THE COMMUNITY INFORMATICS OF AN AGING SOCIETY: A COMPARATIVE CASE STUDY OF SENIOR CENTERS AND PUBLIC LIBRARIES

BY

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DISSERTATION

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ABSTRACT

The information society is also an aging society. This means that as information technology becomes woven into the fabric of daily life, the median age of humanity continues to rise. The participation of this growing population of older adults in the information society is often seen in the popular press and even in scholarship as dependent on their ability to cope with their supposedly declining minds and declining bodies. This study reframes this phenomenon by studying older adults in the communities where they live.

This dissertation asks to what extent and how does community-based information infrastructure support older adult digital literacy. Three theories shape this analysis: 1) information infrastructure as the co-creation of information systems and information users (Star & Ruhleder, 1996), 2) digital literacy as the integration of technology into our lives (Prior & Shipka, 2003), and 3) older adulthood as a socially shaped stage in the human lifecourse (Hutchison, 2014). Using the extended case method approach (Burawoy, 1998), these three theories are scrutinized in relation to the empirical reality I studied. Through this situated understanding (Suchman, 1987), this dissertation contributes to the development of these theories, which are used in multiple academic disciplines. This dissertation further contributes to the fields of community informatics and library & information science, both of which are only beginning to study aging in the information society.

I study senior centers and public libraries, institutions that are ubiquitous in the United States of America, as community-based information infrastructure. This dissertation consists of a comparative case study of three public libraries and three senior centers in a particular Midwestern metropolitan area. I direct particular attention to 209 of the older adults who

participate in technology support services at these six institutions. During a one-year period involving 267 field sessions I conducted participant observation with these older adults, as well as with staff. I also interviewed 54 of these older adults, and seven staff members. I finally reviewed documents produced in the past and in the present by and about the institutions.

The overall finding from this investigation is that community-based information infrastructure is indeed supportive of older adult digital literacy. However, this support is not as robust as it could be. Particular findings include: 1) community-based information infrastructure emerges out of and evolves through individual and social struggle; 2) community-based information infrastructure is rooted in the lives of older adults; 3) ageism conditions both community-based information infrastructure and older adult digital literacy; and 4) older adults are determined and creative learners who with support integrate technology into the diverse rhythms of their lives.

These lives can be best understood through a new concept articulated in this dissertation, the *informatics lifecourse*. This concept refers to how a person learns technology through the stages of his or her life. The informatics lifecourse is populated by countless informatics moments (Williams, 2012), instances of giving and receiving technology support. Breakdowns in the informatics lifecourse of the individual relate to breakdowns at the level of the community. This finding illustrates how individuals and communities are interdependent.

By foregrounding the agency of older adults in the information infrastructure they and others rely on to learn technology across time, this dissertation challenges deficit models of aging premised on decline and disengagement. Public libraries and senior centers are overpressured, publicly funded institutions. By embracing the agency of older adults, these institutions could reconfigure themselves for an information society that is aging.

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CHAPTER 1. INTRODUCTION

In the popular press (and even in the scholarly literature) the digital literacy of older adults is often understood in relation to their supposedly declining minds and bodies. That is, age-related disabilities orient the discourse on older adults and digital technology (Bowen, 2012a). In this dissertation, I instead study this topic in the communities where older adults live. Just as it proverbially "takes a village to raise a child," it may likewise take a local community to support people as they learn, practice, and expand digital literacy in old age. To analyze the hypothesis that community support is crucial for the digital literacy of older adults, this dissertation draws on the theory of information infrastructure to ask: To what extent and how does community-based information infrastructure support older adult digital literacy?

This chapter argues for the practical importance of this study in the world today. This argument has three parts: (1) that the information society is also an aging society; (2) that by participating in public libraries and senior centers, older adults participate in public spheres; and (3) that older adults play important leadership roles in their communities. Better support for the digital literacy of older adults, therefore, could increase their capacity to use technology for themselves and for their communities.

The structure of the remainder of this dissertation is as follows. Chapter 2 situates this study in the academic literature. Chapter 3 explicates the methods used to answer this research question. Chapter 4 analyzes public libraries and senior centers as community-based information infrastructure. Chapter 5 analyzes older adult digital literacy among the participants in this study. Finally, chapter 6 integrates the findings from chapters 4 and 5 to answer this dissertation's overarching research question. This concluding chapter also discusses the implications of this dissertation for theory, practice, and teaching.

A. The information society is also an aging society

Since the 1970s, societies around the world have been transitioning from industrial to informational societies (Castells, 1989), in which digital information technology has been integrated into all aspects of society (Nedovic-Budic & Williams, 2013). This information revolution has been an uneven one; as Nedovic-Budic and Williams (2013) point out, "not every sector of society has crossed the digital divide" (p. 5).

The exclusion of older adults from the information society has been called the grey digital divide (Friemel, 2014; Millward, 2003; Morris, 2007), but this divide is closing. In the USA, six in ten older adults now regularly go online, including four out of ten adults aged 80 and older (Smith, 2014). Nonetheless, digital technology has not yet become fully integrated into older adulthood (Damodaran, Olphert & Sandhu, 2013).

As the median age of the US and global population rises, so do the stakes of this study. The core institutions of the modern age were built on the premise of a large number of youth and a small number of elders. This premise increasingly does not hold true. Between 1960 and 2010, the percentage of the USA population aged 0 to 18 decreased from 36% to 24% (Table 1). During this same time period, the percentage of the population aged 65 or more increased from 10% to 13%. The U.S. Census Bureau (2010) estimates that by 2100 the percentage of the population aged 65 or more will exceed the percentage of the population aged 0 to 18.

