THERE'S NO PLACE LIKE THE CONNECTED HOME

By Lucy Gao

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Abstract

The home is a deeply meaningful and human place. It fulfills not only our fundamental physical needs, but also contributes significantly to our sense of belonging and safety. The home is a place where many domestic technologies are currently situated, shaping and being shaped by the complex social and emotional fabric of the home. To innovators in the technology industry, the home is ripe for a new wave of disruption in the form of the smart home.

By zooming in on the use of technology in the home, this research demonstrates that the current state of domestic technology, including the smart home, has not been designed with people and real homes in mind. Technology providers fail to recognize the home as an ultimately human place - complex and filled with opposing values and tensions. As a result, it does not lend itself to be easily programmed into discrete tasks, simple routines or efficient workflows as technology is predisposed to do.

Through the lens of lived everyday experiences, this research offers a critical look at the future of domestic living as shaped by a predominantly techno-centric narrative. The result is an urgent call for change to be led by technology providers, as well as emerging design considerations to the question: *how might we rethink domestic technology to better support human-centered values in the home*?

Acknowledgment

This journey has been intellectually enlightening and enriching experience. As such, the process has not always been easy. At times it felt like I took one step forward and two steps back. It would not have been possible to finish this project without an incredible network of humans around me.

Much love and gratitude to:

- **Dennis Ly,** my partner-in-crime, who cheered me on from the sidelines and always offered brutally honest but insightful opinions and wisdom throughout this journey.

- **My Parents,** who told me that good things take time and reminded me to be patient during challenging times.

- **Jeremy Bowes and Maya Desai**, my principal and secondary advisors, who challenged my perspectives and often pushed me to consider alternative and opposing views.

- **My SFI colleagues** who always answered my calls for help and generously offered support and feedback. Your presence throughout this process made it much more enjoyable and enlightening.

- **The SFI faculty,** and in particular Helen Kerr and Nabil Harfoush for always keeping an open door and sharing your wisdom and advice.

- **All those** that offered their time, expertise and insights throughout the research process, including experts that I had the pleasure of interviewing and all the research participants.

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PROJECT INTRODUCTION & METHODOLOGY

INTRODUCTION

In 2018, the New York Times released an alarming piece called "*Thermostats, Locks and Lights: Digital Tools of Domestic Abuse.*" In this article, journalist Nellie Bowles (2018) shared several stories of domestic abuse victims, lawyers, shelter workers and emergency responders that reveal how smart home technologies are being used as a new tool for abuse. She wrote:

> *Their stories are part of a new pattern of behavior in domestic abuse cases tied to the rise of smart home technology. Internet-connected locks, speakers, thermostats, lights and cameras that have been marketed as the newest conveniences are now also being used as a means for harassment, monitoring, revenge and control* (Bowles, 2018)*.*

Reading the article, perhaps an immediate reaction is *how could such innocuous objects be used for such malicious intent?* In response, Bowles revealed that these stories stemmed from an imbalance of power and control, where one person in the relationship holds all the power. As such, these connected devices can perpetuate this imbalance by favouring a single-user control and access model.

This is just one extreme example of the misuse of technology and likely encapsulates the experience of only a small portion of all smart home users. However, this example highlights the growing gap between the expectations of how technology will be used and how it is actually used. Despite these gaps, consumer technologies are continuously being released at a breakneck pace. These technologies are becoming smarter, faster and more pervasive in all aspects of our lives, especially in the most human, private and personal domains like the home.

Up until the past several years, the smart home has been more like a fiction than reality. The slow market uptake of smart home technologies at the turn of the 21st century was due to several key issues, including: a lack of user need; privacy; price; and the limits of technology in fully delivering the smart home promise. Within the last few years, a push from several technology giants such as Samsung, Google, Amazon and Apple into the smart home market has made significant strides in the adoption of several key smart home devices. The most significant of the line up is the virtual assistant, which fuels the rapid adoption of other devices (Ramspacher & Sheehan, 2019). According to Ramspacher & Sheehan (2019), the smart home is hitting a tipping point in leading market adoption, with 49% of all Americans owning at least one smart home product or device. With the advent of 5G network, the promises of convenience, security, comfort and pleasure offered by the smart home may finally be fulfilled. Thus, transforming the very space we call home.

At these transformational moments in time, it is important to step back and re-examine this vision of the future as shaped predominantly by domestic technology providers. These are the people that design and develop technologies and related services for domestic use.

This is especially urgent at a time of transition when the actual benefits and unintended consequences of new technologies are rapidly surfacing, just like Nellie Bowles' story. In Neil Postman's *Technopoly: The Surrender of Culture to Technology*, he explores the dichotomy of technology as a friend and enemy:

> *"First, technology is a friend. It makes life easier, cleaner, and longer. Can anyone ask more of a friend? Second, because of its lengthy, intimate, and inevitable relationship with culture, technology does not invite a close examination of its own consequences. It is the kind of friend that asks for trust and obedience, which most people are inclined to give because its gifts are truly bountiful"* (Postman, 1992, p. 7).

The gifts of domestic technology have indeed been plentiful. Appliances like the fridge, the microwave and the laundry machine have relieved homemakers from time and labour spent on household chores. Moreover, the introduction of the television and home entertainment systems have fundamentally changed how leisure and entertainment can be experienced in the home. However, Postman also writes:

> *"The accusation can be made that the uncontrolled growth of technology destroys the vital sources of our humanity. It creates a culture without a moral foundation. It undermines certain mental processes and social relations that make human life worth living"* (Postman, 1992, p. 7).

Postman's message is especially relevant at the intersection of technology and the domestic sphere. After all, which place embodies more meaning, culture, social relationships, memories and emotions than the home? With that understanding, what aspects of life in the home might then be undermined by new technologies? Ultimately, the purpose of this Major Research Project is to bring the home and its inhabitants to the foreground of this conversation around technology. Through analysis of existing gaps, this project will reveal opportunities for technology providers to rethink and redesign domestic technology that better support human-centered values of the home.

This project is intended for an industry audience, especially those that research, design and produce technology and related services for domestic use.

Research Question:

How might we rethink domestic technology to better support human-centered values in the home.

APPROACH TO RESEARCH

The overall framework and approach to research for this project has been inspired by Sohail Inayatullah's Causal Layered Analysis (CLA). This is a foresight method that enables the analysis and synthesis of information about the present and future on four levels - problems, structures, worldview and metaphor. This layered approach not only reveals the surface-level problems that exist today, but also uncover the deeply entrenched systems, structures, worldviews and beliefs that perpetuate these problems.

The CLA is a fitting approach for this project because it "*is concerned less with predicting a particular future and more with opening up the present and past to create alternative futures*" (2004, p.8). In other words, the CLA is a deep dive into "*what was*" and "*what is*" in order to open up "*what could be.*" This project follows this thinking by diving deep into the history of domestic technology, the current state of domestic technology in the context of the home, and explores alternative futures through a speculative design exercise. The project is divided into three key research phases:

- **Phase one** is about opening up the past to better understand the present state of domestic technology, as well as the values supported by domestic technology.

- **Phase two** is to gather evidence based on lived experiences and uncover actual values and needs in the home. Ultimately, gaps between the values supported by domestic technology and actual values in the home are identified.

- **Phase three** is to identify opportunities for domestic technology to better support human-centered values and needs.

This project also borrows from CLA's layered iceberg model in Phase One, but adapted to fit the topic of research (**Figure 1)**. The top layer captures the key domestic technologies that were produced and adopted at a given period. The second layer reveals the main social, economic, political forces that defined the period but also shaped those technologies. The bottom layer reflects how the home was being perceived by industry and technology providers. These perceptions or metaphors of the home are mainly informed by the first two layers.

Figure 2 provides a summary of the research roadmap by breaking down the research question into sub-question, and identifies the associated research methodologies used to answer these questions. Since the topic of research relates to the home and the domestic experience, ethnographic methods were employed to gather evidence from real human experiences.

Key Definitions

Since a large part of this project talks about "values," including values embedded in technology and in the home, it is important to define what it means. According to the Merriam-Webster Dictionary, the most relevant definition of "values" refers to principles or qualities that are intrinsically desirable or important. Similarly, Friedman, Kahn & Borning (2008, p.70) refers to values as "*what a person or group of people consider important in life*," recognizing that values are not universal but rather specific to individuals or groups of people. Combining these two definitions, "values" in this research refer to desirable or important principles or qualities for a person or group of people, such as the producer of domestic technologies and users of such technologies in the context of the home.

Problems
what are the problems (i.e. events, trends, issues)?

Structures
what are the systems or structures in place the perpetuate the problems?

Worldview
which worldviews or cultural phenomenon support the above systems?

Metaphor
what are the deep stories or collective archetypes that are embedded in the collective unconscious?

ORIGINAL CLA

Artefact
what technologies were produced in introduced in the home?

Patterns & Trends
what where the key social, political and economic forces that shaped these artefacts?

Metaphor
how is the idea of the home being framed by technology providers?

ADAPTED CLA

Figure 1: Causal Layered Analysis - Original vs. Adapted

Figure 2

RESEARCH ROADMAP

PHASE ONE

OPEN UP THE PAST

The state of domestic technology today is a product of a century of social, political, economic and technological changes. To understand what values are deeply embedded in these technologies, it is important to examine the evolution of domestic technology in light of major historical shifts. To do so, a combination of methods were used to offer a much richer understanding of how domestic technology and its associated values have changed over time.

PHASE TWO

EXAMINE THE PRESENT

To identify what is not working in the present, it is important to get to know people, their homes and their actual values and needs in the home. As a result, it is imperative to gather first-hand accounts of real lived experiences, and how domestic technology fits into those experiences. Accordingly, ethnographic research methods are used to generate insights.

PHASE THREE

EXPLORE ALTERNATIVE FUTURES

Since the home is very much a human place, alternative futures should be informed by lived experiences of people. The outcome of this research lands on a series of speculative designs of alternative domestic technologies. Speculative design is not used to share finalized solutions, but rather to provoke discussion and reflection on some of those gaps identified earlier.

Key Questions
- How has the home been framed by technology providers over time?
- What values do domestic technology support?

Research Methods
- **Literature review** of key research in areas such as sociology, gender studies and technology and culture studies.
- **Historic timeline combined with the adapted CLA** to uncover when and what technologies were introduced (artefacts), the societal forces that shaped those technologies (patterns and trends), which inform how the home was being framed by technology providers (metaphor).

Key Questions
- What is the home?
- What do people value in the home?
- Do the values framed by technology providers match the actual lived experiences of the home?

Research Methods
- **Literature review** of key research in areas such as human-computer interaction, environmental psychology, sociology and ethnography.
- **A survey** of people's definition, perception and experiences of the home and their attitude towards smart home technology.
- **Four follow-up interviews** in the form of a take-home workbook, which asked participants to draw, record or photograph their routines, objects in their homes and their own metaphor of the home.

Key Questions
- How might we rethink domestic technologies to better support human-centered values of the home?

Research Methods
- **Speculative design** by Dunne & Raby (2013) was used to illustrate the findings and provoke critical thinking around alternative approaches towards designing technology for the home.

THE CO-EVOLUTION OF DOMESTIC TECHNOLOGY AND THE IDEA OF HOME

ARTEFACT
when and what technologies were produced and introduced in the home?

Emergence of domestic electrification followed by "time-saving" technology in the home such as vacuum cleaners, washing machines, refrigerator & the electric iron. Design of these technologies resembled factory tools.

1933 Chicago World's Fair "Century of Progress" exhibits the Homes of Tomorrow

Emergence of black and white television

PATTERNS/STRUCTURES
what were the key social, economic, political and technological forces that shaped these artefacts?

Trend towards urbanization

Decline in domestic servants & rise of the housewife

Professionalization of home economics

80% of American households are electrified

Rise of industrial design

80% o hous to tel

During WWII, women join the labour force and take up traditionally male roles

Suburbanization and rise in home-ownership

WWI	THE GREAT DEPRESSION	WWII	POST-WAR	RISE OF THE MID
	1920	1930	1940	1950	1960

METAPHOR
How is the idea of the home being framed by technology providers?

Home as a Housewife's Place

Home as a Place of Consumption

Home as a Factory

Home as a Place of Technological Progress

Home as a Status Symbol

Figure 3

CO-EVOLUTION OF DOMESTIC TECHNOLOGY & THE IDEA OF HOME

Emergence of home automation (the X-10)

Rise of the Internet and the World Wide Web

Rise of "smart devices," including the iPhone

Rise of the personal computer

Weiser's technovision of "ubiquitous computing"; Expansion of "smart home" research initiatives

Rise of the smart home

"Time-using" technology diffuses across a majority of American households (more than 75%): TV, DVD Player, Video Recorder

88% of Canadian households with access to mobile phones & internet

The "dot-com" boom & emergence of the Big Tech companies

of Canadian holds have access evisions

More women participate in the labour force

Shift towards a knowledge-based and service-based economy

DLE-CLASS

THE INFORMATION AGE

THE DIGITAL AGE

1970   1980   1990   2000   2010   2020   beyond

Home as Individualized Spaces

Home as a Servant

cumulative narratives

Home as a Tethered & Blended Space

POWERFUL IDEAS

In Neil Postman's 1996 book *The End of Education*, he suggested ten principles of technological change that need to be critically examined. One of which states:

> *"Embedded in every technology there is a powerful idea, sometimes two or three powerful ideas. Like language itself, a technology predisposes us to favor and value certain perspectives and accomplishments and to subordinate others"* (Postman, 1996, p.283).

Indeed, technology is not value-neutral. The form and function of every new technology embody the values and worldviews of those shaping the technology. This idea follows the Social Shaping of Technology (SST) theory, which identifies the development and design of new technologies to not only be shaped by technical considerations, but also by broader economic, social and political factors (Williams, 1997).

The purpose of this chapter is to uncover the values deeply embedded in domestic technology today. To do so, the evolution of domestic technologies since the early 1920s has been thoroughly examined, as well as the broader social, political or economic factors that shaped their inception. **Figure 3** illustrates a summary of this research using the adapted CLA method in combination with a historic timeline. Combining these two methods provide both the breadth and depth needed to uncover those "powerful ideas" or values entrenched in domestic technology.

It should be noted that this chapter is a rather brief account of what happened across a century of history. The point is not to explain cause and effect, but to highlight at a high level the confluence of multiple forces that shaped domestic technology in the past and into today.

EARLY 1920s:
HOME AS A HOUSEWIFE'S PLACE

Up until the 1920s, a majority of North American households lived in rural agricultural areas, where the home was mainly a place of production that enabled self-sustaining lifestyles. The Industrial Revolution in the late 18th century and early 19th century fueled rapid settlements in urban areas. This resulted in a significant rise in the number of urban households, so much so that by the 1920s, more Americans lived in urban cities than rural areas for the first time in American history (US Census Bureau, n.d.). This trend was also observed in Canada. Between 1921 and 1931, the number of Canadians living in urban areas rose above 50% (S. C. Government of Canada, 2015). The rise of the Second Industrial Revolution, urbanization and increase in job opportunities marked a new era of economic prosperity and consumer culture. It was also during this time that electricity began to rapidly diffuse across urban households, thus kicking off the "industrial revolution" in the home (Cowan, 1976). This revolution marked the emergence of new electric appliances, such as electric ranges, vacuum cleaners, sewing machines, food processor, washing machine, refrigerator and electric irons (Aldrich, 2003; Bowden & Offer, 1994).

The introduction of domestic electric appliances synchronized with another social phenomenon - the decline of paid domestic servants (Aldrich, 2003; Sager, 2007; Wajcman, 1994). While there were likely a myriad of factors that resulted in the shortage of domestic labour (such as the rise of other professional opportunities for women and increased wages), domestic technology was advertised to facilitate the transition towards a "servantless home" (Sager, 2007). In fact, the suppliers and advertising industry recognized these issues and advertised domestic appliances to housewives as time-saving, cost-saving and labour-saving devices, effectively solving the "servant problem" by substituting machines for human labour (Sager, 2007). At the intersection of these shifts, the role the unpaid, do-it-all housewife began to emerge. The lack of value associated with household chores was due to two factors. First, chores were perceived to be "deskilled" by machines through automation and therefore required no real labour. Second, chores became "emotionalized" through industry advertisers, who equated chores as a housewife's

"Time-saving" technologies are those which can potentially increase discretionary time by reducing the time needed to carry out a task, for example washing machines.

"Time-using" technologies are those which occupy discretionary time and improve its perceived quality, for example television.

(Aldrich, 2003, p.34)

expression of love, loyalty and affection towards her family. Cowan (1976) found that the sentiments in a majority women's magazines in the 20s were guilt and embarrassment (**Figure** 4). She wrote:

> *"Readers of the better-quality women's magazines are portrayed as feeling guilty a good lot of the time, and when they are not guilty they are embarrassed: guilty if their infants have not gained enough weight, embarrassed if their drains are clogged, guilty if their children go to school in soiled clothes, guilty if all the germs behind the bathroom sink are no eradicated, guilty if they fail to notice the first signs of an oncoming cold, embarrassed if accused of having body odor, guilty if their sons go to school without good breakfasts, guilty if their daughters are unpopular because of old-fashioned, or unironed, or-heaven forbid - dirty dressed"* (Cowan, 1976, p. 16).

Evidently, through the mechanization and emotionalization of household chores, the home effectively became an invisible workplace for the housewife. Thus, domestic technology became tools in that workplace.

If Only For Your Children's Sake

More and more as winter comes your children must play indoors—with the nursery carpet as their playground.

And often little hands and knees will be in close contact with that carpet ; and sometimes little fingers that have pressed deep into its pile will make dangerous acquaintance with their owner's mouth.

Are you sure of the absolute, hygienic cleanliness of your carpets ?

Surface sweeping will not effect that. Only the Hoover can guarantee it, because only the Hoover *beats* out all the dangerous, germ-harbouring dirt, from the depths of carpets, as it sweeps them electrically and suctions away all this loosened, swept-up dirt and dust into its dust-proof bag.

And the Hoover does all this in one easy, rapid operation which scatters no dust, to filter into your children's lungs, and cause mysterious illnesses.

A "Servant to the Home," the Hoover's thorough, sanitary cleaning is needed most of all in the nursery. Act now. Any Hoover dealer will gladly give you a demonstration of the Hoover on your own carpets. It commits you to nothing—that is understood—but you will be amazed at the quantity of dirt, dangerous dirt, the Hoover extracts from a carpet usually cleaned by other methods.

Only £3. 19s. down and 31s. a month for a short time pays for the Hoover while you use it. There is also a larger model for hotels, clubs, offices and large residences. Write for illustrated booklet and names of nearest Hoover dealers.

