abilities and needs differently; for Union Collective, care for Peter was central to their collective culture, while at Mountainview Collective, Chris B.'s blindness was not a defining feature of the household.

Being a blind person living in a collective house did not hinder Chris B.'s independence, rather, members of the house cooperated to ensure the home environment was consistently organized and cared for in order to make it more accessible for all members. According to Melissa:

> "We can't leave something out on the floor where Chris' going to step on it or on the counter where he's going to sweep it off. And our fridge has a set place for each thing that we try and always put things in the same place, so Chris knows where it is. So, there are things we as a household have to think about; we don't leave doors ajar or we try not to because he'll crash into them. So, there's just things we all have to be aware of, in – in the same way other people have their things."

Relatedly, at Union Collective, collective living provided social agency for Peter, a 27-year old Deaf person with an intellectual age of approximately 6 years old. Within the supportive structure of the collective, Peter was able to learn new ways to care for himself, including new domestic skills and social norms, and was able to live independently outside of his family home or an assisted living facility. Both households also carefully worked to only invite new members who could commit to these expectations of care, organization, cleanliness and cooperation in the home. In effect, maintaining Chris B. and Peter's social agency provided the rest of the collectives with clear expectations of home culture and its practices.

4.1.3 Memory

Communal ownership and mutual agency created a shared history of lived experiences within each collective household. This history solidified a collective's home culture and animated physical dwellings into sites of memory [25].

Mountainview Collective and Club 16, the two longest established collective households, had the most cohesive collective home cultures. Though these households were often uncertain about the origins of objects or even the collective itself, they were abundant in stories and records of the collective and dwelling. Mountainview Collective kept filed records of each collective member who had lived in the house, as well as records of maintenance and contractors who had worked on the house. Club 16 displayed a collection of postcards from current and former house members – some of whom they hadn't met – on their kitchen fridge, keeping the history of the collective apparent to all.

Dwellings became a site of memory through acts, relationships, systems and storytelling that activated a willingness to remember by all members. Melissa at Mountainview Collective referred to the changes in collective membership over time as "constellations" – a poetic expression of the collective's evolving social configurations and relationships:

> "I call it constellations, like constellation changes, and we try when someone new comes in to encourage them to feel free to, to really move in and be here, and try and speak up and have an equal voice right away, and having said that there are a lot of time honoured traditions and you know, at times people have said they feel like it's hard to make changes because there is so much tradition and I think that's always a balance."

Each constellation would have different routines, uses of space, systems of chores, and styles of cooperation and collaboration based on the abilities, needs and dynamic of its members at the time. Houses experienced shifting demarcations based on the passage of time and the changing "constellations" of members, raising questions about the design intentions of the house and leading us to consider the house as an object that accrues an inscribed history too.

Layers of paint and traces of home improvements, accidents and indentations around the home reminded members of the house's history before them, with them,

and of a possible time after them. This idea was most prevalent at Mountainview Collective which had experienced many upgrades over the course of the collective's tenure. One of the most obvious displays of shifted demarcations and inscriptions on the property was the extensive landscape design by collective members. Rustic wooden handrails and planted trees zig-zag the pathway up to the house, while in other parts of the property, traces of recent damage from wind storms were yet to be patched. Inside, remnants of previous tenants from over forty years ago still peeked through a children's mural on the walls of an old play area.

4.2 Labour, Space, and the House as Actor: Extending the Ownership Spectrum

Intentionally creating a culture of sharing as a core part of their home culture was central to collective living across all of our participating houses. Several of our observations are consistent with Gruning and Lindley's ownership spectrum [18] of shared and non-shared belongings which breakdown into the following categories: *primary ownership* (e.g. a smartphone belonging to one person), *joint ownership* (e.g. two brothers own a video game together), *sole ownership by design* (e.g. objects viewed as specifically for one individual), *and sole ownership by default* (e.g. objects belonging to one individual because no one else would like to co-own). We used these categories as a lens to initially frame and organize findings in our ongoing fieldwork. Yet, over time, we found that key instances in our research did not comfortably sit in this spectrum and raised questions about the alternative dimensions of sharing. This was particularly evident in the ways labour and space were shared (or not shared), and by who or what was doing the sharing. Next, we draw on examples that could help complement and expand the ownership spectrum to include the role of sharing labour, space and ownership by non-human actors (e.g., the house).

4.2.1 Labour

One consequence of communal ownership was the added burden of responsibility for preparation and maintenance it created for members. Owning things together meant buying, cleaning and fixing things together too.