Percent of USA that is…	in 1960	in 2010	in 2050	in 2100
…age 0-18	36%	24%	23%	22%
...age 65 or more	10%	13%	21%	26%

Table 1: USA population aging, 1965–2100 (U.S. Census Bureau, 2010).

With the aging population comes changes to the demographics of older adulthood. In the popular media it is common to hear discussion of what the *Los Angeles Times* (Lee, 2014) calls "a widening demographic gap between older whites and young minorities" (p. 1). In contrast, empirical data show that the median ages of US minority populations are in fact rising faster than the median age of the European American population (Vincent & Velkoff, 2010). In the years to come there will be both more young minorities and more old minorities in the USA.

Percent of humanity that is…	in 1965	in 2015	in 2050	in 2100
…age 0-14	38%	26%	21%	18%
…age 60 or more	8%	12%	21%	28%

Table 2: World population aging, 1960–2100 (United Nations, 2013).

Many nations around the world are also aging. In 1965, 38% of global humanity was aged 0 to 14, while only 8% was aged 60 or more (Table 2). By 2050, 21% of the world will be aged 0 to 14, equal to the percentage aged 60 or more. In 1950 the nation of Japan was among the youngest on the planet, with a median age of 22. By 2025 its median age will be 50 (HelpAge International, 2014; NOVA, 2004; United Nations, 2002; United Nations, 2013; World Health Organization, 2014). Many nations are predicted to soon have a higher median age than the USA: South Korea by 2015, China by 2025, Thailand and Vietnam by 2035, Mexico by 2045, and Brazil by 2050 (United Nations, 2002).

The aging of humanity affects local communities. The aging of the baby boomer generation, born between 1946 and 1964, has been a major force shaping the aging of communities in the USA (Gergen & Gergen, 2000). In 2000, 27% of the local community where this study took place was aged 0 to 19 (Table 3). By 2010, that percentage had dropped to 25%. Simultaneously, the percentage of the community aged 50 to 74 (i.e. the baby boomer

generation) increased from 14% to 17%. The percentages of the local population aged 20 to 49 and aged 75 or more held steady between 2000 and 2010.

Percent of local city that is…	in 2000	in 2010
…age 0-19	27%	25%
…age 20-49	54%	54%
…age 50-74	14%	17%
…age 75 or more	4%	4%

Table 3: Local population aging, 2000–2010. (U.S. Census Bureau, 2000; 2010).
Due to rounding, column totals do not sum to 100%.

B. By participating in public libraries and senior centers, older adults participate in public spheres

The public sphere is neither the state nor the private sphere of domestic life but rather the "sphere of non-governmental opinion-making" (Habermas, 1974, p. 49). The public sphere is important because, as Alkalimat & Williams (2001) state “the public sphere is a social ecology for relevant discourse that shapes policy, public opinion, and the dominant intellectual themes of an era” (p. 182). Since Habermas coined the term in 1962, scholars have shown that there are multiple public spheres, including counter-public spheres formed by populations marginalized from the mainstream public sphere (Downey & Fenton, 2003). For instance, the African American church is an institution in the African American counter-public sphere (Alkalimat & Williams, 2001).

Public libraries and senior centers are also institutions in public spheres (Buschman, 2003; Kim & Ball-Rokeach, 2006). Public libraries are places in which diverse sections of a local community come together to access information and exchange ideas. Senior centers are also places where older adults gather to socialize, engage in programs, and discuss ideas. In

communities throughout the USA, senior centers and public libraries occupy overlapping roles in the lives of older adults (Table 4). As digital technologies become deeply embedded in society, both institutions have included more technology support services for older adults.

Public libraries	Senior centers
--	Travel
Information technology, social media, computer labs	
Information and referral programs	
Career and financial planning	
Health and wellness	
Reminiscing, reflecting, celebrating, commemorating	
Creativity, arts, games	
Community connections, volunteerism	
Intergenerational connections	
Lifelong learning	

Table 4: Comparison of how older adults participate in public libraries and senior centers. Lists based on Schull, 2013, p. vi; Beisgen & Kraitchman, 2003, pp. vii-viii & x.

Generally funded by local government (Beisgen & Kraitchman, 2003, p. x), senior centers emerged in local communities throughout the USA after World War II. Now numbering 11,400 across the country (National Council on Aging, 2014), they have been described as "the one community institution that our independent elderly can identify as theirs" (Cohen, 2003, p. ix). This statement receives empirical support in research on the roles of senior centers in local communities (Myerhoff, 1980). Research also shows that senior centers confront many obstacles as they reconfigure themselves to support the digital literacy of the older adults that participate in them (Gardner, Kamber, & Netherland, 2012).

Not all older adults in the USA participate in senior centers. Depending on how older adulthood is understood, there are between 107 million (aged 50 and older) and 45 million

(aged 65 and older) older adults in the USA (U.S. Census Bureau, 2014), and of that number the National Council on Aging (2014) estimates that only one million older adults participate daily in senior centers. Nonetheless, senior centers aspire to be and often are community hubs for older adults.