Hoover Limited, 288, Regent Street, London, W. 1, and at Birmingham, Manchester, Leeds and Glasgow

The HOOVER

It BEATS.... as it Sweeps   as it Cleans   REG. TRADE MARK

Figure 4: Vintage Hoover vacuum ad in the 20s

1920s:
HOME AS A FACTORY

Frederick Winslow Taylor's principles of scientific management as a means to achieve labour efficiency in factories were also evident in the domestic sphere in the 1920s. The rise of "scientific housekeeping" meant that the layout of the home (especially the kitchen) and household chores can be optimized and made more efficient using the scientific management approach (Wajcman, 1994). Kitchens were often being referred to as a workshop and domestic appliances as tools, similar to the language used for factories (Forty, 1992). In fact, the design of domestic appliances in the 20s often resembled factory tools. Around the same time, home economics became an educational movement and a profession for women in fulfilling the role of efficient household managers and rational consumers (Goldstein, 1997). Home economists were employed by major utility companies in order to reach, educate and sell electricity, power and domestic appliances to women homemakers (Goldstein, 1997). In an effort to reach these consumers, utility companies offered community-based spaces, classes and clubs to educate homemakers in achieving "scientific housekeeping" using electric appliances. It is during this time that practices like "scientific cookery" or "scientific laundry methods" came to be associated with new domestic technology (Goldstein, 1997).

Another design phenomenon that embodied the Taylorism principles of efficiency in the home was the invention of the Frankfurt Kitchen by Margarete Schütte-Lihotzky, an Austrian architect. The Frankfurt Kitchen (**Figure 5)** was designed to achieve efficiency in the kitchen by total redesign of the space and integration of technology to enable continuous and efficient workflows (Henderson, 2017). In fact, these workflows were informed by Schütte-Lihotzky's extensive time-motion-studies (Archer, 2019). Some of the design elements include its small and compactness, continuous counter spaces, integration of labour-saving technologies and built-in storage areas (Archer, 2019). Schütte-Lihotzky's design of the Frankfurt Kitchen were explicitly based on the principles of scientific and rational housekeeping, with the intention of relieving women's work load in the kitchen (Henderson, 2017).

With a myriad of domestic technologies that embodied the values of efficiency and optimization, the home and the domestic experience as defined by technology producers in the 20s could be compared to that of a factory.
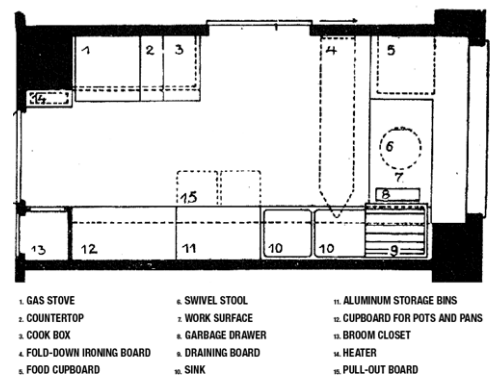

Figure 5: The Frankfurt Kitchen by Margarete Schütte-Lihotzky (source: Minneapolis Institute of Art)

1930s to 40s:
HOME AS A PLACE OF TECHNOLOGICAL PROGRESS

The Great Depression in the 30s and subsequently the Second World War marked a period of scarcity both outside and within the home. The culture of consumerism that emerged during the Roaring 20s were on a temporary halt as households faced austerity measures imposed by the government. As a result, the availability and uptake of consumer goods, including domestic technology, stalled. However, as men went to war, women not only maintained their role as a household managers through austerity, but also assumed traditionally male jobs for the purposes of wartime production. This movement was symbolized by the infamous propaganda poster "Rosie the Riveter."

Despite the bleak economic and social conditions during the Great Depression, one event gave the American public an optimistic peek into the homes of the future. The 1933 Chicago World's Fair designed to celebrate the Industrial Revolution and technological progress, exhibited several "Homes of Tomorrow." One of the homes, The House of Tomorrow (**Figure 6**), showcased a myriad of domestic technologies commonly used today such as central air conditioning, automatic refrigerator, and a dishwasher (Daley, 2016). For the first time, the assemblage of domestic technologies represented technological progress and innovation in the home.

Figure 6: The kitchen featured in the House of Tomorrow by George Fred Keck at the 1933 Chicago World's Fair. The design of the kitchen as well as the technologies incorporated into the kitchen showcase the home as a symbol of technological progress.

1950s to 60s:
HOME AS PLACE OF CONSUMPTION & STATUS

The post-war period of the 50s marked a new era of abundance, affluence and consumerism. The production capacities developed during the war were redirected towards consumer goods, thus solidifying the consumer culture seen today. During this period of prosperity, several major societal shifts with lasting impacts on the domestic sphere also occurred. These shifts included suburbanization, rise in homeownership, the emergence of the middle class and a renewed role of the housewife. With housing becoming an attainable asset for many middle-class households, new material goods catered to the notion of the home as a status symbol and as a place of consumption.

In this context, domestic technologies from the previous decades rapidly diffused across households. For example, the refrigerator, electric iron and laundry machine have penetrated a majority of American households (Livingstone, 2009). What was different, however, was the design of these appliances. The previously industrial aesthetic of household appliances took on a new look due to the rapid rise of consumer product design as an industry. Household appliances started to look more streamlined and simple with sealed-off surfaces. Thus, further reinforcing the home as a place of luxury and status. Similar to the previous decades, marketing of these appliances targeted the housewife, once again promising to eliminate the drudgery of household chores.

The defining technological addition to the home during the fifties was the television (TV). In Canada, only 1% of households had access to a TV at the beginning of the decade. However, by the end of the fifties, more than 80% had a TV (Canadian Broadcasting Corporation, 2018). Similarly, TVs diffused across American households rapidly, from 9% in the 1950s to 87% by 1960 (Livingstone, 2009). There has been no single technology that has impacted the social fabric and physical arrangement of the home as much as the TV. It influenced the way homes are organized, exemplified by introduction of the "television room" or "family room" where seating oriented towards the TV (Livingstone, 2009). It changed how leisure time was spent in the home, how schedules were rearranged to accommodate TV programming, and even how families dined together (Livingstone, 2009). For example, the rise of "TV dinners" - three-part frozen meals cooked in an electric oven - was a perfect embodiment

"Most of the design in the United States today is carried out to satisfy the needs and wants of a mythical Midwestern, middle-income, middle-class family class called Jones, living on the highest energy and gadget level in the world."

- Victor Papanek

of the fifties' obsession with both time-saving appliances and the television (Canadian Broadcasting Corporation, 2018). With the addition of the TV, the home became a place of entertainment and leisure.

Amidst the affluence and consumer culture, many "homes of the future" began to take shape. These visions came from major suppliers of domestic appliances such as General Electric, KitchenAid and Whirlpool, with a particular focus on the kitchen (**Figure** 7). While these "kitchens of the future" all appeared different in their design, the core message remained similar. The kitchen of the future was filled with machines that was supposed to take away the drudgery of housework through efficiency and automation. The future of domestic living also extended to TV shows like The Jetsons. The futuristic home of the Jetsons family in Orbit City was comparable to a machine, where all chores were completely automated. To the Jetsons family, technology was at the forefront of living.

Figure 7: The 1957 Frigidaire "Dream Kitchen of Tomorrow" ad that features the kitchen and cooking as "push-button magic." In the commercial, the housewife sings, "don't have to be chained to the stove all day, just set the timer you are on your way."
(source: Prelinger Archives)

1970s - 80s:
HOME AS INDIVIDUALIZED SPACES

During this period, new time-saving technologies disseminated at a rapid pace, including commercial innovations like the dishwasher and microwave redesigned for domestic use. These technologies continued to perpetuate the Taylorism ideology of efficiency but also convenience (Bell, Blythe, & Sengers, 2005). Around the same time, the mass production of time-using devices also expanded. Technologies like the colour TV, gaming consoles, video cassette recorder (VCR) and cable enabled the home to become a multimedia entertainment centre. The advent of the TV in the fifties saw TV-viewing as a centralized and collective activity situated in the family or living room. However, as the market matured and the price of TV became more affordable, many households purchased more than one TV and placed it in private spaces like bedrooms (Flichy, 2002; Livingstone, 2002). In this multi-set multi-channel media environment, the home not only supported collective interests, but also catered to individual interests. In this sense, the fragmentation of activities in the home enabled the notion of "living together separately" (Livingstone, 2009).

During this period, another disruptive technology found its way into the home that further reinforced the individualization of media use. Originated from the workplace, personal computers (PCs) were made available to the mass market in the 1980s. In 1984, only 15% of American households had a PC in the home, however, that number grew to 60% by the end of the twentieth century (Cornell University, 2015). Unlike the TV, the single-user orientation of PC's user interface also meant that PC-based activities were more solitary in nature. This was reflected in the semi-private or private spaces where PCs were often situated such as the home office or the bedroom (Frohlich & Kraut, 2003).

While the home had always supported both collective and individual activities, new domestic technologies for the first time facilitated the individualization of leisure in the home. According to Arnold, Graesch, Ragazzini & Ochs (2012; p.69), "*the car and the explosion of electronic media have contributed to a long-term decline in collective and interactive leisure and a rise in passive and more private and isolated leisure activities.*" This trend is something that we continue to see today.

1990s - 2000s:
HOME AS A TETHERED AND BLENDED SPACE

In the second half of the twentieth century, there was a general economic shift that pointed towards a decline in the manufacturing sector and growth in service sector jobs. This shift began to significantly impact the nature of work, including gains in both knowledge-intensive services and services with limited education requirements (I. Government of Canada, 2011). At the turn of the century, these labour shifts supported the evolution towards a knowledge-based economy. In this economy, work became increasingly mobile.

It is within this context that new IT technologies such as the Internet and mobile communications began to chip away the physical boundaries of the home, bringing the public sphere (such as the workplace) into the home and vice versa (Venkatesh, Stolzoff, Shih, & Mazumdar, 2001). For example, the growing adoption of the PC and Internet in the home enabled people to conduct business inside the home. Furthermore, the ability to shop online (i.e. eBay and Amazon were both founded in 1995) also blended the boundaries between the home and retail stores. Most importantly, the early adoption of the PC were for educational purposes. The fact that schools integrated computers into its curriculum and setting meant that parents also purchased computers for the home, often placed in children's bedrooms (Venkatesh & Brown, 2001). Through the PC, the home effectively became an extension of the school. Cumulatively, the home became, for the first time, a site for activities that have traditionally taken place outside of the home.

A further reinforcement of this new identity - home as a blended space - came from the mobile phone. Even though the mobile phone was not initially designed for domestic use, its impact on the home has been unparalleled even today. It not only allowed work to creep into the home, but it also enabled the home in becoming a tethered space. The first mobile phone became commercially available in the late 80s for mainly work purposes, as most were integrated into automobiles as car phones or were too large to be "mobile". With every new generation of cellular technology, the mobile phone became smaller, multifunctional and more integral to personal use. The release of the first iPhone in 2007 changed the mobile phone into a smart multimedia device, and altered how users related to these devices. The social fabric of the home, including the relationships and interactions can now be tethered to the mobile device and accessed beyond the physical boundaries of the home. As best described by Palen & Hughes (2007, pg. 340), "*we see instances where parents use mobile phones not only for making themselves available to children for precise matters of giving instructions, coordinating meeting times, and the like, but also use phones to maintain and teach about emotion connection.*"

Today:
HOME AS A SERVANT

Compared to homes just decades earlier, the homes of today are filled to the brim with technology. What was once luxuries, technologies like the fridge, dishwasher and the TV are now considered an essential part of the home. Often, these appliances come with a myriad of functions that promise much more than what it was initially designed to do. Moreover, information and communication technologies (ICT) like computers, mobile phones, laptops and tablets have also secured their place. The home does not only contain the newest gadget, but also a graveyard of broken or obsolescent devices that act as a reminder for how quickly technology can evolve. That is not all, domestic technologies are currently undergoing a "smart" revolution, imposing yet another metaphor of the home.

Today, the smart revolution in the home leverages the rapid proliferation of ICT technology. According to the Government of Canada (2018), access to mobile phones and internet across Canadian households have been on the rise steadily (**Figure 8**). In 2016, approximately 88% of Canadian households had access to mobile services and internet, and households owned on average 1.6 mobile phones (Government of Canada, 2018). It is in this context that the smart home started to gain traction.
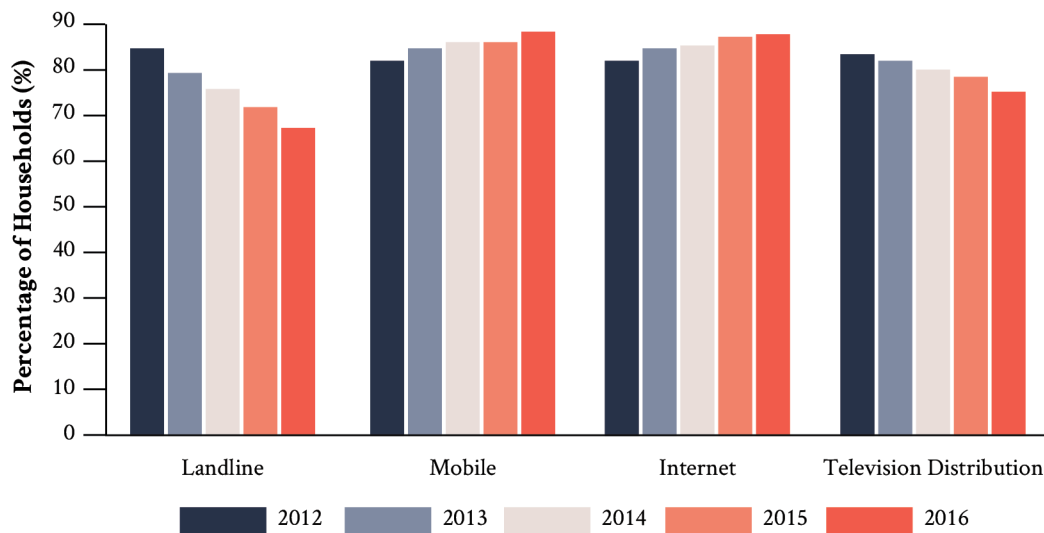

Figure 8: Household communications services subscriptions in Canada (Government of Canada, 2018)

A smart home is essentially "*residence(s) equipped with a high-tech network, linking sensors and domestic devices, appliances, and features that can be remotely monitored, access or controlled, and provide services that respond to the needs of (their) inhabitants*" (Balta-Ozkan, Davidson, Bicket, & Whitmarsh, 2013, p.364). These technologies include a mix of both upgrades to existing technologies such as the smart fridge and new devices such as the voice-activated personal assistant. To visualize just how expansive the current smart home ecosystem is, the ecosystem has been mapped (**Figure 9**). With approximately 1,500 industry players spread across 11 sectors, the smart home market is rapidly growing in terms of the ecosystem of products, key players, and the rate of adoption by average consumers (Ali & Yusuf, 2018).

Despite its perceived novelty, the smart home is not a recent phenomenon. Concepts of the smart home have long been explored in various science fiction novels, films and TV shows. However, central to the development of smart home technology today is Mark Weiser, who was the head of the Computer Science Laboratory at the Xerox Palo Alto Research Centre. In 1992, he wrote an influential piece in the Scientific American called *The Computer for the 21st Century.* In this article, Weiser (1991, p.78) re-imagined the future of personal computing by stating that "*the most profound technologies are those that disappear. They weave themselves into the fabric of everyday life until they are indistinguishable from it.*" He coined this concept "ubiquitous computing" or UbiComp. Following Weiser's article, multiple academic institutions and commercial entities led smart home research initiatives to explore the potential of ubiquitous computing and the smart home. These include: Georgia Institute of Technology's Aware Home; MIT's Internet of Things; Philips' Ambient Intelligence; IBM's pervasive computing; and Intel's proactive computing.

Similar to previous domestic technologies, smart home technologies promise to improve life in the home through efficiency, convenience, security and pleasure. What is different, however, is these technologies also present new capabilities and unforeseen impacts on the home. For starters, the sensing and wireless communication between devices enable users to better control and monitor all aspects of the home, both at home or remotely. In addition, integration of artificial intelligence allows smart home devices to anticipate and respond to the needs of its users through continuous collection, storage and analysis of personal data, shifting connected home into an intelligent home. Just like that, the integration of all these devices in the home might not seem much different than having a full-time servant. The smart home not only promise to automate domestic tasks, but also to anticipate our very needs in the home, all without the grievances attached to a human-to-human, master-servant relationship. However, unlike a human servant, this digital servant is also collecting and sharing personal data with its handful of producers. This speaks to one of the most concerning issues related to smart home technology - privacy and security. According to the Office of the Privacy Commissioner of Canada (2016),

KEY SECTORS

Security & safety systems
Audiovisual
Smart energy
Software platforms
HVAC & lighting
Components
AI & natural language processing
Connected health
Wearables & apps
Smart kitchen
Robotics

MAJOR PLAYERS

Samsung
Apple
Google / Nest
Amazon
Ecobee
Philips
Belkin

KEY MANUFACTURERS

Schneider Electric
Johnson Controls
Logitech
Samsung
Whirlpool
Siemens
Honeywell International
General Electric

OTHER STAKEHOLDERS

Communication carriers
Utility companies
Healthcare providers
Insurance providers
Real estate developers
Venture capitalists
Users

Figure 9: The Smart Home Ecosystem (Sources: Ali & Yusuf, 2018; MaRS Discovery District, 2019)

"While tracking in the Internet of Things involves the tracking of a device, the motivation is to understand the behaviour of the individual behind the device. Indeed, value is derived from the rich information about the individual, their activities, their movements, and their preferences. When inferences are made about the owner of a device, it raises the question whether it is the device being tracked or the individual."

The rapidly rising issue related to privacy is just one example of the tension that exists between what technology offers (convenience) and what people value (privacy). There is a whole set of values that have been deeply embedded in smart home technology thanks to its technological predecessors. As a result, the smart home narrative as told by its providers continues to be about convenient lifestyles, personalized living, optimized workflows, constant connectedness and seamless integration between all aspects of life. This narrative is being further perpetuated by a larger undercurrent of social, economic, political and technological forces.

The adapted CLA diagram (**Figure 10**) provides a summary of those cumulative metaphors, current patterns and structures, as well as artefacts that constitute the smart home.