Meals and chores were major forms of labour in all households. We found meal preparation for a whole household was a persistent activity that required much planning and additional labour. Club 16 and Mountainview Collective both expected their able-bodied members to cook one dinner a week, resulting in several weekly shared dinners for the whole house and any guests. These acts provided household routines for members to maintain social connections. For the individual, these meals allowed them to invest in one laborious culinary event a week, rather than multiple days of labour. All collectives largely served vegetarian meals for efficiency, dietary needs and commitments to sustainable consumption. Meal selection requirements meant individuals had to think creatively to provide meals for all needs and plan shopping for ingredients accordingly within financial and time constraints.

Labour in the form of chores consisted of unstructured monthly "cleaning frenzies" for Union Collective, while more established houses created and adjusted chore systems to meet the needs and constellations of the household at the time. In addition, "work parties" were frequent all-day chore events for Club 16 and Mountainview Collective. Chore systems often worked as scheduled forecasts of future tasks and sometimes acted as a check-off system that reminded members of tasks at hand, and visualized other's labour and contribution to the household.

At times, shared labour caused a "diffusion of responsibility" for Mountainview Collective. Communal ownership created an over-reliance on the group, causing individuals to delay or defer individual responsibility of issues that affected the whole collective. House members recognized individual contributions to the collective should be meaningful and that an equitable contribution of labour was more valuable than equal participation. As Melissa explained:

> "We realize that in a collective system we don't have to do equal amounts of things, but we all have to contribute meaningfully and it's going to be different types of contributions based on the personalities. You know, some people do lots of outside stuff but not much inside, some people do lots of inside but not outside, and we get into conflict if somebody starts counting how many buckets of weeds each of us took because maybe some people do five times as much as others but then the people that aren't doing the weeds are cleaning something else that… so-so it's kinda just the cosmic balance is what's important."

Equitable forms of individual contribution were generally encouraged; however, the balance of equitable and equal labour became a fuzzy and subjective topic. Chris B. elaborated on this:

> "Yeah, and for me, like, I really think the balance comes down to are you balancing your contribution with what you get out of… out of living here? Like, I hear what Melissa says about the 'cosmic balance' idea,

> but I also think it also allows for inequity to occur. Sort of, if you just say, 'everybody's all doing their part and let's not look too carefully' and then I think there are some un… unfairness that that occurs. Because that benefits not doing your fair share."

House labour was a valued form of contribution to all collectives, and the cost of shared ownership was equitable individual labour. The labour we witnessed in our collectives was only a glimpse into the work necessary to maintain a collective house. Our research highlights the nuanced cooperative practices, communal trust, and often unseen and undervalued labour expended in all domestic spaces in collective homes.

4.2.2 Space

Like labour, the importance of space was a major consideration for shared ownership in our collective households. Similar to Gruning and Lindley's findings with romantic couples and families living together in conventional homes [18], collective households used designations of public "our" spaces and private "mine" spaces to delineate shareable status.

These designations were still being defined at the youngest collective, Union Collective. In this collective, Lou's bedroom was one space that kept shifting in share status. Despite being converted from a public storage closet, four-year old Lou's bedroom was still being used as a linen closet. It meant the child's room was a semi-private and public space, confusing members who needed to access linens but did not want to disrupt a sleeping child.

Although demarcations of public-private spaces were complex at times, members raised the importance of social connections that the collective social structure and shared spaces provided. Multiple people sharing space also created unplanned opportunities for social engagement which all houses agreed was a social benefit of collective living. As Patricia from Club 16 described:

> "…maybe we're not actively hanging out but we're all here and still appreciating each other. Maybe we're all doing our own thing, and then once in a while someone throws out a joke. You don't have that with other people if you make plans. Like, 'do you just want to sit beside each other and not talk for an hour?'."

Comments such as "I function better with other people around me" (An-Albert, Union Collective) or "my life is better when I'm living with other people" (George, Mountainview Collective) were frequently mentioned.

An additional quality to space we encountered was the role of sound. Sound defied physical boundaries or even public-private demarcations at Mountainview Collective which used different ornamental bells to indicate different routines in the home during the day, including a dinner bell to notify all members in the house to gather for dinner. Some members negotiated unwanted sound-space issues by using earplugs during sleep hours. Here, "space" is complicated and socially and materially negotiated; shaped by how people value their domestic environments.