Public libraries also aspire to serve all members of local communities, including older adults (van Slyck, 1995; Zickuhr, Purcell, & Rainie, 2014). There are 16,536 public libraries in communities throughout the USA (American Library Association, 2016). Despite this mission to serve all, public library work with older patrons only began receiving national attention during the second half of the twentieth century. In 1957, the American Library Association's Adult Services Division administered a survey of public library services for older adults. This survey led to the publication in 1961 of *Service to the Aging*, the first handbook on public library services for older adults (Casey, 1975). In 1975, the American Library Association's Reference and Adult Services Division (now Reference and User Services Association) published *Library Services to Older Adult Guidelines*, the first professional guidelines on this population (American Library Association, 1987). The guidelines have been revised three times, in 1987, 1999, and 2008 (American Library Association, 2008).

Schull (2013) identifies the period from 2005 to 2011 as "a turning point, a time when librarians started to respond to the aging of America" (p. vii). During this time, librarians at the vanguard of this trend developed new programs and services for older adults. Increasing focus on lifelong learning in the USA's Institute of Museum and Library Services drove many of these developments (Borg & Mayo, 2005; De la Peña McCook & Barber, 2002; Rothstein & Schull, 2010), and some public libraries started initiatives to support older adults learning digital technologies (Schull, 2013, p. vi). Despite these advances, however, research suggests that many

public libraries have not yet reconfigured themselves to support the digital literacy of older adults in their communities (Bennett-Kapusniak, 2013; Charbonneau, 2014; Perry, 2014).

C. Older adults play leadership roles in their communities

Through seven years of community informatics research on digital heritage in local communities, I discovered that older adults play important leadership roles in their communities. From 2007 to 2009, I conducted action research with the Katherine Dunham Center for Arts and Humanities in East St Louis, seeking to understand how the preservation of the center's archival records relates to the empowerment of the marginalized African American community in which the center is located (Lenstra, 2008). I found that the nucleus of the center's board, tasked with sustaining the center across time, is composed of retired older adults.

The finding that older adults play leadership roles in their communities was extended in a subsequent research project, though somewhat inadvertently. This study, which ran from 2010 to 2013, investigated how a collaboratively constructed digital heritage library, known as eBlackCU, became integrated into community life (Lenstra & Alkalimat, 2012a). Although the project initially focused on teenagers, older adults participated more and more as it developed. The formal structure of the project included me hiring, training, and supervising a team of 10 teenage digital archivists, in addition to collaborating with two local high schools (Lenstra, 2014b). I found, however, that the people most engaged in the project were older African Americans. Older adults wanted help using the digital library to access heritage information, and they also wanted to contribute memories and documents to the digital library. In 2012, a statewide workshop series on Digital Local & Family History organized in and around Illinois

public libraries confirmed these trends: the median age of the 70 participants was 60 (Lenstra, 2014a).

Most fascinating of all, I also discovered older adults already using digital technologies to lead community archives. I identified one older adult who from December 2009 to February 2010 posted almost 9000 photographs that document her community to Facebook (Table 5). This woman has continued this work into the present and is known as the unofficial historian of her local African American community. The digital practices of older adults like her suggest that better support for the digital literacy of older adults will enable older adults to use technology to lead their communities in similar ways.

Topic of album	Number of images	Percent of total
Events	3608	42%
Personal/Family	1587	18%
Funerals	1239	14%
Church	1181	14%
People	904	11%
History	72	1%
All	8591	100%

Table 5: Photographs uploaded by Facebook Archivist, December 2009–February 2010 (Lenstra & Alkalimat, 2012b).

D. Summary

In our increasingly digital society, older adults have much to offer. Nonetheless, digital divides hinder the full participation of older adults in their communities. As institutions in the public sphere, public libraries and senior centers could support and may already be supporting the digital literacy of the older adults. This dissertation investigates this topic by asking to what extent and how do these institutions of community-based information infrastructure support older adult digital literacy.

CHAPTER 2. REVIEW OF THE LITERATURE

This chapter argues for the theoretical and scholarly importance of this dissertation by situating it in the research literature of multiple academic disciplines. The literature on the topic of older adult digital literacy tends to quickly pass over the institutional and community contexts in which digital learning takes place. In this dissertation, I study older adult digital literacy in this community context by utilizing the theory of information infrastructure to understand to what extent and how public libraries and senior centers support older adult digital literacy.

Theoretical understanding of the topic of older adult digital literacy is further hindered by assumptions in the literature that: (1) older adults should use technology like young people, and (2) that the aging minds and bodies of older adults structure their relationship with technology. In addition, theoretical ambiguity around the concept of "older adulthood" itself hinders our understanding of older adult digital literacy. As a result of these ambiguities and lacunae in the literature, more research is needed to understand how and why communities support older adult digital literacy. To reiterate, this problem is important in the world because (1) our information society is also an aging society, and (2) older adults play important leadership roles in their communities. Public libraries and senior centers are institutions in the public sphere that may already structure how older adults engage with technology. Understanding the roles these institutions play in the digital literacy of older adults will improve the capacity of these and other institutions to create a more inclusive information society.

By way of introduction to this review of the literature, I now define the terms of this dissertation's research question in relation to the literature. The research question investigated in this dissertation is: To what extent and how does community-based information infrastructure support older adult digital literacy?