Artefacts

What technologies are produced and introduced in the home?
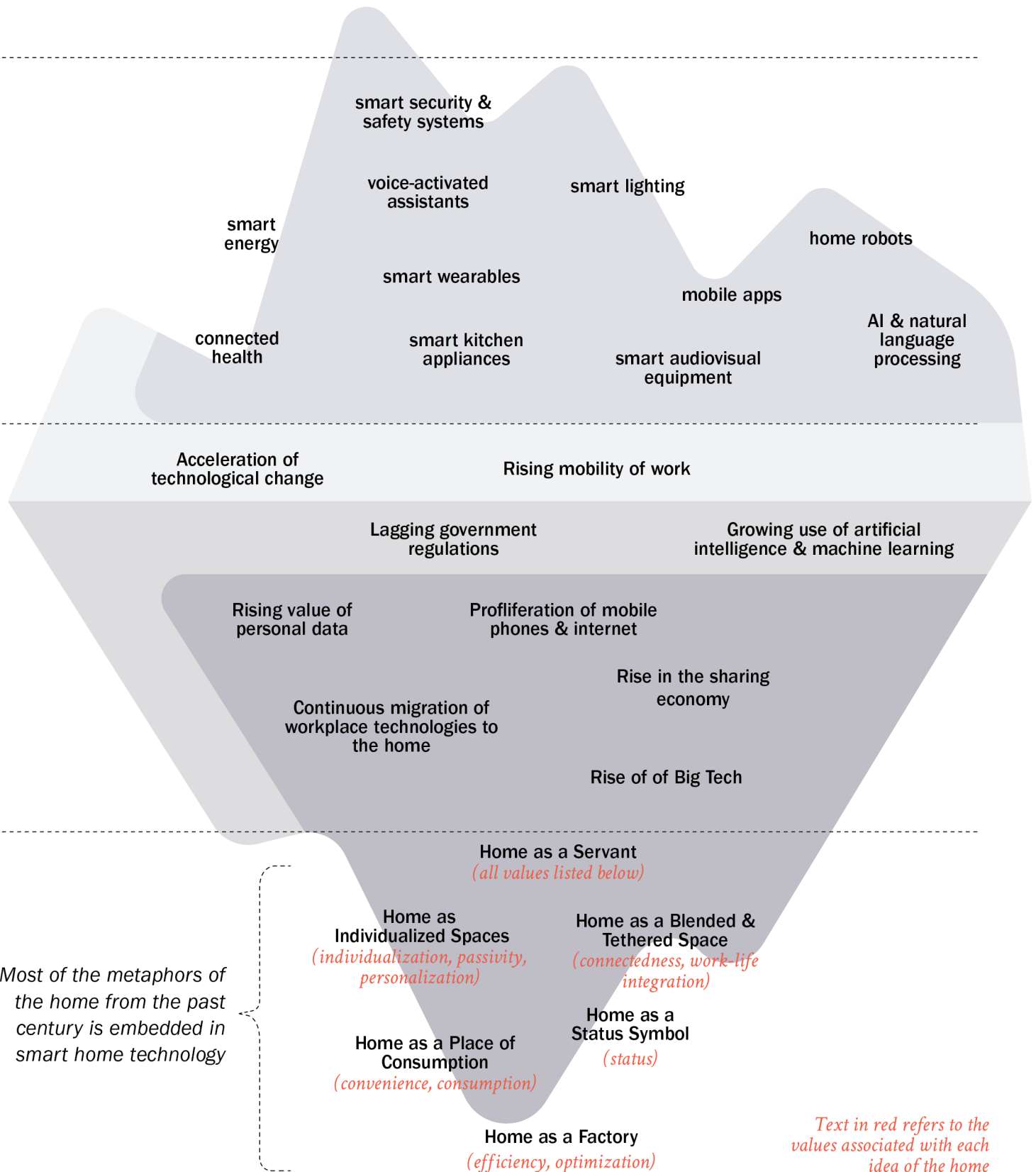
Patterns / Structures

What are they key social, economic, political and technological forces that shaped these artefacts?

Metaphors

How is the idea of the home being framed by technology providers?

Figure 10: An adapted CLA of smart home technology showing the all the layers of identities that are embedded in the Smart Home narrative

ADAPTED CAUSAL LAYERED ANALYSIS OF SMART HOME TECHNOLOGY

smart security & safety systems

voice-activated assistants

smart lighting

smart energy

home robots

smart wearables

mobile apps

connected health

smart kitchen appliances

smart audiovisual equipment

AI & natural language processing

Acceleration of technological change

Rising mobility of work

Lagging government regulations

Growing use of artificial intelligence & machine learning

Rising value of personal data

Profliferation of mobile phones & internet

Rise in the sharing economy

Continuous migration of workplace technologies to the home

Rise of of Big Tech

Home as a Servant
(all values listed below)

Home as Individualized Spaces
(individualization, passivity, personalization)

Home as a Blended & Tethered Space
(connectedness, work-life integration)

Home as a Status Symbol
(status)

Home as a Place of Consumption
(convenience, consumption)

Most of the metaphors of the home from the past century is embedded in smart home technology

Home as a Factory
(efficiency, optimization)

Text in red refers to the values associated with each idea of the home

Tomorrow:
HOME AS A MACHINE?

Looking at the timeline from the early twentieth century to today, technologies in the home have revealed a rather linear vision of the future with fixed roles for technology in the home. It is one where household chores are either optimized or completely eliminated by a plethora of new devices. It is also one where the values of consumption, individualization and convenience prevail. Today, technology in the home has come full circle since the early 1920s, when the decline of domestic servants was "offset" by household appliances. Now an entire ecosystem of devices could transform the entire home into a digital servant, one with human names like Alexa (**Figure 11**).

Following this trajectory, it is not hard to see where the future of smart home might end up. Such a linear progression of domestic technology has been identified by Williams (1997, p.6) as an entrenchment of technology that occurs "*because technologies develop cumulatively, utilising, where appropriate, the knowledge base and the social and technical infrastructure of existing technologies. An important aspect of the success of the modern technological project is the way it has been able to build upon earlier achievements.*" As a result of these "path dependencies," each wave of technological innovation carries with it the legacy (such as form, function and ideologies) of those that it is trying to replace, even if those legacies are no longer serving the needs of users or are irrelevant in today's context (Williams, 1997).

Even though there has been a compelling story told by technology providers of the gifts that technology might give us, the long-term social repercussions of living in a hyper-connected home and society cannot yet be fully fathomed. In a 2018 report released by Pew Research Centre titled "The Future of Well-Being in a Tech Saturated World," speculations made by 1,150 experts cover the entire spectrum of utopian to dystopian visions of the future. One of those futures is the idea of a "digital caste system," which is based on the current monopoly and omnipresence of Big Tech companies such as Google and Amazon. In this future, Webb (2019) imagined these few companies as the "operating system for everyday life." She wrote:

> "*By choosing Google, Apple or Amazon today, you are also aligning your family values with the values of one of the big tech giants. And soon, you may have to choose — making just one of these companies a custodian of all your family's data. The unintended consequence of this kind of home automation could be a digital caste system that's much more daunting than the prospect of making microwave popcorn the old-fashioned way*" (Webb, 2019).

It is hard to say right now what the unintended consequences might be living in a hyper-connected home. What is clear, however, is that a wide gap currently exists between the

realities of the domestic experience and the ideas of the home framed by technology providers. Households are more diverse now than ever, and the underlying social and cultural fabric of the home cannot be easily translated into a set of predefined problems for technology to solve. As best summarized by Bell & Kaye (2002),

> *"In creating technology for the home, in particular for the kitchen, technologists have forgotten that these domestic spaces are inhabited and used by people. These spaces function not as sites for technologists' or technological in(ter)vention, but as sites where meaning is produced, as well as meals. These spaces are the places where we dwell."*

The next chapter brings the lived realities of the home to the forefront of this conversation.
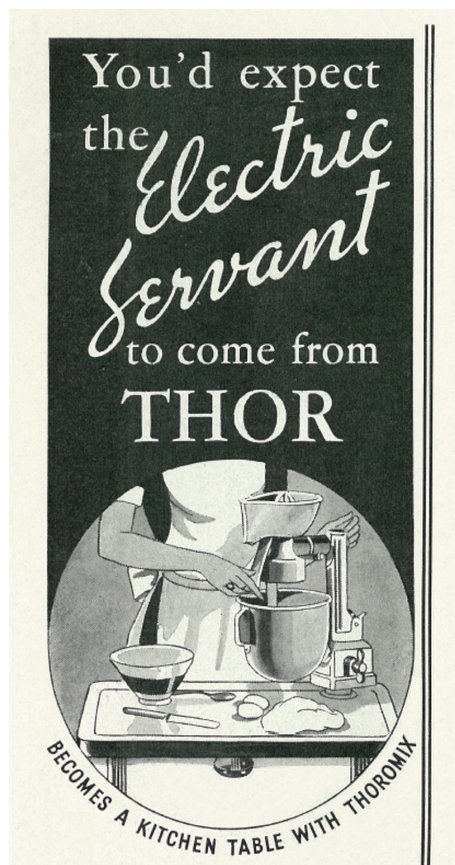

Figure 11: A comparison between an ad in the 20s featuring the Thor electric food mixer vs. ads of the Amazon Echo (recreated by author) that asks Alexa to do things without lifting a finger. Both compare technology to a servant.

REALITIES OF EVERYDAY LIFE IN THE HOME

"A home is much more than a shelter; it is a world in which a person can create a material environment that embodies what he or she considers significant. In this sense the home becomes the most powerful sign of the self of the inhabitant who dwells within."

(Csikszentmihalyi & Halton, 1981, p.123)

UNDERSTANDING THE EXPERIENCE OF THE HOME

The previous chapter revealed the dominant values supported by domestic technology. Unsurprisingly, many of these values (such as efficiency, integration and connectedness) mirror those of the workplace. This is because many domestic technologies were designed for the workplace before they migrated to the home. These values have been so deeply entrenched that every new iteration of domestic technology further perpetuate those same ideologies and associated values. Following this trajectory, it is not hard to imagine the future of the domestic experience as one similar to the home of the Jetsons in Orbit City. However, evidence suggests that these values supported by domestic technology do not fully reflect the realities of the home and domestic life.

So what constitutes the home and domestic experience? This is a loaded question and even a preliminary scan of existing literature revealed a plurality of discourses on this topic, especially in the field of social sciences. Some of these perspectives range from geography, architecture, economics, gender, spirituality, psychology, culture and the material environment. The purpose of this chapter, however, is not to provide a summary of those various discourses. It is to begin identifying aspects of the home that should be taken into consideration when designing technology for the domestic sphere.

To enrich the understanding of the home based on existing literature, ethnography tools were employed to gather preliminary evidence of people's lived experiences. First, a three-part survey was developed to gather responses from participants on their experience in the home and their attitude towards technology. A total of 54 participants responded to the survey. These participants represent a diverse range of living arrangements including young couples, nuclear families, young adults living with parents, students living in dorms and those with roommates. **Figure 12** provides a snapshot of the general demographic characteristics of those participants.

Using preliminary insights gleaned from the survey, follow-up interviews were conducted. These interviews took place on-line and were guided by a workbook that participants completed on the spot or after the interview (**Figure 13**). The workbook contained three sets of questions that participants responded to through writing, illustrations and photographs. This creative component of the interview was used to elicit more nuanced insights about the participants and their experiences. The four participants were chosen based on their survey answers and expressed interest in this part of the research. As expected, the results of the workbook added a layer of richness around the survey results.
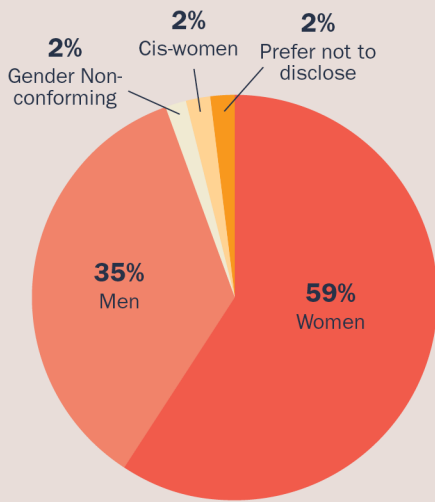
Analysis of both the survey data and workbook consisted of coding and affinity mapping. Affinity mapping is essentially a qualitative method used to cluster similar ideas to identify emerging patterns or themes in the responses. Since the coding was done by myself, there was inherently bias in how the responses were interpreted.
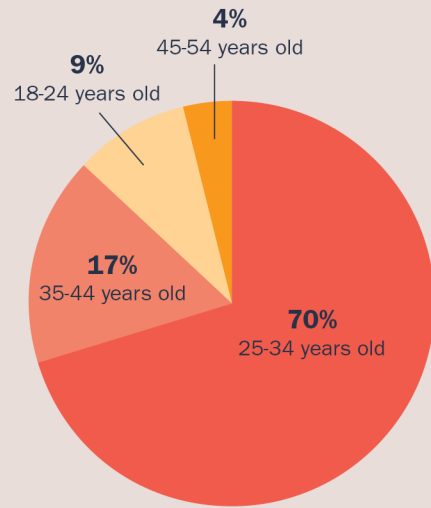
Figure 12

WHO PARTICIPATED IN THE SURVEY?

54
total participants

60%
women

70%
between the ages of 25-34
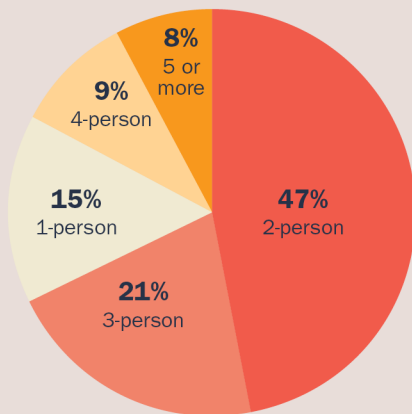
65%
employed full-time

47%
live in two-person households

GENDER

- 2% Gender Non-conforming
- 2% Cis-women
- 2% Prefer not to disclose
- 35% Men
- 59% Women

AGE

- 4% 45-54 years old
- 9% 18-24 years old
- 17% 35-44 years old
- 70% 25-34 years old

HOUSEHOLD SIZE

- 8% 5 or more
- 9% 4-person
- 15% 1-person
- 47% 2-person
- 21% 3-person

EMPLOYMENT STATUS

- 6% self-employed
- 4% unemployed
- 9% part-time
- 17% student
- 65% full-time
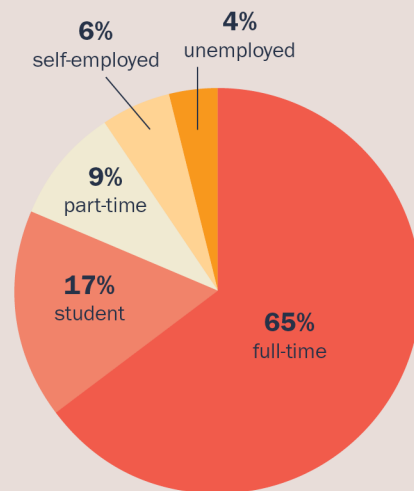
One of the biggest limitations of the survey was the lack of participation from multi-generational households, single-parent households, older adults or those with alternative living arrangements such as co-housing.

Activity Three:
The Metaphor of Home

When I asked in my survey what the home means to people, many have responded that the home is a sanctuary to relax, rejuvenate and recharge. Yet the anxieties of the world outside of home are increasingly present in our homes enabled by technology and the need to stay connected. In that sense, is our home still truly a sanctuary? If so, what is the makeup of such a home?

Comparing the home to a sanctuary is a metaphor, and this exercise is about re-imagining what the home should be, according to your own metaphor. See instructions on the left-hand side to complete this exercise.

1. Think of a metaphor for your home and fill it in the blank. Some suggestions are included but you are encouraged to come up with your own. You don't need to pick a metaphor that captures everything you want your home to be. It could be something that reflects your most important value.

My home is

Activity Two:
Through My Lens

One can argue that the home is a reflection of its inhabitant, represented through the design of the space and the objects brought into the home. In turn, the curated physical and material environment in the home further reinforces the values of its inhabitants. The purpose of this exercise is to uncover how you choose to represent yourself in the home through space and objects.

1. Take a look at the four photo frame cut outs and subject matter to be photographed:
   - my favourite space
   - objects on display
   - object I can't live without
   - object to be discarded

2. Use the cut-outs to frame each subject matter that corresponds with the instruction on the cut out. Then, take a photo of that frame with your phone or digital camera.

3. In the corresponding boxes on this exercise sheet, explain the rationale behind each photo you took. Some prompt questions have been included to guide your thinking.

   After you complete the exercise, email the photos to ... com

Activity One:
My Daily Routine

As writer Annie Dillard contemplated on the tension between presence and productivity, she wrote "how we spend our days is, of course, how we spend our lives." A major part of life at home consists of daily routines, and the purpose of this activity is to uncover 1) how you typically spend your evening or day at home, and 2) how you would ideally like to spend that time

1. First, think about whether you would like to depict an evening or a day. Then, think about the timing and sequence of activities that make up a typical evening or day at home.

2. Draw and annotate those activities in the box below labelled "typical" along the timeline. If you are doing multiple things at once (i.e. cooking and listening to music), please record all of the activities. The drawings can be simple and don't need to look perfect!

3. As you complete your typical day/evening, reflect on how you would like to spend that time ideally. Then, draw and annotate your ideal evening/day in the box below labelled "ideal". If some or all of your typical routine is ideal, you can just write "same as typical"

Typical
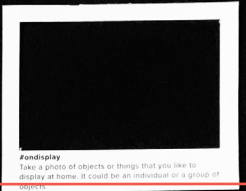
Timeline

Ideal

4. In the space below, please write down some of your biggest obstacles in achieving your "ideal" routine (is it time? people? tools? skills? space...)

Example

8:00 PM

7:00 PM
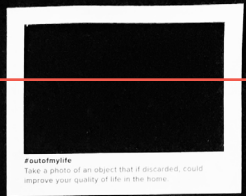
#outofmylife
Take a photo of an object that if discarded, could improve your quality of life in the home.

#ondisplay
Take a photo of objects or things that you like to display at home. It could be an individual or a group of objects.
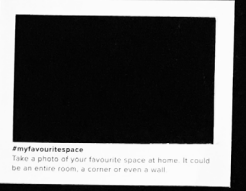
#myfavouritespace
Take a photo of your favourite space at home. It could be an entire room, a corner or even a wall.
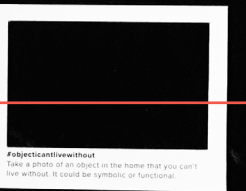
#objectcantlivewithout
Take a photo of an object in the home that you can't live without. It could be symbolic or functional.

Figure 13

FOLLOW-UP INTERVIEW WORKBOOK

Activity Three: Metaphor of the Home

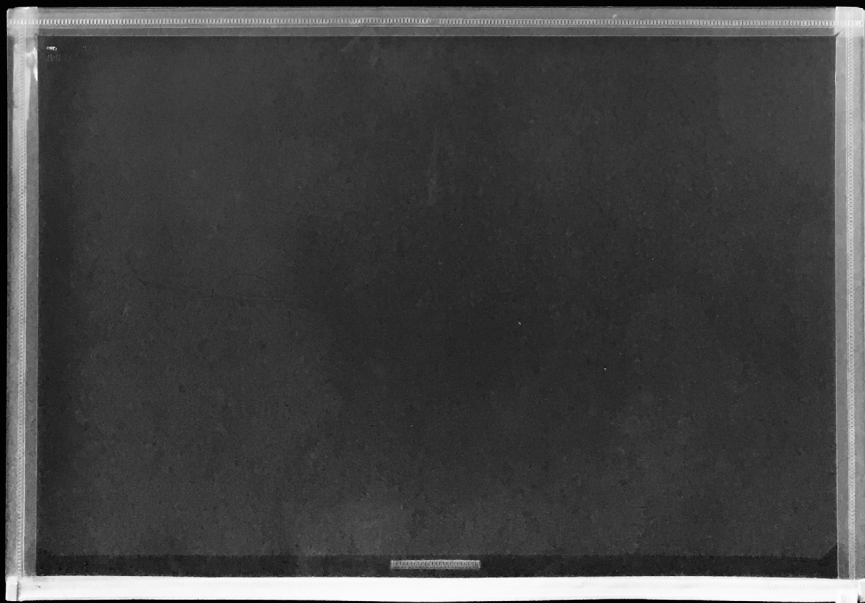Participants were asked to come up with their own metaphor of the home, and based on that metaphor, illustrate elements of the home they want to keep, create or destroy.