4.2.3 The house as actor

Across our collective households we observed the house itself as an actor with owner and borrower status. Discarded or forgotten objects from current and past members, often furniture or kitchenware, were considered to "belong to the house". Other times, objects were bought by members specifically for the house. In these instances, members collectively agreed to invest money and time in things the house needed, such as new wall shelves for storage or linens. As exemplified by An-Albert from Union Collective:

> "…if I buy new lamps or some sheets or a new duvet or anything like that, that now belongs to the house".

A unique case of the house as borrower was from Club 16, who shared the story of the house piano that had predated the current constellation of members' arrival. Unused by the household who were unaware of its origins, the collective members had recently decided to giveaway the piano for free on Craigslist, a public online trading board. Soon after making this decision, a former collective member they had never met but had vaguely heard of, knocked on their door in passing, and identified themselves as the original owner of the piano, and asked to retrieve it. In this example, the house was a default borrower of an extended loan.

Similarly, we witnessed the mass accumulation of discarded, forgotten and loaned objects at Mountainview Collective. The collective had accrued a garage full of boxes and items with no obvious owner; some were a result of "the diffusion of responsibility" by former members who left belongings for the house to manage. Although many of these items could be viewed as being under the ownership of the house, because they were not of value to the house, the collective members annually donated them to charity or sold them on Craigslist to create more space for the collective.

In these examples, belongings are not necessarily owned by a person but the house; and by extension its current and future members. This indicates that the house can be a member of the collective too. It holds a place in

the ownership spectrum as with its human members and has ownership stakes in the collective; benefiting through improvements, being lived in, and having inhabitants who extend its "life' and constantly remember its past.

4.3 Maintaining Infrastructure & Household Longevity

For all parties to co-exist in our collective households, including the collective group, individual members, and dwelling; much effort was exerted to maintain a systematic and social infrastructure and longevity of the household. These efforts demonstrated the long-term view of collective households – given the ideal circumstances and external resources, collective households could exist indefinitely. Approaches to maintaining infrastructure and household longevity were three-fold: cooperation within the household, recognition from external systems and pressures, and social acceptance of the collective housing model.

4.3.1 Cooperation within the household

Internally, collectives approached time with a gradual and indefinite view. Collaboration and cooperation were employed in all households as a means to secure the unknown future of the collective. This manifested in the adoption of Do-It-Yourself (DIY) culture, noticeable commitments to sustainability practices and flexible practices that supported social cohesion.

DIY culture was a prominent strategy used to save money while renewing social bonds and sustainable values. Club 16's shared recreation of homebrewed beer, itself an act of DIY self-sufficiency, led to the adaptation of a secondary beer fridge in the garage. This refrigerator was repurposed by the members to hold multiple beer kegs and redesigned with beer taps to allow members to more easily enjoy their pastime. Another DIY collaboration with a long-term view was observed at Mountainview Collective which had collected over three-year's worth of firewood for the house. Firewood was not only a practical necessity, but ensured the house was kept sustainably warm with wood sourced from the property or donated by neighbours. Sustainability was an especially long-term approach to longevity. All houses composted, recycled regularly and attempted some form of local or home farming as commitment to home culture values. By contributing to the sustainability of the planet, all houses were supporting the longevity of their collective too.

Social practices including communication, routines and flexibility also perpetuated long-term social cohesion in the collective household. Union Collective incorporated written language, text messaging, ASL and in-person communication to their daily routines; in addition, An-Albert incorporated more routines into Peter's day, such as Peter dropping off Lou at daycare on his way to work with Peter's long-term health and intellectual development in mind.

Other social practices such as successfully switching group communication methods from a physical message notebook to Google Hangouts chat or not obligating members to cook or clean during times of hardship allowed households to persist. Change was effective at times but not always successful, as was the case of Mountainview Collective and their multiple attempts at restructuring their chores systems, depending on the house constellation. The collective described their learned cooperation:

Chris B: "…you know, like we used to be much more consensus-oriented and then we realized like, okay, we're spending a lot of time to come to an agreement on an issue that, you know, three people really don't even care about. But, yeah, they have a lot of words to say about it but whatever way the decision goes didn't matter to them at all."

Joey: "So, you evolved a new method through that. Collective wisdom."

For the oldest collective, despite establishing a shared power structure, group consensus was not always required for every decision. Instead, members developed the notion of a "bead" to describe individual stake in collective issues in an attempt to make decision-making more effective and equitable. Explained by Melissa:

> "Then, I can just say it's a small 'bead' for me, and then there might be two people who feel quite strongly about it, and then if it's just two if us, we'll often say 'Well, why don't you two figure out what to do and we'll just go with it' and it's like, okay, simple. Those two will figure it out."