By community, I mean multi-generational groups of people connected by a shared history, and based in the geographical spaces where daily life is lived (Williams & Durrance, 2009), and by information infrastructure, I mean the relationships between information systems and information users (Star, 1999). These always evolving relationships lead to always evolving information institutions. By older adult, I mean humans occupying that stage of the human lifecourse which occurs during the latter period of a normal life: a life that does not suffer from premature death. The boundaries of this stage of life are cultural and social and change over time, and from place to place (Cole, 1992). By digital literacy, I mean the state of having integrated digital technology into the social activities of life (Prior & Shipka, 2003, p. 185). Since there are multiple ways of being in the world, there are multiple ways to be digitally literate.

This review of the literature begins with the theory of information infrastructure. This theory has been used to understand governance, scholarly communication, and corporate organizations. Although some scholars have found that information systems condition how older adults learn technology, the relationship between information systems and the digital literacy of older adults has not been systematically analyzed. More generally, the information infrastructure of marginalized communities has not been systematically analyzed.

After establishing the theoretical framework of information infrastructure, I then discuss how scholars understand digital literacy to be shaped in social settings, through the actions of daily life. Beginning in the late 1980s, a growing number of scholars have studied how and why older adults learn and use digital technologies. Nonetheless, we lack theoretical understanding of older adult digital literacy as a social phenomenon shaped in local communities.

A problem facing our understanding of older adulthood is that there is no scholarly consensus on what “older adulthood” actually means. In studies of older adults and digital

technologies, older adulthood has been operationalized in multiple ways. To understand older adulthood on a firm theoretical footing, I draw on the lifecourse approach to sociology to suggest that older adulthood is a socially evolving stage of the human lifecourse.

Finally, I introduce the field of community informatics. Community informatics scholars have found that local, historical communities shape how people use and learn to use digital technologies. This review of the literature shows that research is indeed emerging on the topic community informatics and older adults, but more research is needed to theoretically understand how communities support the digital literacy of their older members.

Having surveyed the body of scholarly knowledge on older adulthood and digital literacy, and identified some lacunae within, this chapter concludes by discussing the literature on the methodology and methods used to conduct this investigation.

A. Information infrastructure and older adults learning technology in institutions

The theory of information infrastructure was chosen as a guiding theoretical framework for this dissertation for three reasons: (1) the theory frames information users as active agents in information systems; (2) unlike other theories premised on this assumption, information infrastructure has a specific multi-dimensional definition that aids in its operationalization; and (3) the theory has not been widely used to understand how marginalized communities use information, suggesting a gap in our theoretical understanding that this dissertation can address.

Information users as active agents in information systems. Over the last 50 years, scholars in the field of library & information science have debated how to study information users and information systems. Before the 1980s, much of the literature focused on information

systems. The paradigmatic case of systems-centered research is Parker and Paisley's study of information systems for scientific communication (Parker & Paisley, 1966). Reacting to this trend, scholars such as Dervin and Nilan (1986), Kuhlthau (1991), and Wilson (2000), among others, established through their research user-centered theories of information behavior. The focus in this research is on how users and user groups search for and use information.

More recently, theories of information behavior have shifted from information users in the abstract to information users in the context of information systems (Courtright, 2008). Related to trends in social informatics and in science and technology studies (Frohmann, 2004; van House, 2003), this shift has emerged around concepts such as information infrastructure (Star & Ruhleder, 1996), cyberinfrastructure (Atkins et al., 2003), and socio-technical systems (Lamb & Kling, 2003), among others.

In these new theories of information behavior, the focus is on the interchange and interplay between, as well as the mutual shaping of information systems and information users. As Lamb and Kling (2003) wrote in their critique of the user-centered paradigm:

> Using analyses from a recent study of online information service use, we develop an institutionalist concept of a social actor whose everyday interactions are infused with ICT use. We then encourage a shift from the user concept to a concept of the social actor in IS research. We suggest that such a shift will sharpen perceptions of how organizational contexts shape ICT-related practices, and at the same time will help researchers more accurately portray the complex and multiple roles that people fulfill while adopting, adapting, and using information systems. (p. 197)

As Lamb and Kling suggest, the focus in these new theories of information behavior is on analyzing both information systems and the social actors who shape them: systems shape users, and users shape systems. This theory has many parallels to recent media and communication scholarship focused on understanding how technology users play active roles in designing the technologies they use (Oudshoorn & Pinch, 2003).

Contributing to these theoretical trends, Star (1999) theorizes that information infrastructure results from the interactions of information users and information systems. Information infrastructure, she writes, is "a fundamentally relational concept, becoming real infrastructure in relation to organized practices" (Star, 1999, p. 380). Real infrastructure here consists of those information systems that have been integrated into the organized practices of a group.

Guribye (2015) traced the conceptual history of information infrastructure back to Kling and Scacchi's (1982) work on the Web of Computing. Kling and Scacchi (1982) found that "computing consists of a web of practices and interconnected computational units" (cited in Guribye, 2015, p. 186). Here again, the focus is on interconnected systems and users. According to this theoretical framework, to analyze information infrastructure requires attending to the interactions between information systems and information users. Information infrastructure is not just stuff, the substrate of information practices. Rather, information infrastructure conditions the information practices it supports and is in turn adapted and changed through those practices.

Studying information infrastructure. Like all theories, the theory of information infrastructure evolves over time. Although Star and Ruhleder (1996) initially defined information infrastructure as consisting of eight dimensions, Star (1999) later added a ninth. More recently, Guribye (2015) added another dimension to aid in research on information infrastructure designed to support learning, bringing the total to ten.