Activity Three: Through My Lens

Participants were asked to take photos of and talk about: 1) their favourite space, 2) objects on display 3) an object that they can't live without, and 4) an object that they want to get rid of.

Activity Three: My Daily Routine

Participants were asked to illustrate their existing and ideal evening routines in the home, and identify the biggest challenges in achieving their ideal routine.

As expected, the responses provided a more rich and nuanced layer of information to complement the survey results.

UNPACKING THE HOME

From the literature review and results of primary research, it is clear that one of the biggest challenges of designing for the home is that the home is a multi-dimensional space filled with meaning, idiosyncrasies and even contradictions. Within the physical and perhaps conceptual boundaries of the home, there are artefacts, activities, relationships, memories, histories, culture and meanings that are tightly interwoven. As a result, the home is a unique space and place for each individual.

While there is a rich and diverse body of work that contributes to the understanding of the home, not many view the home through a holistic lens. The framework that is most relevant to this project is Sixsmith (1986)'s model of the meaning of home. Sixsmith found that the home can be experienced on three levels: the physical home, the personal home and the social home. As the name suggests, the physical home refers to the physical environment, structure and architecture of the home. The social home encompasses the type and quality of relationships that exist within the home, as well as the emotional environment created from by the relationships. Finally, the personal home defines the home as an extension of the self, including self-identity, self-expression and emotions. **Figure 14** summarizes the three types of home or "three experiential modes" developed by Sixsmith:

Physical Home	Social Home	Personal Home
Home is seen as a composition of the physical space and the objects within	Home is seen as a product of the social relationships and activities	Home is seen as an extension of oneself, including self-identity, expression & emotional needs
Structure Services Architecture Work environment Spatiality	Type of relationship Quality of relationship Friends and entertainment Emotional environment	Happiness Belonging Self-expression Critical experiences Permanence Privacy Time Meaningful places Knowledge Desire to return

Figure 14: Sixsmith (1986)'s tripartite division of the home

To contextualize Sixsmith's findings, a question was included on the survey that asked the participants "*what does home mean to you?*" As expected, the responses were diverse but also converge on some key themes. For example, in the survey, most participants did not describe the home in the physical sense, such as a shelter or just a place to sleep. Rather, almost all referred to the personal or social aspects of the home.

For example, the most common description of the home was that it is a place of comfort, refuge and safety. In most cases, safety did not mean protection from physical harm, but rather, it meant safe to be who they are and to be vulnerable:

- *"A safe place to which you can really relax without being concerned of others."*
- *"Home is a feeling where you feel protected, private, and comfortable enough to be vulnerable. It is a combination of place, people, and memory."*

Many of them also spoke of the home as a place for self-expression but also to gather and connect with family and friends. This means that the home can be personal and also shared, highlighting the personal-social dichotomy of the home:

- *"Home is your space in the world. It's where you go to regroup, re-energize, as well as create some of the most meaningful memories in your life. It's the space that you get to create as yours and live how you want."*
- *"Home is where I am greeted by people I love. There is a sense of safety and security that you wouldn't get anywhere else. It allows me to be comfortable and vulnerable with the people who live there with me."*
- *"Home is a place that I feel safe, secure and happy within close proximity of my friends and family. It's a place that I can relax and recluse, but also gather and connect."*

Some spoke of the home in contrast with the "outside world," which were described as uncertain, bustling, stressful and a place where they need to have their guard up:

- *"Home is a constant - it's a place of certainty in a world of uncertainty."*
- *"It is a place of solitude away from the bustle of the outside world."*
- *"Being at home lets you to shed all the external stress and outward facades that you may have to deal with in your daily life and just be yourself."*

Evidently, Sixsmith's tripartite approach to understanding the home is still relevant and a useful framework for this project. One thing that should be emphasized, however, is how much the physical, personal and social homes are intertwined and indivisible in real life. Often, the physical environment of the home is a reflection of the self or shaped by the social relationships it contains.

To add to Sixsmith's work, there is one more realm of the home that should be included - the home as a symbolic environment. This observation came from responses that described the home using a metaphor, such as the *home as a sanctuary* or *home as a basecamp*. These metaphors paint vivid pictures of what the homes feel like, but do not quite fit into the physical, personal or social experiences of the home. The quote that best encapsulates the idea of home as a symbolic environment comes from Csikszentmihalyi & Halton (1981) in their monumental book *The Meaning of Things: Domestic Symbols and the Self*. They wrote:

> "*A home is much more than a shelter; it is a world in which a person can create a material environment that embodies what he or she considers significant. In this sense the home becomes the most powerful sign of the self of the inhabitant who dwells within...The importance of the home derives from the fact that it provides a space for action and interaction in which one can develop, maintain and change one's identity. In its privacy, one can cultivate one's goals without fear of ostracism or ridicule. The home is a shelter for those persons and objects that define the self; this it becomes, for most people, an indispensable symbolic environment*" (Csikszentmihalyi & Halton, 1981, p.123).

Combining findings from primary research, as well as works from Sixsmith (1986) and Csikszentmihalyi & Halton (1981), it can be said that the fabric of home consists of four dimensions - physical, personal, social and symbolic (**Figure 15**). These four dimensions ultimately shape what people do in the home such as activities, routines and social interactions - the very aspects of the home that domestic technology is trying to mediate. However, evidence also suggests that technology providers do not have a holistic understanding of the home and how these four dimensions interact with one another. For example, these dimensions are fluid and ever-changing with time. More importantly, they can contradict each other, resulting in opposing values that co-exist in the home. This reality makes it incredibly difficult to design technologies that are supportive of a range of human-centered values and needs in the home.
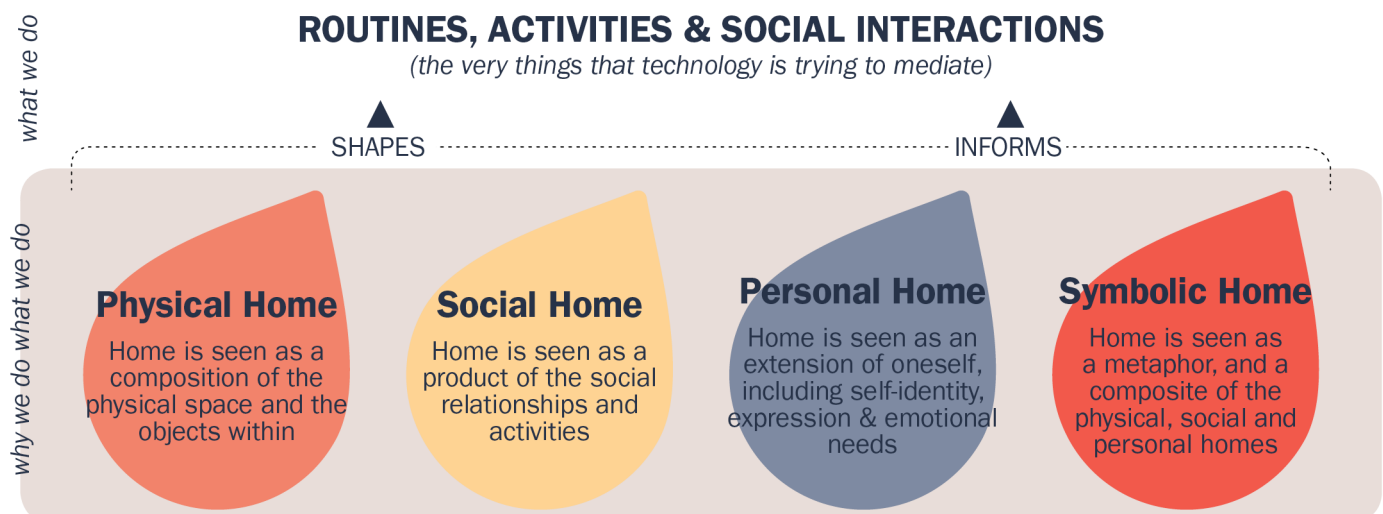

Figure 15: The Four Dimensions of the Home

SIX TENSIONS IN THE HOME

This section highlights the six tensions in the home that stemmed largely from the survey and follow-up interviews, and further supported by existing literature. These tensions represent the realities of everyday life in the home, and context in which new technologies will be situated. Evidence also suggests that domestic technology supports only one side of these tensions, resulting in frustrating user experiences, lackluster products, missed opportunities or worse, unintended negative consequences for users.

Efficiency vs. Mindfulness

One of the best examples that highlights this dichotomy is household chores. Since the Industrial Revolution, the message around domestic technologies, especially time-saving technologies, relates to the mechanization of household chores such as cooking, cleaning and washing to achieve optimal efficiency. However, studies have shown that the actual time spent on household chores have remained consistent despite a growing array of technologies designed to save time. One commonly accepted explanation is that the standard for cleanliness increased with new technologies (Bowden & Offer, 1994; Goldstein, 1997; Wajcman, 1994). For example, the convenience of washing machines led to clothes being washed more often. Despite all the technologies that have accumulated in the home, the war against household chores wages on with newer and smarter weapons. Currently, devices on the market advertised as faster or better ways to complete chores are abundant and diverse - smart vacuums, self-ordering smart fridges and automated pet feeders just to name a few. In the face of technology, household chores are framed as orderly and programmable problems to be optimized or even eliminated.

For some, the efficiency afforded by technology is welcomed. After all, time is a scarce resource in the modern household. However, what do chores actually mean to members of a household? For starters, they are very much an essential component of the "social home." For example, a 2013 study of 32 middle-class families across Los Angeles reveal chores as anxiety-inducing and time-intensive activities that could lead to household tensions and resentment (Klein, Izquierdo, & Bradbury, 2013b). Much of this points to shifting expectations around who should do chores, especially in the realities of busy modern day households. Even though there is still disparity in the division of labour at home, men's participation in housework has doubled in the past 40 years, along with more time spent on childcare (Klein, Izquierdo, & Bradbury 2013). As a result, what was seen as traditionally women's domain, chores are slowly becoming a shared domain in a multi-person household. Without a clear framework for identifying roles and responsibilities in the home, chores have become a collaborative effort and a constant source of negotiation, tension and even resentment (Klein, Izquierdo, & Bradbury 2013). This

"According to a 2007 Pew Research Poll, sharing household chores was in the top three highest-ranking issues associated with a successful marriage—third only to faithfulness and good sex. In this poll, 62 percent of adults said that sharing household chores is very important to marital success. There were no differences of opinion reported between men and women, between older adults and younger adults, or between married people and singles."

- Klein, Izquierdo & Bradbury, 2013 p. 114

was echoed by one of the research participants who currently lives with a sibling. In her interview, she revealed that there is an unspoken policy around washing dishes where the person who does not cook has to clean up. It is also something that is heavily negotiated on a daily basis. Her response revealed the desirability in achieving an "equitable" distribution of household tasks, and the fact that it is an "unspoken policy" suggests that it might be an expected rule but not often communicated. As such, even a simple task like washing dishes is imbued with human elements. As best summarized by Klein, Izquierdo, & Bradbury (2013, p. 114), "*more than constituting a series of simple instrumental tasks, household work represents a complex set of interpersonal exchanges that enable family members to achieve (or fail to achieve) solidarity and cohesiveness.*"

Some household chores can also contribute positively and meaningfully to the social home, such as food provisioning. In the primary research, several participants have identified the kitchen as a place that brings them the most joy because of their love for cooking or because how it can bring everyone together. For example, one participant sees the kitchen as a space for creativity: "*(I) love activities like baking and it's where my partner and I create together and collaborate.*" For households with children, Davidoff, Lee, Yiu, Zimmerman, & Dey (2006) found through their study that cooking is vital to the identities of parents and what constitutes a "good parent." Similarly, one of the research participants revealed that the kitchen is a place of learning for her child. In her kitchen, there is a piece of Ikea furniture that was "hacked" for her child to use so he could stand and see what is happening as she prepares meals in the kitchen. Appropriately, she named this stand the "Learning Tower" (**Figure 16**). Evidently, the simple act of preparing a meal can be an expression of love, memory, culture, tradition or identity, not to mention its importance in people's overall health and well-being.

It should be highlighted that food provisioning does not only consist of cooking, but also meal planning, grocery shopping, food storage, consumption and even waste. Each part of this process is riddled with different challenges, routines, interactions and meaning and do not lend themselves to be easily programmed, improved or automated (see **Figure 17** as an example). As a whole, meal preparation is a constant negotiation between conflicting values such as health vs. indulgence, novelty vs. tradition, economy vs. extravagance, and care vs. convenience (Warde, 1997). Overall, the tensions between efficiency and mindfulness have been echoed by several participants when talking about food provisioning:

Figure 16: The Learning Tower

- One participant reflected on grocery shopping as a mindful activity: "*I have always been a very "manual" person. I like the process of doing things myself. For example, I like grocery shopping in-person at the grocery store because I get to touch the things I want to buy. The act of touching things actually connects me to them and helps me plan*

for what I'm going to do with them, which is very helpful for meal planning. So, I wouldn't be interested in a fridge that ordered my food for me, for example."

- A couple with full-time jobs expressed that they typically rely on UberEats take-out in the evenings, which is likely their most "*unhealthy meal of the day.*" However, both expressed a desire to "*make a healthy and more considerate meal with fresh ingredients.*"

Therefore, simply automating any part of this process might contradict the notion of food provisioning, along with other household chores, as a deeply social, emotional and meaningful activity in the home.

FridgeCam's idea of a fridge   Author's own fridge

Figure 17: The purpose of the FridgeCam is to allow users to remotely check the contents of their fridge while grocery shopping so they know what to buy. The usability of the FridgeCam largely depends on having a neat and orderly fridge. However, the reality is that most fridges are unorganized, filled with things stacked on top of each other in unmarked containers or tucked into the back and out of sight. This lived reality renders fridge cameras a relatively useless feature for some users.

Home as Individual/Personal Space vs. Home as Collective/Shared Space

In reference to the four dimensions of the home, it is clear that the home can be experienced as individual (the personal home) or a shared space (the social home). One of the research participants articulated this exactly, stating: "*home is a place that I feel safe, secure and happy within close proximity of my friends and family. It's a place that I can relax and recluse, but also gather and connect.*" This dichotomy of the home is likely not a problem in an one-person household. However, in a multi-person household, different individual needs (such as self-expression and emotional needs) co-exist in a shared space. Often, these needs, values and preferences can be diverse, resulting in conflict and negotiations.

There has been a deeply embedded notion of the ideal household for domestic technology (including the smart home): the middle-class nuclear family. This family consists of a heterosexual, married couple with two young children living in a suburban house that they own. This family can often be seen as harmonious and collaborative with clearly-defined goals, responsibilities and relatively fixed and stable needs and preferences (Wilson, Hargreaves, & Hauxwell-Baldwin, 2014).

In reality, households today are anything but stereotypical (**Figure 18**). There are diverse ways in which families can now be categorized including household type, family structures, identities, living arrangements, lifestyles and experiences (Battams, 2018). It goes without saying that households are continuously evolving. In Canada, multi-generation households have been the fastest-growing household type between 2001 and 2016 (Battams, 2018). In addition, More than one in three (34.7%) young adults aged 20 to 34 were living with at least one parent in 2016, with a higher share for those living in large metropolitan areas such as Toronto (S. C. Government of Canada, 2017). Needless to say, housing types are also changing. There is also a growing portion of the population living in smaller dwelling types such as micro apartments, tiny homes, or people living in alternative arrangements such as co-living.
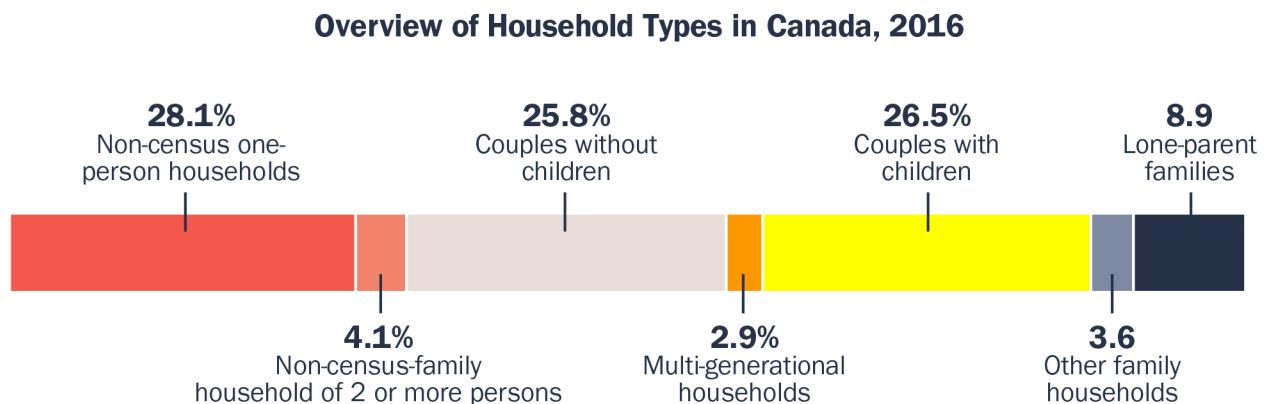
Overview of Household Types in Canada, 2016

Figure 18: Overview of Household Types in Canada, 2016 (source: StatsCan)

Why do all of this matter when it comes to smart technology usage in the home? As household types, family structures, housing types and living arrangements evolve, the very space that we share with others and who we share it with is becoming incredibly diverse. This poses a real challenge for smart home technology, since it favours single-user control and access. Without technology, whose preferences prevail in the home is likely determined through verbal negotiations. When this process is mediated by technology that favour single-user control, the preferences of those that control the technology prevail. This insight is echoed by Baillie & Benyon (2008), who identified two distinctive user groups of smart home technology. The active users set up, maintain and control the rules and settings of smart technology, and passive users that comply to those rules (Baillie & Benyon, 2008). It is not hard to imagine a scenario in which a "technophile" young adult living with parents actively sets up and controls all the smart home devices, while the parents become passive users in their own home. This scenario is actually reflected in the survey, out of the 11 participants that were young adults living with parents, five of them reported that they set up and control the smart devices in the home.