These households understood that for the collective to function indefinitely, short-term flexibility was necessary.

4.3.2 External systems and pressures

External systems and a lack of recognition from institutions were major factors that influenced the longevity of our collective homes too. Members reported that their leases provided less long-term guarantees and fewer management responsibilities from property owners. Less than desirable leases were considered to be an inescapable reality of securing affordable rental agreements. As a result, most of our houses required extra

labour from the members, as was the case in Mountainview Collective, which considered their landlady "very hands off"; while others like Union Collective, agreed to undesirable rental conditions such as monthly property inspections.

In order to maintain their leases and their collectives, each house took great care to manage their relationships with property owners. Each house discussed the learned value of having one member represent the entire household with owners and property managers. Having one contact for the property owner to contact and limiting the need to request repairs meant reducing the risk of being on the property owners' "radar" and inadvertently encouraging rental increases for all households. Club 16 described this issue:

> Todd: "Yeah, so we have somebody we call in case things are broken… although we've –in order to keep the relationship good– any little things that we can ourselves, we'll just do."
>
> Chris A.: "So, like the fire alarm. The smoke alarm."
>
> Todd: "Yeah, so we can do that or fix little things in the bathroom. Yes, technically that's the landlord's responsibility but we don't want to poke the bear."

Households also indicated larger external systems and institutions including home insurance, mortgages and bylaws were not designed to support their model of housing. Knowing of a few member-owner models of collective housing in the city, Mountainview Collective had recently investigated the potential of purchasing their own collective property. They found banks did not offer home loans to collectives and dovetailed with a lack of legal framework to provide ramifications of collective ownership under the law. Discouraged by the lack of institutional support the collective did not pursue collective homeownership.

4.3.3 Social Acceptance

Social acceptance of collective homes as a valid model of housing was another major sub-theme that would otherwise support the longevity of collective home environments. Many of our homes reported their friends and workmates did not understand, nor accept their home environment. Most members described disbelief from people in their social circles who were unfamiliar with collective housing.

Collective housing was sometimes associated with adolescence and student share houses even for members of Mountainview Collective who had lived in the house for more than two decades. Comments such as "*Now that you're grown up are you gonna get a real place to live?*" were reported to be commonly heard by residents including Melissa.

While some members mentioned a general confusion of collectives for communes, which were seen as fringe religious communities or cult-like communal living environments where individuality was stripped. Other members reported exoticisation of collective living, while the majority of reactions missed the element of intentional communal communities altogether and considered collectives as conventional share houses. These social misunderstandings extended to relationships with property owners too.

In the case of Union Collective, it led An-Albert to not disclose the collective intention of her rental application. Still, the most established collective, Mountainview Collective, had made some progress in educating their property owners about collective living. Their property owner had come to broadly recognize the intentional nature of collective living and supported it by increasing the house's rent minimally each year.

Mountainview Collective recognized the value of collectives creating social bonds beyond their home. They fostered a larger collective community by holding social events for other collectives. This expanded the influence of their home in greater collective community. For them, creating a collective home culture beyond their house was to create a collective community.

Establishing and securing the collective household as a home was a challenging and constant issue for all households. While collective households could support themselves by managing internal issues, external pressures and systems that did not support their long-term existence impacted each household. These external factors were outside of the collective household's influence. These frictions point to opportunities for design interventions to better support an indefinite timeline for collective households.

5 DISCUSSION

Our findings offer new insights into the intricacies of collective living and the values, desires, and practices tied to collective homes. Better understanding how multiple people living together approach ownership communally, but who may not share the same familial ties and social configuration contributes to growing calls in the HCI community for more diverse accounts of domestic

practices and 'the home' [1] [11] [12] [19] [23]. Next, we discuss our findings with attention to the domestic sharing and ownership spectrum.

5.1 Expanding the Domestic Sharing & Ownership Spectrum

Collective houses represent complex, nebulous, and heterogenous households that help identify new considerations for thinking about and designing for ownership. Findings from our work support Gruning and Lindley's ownership spectrum [18]; and, help extend this spectrum to include *communal ownership*, *deferred ownership* and *pointed-joint ownership*. Next, we unpack these extended ownership categories, and reflect on them in the context of factors shaping ownership including *origin*, *location of a belonging*, and *labour*.