The ten dimensions used to study information infrastructure in this dissertation are:

- **Embeddedness**. Infrastructure is sunk into and inside of other structures, social arrangements, and technologies. People do not necessarily distinguish the several coordinated aspects of infrastructure.

- **Transparency**. Infrastructure is transparent to use, in the sense that it does not have to be reinvented each time or assembled for each task, but invisibly supports those tasks.
- **Reach or scope**. This may be either spatial or temporal—infrastructure has reach beyond a single event or one-site practice.
- **Learned as part of membership**. The taken-for-grantedness of artifacts and organizational arrangements is a sine qua non of membership in a community of practice. Strangers and outsiders encounter infrastructure as a target object to be learned about. New participants acquire a naturalized familiarity with its objects, as they become members.
- **Links with conventions of practice**. Infrastructure both shapes and is shaped by the conventions of a community of practice (e.g., the ways that cycles of day-night work are affected by and affect electrical powerrates and needs).
- **Embodiment of standards**. Modified by scope and often by conflicting conventions, infrastructure takes on transparency by plugging into other infrastructures and tools in a standardized fashion.
- **Built on an installed base**. Infrastructure does not grow de novo; it wrestles with the inertia of the installed base and inherits strengths and limitations from that base. Optical fibers run along old railroad lines; new systems are designed for backward compatibility, and failing to account for these constraints may be fatal or distorting to new development processes.
- **Becomes visible upon breakdown**. The normally invisible quality of working infrastructure becomes visible when it breaks: the server is down, the bridge washes out, there is a power blackout. Even when there are back-up mechanisms or procedures, their existence further highlights the now-visible infrastructure.
- **Is fixed in modular increments, not all at once or globally**. Because infrastructure is big, layered, and complex, and because it means different things locally, it is never changed from above. Changes take time and negotiation, and adjustment with other aspects of the systems are involved. Nobody is really in charge of infrastructure. (Star, 1999, pp. 381–382)
- **Has a pedagogical approach**. In the analysis of educational and learning practices, the presence of (or even the lack of) a pedagogical approach will serve a central role, as the object of such practices is related to some instructional or learning activity. (Guribye, 2015, p. 190)

To help scholars visually understand the interplay of these different dimensions, Bowker, Baker, Millerand, and Ribes (2009) arrayed eight of these dimensions along technical/social & global/local axes (Figure 1). According to this model, some dimensions of information infrastructure tend to be more shaped at the local or global levels and at the technical or social levels. Bowker et al. (2009) write:

> In building cyberinfrastructure, the key question is not whether a problem is a "social" problem or a "technical" one. That is putting it the wrong way around. The question is whether we choose, for any given problem, a primarily social or a technical solution, or some combination. It is the distribution of solutions that is of concern as the object of study and as a series of elements that support infrastructure in different ways at different moments. (p. 102)

These different dimensions of information infrastructure, and their interrelationships, collectively compose a theory of information behavior. This theory is premised on the idea that information systems and information users co-evolve.

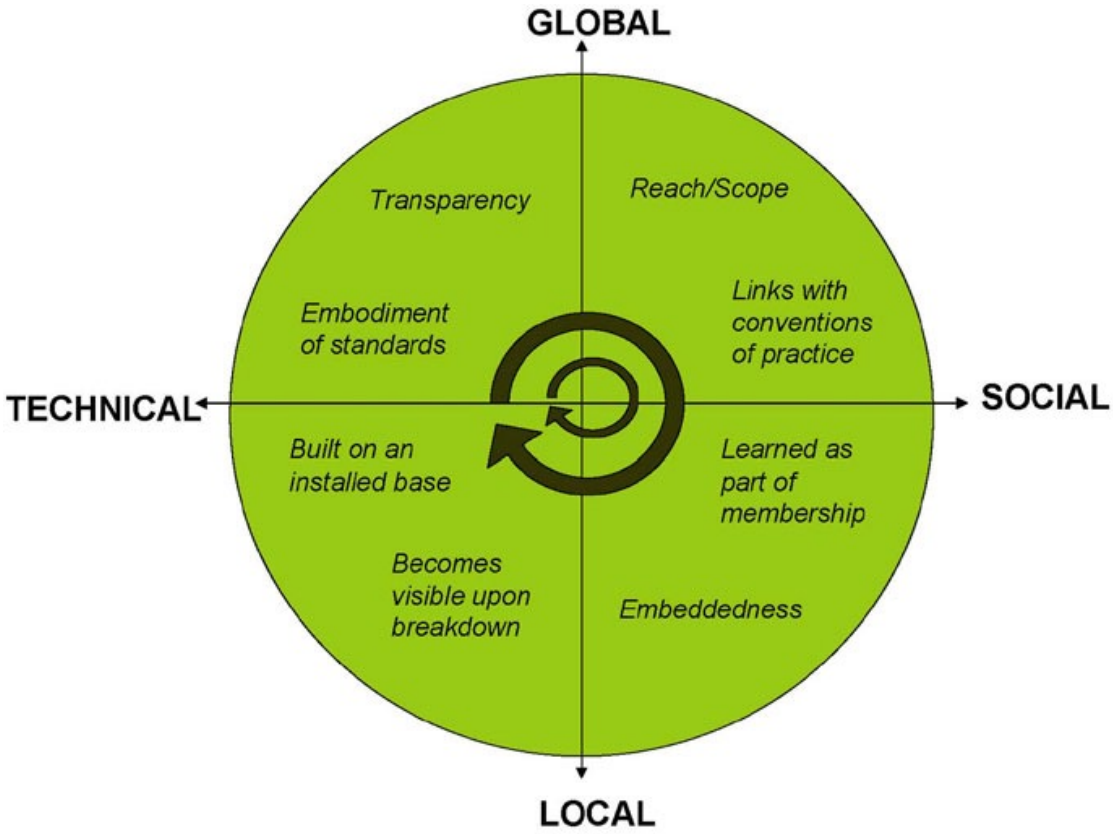

Figure 1: Information infrastructure as distributions along technical/social and global/local axes. From Bowker, Baker, Millerand, & Ribes, 2009.