Needless to say, in a home where relationships are relatively harmonious, who sets up the Nest and determines the ideal temperature is a relatively innocuous issue. However, not all homes can be considered harmonious or even safe. In households with extreme asymmetry of power that often result in abusive or violent relationships, smart home technologies have been used to perpetuate those dynamics. In the aforementioned New York Times article that explored the role of smart home devices in domestic abuse, Bowles (2018) revealed that "*usually, one person in a relationship takes charge of putting in the technology, knows how it works and has all the passwords. This gives that person the power to turn the technology against the other person.*" Examples of misuse by abusers include remote surveillance and changing of settings on devices like smart thermostats, speakers or locks. Emergency responders have also pointed out that many victims of smart home-enabled abuse were women, while smart home devices were largely installed and controlled by men (Bowles, 2018). By favouring single-user control and access, these connected devices can perpetuate power imbalances in a shared setting, resulting in unfortunate circumstances.

These are only a few examples of the contrast between the expected and actual use of domestic technology in a shared setting. Failure to recognize the diverse social compositions of families and how people co-exist in the same domestic space, unintended consequences are bound to take place.

Convenience / Personalization vs. Privacy

As briefly mentioned in Chapter Two, one of the thorniest issues that exist in the conversation around smart home technology today is the paradox between convenience and privacy. This paradox is not only relevant to the smart home, but one that is deeply embedded in living a digitally connected life. It entails discussions around data ethics, accountability, transparency, surveillance, consent, consumer awareness and rights.

In today's economy, data is comparable to a new currency or asset with immense value in the digital age. Consequently, companies are rushing to collect, control and assess the data in order to stay relevant in this emerging data economy. Large technology companies such as Google and Amazon are ahead of the game in this regard due to how integral they already are in people's everyday lives. They offer convenient services and tools in exchange for data, then the data can be used to offer even better and more personalized products or services. These companies are also eager to dominate the smart home market. After all, the home is like a gold mine filled with valuable data related to day-to-day living.

The biggest issue with smart home technology, however, is how much it contradicts the expectations for privacy in the home. In a Supreme Court of Canada case *R vs. Silveira,* Justice Cory (1995) states: *"(t)here is no place on earth where persons can have a greater expectation of privacy than within their 'dwelling-house.'"* Indeed, the home as a "private," "personal" and "safe" place have been echoed repeatedly by research participants. Contrary to those expectations, smart home technology providers continue to push the boundaries. Just earlier this year, it was widely reported that voice recordings captured through the Amazon Echo were being used to improve its speech recognition and natural language capabilities. In fact, thousands of Amazon employees around the world listened to these recordings as a part of Alexa's "voice review process" (Day, Turner, & Drozdiak, 2019).

In the survey, when participants were asked what they liked or disliked about smart home technology, convenience versus privacy were the most polarizing responses (**Figure 19**). It was clear that the participants were generally aware of the issues of privacy, comparing smart home technology providers to "big brother" and have voiced concerns related to hacking, data collection and eavesdropping. However, many of the same people also own multiple smart devices in the home, citing convenience as the biggest factor for adoption. In addition, most participants just said they liked the convenience without providing many specific tangible benefits of these technologies.

While users are demanding more from technology companies to protect user privacy and personal data, they are also willing to easily give it up for convenient and personalized services and products. In a study conducted by Athey, Catalini and Tucker (2017), they concluded that "*consumers deviate from their own stated preferences regarding privacy in the presence of small incentives, frictions, and irrelevant information.*" Athey (2017) suggested that the lack of meaningful privacy choices and information overload likely contribute to this privacy paradox.

Currently, several Big Tech companies like Facebook are under scrutiny on issues related to data and privacy. In addition, regulators are desperately trying to establish oversight and governance on these issues. Some of these recent moves include Europe's General Data Protection Regulation (GDPR) and the International Grand Committee on Big Data, Privacy and Democracy.

It is reasonable to say that a turning point has been reached on the issue of privacy. As regulations tighten, companies that can offer both convenience and meaningful choices regarding privacy will prevail and compete in a rapidly changing policy landscape.
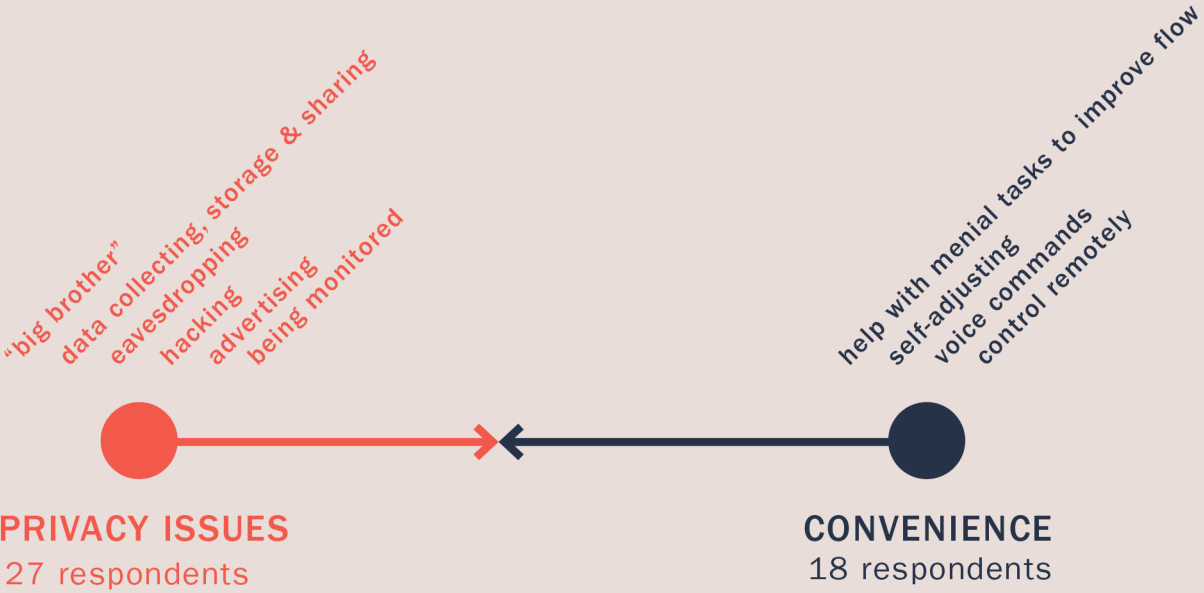

Figure 19: Responses to the survey question "what do you like or dislike about smart home technology?"

Connectedness vs. Desire to Disconnect

As wi-fi becomes enabled on all kinds of devices, it become much easier to tune into the outside world like work, news and social media. Today, it is possible to browse the internet, listen to music or even request an Uber on the door of a Smart Fridge. It is clear that the level of connectedness is unprecedented.

However, being connected is not often desirable. Many participants of this research have mentioned the desire to disconnect and unplug from technology, especially those that remind them of work such as their phones (for checking email) and their laptops.

The nature of work have been undergoing major transformations since the early 21st century. With the proliferation of mobile communication devices, the boundaries between work and life in the home are becoming increasingly blended (Reissner, Izak, & Hislop, 2017). On the plus side, the mobile and flexible nature of work as mediated by technology is providing people with more freedom to choose when, where and how work can be conducted. However, the deteriorating work-life boundaries enable work commitments to further creep into the home, especially for the rising number of people that now work remotely from home (Kopf, 2018).

There is an emerging body of work that explores a mix of temporal, spatial and sociomaterial disruptions that occur due to an erosion of this boundary. Kossek (2016) identified this work-life integration as work-life fragmentation, stating,

> "*Work has become more transactional, short term, and episodic with the increased use of mobile communication technologies. Cell phones and email have increased the pace and frequency of work and family interactions during the day...Now there is a rise in daily work—life interruptions, with easy switching back and forth between work and personal texts, emails, and websites, often resulting in fragmented and brief attention, and process losses from lack of sustained focus on the work or nonwork role*" (p.260).

This erosion of work-life boundary and "work-creep" has been echoed repeatedly by research participants, some of whom have identified the office as their least favourite space due to its association with work. For example, one participant identified that he would like to get rid of his computer monitors to separate work from his home life. In fact, the impact of work in the home for some participants extend beyond just doing work from home, it also includes time spent to unwind from work and also to prepare for work the next day (picking outfits, setting agenda). This leaves people with very little time to actually do anything else.

In the development of smart home technology, there seems to be a further erosion of this boundary by introducing more devices that can achieve seamless work-life integration and greater connectivity between all aspects of life. For example, in an ad for the Google Home, a woman is seen making work-related arrangements via the Google Home using voice control

as she gets ready for her business trip. For some, this might be a welcoming feature, but for others that are desperately trying to separate work from home, this might be detrimental. The tension between the flexibility offered by work-life integration and the fragmentation of time that result from it should be acknowledged by technology providers.

The Importance of Material Objects vs. the Desire to Declutter

Without a doubt, material possessions play a large role in contributing to the overall experience of the home. In relation to the four dimension of the home, material possessions make up a large part of the physical home. At the most basic level, material objects in the home can play a functional role in meeting people's basic needs. More importantly, objects are an extension of the self, such as identity, past experiences and connection to others (Roste, Ferrari & Jurkat, 2016). Research participants identified all kinds of objects as sources of meaning, such as photographs, mementos, books, a blanket and a record player. These objects are often on display in the home, signifying their importance. For example, one participant enjoys placing a stack of books on the coffee table as a reminder for her to read more, thus books become a representation of her greater aspirations.

Even though objects and things contribute significantly to the meaning of home, the presence of excessive material things can detract from the overall experience in the home and lead to psychological stress. In fact, the survey revealed that the presence of clutter is the single biggest source of frustration in the home. This is not surprising. A look at the booming industry fueled by the minimalism and decluttering movements (e.g. Marie Kondo's *The Life-Changing Magic of Tidying Up*) might indicate a growing frustration with consumption and mindless accumulation. This tension is more pronounced in households with children, where children-related clutter tends to spread in all corners of the home (Arnold, Graesch, Ragazzini & Ochs, 2012).

This tension between material possession and the desire to declutter is succinctly highlighted by Csikszentmihalyi & Halton (1981, p.123):

> *"If things attract our attention excessively, there is not enough psychic energy left to cultivate the interaction with the rest of the world. The danger of focusing attention exclusively on a goal of physical consumption - or materialism - is that one does not attend enough to the cultivation of the self, to the relationships with others, or to the broader purposes that affect life. As the economist Linder pointed out, the acquisition and maintenance of objects can easily fill up a person's life, until there is no time to do anything else, not even to use the things that are exhausting all of one's psychic energy. When such a pass is reached, the adaptive value of objects is reversed; instead of liberating psychic activity, the things bind it to useless tasks. The former tool turns its master into its slave."*

This tension also highlights a larger societal sentiment around compulsive versus mindful consumption. Today, the design and features of smart home technology make it easier and more frictionless to consume mindlessly. Take on-line shopping for example, Amazon's

proprietary "one-click" ordering and same-day delivery make shopping as easy as possible, thus encouraging impulsive purchases and mindless consumption. Furthermore, the online experience of "one-click" shopping is being replicated in the smart home ecosystem, where the digital assistant and even smart fridges can make purchases. For example, the Amazon dash wand and its integration with Alexa enable shopping in the home through voice-activation and even scanning, adding items directly into an on-line cart.

The convenience of material accumulation no doubt benefits technology providers' bottom line, but also allow people more easily meet their material needs. However, the ease of such accumulation can also lead to excess, which is detrimental to people's psychological well-being not to mention broader environmental implications.

Active Leisure vs. Passive Leisure

The last tension that arose from the research relates to the use of time for leisure, and the role of technology in mediating that time. Several participants have pointed to the passive use of leisure time as problem (such as watching TV or mindless browsing). Instead, they rather use that time to actively engage in more interactive activities or socialize with others without the presence of technology. This tension becomes pronounced during two routines - dinnertime and bedtime. Three participants expressed that dinnertime usually consists of dining in front of the television. Often, interactions during this time is rare even for those in a multi-person household, with the key reasons being that they are "*too exhausted from work to engage.*" Similarly, the same participants described the usage of technology during their bedtime routine as unhealthy. When they cannot sleep, they turn to their phones, tablets or laptops to wind down.

Leisure has always been a central aspect of life at home for individuals and families. An extensive ethnographic study done by Arnold, Graesch, Ragazzini & Ochs (2012, p.69) found that "*Americans spend considerable sums of money to create leisure 'refuges' such as master bedroom suites and back yard patios, both often featuring 'spa' tubs.*" However, the researchers found that despite the desire for leisure, there has been a rise in passive and more private and isolated leisure activities that can be attributed to the explosion of electronic media (Arnold et al., 2012). Case in point, they found that TV watching consumed 50 percent of their participants' leisure time.
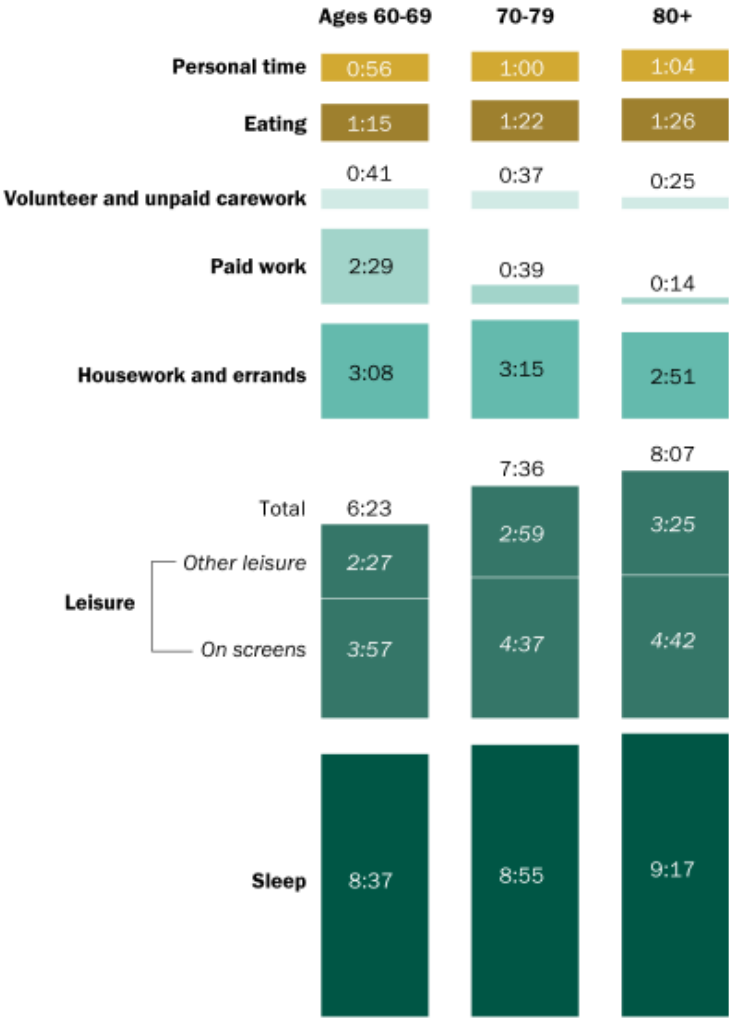
The ethnographic study conducted by Arnold et al. took place between 2001 and 2005, just before the time of smart phones, tablets, Youtube and Netflix. The advent of these technologies and platforms continue to promote passive leisure time. More alarmingly, the consumption of media can now conveniently take place anytime, anywhere, and on multiple devices. The frictionless and seamless experience intentionally designed into domestic technology products and services has made the consumption of media much easier and mindless. In fact, Pew Research Centre (2019) found that the total time that Americans ages

60 and older spend on their TVs, computers, tablets or other electronic devices has risen almost half an hour per day between 2005 to 2015, to a total of four hours and 16 minutes (**Figure 20**).

As a result, people can default to these passive activities than activities that require mental or physical energy. However, the ideals around the active use of leisure time - exercising, hobbies, creative endeavors - are still very much present, and will perhaps become more urgent in a hyper-connected multimedia home.

At the oldest ages, more leisure

Average time spent daily on each activity, by age (hours: minutes)

	Ages 60-69	70-79	80+
Personal time	0:56	1:00	1:04
Eating	1:15	1:22	1:26
Volunteer and unpaid carework	0:41	0:37	0:25
Paid work	2:29	0:39	0:14
Housework and errands	3:08	3:15	2:51
Leisure Total	6:23	7:36	8:07
Other leisure	2:27	2:59	3:25
On screens	3:57	4:37	4:42
Sleep	8:37	8:55	9:17

Note: Based on non-institutionalized people. Figures may not add to subtotals due to rounding.

Figure 20: Pew Research Centre (2019)'s time-use survey summary people ages 60 and older

TO SUMMARIZE

Having explored the six tensions that represent lived experiences in the home, one thing becomes clear - the techno-centric view of the home and domestic experiences is incredibly distorted and biased. By catering to one set of values, domestic technologies continue to perpetuate a vision of domestic living that is not reflective of the realities of everyday life in the home (**Figure 21**). As a result, products and features can end up becoming frustrating to use or worse, leading to unintended consequences. For users of these technologies, they are forced to adhere to one set of values over another, resulting in undesirable trade-offs.

As smart technology becomes a more integral part of the home, technology providers play a paramount role in designing products that support the whole experience of the home. This means catering to a range of values, such as both convenience and privacy, efficiency and mindfulness. The outcome should be positive-sum, not zero-sum.

Despite these existing gaps, there are still opportunities for change. These changes represent a shift in perspective for technology providers and a more holistic understanding of the range of values embedded in the home. Some of these opportunities include:

- **Design for more than efficiency:** instead of designing to optimize or eliminate all household chores, technology providers should consider some household chores (such as food provisioning) as sources of connection, play, collaboration and learning for all members of the household. For example, technology can be used to facilitate chores as a collaborative team effort, and even build in opportunities for learning for those with children.

- **Design for an equitable, shared environment:** domestic technologies should enable dynamic and equitable multi-user access and control interfaces beyond just offering different user profiles. This approach should respect the preferences and roles of multiple users that are co-present in the same space. It should also recognize that preferences are often not fixed but can change with time. As such, setting rule-based preferences are not ideal in a shared environment.

- **Privacy by design:** technology providers should respect the home as an extremely private space and proactively implement data privacy and security measures through design without forcing users to make trade-offs. One approach is adopting the seven Privacy by the Design principles developed by Dr. Ann Cavoukian.

- **Design for balance:** technology should be designed to enable users to achieve balance in their hyper-connected lives. This means providing tools or features that allow users to manage and maintain boundaries between work and leisure or even encourage behaviours like mono-tasking.

- **Design for mindful consumption:** technology providers should recognize mindful consumption or even anti-consumption as a growing user need and a shift in value. Design features could support values like shared ownership, repair, reuse and recycle.