Communal ownership is co-ownership with intention. Unlike *joint-ownership* [18]—which is considered to be equal ownership by multiple people, such as two brothers who own a video game together—communal ownership is ownership by multiple members, but not necessarily equally. Each owner is able to be share the communally owned belongings with other people if they choose. Food, furniture, musical instruments, tools, house diaries and records, and communal spaces are examples of communal owned things in collective houses. Communal owners appreciate things are not necessarily consumed or maintained equally. Communal owners may contribute equally where possible, to ensure the ongoing, longer-term availability of these shared things.

Second, oscillating between unshared things and shared things is *deferred ownership*, which represents a type of ownership where no clear owner(s) is apparent, but something is nonetheless "owned". A common situation of deferred ownership was seen in our collective houses when the house "owned" things, such as the accumulation of furniture at Mountainview Collective or the story of the piano at Club 16. In these examples, the "diffusion of responsibility" was apparent, however, other instances across all houses showed the house was *given* ownership by its members. In deferred ownership, things are sometimes borrowed but not in other cases. In this, sharing is available but not always taken up. We distinguish *deferred ownership* from *sole ownership by default* [18] for this reason.

Pointed-joint ownership is a nuanced form of *joint ownership* [18] and not quite primary ownership. Mountainview Collective's idea of "the bead" exemplifies this concept, where one person might lead the assurance of joint or communally owned things for the group. An item is not primarily owned by an individual but cared for by one or more people, which may change over time. This situation occurred at Club 16 where a shared rice cooker broke and was replaced by the only member who cared for its replacement and continued shared use. Th is member relinquished any primary ownership for communal or joint ownership. This category differs from deferred ownership as pointed-joint ownership of items were always wanted for sharing by someone, yet not quite 'given to the house'.

Our research also contributes to the determinants of ownership originally proposed by Gruning and Lindley [18]. In their work, the *origin* and *location* of an item determined its ownership. Whether bought or gifted to the owner, these acts directly shaped who the owner was, while the location of an item at home determined the degree to which it was shareable. Our findings support these ideas, but also extend them. We found that origins can easily become complicated in collective homes, which suggests an opportunity for the definition of "origin" to be broadened to also include the forgotten, "unknown" and possibly insignificant.

Similarly, in the context of collective domestic living, emphasizing "space" over "location" can help productively widen the scope of the second determinant of ownership. Here, space can indicate the location of an object or can be deconstructed to include soundscapes and dwelling-stakeholders. Our findings have illustrated how sound traverses and shapes space in the home. Rethinking sharing to include shared soundscapes, shifting demarcations and stakeholders (i.e. the house as actor) would also open new possibilities to support communal domestic sharing.

Finally, we propose "labour" as an important third determinant of ownership. Considering the labour performed in domestic work practices is a valuable lens to open up discussion about the value of one's contribution to group satisfaction and merits ownership determinacy. Ensuring any form of domestic ownership required constant labour in our collective homes. Members with a "bead", initiators of pointed-joint ownership and people responsible for various chores all performed labour that influenced ownership. Where labour is no longer performed or abandoned altogether, the absence of labour also determined ownership, as is the case of deferred ownership. Who does (or doesn't) do the work to ensure and maintain sharing as a contribution to the household

determined ownership in our collective domestic environments.

6 DESIGN IMPLICATIONS AND OPPORTUNITIES

There is an opportunity for the HCI community to better support collective domestic environments in all their social, organizational and temporal forms. Extending the ownership spectrum to better support collective ownership and practices can also be treated in parallel to broader HCI initiatives to decenter and expand beyond designing for individualistic notions of 'the user' [2]. Our work contributes to these efforts by opening up new design opportunities for attending to the relations among each household member, the collective as a group, and the activation of the house as a dwelling-stakeholder that holds traces of past decisions, actions and experiences that impact the present and the future [14], as well as each party's needs and capacities. Collectivism complicates the idea of the "user" in a domestic space because there is often more than one owner, no owner, a non-human owner, or household consensus is necessary for decision-making about the household. A focus on the individual user devalues the collective; the "user" is instead multifaceted and multiple. Jenkins discusses the user as plural – representative of a group [19]. Next, we build on this idea with opportunities for supporting the social and temporal dimensions of the collective home.