The social processes through which information infrastructure evolves over time are often not visible to those who create or rely on it (Star, 2002, p. 116). Bowker (1994) calls the process of making information infrastructure visible through research an "infrastructural

inversion" (p. 10), in which social practices are inverted to understand how infrastructure supports them. Without infrastructural inversion, we cannot understand how information infrastructure shapes our social world (Bowker & Star, 1999). All social practices have an infrastructural component, but we rarely attend to infrastructure in the course of daily life, even though our lives depend on it. It is only through infrastructural inversion that the invisible can become visible.

Gaps in our understanding of the information infrastructure of marginalized populations. In LIS, the theory of information infrastructure has had its biggest impact in research on how scientists and specialists use information and information systems (Palmer & Cragin, 2008; van House, 2003). Past research on information infrastructure has analyzed science (Bowker et al., 2009), ICT for Development (Ure et al., 2009), government (Edwards, Bowker, Jackson, & Williams, 2009), health care (Sahay, Monteiro, & Aanestad, 2009), and workplaces (Pipek & Wulf, 2009). Some of these scholars have started a new field they call Infrastructure Studies (Edwards et al., 2009; Jackson, Edwards, Bowker, & Knobel, 2007).

This field has struggled to attend to the information infrastructure of marginalized populations. In a special issue on infrastructure studies in the *Journal of the Association for Information Systems*, Edwards, Jackson, Bowker, and Williams (2009) found that:

> Questions of distribution, power, and justice need to be addressed urgently and systematically by our field. How can claims on, through, and against infrastructure be formulated, organized, and heard? What constitutes adequate representation or participation in the process of infrastructural change and development? Under what conditions can rival interests in infrastructure (large and small, modest and profound) be acknowledged, addressed, and accommodated, in ways that enhance the legitimacy, appropriateness, and long-term efficacy of infrastructural change? (p. 372)

This statement suggests that issues of social justice and equity are not currently being addressed in scholarship on information infrastructure. This work can only be achieved by examining the infrastructure of people who face injustice and inequity in their daily lives.

Older adults learn and practice digital literacy in institutions

Some scholars have found that institutions condition how older adults learn technology. However, the relationship between information infrastructure and the digital literacy of older adults has not been systematically analyzed. Most research on this topic quickly passes over the roles of institutions in the digital literacy of older adults. This suggests that an infrastructural inversion of older adult digital literacy could add to our understanding of this phenomenon.

In a study of older adults in the USA and in China using technology, Xie (2005) found that: "the patterns and characteristics of SeniorNet and OldKids users' online and offline interactions are influenced by the history, mission, and available resources of these organizations" (p. 177). Sayago and Blat (2010) conducted a longitudinal ethnographic study of computer labs in senior centers. They found that older adults adapt these spaces to how they want to use technology. Ito, O'Day, Adler, Linde, and Mynatt (2001) also found that older adults adapt a social networking site to meet their needs. Gardner, Kamber, and Netherland (2012) found that the organizational context of technology support services in senior centers shapes how older adults learn technology there:

> In the typical arena of organizations and agencies providing services to older adults, technology programming often plays a marginal role (i.e., a service appended to providers' core competencies such as meals provision and case management and provided through volunteer or non-specialist staff). As a consequence, technology programs are often delivered in fragmented, or ad hoc fashion, and falter due to erratic staffing, inappropriate curriculum, technology breakdowns, poor funding, and limited capacity. (p. 13)

These findings illustrate how older adult digital literacy and learning are shaped by the institutions and organizations where these practices take place.

Many other studies of older adults using technology take place in local institutions, but without attending to the institutional contexts of that use. For instance, in studies of older adults learning and using technology in senior centers (Davidson, Santorelli, & Kamber, 2012; Lee, Chaysinh, Basapur, Metcalf, & Mandalia, 2012; Saunders 2004), senior computing clubs (Burgess, Hasan & Alcock, 2013; Naumanen & Tukiainen 2009; Wood, Lanuza, Baciu, MacKenzie, & Nosko, 2010), and assisted living facilities (Linton 2012), the focus has been on the older adults themselves. The institutional contexts of their digital practices are passed over quickly.