- **Design for active lifestyles:** instead of designing more screen-based products that favour passive use and consumption, technology providers should consider products and features that can engage users in achieving more active lifestyles or hands-on activities. Example design approaches include gamification of physical activities.

Even though these opportunities seem straightforward enough, implementing them will be complex and challenging. They require the uprooting of existing business models, a shift in mindsets and a critical look at some of the values that have been deeply embedded in the industry. It also calls into questions around education curriculum and technology management practices.

Elements of the Home	Techno-centric framing of the home	Example designs based on techno-centric framing	Alternative framing of the home based on lived experiences
Home is	An extension of work An extension of shops A data mine	• Email integration • Voice-activated shopping • Wi-fi enabled devices	A sanctuary A safe place A retreat
Households are	Homogeneous Harmonious	• Single-user control • Rule-based settings	Diverse Conflicted Idiosyncratic
Activities are	Individualized Passive	• Screen-based products	Shared Active
Household chores are	Tasks to be optimized	• Self-ordering fridges	Collaborative activities Negotiated activities Source of learning Source of connection
Kitchen is	A workshop	• Smart kitchen counters with various screens	Place to create Place to collaborate Place for learning

Figure 21: Framing Distortions of Domestic Technology

REIMAGINING TECHNOLOGY FOR EVERYDAY LIFE IN THE HOME

"Optimism is a strategy for making a better future. Because unless you believe that the future can be better, it's unlikely you will step up and take responsibility for making it so. If you assume that there's no hope, you guarantee that there will be no hope. If you assume that there is an instinct for freedom, there are opportunities to change things, there's a chance you may contribute to making a better world. The choice is yours."

Noam Chomsky

SPECULATIVE DESIGN AS A TOOL

The ultimate goal of this project is to address "*how might we rethink domestic technology to better support human-centered values in the home.*" Several emerging opportunities have been identified in the previous chapter. All of them represent alternative approaches that support and embrace the ambiguous and contradictory nature of the home. Making changes based on these opportunities is challenging task. It involves checking deeply embedded values, biases and assumptions, and creating spaces where alternative futures can take hold.

As a final stage for this project, speculative design has been chosen as a method to illustrate the possibilities for change. Developed by Anthony Dunne and Fiona Raby, speculative design is not concerned with design as problem solving but rather uses "*design as a means to speculate how things could be*" (Dunne & Raby, 2013, p.2). Dunne & Raby (2013) further emphasized that speculative design is not about pinning down the future. Rather, it opens up discussion and provoke critical thinking about the present and future.

This method is fitting for this project because to address each of the six tensions in the home and come up with adequate solutions would be irresponsible, since each of them deserve more in-depth research and analysis. Speculative design allows for the early exploration of emerging design interventions that could take place to navigate the tensions, and bring forth a more balanced approach to technology design. Moreover, visualizing the future through design provides a more tangible way to ground theory and research.

For the scope of this project, three of the six tensions presented in the previous chapter have been chosen to be further explored. These design ideas are based on additional research, and are deeply inspired by from technologies, practices or behaviours that currently exist. Each of the speculative design scenarios are framed with a "*what if*" question to leave room for further exploration. It should be emphasized that the speculative design scenarios presented in this chapter are not meant to look like finished or refined products. They are only conceptual idea used to push boundaries and explore alternatives.

Although speculative design has not been widely used to explore alternative framings of the home, one example that comes to mind is The Microbial Home by Phillips Design (**Figure 22**). Phillips Design envisions the home as a "biological machine," where various machines are connected to filter, process and recycle what is conventionally considered as waste (Etherington, 2011). This design integrates both inputs and outputs from domestic activities (such as cooking) to form a cyclic system. Perhaps far from practical in a real home, this speculative scenario points to alternative ways of living that explore values such as sustainability and eco-consciousness.
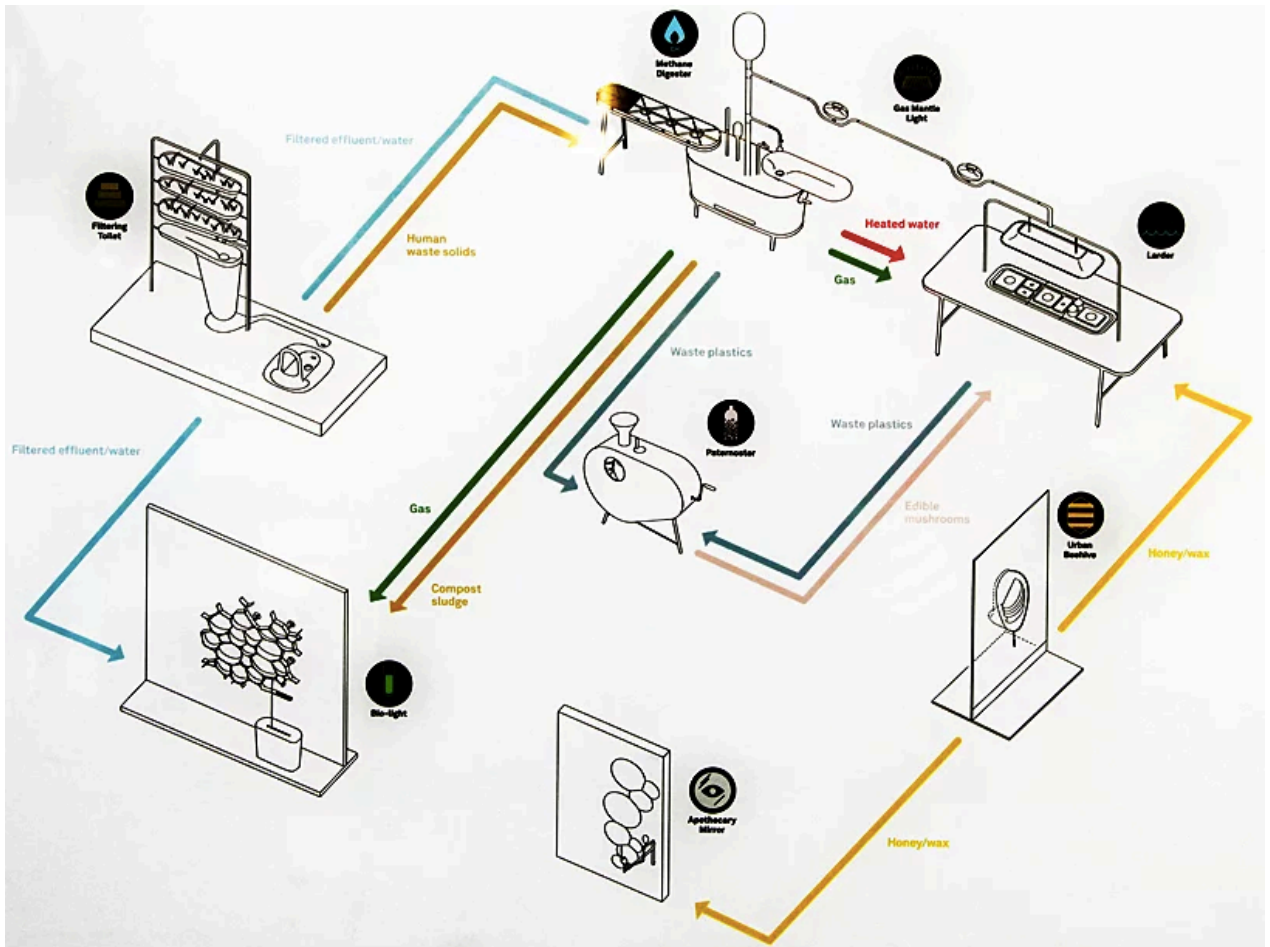
Figure 22: The Microbial Home by Phillips Design

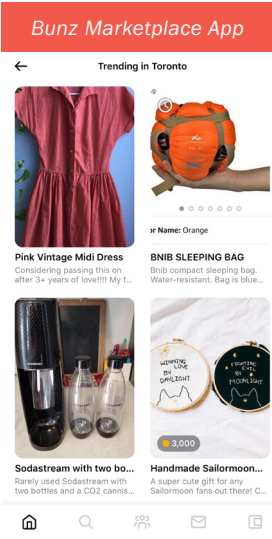# IMPORTANCE OF MATERIAL OBJECTS VS. DESIRE TO DECLUTTER

Evidence has shown that material objects in the home take on significant meaning and are often an extension of the individual or household. However, the problem of excessive material presence can be a source of frustration and psychological stress.

To manage excessive material possession through decluttering, many people have turned to online second-hand marketplaces sell or trade for goods. One of such platforms is called Bunz. Founded in Toronto and available nationwide, this online community acts like a barter system and allows users to trade goods and services with exchanging money.

Bunz is, of course, one of the many online marketplaces and communities that allow users to get rid of unwanted items in the home. People have also adopted more proactive approaches in reducing mindless consumption. Consider the minimalism and "KonMari" movements that encourage people to only keep things in the home that "spark joy." As a result, some people have taken rather extreme measures to track their purchase and usage of things. These measures include Excel spreadsheets that require the manual input of information and data.
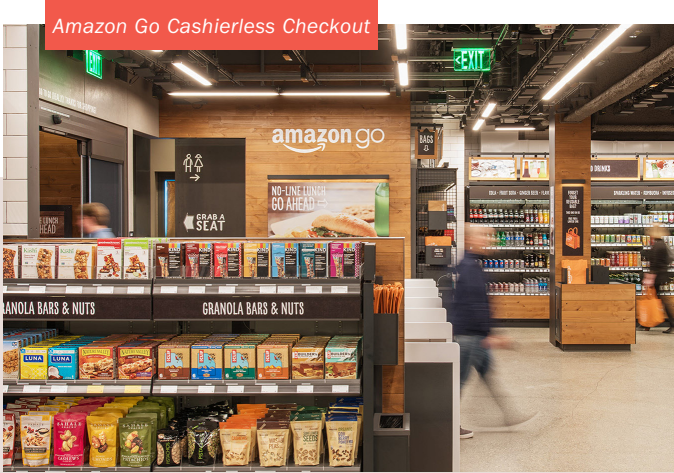
Combining these ideas, this speculative scenario asks "*what if there is a way to digitally track unwanted objects in the home and match it with potential new owners?*" In this scenario, there a small sensor would be installed at the entrance of doorways that tracks what comes into the homes and what is unused for a period of time. When things become unused for a prolonged period of time, users will be notified and can decide to put them up for sale or for trade in the online marketplace. There can also be a matching algorithm between items on people's wishlist and the community marketplace.

This type of sensor technology current exists, exemplified by Amazon Go stores and the cashierless checkout. Customers can walk in, pick up groceries and walk out without having to go through a cashier. Sensors in the store can track items that customers pick up and automatically add them to an online cart.

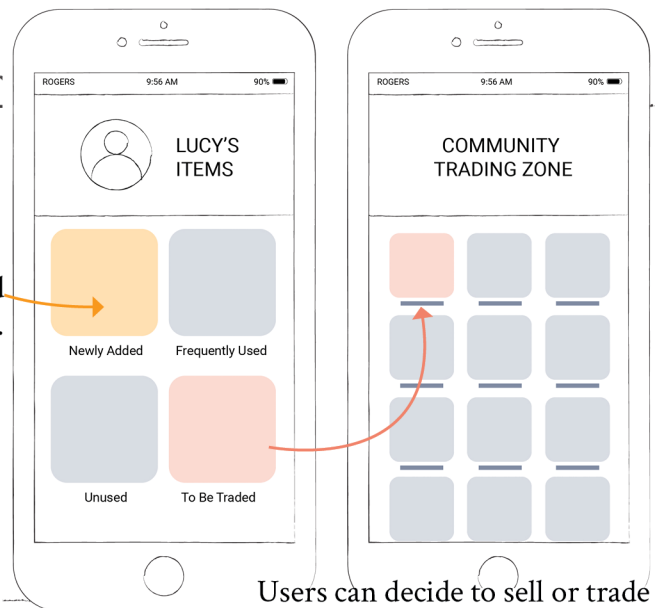Bunz Marketplace App

Sample Wardrobe Tracker (mgetsdressed.com)

Amazon Go Cashierless Checkout

When new items are brought into the home, the sensor is triggered.

Items are automatically added to an online inventory.

What if there is a way to digitally track unwanted objects in the home and match it with potential new owners?

ROGERS 9:56 AM 90%

LUCY'S ITEMS

Newly Added   Frequently Used
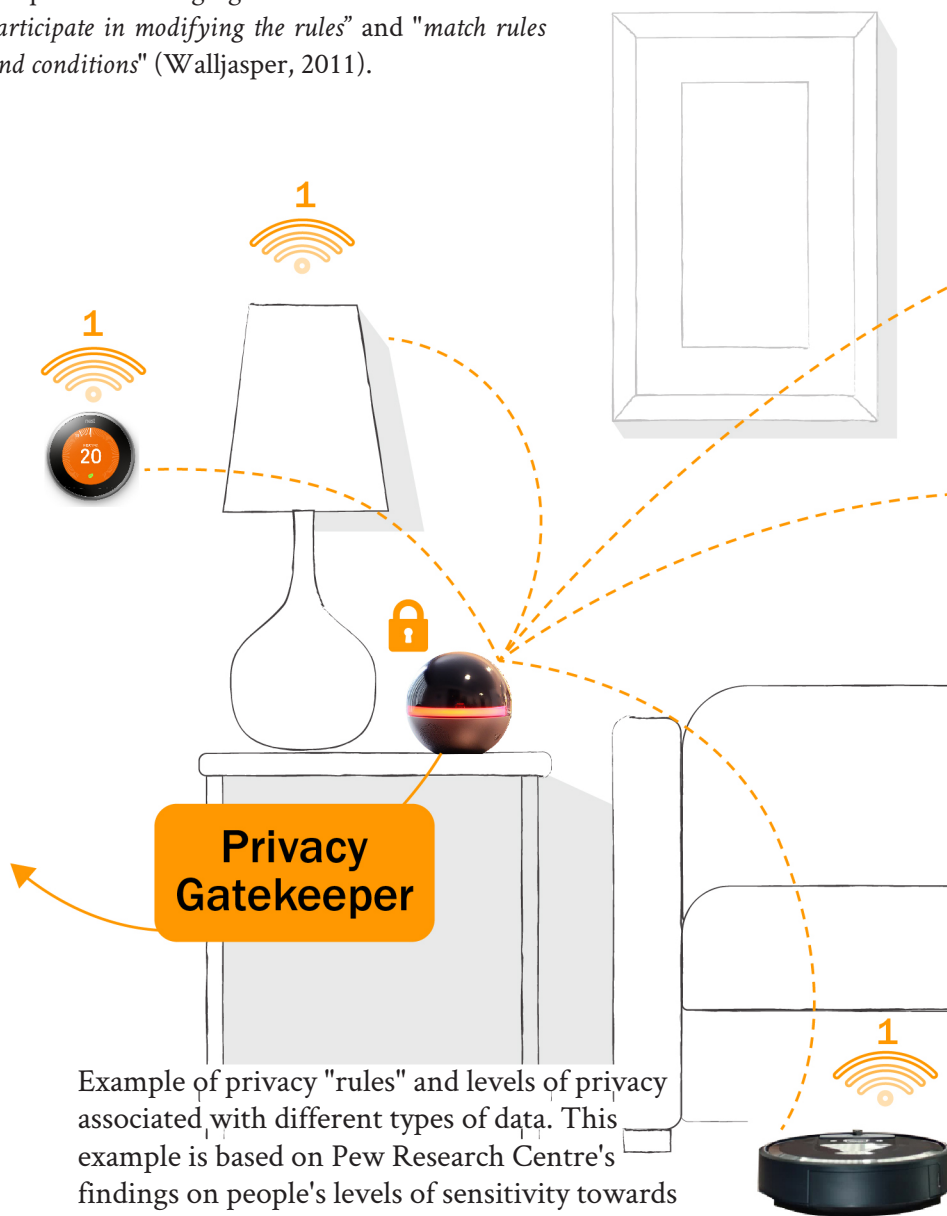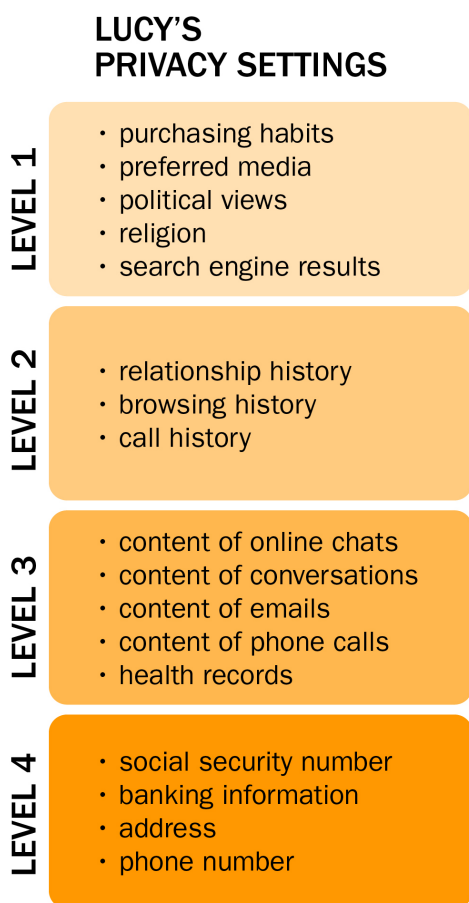
Unused   To Be Traded

ROGERS 9:56 AM 90%

COMMUNITY TRADING ZONE

Users can decide to sell or trade items that have not been used for a prolonged period of time in an online marketplace.

CONVENIENCE/PERSONALIZATION VS. PRIVACY

As mentioned in an earlier chapter, the connected devices that exist in the home provide convenience in exchange for privacy and personal data. Choosing to use these devices means user privacy will be compromised, resulting in a zero-sum game between convenience and privacy. This speculative design asks: "*what if there is a third-party service that protects our privacy while we continue to use our smart devices (i.e. a gatekeeper of privacy and data).*"

This speculative design is inspired by PayPal, which acts as a third-party service between users and online e-commerce vendors. It protects users' credit card information when shopping online. This idea is further informed by Elinor Ostrom, the winner of the Nobel Prize in Economics. Two of her eight principles for managing a data commons include: "*those affected by the rules should be able to participate in modifying the rules*" and "*match rules governing use of common goods to local needs and conditions*" (Walljasper, 2011).

LUCY'S PRIVACY SETTINGS

LEVEL 1
- purchasing habits
- preferred media
- political views
- religion
- search engine results

LEVEL 2
- relationship history
- browsing history
- call history

LEVEL 3
- content of online chats
- content of conversations
- content of emails
- content of phone calls
- health records

LEVEL 4
- social security number
- banking information
- address
- phone number

1

1

20

Privacy Gatekeeper

1

Example of privacy "rules" and levels of privacy associated with different types of data. This example is based on Pew Research Centre's findings on people's levels of sensitivity towards various types of personal information (Pew Research Centre, 2016).