6.1 Designing for divergent domestic power structures

Approaches to designing for collective environments should consider the unique social dynamics of the household. The path to achieving collective goals were not always agreed upon or without faults. Mountainview Collective, the oldest collective in our study, was noticeably invested in ideas of individual power within a collectivist environment. While Joey introduced the collective as a "*shared power structure*" where "*everybody has an equal say, everybody gets listened to…*", during the course of our interview, members shared stories of social experiments within the house to test models of power to improve contribution. These instances highlighted the complicated nature of collectivism, yet, ultimately no satisfactory resolution was determined. There is a need for future work to further explore how more flexible systems could be designed to support collective households and shared domestic living arrangements by better embracing inclusive equitable labour to support the physical and social organization of the home over time.

Building on recent works highlighting the value of generating of rich digital use-histories around shared tools and objects (e.g., [15]), there is also an opportunity to explore the role systems could play in illustrating domestic labour or visualizing contribution to the collective workload to support stronger relationships among residents and thus the gratification of home. For instance, the management of chores might be made more obvious if common work-related instruments, like vacuum cleaners or wood splitters, could be encoded with metadata to indicate subtle information about their last use and, perhaps the longer-term role and history of the artifact within the collective. While the outcome of work (i.e. clean floors or a pile of wood) might seem like enough of an indicator of work completed, each resident might notice this work at different times in different ways – or never at all, such might be the case of living with a Deaf or blind person. Here, we echo the concerns of the Mountainview Collective; *how do we decide the value of a member – or user – and their capacity for contribution to the group?* Is there room for equitability or only equality among stakeholders? Clearly such concerns will have to be handled carefully and sensitively in the design of technologies for collective environments.

6.2 Designing for collective living through a long-term lens

Looking at collective housing as a long-term housing model pushes HCI researchers and designers re-evaluate the norms of domestic longevity and 'the home'. In our examples, constellations of household members enacted cooperative approaches to ensure the future of the house. This cooperation involved internal stakeholders who could provide labour, organizing systems, and routines inside the house to achieve common goals, while externally, infrastructure and public systems were not designed to support their home. While interventions in public policy design, social welfare and architecture could better support all models of housing and changes in people's needs; from an HCI point of view, reconsidering timespans for design and macro-domestic environments could provide infrastructural support for shared ownership. There is an opportunity for interventions to explore scaling house interaction broadly to a network of houses within broader communities and cities. There is a need for future work to investigate systems designed to enable multiple smart homes to "speak" to one another, perhaps producing their own networked collectives with other distributed households and their members. In this example, there is an opportunity for the HCI community to support the expansion of external systems beyond the

house and the social acceptance of collective living. Future work in this area could contribute to nascent and growing initiatives calling for new strategies to address the diverse needs of intentional domestic communities [19] [20] [23] and, more broadly, 'post-capitalist' HCI research and practice [13] [16].

7 CONCLUSION

In our paper, we provided an in-depth design ethnography of three collective households in metropolitan Vancouver, Canada. As an alternative model of housing, our collective households demonstrated the diverse ways they approach ownership and sharing in the domestic space. By creating a supportive home environment for all members of the household –at all stages of life, abilities, and needs– collectives granted individual agency to members which in turn further contributed to their group participation and household satisfaction. We interpreted and synthesized findings in the service of expanding the ownership spectrum [18] by introducing three nuanced categories of collective ownership, as well as broaden the determinants of ownership to include labour. Finally, we presented design implications and opportunities for the HCI community to better support collective domestic environments located in metropolitan centers in the global north in all their social, organizational and temporal forms.

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REFERENCES

[1] Ryan Aipperspach, Ben Hooker, and Allison Woodruff. 2009. The heterogeneous home. *interactions* 16, 1: 35–38.

[2] Eric P. S. Baumer and Jed R. Brubaker. 2017. Post-userism. *Proceedings of the 2017 CHI Conference on Human Factors in Computing Systems - CHI '17*, ACM Press, 6291–6303.

[3] Genevieve Bell, Mark Blythe, and Phoebe Sengers. 2005. Making by making strange: Defamiliarization and the design of domestic technologies. *ACM Transactions on Computer-Human Interaction (TOCHI)* 12, 2: 149–173.

[4] Genevieve Bell and Paul Dourish. 2007. Back to the shed: gendered visions of technology and domesticity. *Personal and Ubiquitous Computing* 11, 5: 373–381.

[5] Mark Blythe and Andrew Monk. 2002. Notes towards an ethnography of domestic technology. *Proceedings of the 4th conference on Designing interactive systems: processes, practices, methods, and techniques*, ACM, 277–281.

[6] Trudi Bunting, Alan R. Walks, and Pierre Filion. 2004. The uneven geography of housing affordability stress in Canadian metropolitan areas. *Housing Studies* 19, 3: 361–393.