Public libraries have also been studied in relation to the digital practices of older adults. As public libraries endeavor to adapt to their aging communities, support for older adult digital literacy has become a role many public libraries have taken on (Rothstein & Schull, 2010; Schull, 2013). For instance, the International Federation of Library Associations and Institutions' (IFLA) bibliography of library literature on disadvantaged persons published between 2001 and 2008 shows that approximately one-third of the literature on library services for the elderly focuses on technology (Locke, Panella, & Girolami, 2010). Xie and her colleagues have found that public libraries in the USA help older adults learn digital technologies (Xie & Jaeger 2008), particularly in relation to health information (Xie & Bugg, 2009). Wicks (2003) also found public libraries innovating to support older patrons who desire to learn computing. Kumar, Ureel II, King, and Wallace (2013) found that computer science students who volunteer in a rural public library to help older adults learn technology contribute to the digital literacy of older adults. In Romania, Cimpoieru (2011) found that partnerships between public librarians and senior centers enable

senior centers to better support older adult digital literacy. This finding suggests that senior centers and public libraries can work together to support older adult digital literacy.

Nonetheless, there are gaps in our understanding of how public libraries are reconfiguring themselves to support the digital literacy of older adults. In her survey of public libraries in New York City and Atlanta, Perry (2014) found that, in general, public libraries have not yet fully reconfigured themselves to serve their aging communities. Similarly, in her survey of the public libraries in US capital cities, Bennett-Kapusniak (2013) found that very little programming exists for older adults. In particular, computer technology services were found to be lacking. Charbonneau (2014) found that public library websites do not adhere to senior-friendly website guidelines. These findings suggest that public libraries do not always provide robust support for the digital literacy of older adults, but more research is needed of this topic. Past research has relied on surveys of librarians or the analysis of library websites. Less studied has been how older adults, as active agents in their communities, shape the technology support services they use in public libraries.

In summary, the theory of information infrastructure provides conceptual tools for understanding how information users and information systems co-evolve. The emerging field of infrastructure studies has focused primarily on scientists and specialists. Our understanding of the information infrastructure of marginalized populations is minimal. Scholarship on how institutions shape the digital practices of older adults suggests that using the theory of information infrastructure to understand older adult digital literacy could enrich scholarly understanding of this topic.

B. Older adult digital literacy is a social phenomenon

Increasingly, scholars recognize that digital literacy is a social phenomenon. That is to say, people use and learn to use technology in social contexts. This conceptualization of digital literacy is not universally held in the academy. For instance, some theories of information literacy in library & information science assume that literacy is a process that takes place solely in the individual's mind (e.g. Mackey & Jacobson, 2014). Digital literacy does have cognitive dimensions, but increasingly scholars in the fields of education, computer supported cooperative work, library & information science, and elsewhere find that literacy in the information age is best understood as a social phenomenon, not limited to the mind of any one individual (Belshaw, 2012).

Theoretical understanding of the digital literacy of older members of society is limited. Research up to now has focused primarily on young people and on students (Bowen, 2011). Nonetheless, an emerging body of research literature investigates how older adults learn technology, although this literature has tended to focus on how older adults use digital literacy to improve their health (Bowen, 2012b; Heart & Kalderon, 2013; Morris, 2007; Neves, Amaro & Fonseca, 2013). It is undeniably important that older adults live healthy lives, but the same is true for all sectors of the population. As a result of this focus on health in the research on older adult digital literacy, we lack a robust understanding of older adult digital literacy in general.

Digital literacy is social

In recent years, digital literacy has been studied by many scholars. This literature has led to the growth of ever-more-complex typologies of what it means to be literate in the digital age (Belshaw, 2012). Historically synonymous with the ability to read and write, what it means to be

literate has changed as the communications landscape has changed. These new literacies (Lankshear & Knobel, 2011) include information literacy, computer literacy, media literacy, digital literacy, and a host of others. For theoretical clarity, this dissertation encompasses all of these different literacies within the concept of digital literacy, since they all require being able to use digital technology with some fluency.

Two bodies of literature shape how the concept of digital literacy is used in this dissertation: (1) Education literature that theorizes digital literacy to be shaped and enacted in society (Bowen, 2011; Gee, 2010; Ito et al., 2010; Prior & Shipka, 2003), and (2) computer supported cooperative work (CSCW) literature that theorizes digital learning as a social accomplishment among groups of people (Epperson, 2006; Guribye & Wasson, 2002; Randall, Harper & Rouncefield, 2005; Twidale, 2005). Both traditions utilize interviews and ethnography to study digital literacy and learning, but where education scholars study digital literacy in society and in individual lives (Bowen, 2011; Flower, 2008; hooks, 1994; Prior & Shipka, 2003; Selfe & Hawisher, 2004), CSCW scholars focus on the particularities of digital learning as it emerges in real-time in situated spaces (Guribye & Wasson, 2002; Twidale, 2005). In both fields, digital literacy and learning are theorized as emerging out of the social situations of the individuals and groups studied.

Scholars in library & information science also contribute to the development of social theories of digital literacy. In her discussion of the information literacy literature, Pawley (2003) called for research that attends to the political, economic, and institutional contexts of literacy. Based on research on how the Chicago Public Library supports digital literacy, Williams (2012) and her colleagues (Duffy, Jennings, & Williams, 2012) adapted the traditional logo of the

American Library Association, which focused on the individual, to foreground the social dimensions of digital literacy and learning (Figure 2).

Figure 2: Evolving understanding of literacy in public libraries. From left, traditional National Library Symbol, the American Library Association; new National Library Symbol, American Library Association; logo created by University of Illinois Community Informatics Research Laboratory. From Duffy, Jennings, & Williams, 2012.