Combining these idea, this third-party privacy service or device will allow users to set their preferred levels of privacy and "rules" around who, how and what data can be collected and shared. For example, it can assign a privacy level to each device based on the functionality of devices. For example, a smart vacuum could be assigned a "Level 1" privacy setting since its function is simple and discrete. Such a third-party can also negotiate for the mutually beneficial use of data on the user's behalf with the smart home service providers, or alert users when some devices are inadvertently eavesdropping.

What if there is a third-party service that protects our privacy while we use our smart devices (i.e. a gatekeeper of privacy and personal data)?

A "privacy level" is assigned to each of the connected devices.
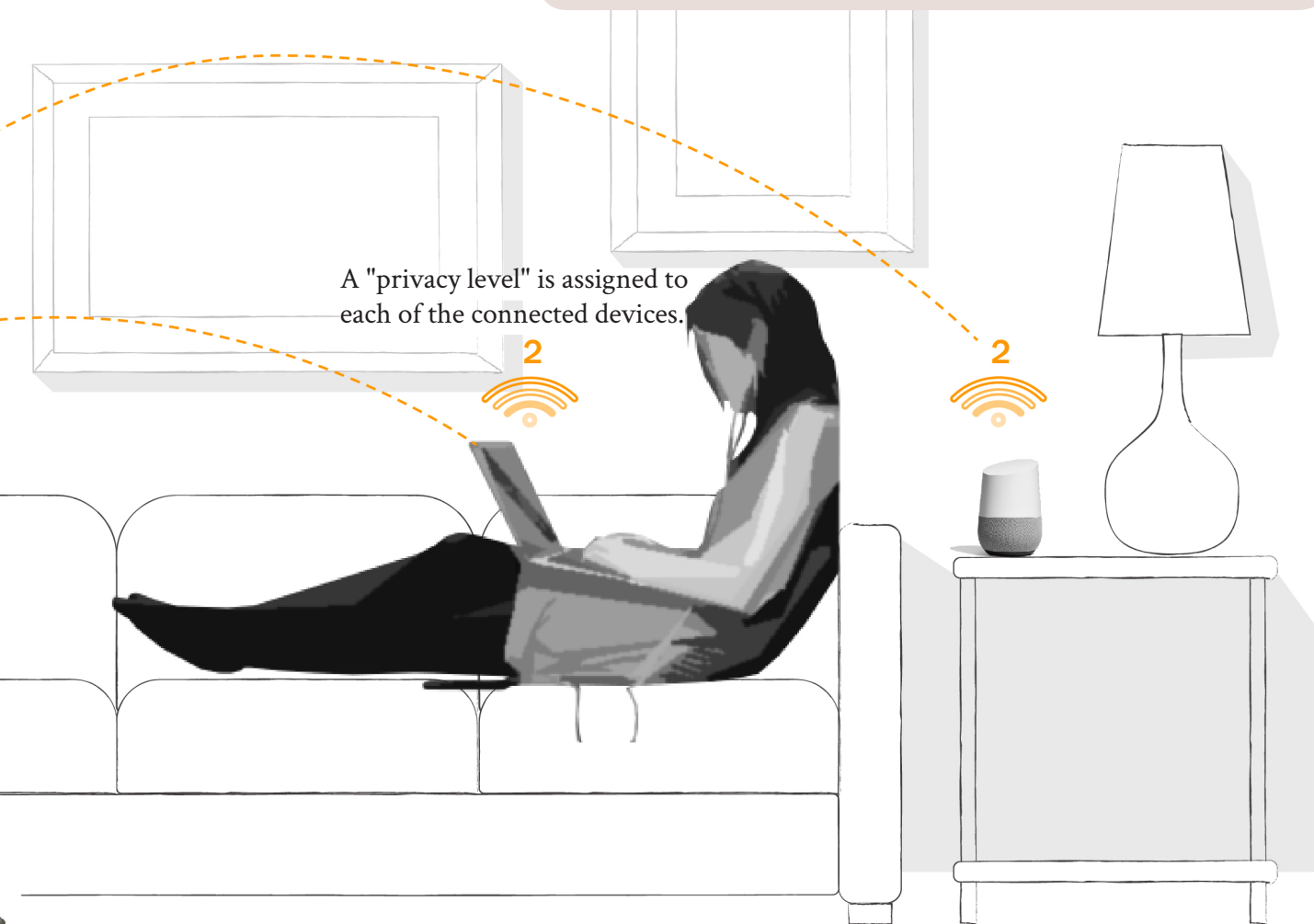
CONNECTEDNESS (AUTOMATIC) VS. DISCONNECT (MANUAL)

Currently, the smart home devices available on the market, including digital assistants, have not yet reached the level of intelligence envisioned by many. However, with rapid development and progress in areas such as artificial intelligence, machine learning and big data, these devices might soon reach a level of ubiquity and "smartness" that make life more convenient. According to Schulevitz (2018), "*By 2021, according to another research firm, Ovum, there will be almost as many voice-activated assistants on the planet as people. It took about 30 years for mobile phones to outnumber humans. Alexa and her ilk may get there in less than half that time.*" In this article, Schulevitz (2018) also compared the digital assistant to a family member, one that we communicate with and not through.

In this hyper-connected environment, perception of time may become even more fragmented and attention scattered. For some, they might relish in the conveniences afforded by these intelligent devices, for others, they might wish to occassionally disconnect. As a result, this speculative scenario explores this question: "*what if there is a way to adjust the level of smartness on smart home devices, or dumb down smart devices completely?*" For example, a semi-smart Alexa can only respond to basic questions and commands, and a completely dumbed-down Alexa is just a regular speaker.

In the Christopher Nolan 2014 epic *Interstellar*, there was a scene that featured a brief interaction between the lead character Cooper and his robot TARS. TARS appears visually as a hyper mechanical robot but has a human-like humour due to built-in humour settings. When TARS made an offensive joke during take off, Cooper was able to adjust his "humour setting," bringing it down to 75%.

This idea is perhaps not entirely implausible. There are companies that are bringing "dumb phones" or feature phones back onto the market, including Nokia. These devices only do what mobiles phones were meant to do - make calls and text. These are attempts made to reclaim attention in a distracted world.

Punkt MP01 "dumb phone" released in 2017

Hey Google, dial down your smart setting to 60%.

dumb   smart
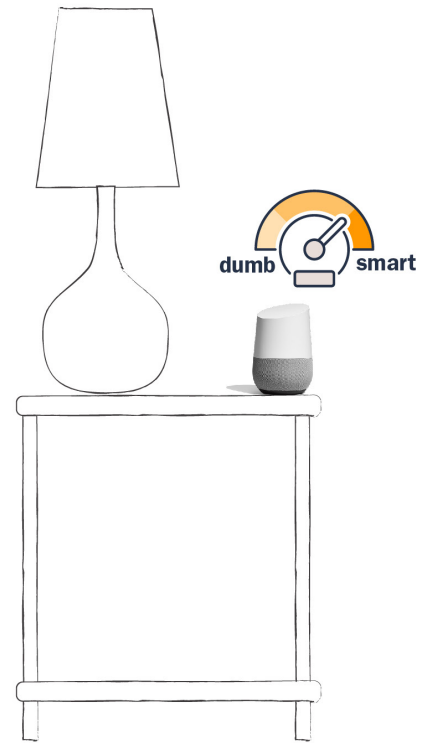
A digital assistant functioning at a 60% "smartness" level may not be able to have an intelligent conversation or offer personalized responses and suggestions. It could still look-up queries through online search and make lists.

What if there is a way to adjust the level of "smartness" on smart home technology or to dumb down smart devices?

REFLECTION

In the process of developing the three speculative design scenarios, one thing becomes quite clear - alternative futures are already here if we know where to look. To quote William Gibson, "*the future is already here, it's just not very evenly distributed.*" There are a small subset of users and indutry players that are challenging the status quo through do-it-yourself, low-tech solutions or alternative product offerings.

These speculative design scenarios are far from becoming viable products, and much research are still needed to ensure the desirability, feasiblity and viability of new technological innovations. However, the design process did yield interesting insights related to emerging considerations for design. It should be emphasized that these insights are not to be perceived as "design principles," but rather a series of observations that were made during the research and design process for each of the scenarios:

- **Designing for opposing values in the home means giving people the power and control to make their own choices.** There should be flexibility and optionality built into technology systems for the home. For example, the idea of letting users set their own privacy rules or determine how "smart" they want their devices to be, allow users to tailor technology to their own judgment and values. Accordingly, the idea of designing for human agency and self-determination is rapidly emerging as an ethical framework for technology design. For example, Friedman & Kahn (2017) have advocated for the idea of responsible computing, where "*first, computational systems should be designed in ways that do not denigrate the human user to machine-like status. Second computational systems should be designed in way s that do not impersonate human agency by attempting to mimic intentional states*" (p.12). Both approaches preserve user's autonomy in decision-making.

- **Designing for one set of values will often have implications on other values.** Even though only three tensions have been explored, it became clear that reframing the design opportunity around one set of values impacts the other sets of values. For example, the idea of adjusting the level of smartness on a connect device will likely have privacy implications. A dumb device would render data collection a largely unnecessary activity, since it does not need data to personalize its services.

- **Draw inspiration from lived experiences.** Evidence from the survey, the interviews and secondary research shows that there are a lot issues in the home that can result in frustration and psychological stress. However, people also come up with their own solutions to the problems. For example, the wardrobe trackers that people develop and use to reduce consumption and instill mindfulness is a a perfect representation of what is considered a "frugal innovation." In addition,

people establish their own rules for managing technology use, such as setting physical and conceptual boundaries in the home for when and where technology should or should not be used. These rules reveal the various ways in which people learn to take control in an environment filled with devices that are vying for attention. As connected devices become more complicated and ubiquitous, how people use and manage their own technology use should be acknowledged and taken into consideration.

CONCLUSION & NEXT STEPS

CONCLUSION

What started out as a simple question of "*are we living with too much technology?*" turned into a rather non-linear and expansive research process. By zooming in on the use of technology in the home, it became rather clear that domestic technology, such as the smart home, have not been designed with people and real homes in mind. Technology providers fail to recognize the home as an ultimately human place, one that is complex and filled with opposing values and tensions. It is also a place that does not lend itself to be easily programmed into discrete tasks, simple routines or efficient workflows as technology is predisposed to do. As technologies become smarter and more pervasive in the home and in the broader community, it is imperative to re-examine the future of domestic living as shaped by a predominantly techno-centric narrative.

This project undertook such a re-examination resulting in revealing insights and an urgent call for change. First, the analysis of the evolution of domestic technology uncovered a set of deeply embedded values embraced by domestic technology. Values such as efficiency, convenience and consumption continue to shape the design of new technologies like the smart home, and perpetuate a future where the home becomes a machine for living. Such a vision can be traced back to the early 20th century and remain relatively unchanged even today.

Through an in-depth look into the realities of the home, it can be concluded that those values supported domestic technology are largely distorted and biased. The vision of the "home as a machine for living" does not represent the actual conditions in the home, especially the sets of contrasting values that people uphold in their day-to-day living. For example, people want to save time through efficiency but also desire more mindful living that is slow and deliberate. However, those biased and distorted assumptions embedded in the design of technology predispose users to favour one set of values over the other. By choosing to use certain technologies, users are forced to make undesirable trade-offs with lasting impacts. Ultimately, this future of domestic living is not human-centered.

Having identified several limitations in the current state of domestic technology, there is also opportunities for change. This means recognizing opposing values that co-exist in the home, and designing domestic technologies that balance these tensions. Such change is not easy. It requires technology providers to challenge century-old assumptions about the home and reframe the role of technology in the home.

Change is not easy but it is possible. To illustrate a way forward and a different future, three speculative scenario were developed. These scenarios demonstrate that it is plausible to design technologies that support and embrace the often ambiguous and contradictory nature of the home. To do so, users must be presented with meaningful choices and actual control over their devices, without bias or manipulation. The outcome should be technologies that

support users in their day-to-day living according to their own judgment and values. In other words, the alternative but more human-centered approach is to design for human agency.

While this call for action likely sits uncomfortably with most technology providers, I believe it is also the only way forward. This is especially urgent when technologies are slowly shaping a place as sacred as the home. Although some may challenge this line of thinking by pointing to the freedom of users to stop using products or features that do not align with their values, the reality is much more complicated. A mix of biased technology design and human nature mean that choice-making is largely dependent on what is an easier choice and not always what is the right choice for a user to make. As such, people will continue to purchase smart home technologies for the added convenience even though their privacy is likely compromised.

As a result, I believe technology providers should be at the forefront of change. From products, services, features, interfaces to even the most minute design details, all should be designed without bias or manipulation. After all, what is good for users is good for business. In addition, regulatory frameworks should also be in place to guide change and reinforce good practices.

With reference to Postman's quote at the beginning of this project, when designed in socially responsibly ways, technology can be a friend that is supportive of the range of human-centered experiences and values in the home. When designed irresponsibly and without care, these same technologies can be detrimental to the very core and essence of what home means to people - a place of belonging, safety and meaning.

WHAT'S NEXT?

The scope of this project has remained rather broad and at a birds-eye level for two reasons. One is to explore a diverse range of challenges when designing technology for the home. Research into the evolution of domestic technology since the early 20th century reveal just how deeply embedded these challenges are. Second, I wanted to survey as much of the landscape as possible before identifying opportunities for further research. This project is by no means comprehensive, and several gaps remain, highlighted in the following next steps:

- **Go deep and co-design** speculative scenarios with research participants. This process might shed more light on people's needs in the home and technologies that can meet those needs.

- **Go deep and conduct more research** into the six tensions using ethnographic tools. There are so much more packed into each of the tensions than what was presented in this project.

- **Go deep and develop a more detailed framework** or even an evaluation tool that can be used to check assumptions and biases during the design process.

- **Go wide and reach out to other types of households and homes** that were not included in this study. This could include multi-generational households, households with older adults, or those living in alternative housing types or living arrangements like tiny homes or co-housing.

- **Go wide and examine how change can take place in the industry** and what kinds of structures and systems need to be in place to enable change. This is perhaps the most challenging but also crucial task, which involves re-examining business practices and business models to identify potential points of intervention for systemic change. It also means identifying regulatory frameworks that need to be in place to dictate such change.

This Major Research Project is just a beginning, and future research can follow many diverging paths. However, wherever this research may end, I am confident that it will contribute to a better understanding of the home and technologies that fully support and embrace the human condition.

REFERENCES

Aldrich, F. K. (2003). Smart homes: Past, present and future. *In Inside the Smart Home* (pp. 17–39). London: Springer.

Archer, S. (2019, May 8). The Frankfurt Kitchen Changed How We Cook And Live. Retrieved May 13, 2019, from CityLab website: https://www.citylab.com/design/2019/05/modern-kitchen-history-design-ideas-domestic-architecture/586345/

Arnold, J., Graesch, A., Ragazzini, E., & Ochs, E. (2012). *Life at Home in the Twenty-first Century: 32 Families Open Their Doors.* The Cotsen Institute of Archaeology Press.

Athey, S., Catalini, C., & Tucker, C. (2017). The Digital Privacy Paradox: Small Money, Small Costs, Small Talk. *Stanford Institute for Economic Policy Research*, 35.

Balta-Ozkan, N., Davidson, R., Bicket, M., & Whitmarsh, L. (2013). Social barriers to the adoption of smart homes. *Energy Policy*, 63, 363–374. https://doi.org/10.1016/j.enpol.2013.08.043

Battams, N. (2018). *A Snapshot of Family Diversity in Canada.* Retrieved from The Vanier Institute of the Family website: https://vanierinstitute.ca/snapshot-family-diversity-canada-february-2018/

Bell, G., Blythe, M., & Sengers, P. (2005). Making by Making Strange: Defamiliarization and the Design of Domestic Technologies. *ACM Trans. Comput.-Hum. Interact.*, 12(2), 149–173. https://doi.org/10.1145/1067860.1067862

Bell, G., & Kaye, J. (2002). Designing Technology for Domestic Spaces: A Kitchen Manifesto. *Gastronomica*, 2(2), 46–62.

Bowles, N. (2018, August 7). Thermostats, Locks and Lights: Digital Tools of Domestic Abuse. *The New York Times.* Retrieved from https://www.nytimes.com/2018/06/23/technology/smart-home-devices-domestic-abuse.html

Canadian Broadcasting Corporation. (2018). Back in Time for Dinner. Retrieved from https://gem.cbc.ca/media/back-in-time-for-dinner/season-1/episode-2/38e815a-00eaa6cf1ab

Cornell University. (2015, June). Digital Literacy and Utilization: A Polling Data Overview | Roper Center for Public Opinion Research. Retrieved May 16, 2019, from https://ropercenter.cornell.edu/blog/digital-literacy-and-utilization-polling-data-overview

Cory J. (1995). in *R v. Silveira.* 2 SCR 297, 1995 CanLII 89 (SCC).

Cowan, R. (1976). The "Industrial Revolution" in the Home: Household Technology and Social Change in the 20th Century. *Technology and Culture*, 17(1), 1–23.

Davidoff, S., Lee, M. K., Yiu, C., Zimmerman, J., & Dey, A. K. (2006). Principles of Smart Home Control. In P. Dourish & A. Friday (Eds.), *UbiComp 2006: Ubiquitous Computing* (Vol. 4206, pp. 19–34). https://doi.org/10.1007/11853565_2

Day, M., Turner, G., & Drozdiak, N. (2019, April 10). Amazon Workers Are Listening to What You Tell Alexa. Bloomberg.Com. Retrieved from https://www.bloomberg.com/news/articles/2019-04-10/is-anyone-listening-to-you-on-alexa-a-global-team-reviews-audio

Etherington, R. (2011, October 29). Microbial Home by Philips Design. Retrieved from Dezeen website: https://www.dezeen.com/2011/10/29/microbial-home-by-philips-design/

Forty, A. (1992). *Objects of Desire: Design and Society.*

Friedman, B., & Kahn Jr, P. H. (2017). Human agency and responsible computing: Implications for computer system design. *Computer Ethics*, 241-248.

Friedman, B., Kahn, P. H., & Borning, A. (2008). Value sensitive design and information systems. *The handbook of information and computer ethics*, 69-101.

Frohlich, D., & Kraut, R. (2003). The Social Context of Home Computing. In R. Harper (Ed.), *Inside the Smart Home* (pp. 127–162). London: Springer.