[7] Tom Carter. 1997. Current practices for procuring affordable housing: The Canadian context. *Housing Policy Debate* 8, 3: 593–631.

[8] Andy Crabtree and Tom Rodden. 2004. Domestic routines and design for the home. *Computer Supported Cooperative Work (CSCW)* 13, 2: 191–220.

[9] Andy Crabtree, Tom Rodden, Terry Hemmings, and Steve Benford. 2003. Finding a Place for UbiComp in the Home. *UbiComp 2003: Ubiquitous Computing*, Springer Berlin Heidelberg, 208–226.

[10] Dries De Roeck, Karin Slegers, Johan Criel, et al. 2012. I would DiYSE for it!: a manifesto for do-it-yourself internet-of-things creation. ACM Press, 170.

[11] Audrey Desjardins and Ron Wakkary. 2016. Living In A Prototype: A Reconfigured Space. *Proceedings of the 2016 CHI Conference on Human Factors in Computing Systems - CHI '16*, ACM Press, 5274–5285.

[12] Audrey Desjardins, Ron Wakkary, and William Odom. 2015. Investigating Genres and Perspectives in HCI Research on the Home. ACM Press, 3073–3082.

[13] Carl DiSalvo and Tom Jenkins. 2017. Fruit Are Heavy: A Prototype Public IoT System to Support Urban Foraging. *Proceedings of the 2017 Conference on Designing Interactive Systems - DIS '17*, ACM Press, 541–553.

[14] Tao Dong, Mark S. Ackerman, and Mark W. Newman. 2014. "If these walls could talk": designing with memories of places. *Proceedings of the 2014 conference on Designing interactive systems - DIS '14*, ACM Press, 63–72.

[15] Anton Fedosov, William Odom, Marc Langheinrich, and Ron Wakkary. 2018. Roaming Objects: Encoding Digital Histories of Use into Shared Objects and Tools. *Proceedings of the 2018 on Designing Interactive Systems Conference 2018 - DIS '18*, ACM Press, 1141–1153.

[16] Tom Feltwell, Shaun Lawson, Enrique Encinas, et al. 2018. "Grand Visions" for Post-Capitalist Human-Computer Interaction. *Extended Abstracts of the 2018 CHI Conference on Human Factors in Computing Systems - CHI '18*, ACM Press, 1–8.

[17] Alix Freiler and Meg Holden. 2012. Homelessness in the Livable City: Public Space Regulation in Olympic City, Vancouver's Poorest Neighborhood. *Critical Planning* 19, Summer.

[18] Jane Gruning and Siân Lindley. 2016. Things We Own Together: Sharing Possessions at Home. ACM Press, 1176–1186.

[19] Tom Jenkins. 2017. Living Apart, Together: Cohousing as a Site for ICT Design. ACM Press, 1039–1051.

[20] Tom Jenkins. 2018. Cohousing IoT: Design Prototyping for Community Life. ACM Press, 667–673.

[21] David Kirk, Shahram Izadi, Otmar Hilliges, Richard Banks, Stuart Taylor, and Abigail Sellen. 2012. At home with surface computing? *Proceedings of the 2012 ACM annual conference on Human Factors in Computing Systems - CHI '12*, ACM Press, 159.

[22] Nathanael Thomas Lauster. 2016. *The death and life of the single-family house : lessons from Vancouver on building a livable city / Nathanael Lauster.* Philadelphia : Temple University Press.

[23] Gilly Leshed, Maria Håkansson, and Joseph "Jofish" Kaye. 2014. "Our life is the farm and farming is our life": home-work coordination in organic farm families. ACM Press, 487–498.

[24] Carman Neustaedter and A. J. Bernheim Brush. 2006. "LINC-ing" the family: the participatory design of an inkable family calendar. *Proceedings of the SIGCHI conference on Human Factors in computing systems - CHI '06*, ACM Press, 141.

[25] Pierre Nora and Lawrence D. Kritzman. 1996. *Realms of Memory: The Construction of the French Past*. Columbia University Press, New York.

[26] Jon O'Brien and Tom Rodden. 1997. Interactive systems in domestic environments. *Proceedings of the 2nd conference on Designing interactive systems: processes, practices, methods, and techniques*, ACM, 247–259.

[27] Jon O'Brien, Tom Rodden, Mark Rouncefield, and John Hughes. 1999. At home with the technology: an ethnographic study of a set-top-box trial. *ACM Transactions on Computer-Human Interaction (TOCHI)* 6, 3: 282–308.

[28] William Odom, Yeoreum Lee, Da-jung Kim, et al. 2013. Fragmentation and transition: understanding perceptions of virtual possessions among young adults in Spain, South Korea and the United States. ACM Press, 1833.

[29] William T. Odom, Abigail J. Sellen, Richard Banks, et al. 2014. Designing for slowness, anticipation and re-visitation: a long term field study of the photobox. *Proceedings of the SIGCHI Conference on Human Factors in Computing Systems*, ACM, 1961–1970.

[30] William Odom and Ron Wakkary. 2015. Intersecting with Unaware Objects. ACM Press, 33–42.

[31] William Odom, John Zimmerman, and Jodi Forlizzi. 2014. Placelessness, spacelessness, and formlessness: experiential qualities of virtual possessions. ACM Press, 985–994.

[32] Doenja Oogjes, William Odom, and Pete Fung. 2018. Designing for an other home: expanding and speculating on different forms of domestic life. .

[33] Noah Quastel, Markus Moos, and Nicholas Lynch. 2012. Sustainability-As-Density and the Return of the Social: The Case of Vancouver, British Columbia. *Urban Geography* 33, 7: 1055–1084.

[34] Tony Salvador, Genevieve Bell, and Ken Anderson. 2010. Design Ethnography. *Design Management Journal (Former Series)* 10, 4: 35–41.

[35] Statistics Canada. 2017. Focus on Geography Series, 2016 Census. *Statistics Canada*. Retrieved August 20, 2018 from https://www12.statcan.gc.ca/census-recensement/2016/as-sa/fogs-spg/Facts-cma-eng.cfm?GC=933&GK=CMA&LANG=Eng&TOPIC=1.

[36] Gregory L.F. Suttor. 2016. *Still renovating: a history of Canadian social housing policy*. McGill-Queen's University Press, Montreal.

[37] Laurel Swan, Alex S. Taylor, and Richard Harper. 2008. Making place for clutter and other ideas of home. *ACM Transactions on Computer-Human Interaction* 15, 2: 1–24.

[38] Joshua G. Tanenbaum, Amanda M. Williams, Audrey Desjardins, and Karen Tanenbaum. 2013. Democratizing technology: pleasure, utility and expressiveness in DIY and maker practice. *Proceedings of the SIGCHI Conference on Human Factors in Computing Systems - CHI '13*, ACM Press, 2603.

[39] Alex S. Taylor and Laurel Swan. 2005. Artful systems in the home. *Proceedings of the SIGCHI conference on Human factors in computing systems*, ACM, 641–650.

[40] Alex S. Taylor, Susan P. Wyche, and Joseph "Jofish" Kaye. 2008. Pottering by design. ACM Press, 363.

[41] Peter Tolmie, James Pycock, Tim Diggins, Allan MacLean, and Alain Karsenty. 2002. Unremarkable computing. *Proceedings of the SIGCHI conference on Human factors in computing systems*, ACM, 399–406.

[42] Dick Urban Vestbro. 2000. From collective housing to cohousing—a summary of research. *Journal of Architectural and Planning Research*: 164–178.

[43] Jong-bum Woo and Youn-kyung Lim. 2015. User experience in do-it-yourself-style smart homes. ACM Press, 779–790.

[44] Allison Woodruff, Sally Augustin, and Brooke Foucault. 2007. Sabbath day home automation: "it's like mixing technology and religion." *Proceedings of the SIGCHI conference on Human factors in computing systems - CHI '07*, ACM Press, 527.

[45] Allison Woodruff, Jay Hasbrouck, and Sally Augustin. 2008. A bright green perspective on sustainable choices. *Proceedings of the SIGCHI Conference on Human Factors in Computing Systems*, ACM, 313–322.

[46] Alexandra Zafiroglu and Michele Chang. 2007. Digital homes on wheels: designing for the unimagined home. *Personal and Ubiquitous Computing* 11, 5: 395–402.

[47] 2013. Vancouver is Canada's most expensive city, but not in the world's top 10. *The Canadian Press*. Retrieved from https://search.proquest.com/docview/1412509569?accountid=13800.

[48] 2013. Vancouver ranked world's third most-livable city, with Toronto and Calgary next. *The Canadian Press*. Retrieved from https://search.proquest.com/docview/1428918630?accountid=13800.

[49] Collective Housing Society of Greater Vancouver. *Collective Housing Society of Greater Vancouver*. Retrieved November 22, 2017 from http://collectivehousing.weebly.com/.