Goldstein, C. M. (1997). From Service to Sales: Home Economics in Light and Power, 1920-1940. *Technology and Culture*, 38(1), 121–152. https://doi.org/10.2307/3106786

Government of Canada, C. R. and T. C. (CRTC). (2018, August 16). Communications Monitoring Report 2018. Retrieved July 29, 2019, from https://crtc.gc.ca/eng/publications/reports/policymonitoring/2018/cmr1.htm

Government of Canada, I. (2011). Impacts of Structural Changes in the Canadian Economy - Economic analysis and statistics [Research Reports]. Retrieved from https://www.ic.gc.ca/eic/site/eas-aes.nsf/eng/h_ra02276.html#labour-changes

Government of Canada, S. C. (2015, April 13). Canada goes urban. Retrieved August 1, 2019, from https://www150.statcan.gc.ca/n1/pub/11-630-x/11-630-x2015004-eng.htm

Government of Canada, S. C. (2017, August 2). Census in Brief: Young adults living with their parents in Canada in 2016. Retrieved from https://www12.statcan.gc.ca/census-recensement/2016/as-sa/98-200-x/2016008/98-200-x2016008-eng.cfm

Harvard Design Magazine: FAMILI: Proxy Paranoia or Technological Camaraderie. (n.d.). Retrieved from http://www.harvarddesignmagazine.org/issues/47/famili-proxy-paranoia-or-technological-camaraderie-issue-47

Henderson, S. R. (2017). Margarete Schütte-Lihotzky A Career in the Design Politics of the Everyday. In M. van Helvert (Ed.), *The Responsible Object: A History of Design Ideology for the Future* (p. 288). Valiz.

Walljasper, J. (2011, October 2). Elinor Ostrom's 8 Principles for Managing A Commmons | On the Commons. Retrieved August 11, 2019, from https://www.onthecommons.org/magazine/elinor-ostroms-8-principles-managing-commmons

Inayatullah, S. (1998). Causal Layered Analysis: Poststructuralism as method. *Futures,* 30(8), 815–829.

Inayatullah, S. (2004). *The Causal Layered Analysis (CLA) Reader.* Tamkang University Press.

Klein, W., Izquierdo, C., & Bradbury, T. (2013a). Housework. In *Fast-Forward Family: Home, Work, and Relationships in Middle-Class America.* University of California Press.

Klein, W., Izquierdo, C., & Bradbury, T. (2013b, March 1). The Difference Between a Happy Marriage and Miserable One: Chores. Retrieved from The Atlantic website: https://www.theatlantic.com/sexes/archive/2013/03/the-difference-between-a-happy-marriage-and-miserable-one-chores/273615/

Kopf, D. (2018, September 17). Slowly but surely, working at home is becoming more common. Retrieved from Quartz at Work website: https://qz.com/work/1392302/more-than-5-of-americans-now-work-from-home-new-statistics-show/

Kossek, E. E. (2016). Managing work-life boundaries in the digital age. *Organizational Dynamics*, 45(3), 258–270.

Livingstone, S. (2009). Half a century of television in the lives of our children. In The end of television? Its impact so far. *The Annals of the American Academy of Political and Social Science* (pp. 151–163).

Ng, A. (2019, March 7). Your landlord turns your apartment into a smart home. Now what? Retrieved from CNET website: https://www.cnet.com/news/your-landlord-turns-your-apartment-into-a-smart-home-now-what/

Office of the Privacy Commissioner of Canada. (2016, February 17). The Internet of Things: An introduction to privacy issues with a focus on the retail and home environments. Retrieved from https://www.priv.gc.ca/en/opc-actions-and-decisions/research/explore-privacy-research/2016/iot_201602/

Pew Research Centre. (2016, January 19). Social security numbers, health info among the most sensitive data. Retrieved from Pew Research Center website: https://www.pewresearch.org/fact-tank/2016/09/21/the-state-of-privacy-in-america/ft_16-01-20_ssnumbers-1/

Postman, N. (1996). *The End of Education: Redefining the Value of School.* New York: Knopf.

Reissner, S. C., Izak, M., & Hislop, D. (2017). Mobile workers' Boundary Work: The Fluidity of Time, Space and Objects. *33rd European Group for Organizational Studies (EGOS Colloquium).* Retrieved from https://eprint.ncl.ac.uk/pub_details2.aspx?pub_id=232116

Roster, C. A., Ferrari, J. R., & Jurkat, M. P. (2016). The dark side of home: assessing possession 'clutter'on subjective well-being. *Journal of Environmental Psychology*, 46, 32-41.

Sager, E. (2007). The Transformation of the Canadian Domestic Servant, 1871–1931. *Social Science History*, 31(4). https://doi.org/10.1215

Sixsmith, J. (1986). The meaning of home: An exploratory study of environmental experience. *Journal of Environmental Psychology*, 6(4), 281–298. https://doi.org/10.1016/S0272-4944(86)80002-0

US Census Bureau, C. H. S. (n.d.). Urban and Rural Areas: History. Retrieved from https://www.census.gov/history/www/programs/geography/urban_and_rural_areas.html

Wajcman, J. (1994). *Feminism Confronts Technology*. Penn State University Press.

Webb, A. (2019, March 10). Opinion | Are You an Amazon or an Apple Family? The New York Times. Retrieved from https://www.nytimes.com/2019/03/09/opinion/sunday/10Webb.html

Weizenbaum, J. (1972). On the Impact of the Computer on Society. *Science*, 176(4035), 609–614. Retrieved from JSTOR.

Williams, R. (1997). The social shaping of information and communications technologies.

Wilson, C., Hargreaves, T., & Hauxwell-Baldwin, R. (2014). Smart homes and their users: A systematic analysis and key challenges. *Personal and Ubiquitous Computing*, 19(2), 463–476.

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Image Credits

SUPPLEMENTARY DOCUMENTS

Online Survey Consent Form

Date: March 2019
Project Title: **There is no place like a connected home: exploring the trade-offs in a hyper-connected home**

Principal Investigator(s):

Jeremy Bowes	**Lucy Gao**
Professor	**Graduate Student**
Faculty of Design	**Strategic Foresight and Innovation**
OCAD University	**OCAD University**
jbowes@faculty.ocadu.ca	▮▮▮▮▮▮▮▮▮▮▮▮▮▮▮

INVITATION
Thank you for your interest in participating in our research for a Major Research Project (MRP) on the connected home titled *There is no place like a connected home: exploring the trade-offs in a hyper-connected home*. This research focuses on the future of the smart home, and critically examines its unintended consequences from a human-centered perspective. This research is being undertaken in partial completion of the Masters in Design in Strategic Foresight and Innovation at OCAD University. Please take your time to review this consent form and discuss any questions you may have with **Lucy Gao**, one of the Principal Investigators.

This research is currently being funded by the Joseph-Armand Bombardier Canada Graduate Scholarships (SSHRC). There are no perceived or potential conflict of interest between the area of research, the researchers and the funding source.

WHAT'S INVOLVED
You will participate in answering an online survey will take approximately 15 minutes. The survey will include questions about your usage of smart home technologies, and perspectives on their potential impacts. There will also be questions related to the values and experiences that smart home technologies may enhance or replace.

POTENTIAL BENEFITS AND RISKS
Information gathered in this survey will advance the research on smart home technologies and the impact they might have on their users. When the research is completed, you will be notified (if you choose) and will have access to publicly available final reports and documents. Some of the insights garnered from this study might potentially increase your awareness on the impacts of smart home technologies. I cannot guarantee, however, that you will receive any direct benefits from participating in this study.

There might be low levels of psychological risk from the stress of thinking critically about smart home technologies and the impacts that they may have on you. To alleviate this risk, you will not be under any obligation to participate in the research study or to answer any questions that make you feel uncomfortable. You also have the right to withdraw your participation at any time before July 31, 2019.

CONFIDENTIALITY
The data collected will remain completely confidential, and will not be shared with anyone besides the researchers listed in this application. In addition, no data will be attributed to you in any form in the final report. You will not be required to provide your name or contact information in the survey, unless you opt in to allow the researcher to follow up with you for additional research or study updates. In this case, your name and contact information will be stored separately from your survey data. Data collected during this study will be stored on password protected, encrypted USB key or hard drive to be kept in a locked

cabinet in the researcher's home. All collected data will be kept for up to a year after the completion of the study, after which time they will be permanently destroyed.

VOLUNTARY PARTICIPATION
Participation in this study is voluntary. If you wish, you may decline to answer any questions or participate in any component of the study.

Further, you may decide to withdraw from this study at any time, or request withdrawal of your data prior to data analysis and you may do so without any penalty or loss of benefits to which you are entitled. Your choice of whether or not to participate will not influence your future relations with OCAD University or the investigators Lucy Gao and Jeremy Bowes involved in the research.

To withdraw from this study, let Lucy Gao know at any point during the study using the contact information provided above. To withdraw your data from the study, please contact Lucy by email at █████████████████ no later than July 31, 2019. All data collected from you until the withdrawal date will be permanently deleted (digital data) or shredded (notes).

PUBLICATION OF RESULTS
Results of this study will be published in a publicly available final report, and will shared through conferences and colloquia. In any publication, data will be presented in aggregate forms. Quotations from interviews or surveys will not be attributed to you without your permission. If you opt in to receive updates related to the study, including a link to the final publication, we will send these to you via email.

CONTACT INFORMATION AND ETHICS CLEARANCE
If you have any questions about this study or require further information, please contact Lucy Gao using the contact information provided above. This study has been reviewed and received ethics clearance through the Research Ethics Board at OCAD University [REB 2661]. If you have any comments or concerns, please contact the Research Ethics Office through research@ocadu.ca.

CONSENT FORM

I agree to participate in this study described above. I have made this decision based on the information I have read in the Information-Consent Letter. I have had the opportunity to receive any additional details I wanted about the study and understand that I may ask questions in the future. I understand that I may withdraw this consent at any time prior to synthesis of material on July 31, 2019.

☐ Yes, I would like to hear more about the study. You may reach me by (provide contact information):
     Email:

☐ Yes, I would like the researcher to contact me directly regarding participation in the next phase of the research. You may reach me by (provide contact information):
     Email:

Name: _____

Signature: _____   Date: _____

Thank you for your assistance in this project. Please keep a copy of this form for your records.

Online Survey Invitation

Dear [name of candidate],

My name is Lucy Gao and I am a Principal Investigator under the faculty supervision of Professor **Jeremy Bowes** at OCAD University. I am writing to you to ask if you would agree to participate in completing an online survey for a study titled ***There is no place like a connected home: exploring the trade-offs in a hyper-connected home***.

The research project explores the future of the smart home, and critically examines its unintended consequences from a human-centered perspective. The research question is: **What values are enhanced or challenged in a hyper-connected home? How might we alleviate the unintended consequences of smart home technologies.**

In order to answer the research question, we hope that you will help us complete a survey that will take approximately 15 minutes. The survey will include questions about your perspectives on the potential impacts of the smart home, and the values and experiences that a smart home may offer or replace. All data collected from the survey will not be made available to anyone except the researchers and will be kept confidential. In addition, no data will be attributed to you in the final report.

Information gathered in this interview will advance the research on smart homes and the impact they might have on their users. When the research is completed, you will be notified (if you choose) and will have access to publicly available final reports and documents. Some of the insights garnered from this study might potentially increase your awareness on the impacts of smart home technologies. I cannot guarantee, however, that you will receive any direct benefits from participating in this study.

There might be low levels of psychological risks from the stress of thinking critically about smart home technologies and the impacts that they may have on you. To alleviate this risk, you will not be under any obligation to participate in the research study or to answer any questions that make you feel uncomfortable. You also have the right to withdraw your participation at any time before July 31, 2019.

The results of the survey will remain completely confidential, and will not be attributed to you in any form in the final report. Only researchers associated with this study will have access to the password protected study records. Paper files will be locked securely. All data will be destroyed one year after the completion of the study.

If you have any questions about this study or require further information, please contact the Principal Investigator Lucy Gao or the Faculty Supervisor Jeremy Bowes using the contact information provided above. This study has been reviewed and received ethics clearance through the Research Ethics Board at OCAD University [2019-27]. If you have any comments or concerns, please contact the Research Ethics Office through research@ocadu.ca.

Appendix F
Draft Online Survey

[see following pages for the draft survey as it appears on Google Forms]

Follow-up Interview Consent Form

Date: May 2019
Project Title: **There is no place like a connected home: exploring the trade-offs in a hyper-connected home**

Principal Investigator(s):

Jeremy Bowes	**Lucy Gao**
Professor	**Graduate Student**
Faculty of Design	**Strategic Foresight and Innovation**
OCAD University	**OCAD University**
jbowes@faculty.ocadu.ca	▇▇▇▇▇▇▇▇▇▇▇▇

INVITATION
Thank you for your interest in participating in our research for a Major Research Project (MRP) on the connected home titled ***There is no place like a connected home: exploring the trade-offs in a hyper-connected home***. This research focuses on the future of the smart home, and critically examines its unintended consequences from a human-centered perspective. This research is being undertaken in partial completion of the Masters in Design in Strategic Foresight and Innovation at OCAD University. Please take your time to review this consent form and discuss any questions you may have with **Lucy Gao**, one of the Principal Investigators.

This research is currently being funded by the Joseph-Armand Bombardier Canada Graduate Scholarships (SSHRC). There are no perceived or potential conflict of interest between the area of research, the researchers and the funding source.

WHAT'S INVOLVED
You will participate in a semi-structured interview which may take place in person or online and will last roughly 45-60 minutes. The interview will include questions about your usage and attitude towards smart home technology. Questions may also be asked to clarify or dive deeper into your survey response. A part of the interview will also involve creative exercises such as drawing.

POTENTIAL BENEFITS AND RISKS
Information gathered in this interview will advance the research on smart home technologies and the impact they might have on their users. When the research is completed, you will be notified (if you choose) and will have access to publicly available final reports and documents. Some of the insights garnered from this study might potentially increase your awareness on the impacts of smart home technologies. I cannot guarantee, however, that you will receive any direct benefits from participating in this study.

There might be low levels of psychological risk from the stress of thinking critically about smart home technologies and the impacts that they may have on you. In addition, the iterative and semi-structured nature of this interview may lead to discussions that are sensitive in nature and uncomfortable, especially if the questions are based on your survey responses. To alleviate this risk, the researcher will send you a rough list of questions that may be asked during the interview. The researcher will not record this session via audio, video or photography to respect your privacy. Only handwritten notes will be taken. In addition, you will not be under any obligation to participate in the research study or to answer any questions that make you feel uncomfortable. You also have the right to withdraw your participation at any time before July 31, 2019.

CONFIDENTIALITY
The data collected will remain completely confidential, and will not be shared with anyone besides the researchers listed in this application. In addition, no data will be attributed to you in any form in the final report. As a result, all data will be presented in aggregated form. Since this form of research takes place in

an intimate environment, we will ask for your name, email and address prior to the research for coordination purposes. To ensure anonymity, your name, email and address will be destroyed upon completing data collection. If you opt in to allow researcher to follow up with you for updates on the study, your name and email will be stored separately from your interview data. Data collected during this study will be stored on password protected, encrypted USB key or hard drive to be kept in a locked cabinet in the researcher's home. All collected data will be kept for up to a year after the completion of the study, after which time they will be permanently destroyed.

VOLUNTARY PARTICIPATION
Participation in this study is voluntary. If you wish, you may decline to answer any questions or participate in any component of the study.

Further, you may decide to withdraw from this study at any time, or request withdrawal of your data prior to data analysis and you may do so without any penalty or loss of benefits to which you are entitled. Your choice of whether or not to participate will not influence your future relations with OCAD University or the investigators Lucy Gao and Jeremy Bowes involved in the research.

To withdraw from this study, let Lucy Gao know at any point during the study using the contact information provided above. To withdraw your data from the study, please contact Lucy by email at ███████████████████ no later than July 31, 2019. All data collected from you until the withdrawal date will be permanently deleted (digital data) or shredded (notes).

PUBLICATION OF RESULTS
Results of this study will be published in a publicly available final report, and will be shared through conferences and colloquia. In any publication, data will be presented in aggregate forms. Quotations from interviews or surveys will not be attributed to you without your permission. If you opt in to receive updates related to the study, including a link to the final publication, we will send these to you via email.

CONTACT INFORMATION AND ETHICS CLEARANCE
If you have any questions about this study or require further information, please contact Lucy Gao using the contact information provided above. This study has been reviewed and received ethics clearance through the Research Ethics Board at OCAD University [2019-27]. If you have any comments or concerns, please contact the Research Ethics Office through cpineda@ocadu.ca.

CONSENT FORM

I agree to participate in this study described above. I have made this decision based on the information I have read in the Information-Consent Letter. I have had the opportunity to receive any additional details I wanted about the study and understand that I may ask questions in the future. I understand that I may withdraw this consent at any time prior to synthesis of material before July 1, 2019.

☐ Yes, I would like to hear more about the study. You may reach me by (provide contact information):
      Email:

Name: _____

Signature: _____   Date: _____

Thank you for your assistance in this project. Please keep a copy of this form for your records.

Follow-up Interview Invitation

Dear [name of candidate],

My name is Lucy Gao and I am a Principal Investigator under the faculty supervision of Professor **Jeremy Bowes** at OCAD University. I am writing to you to ask if you would agree to participate our research for a study titled ***There is no place like a connected home: exploring the trade-offs in a hyper-connected home***.

The research project explores the future of the smart home, and critically examines its unintended consequences from a human-centered perspective. The research question is: **What values are enhanced or challenged in a hyper-connected home? How might we alleviate the unintended consequences of smart home technologies.**

In order to answer the research questions, we hope that you can participate in a semi-structured interview that will take approximately 45-60 minutes. The researcher will ask you questions related to your usage of and attitude towards smart home technologies. In addition, follow-up questions might be asked to clarify or dive deeper into your survey responses. A part of the interview will also involve creative exercises such as drawing. During this session, notes will be taken to ensure the accuracy of the information captured, but no audio, video or photography will be used for record-keeping.

Information gathered in this interview will advance the research on smart homes and the impact they might have on their users. When the research is completed, you will be notified (if you choose) and will have access to publicly available final reports and documents. Some of the insights garnered from this study might potentially increase your awareness on the impacts of smart home technologies. I cannot guarantee, however, that you will receive any direct benefits from participating in this study.

There might be low levels of psychological risk from the stress of thinking critically about smart home technologies and the impacts that they may have on you. In addition, the iterative and semi-structured nature of this interview may lead to discussions that are sensitive in nature and uncomfortable, especially if the questions are based on your survey responses. To alleviate this risk, the researcher will send you a rough list of questions that may be asked during the interview. The researcher will not record this session via audio, video or photography to respect your privacy. Only handwritten notes will be taken. In addition, you will not be under any obligation to participate in the research study or to answer any questions that make you feel uncomfortable. You also have the right to withdraw your participation at any time before July 1, 2019.

The results of the survey will remain completely confidential, and will not be attributed to you in any form in the final report. Only researchers associated with this study will have access to the password protected study records. Paper files will be locked securely. All data will be destroyed one year after the completion of the study.

You may decline to answer any questions you do not wish to answer and you may also decline to take a tour through your studio environment. You can withdraw your consent to participate and ask that your data be destroyed by emailing Lucy Gao at any time during the study. Only researchers associated with this study will have access to the password protected study records. Paper and digital files will be locked securely. All data will be destroyed at the conclusion of this project.

Thank you and please don't hesitate to ask if you have any questions or concerns.