Older adult digital literacy is also social

A growing number of scholars have studied how and why older adults learn and use digital technologies. Nonetheless, we lack theoretical understanding of older adult digital literacy as a social phenomenon. This review of the literature on older adult digital literacy reveals two primary gaps in our understanding of this phenomenon. First, scholars have assumed that older adults use technology in ways that mirror how young people use technology (Bowen, 2011). Second, scholars have assumed that older adults use technology primarily to contribute to their health (Heart & Kalderon, 2013). As these scholars point out, these assumptions hinder our ability to understand how older adults learn and use technology in daily life.

Much of the research literature on digital literacy focuses on youth and students. The studies of Ito et al. (2010), Jenkins, Purushotma, Weigel, Clinton, and Robison (2009), and Gee

(2010) on the digital literacy of youth have influenced scholarly understanding of older adult digital literacy. For instance, in a study of how older adults use technology, Bloch and Bruce (2011) used a youth media literacy framework to understand how older adults learn to use digital technology. Bowen (2011; 2012a; 2012b) critiqued this approach to older adult digital literacy, which she calls an "age bias in digital literacy research" (2011, p. 586). In her review of the digital literacy literature, Bowen (2012a) found that leading literacy theorists:

> Favor (and make generalized assumptions about) the literate expertise of young people …. These theorists place young people at the cutting edge, and place older people struggling (and failing) to catch up, perhaps finding it impossible to "get it" at all. (pp. 6–7)

Bowen argues that until scholars bring the same fine-grained sociological analyses to older adults they brought to young people, theories of digital literacy will continue to exhibit an "age bias" that renders invisible the digital practices of older adults (Bowen, 2011).

The second gap in our understanding of older adult digital literacy emerges from the fact that much of the research on this topic assumes that older adults will use digital literacy primarily to improve their health. For instance, in their study of how and why older adults adopt digital technologies, Heart and Kalderon (2013) theorized that digital literacy among older adults will naturally lead them to use technology primarily for health related reasons. The objective of their paper was to "assess use by older adults of technology … in order to evaluate their readiness to adopt health-related ICT" (Heart & Kalderon, 2013, p. 209). Here the focus is not on digital literacy per se, but rather on digital literacy for health.

This coupling of older adult digital literacy and health appears throughout the literature, including in Library and Information Science. Asla and Williamson (2015) analyzed the information behaviors of older adults living in what they call the Fourth Age, or the "ill-derly or

disability zone" (p. 1) occupied by those very old individuals coping with physical and mental disabilities. It is true that older adults suffer cognitive and physical disabilities at rates that exceed the larger population. But the number of older adults suffering from disabilities is still proportionally small: Only 20% of older adults in the USA have chronic disabilities (Freedman, Martin, & Schoeni, 2002). In the *Journal of the American Medical Association*, three prominent scholars of geriatrics stated unequivocally that "disability and underlying physical, cognitive, and sensory limitations are not inevitable consequences of aging" (Freedman, Martin, & Schoeni, 2002, p. 3137). It is important for older adults to lead healthy lives, and digital technologies may play a part in this process—but this is true for people of all ages.

These gaps suggest we need more research that analyzes older adult digital literacy as it unfolds in the lives of older adults. A growing number of scholars have in fact studied how older adults use and learn to use technology in daily life. These scholars come from multiple disciplines, including gerontology, education, media studies, computer science, and library & information science. One of the largest and most important sources of literature on older adult digital literacy is the journal *Educational Gerontology.* This journal features many research articles analyzing training programs focused on helping older adults become digitally literate (Kim, 2008; Saunders, 2004; Wood et al., 2010; Xie, 2007; Xie, Watkins, Golbeck, & Huang, 2012). These and other gerontologists have pioneered the study of older adult digital literacy.

These scholars have found that social support is crucial for older adult digital literacy. Without social support, older adults lack both the motivation to learn technology and the technical resources necessary to learn. As early as 1988 gerontologist Lesnoff-Caravaglia (1988) found that among older adults the "absence of relatives and significant others may reduce the

motivation for adopting a technology" (p. 276, cited in Richardson, Weaver, & Zorn, 2005). In a mixed-methods study in the United Kingdom, Selwyn (2004) found that:

> Older adults tended to rely on a variety of informal and social strategies—most notably, the informal acquisition of computers through the extended family …. Family and friends are therefore very important elements in many of our interviewees' adoption of ICT. (p. 374)

Selwyn (2004) called this the "constant process of ... recycling and informal redistribution of computers from the workplace to the family and from family member to family member" (p. 375). These findings illustrate that older adult digital literacy depends on social support found among close contacts.

Many scholars have found that older adult digital literacy is structured and supported by families (Hardill, 2014). Nonetheless, the family is not enough to sustain the digital literacy of older adults. Summarizing the findings from the Sus-IT project, which included 750 older adults from throughout England and Scotland, Hardill (2014) wrote that:

> Sustaining digital engagement is linked to the significant, indispensable and crucial ICT support role of (extended) family members, who provide intergenerational support, along with motivational factors, acting as drivers for digital engagement …. But not all older adults received the help and support needed to become confident users from family members, and for such older adults support from the community, often involving young people, organized formally by neighborhood and community groups is providing a vital resource supporting older people sustain their use of digital technologies. (p. 280)

Older adults draw on diverse sources of support as they use digital technologies, and the family plays a crucial role. But the family, by itself, is not sufficient; extra-familial support is required.

Intergenerational support in local communities contributes to older adult digital literacy. Bowen (2012a) discussed how older adult digital literacy emerges out of "the social networks of expertise distributed among friends and loved ones" (p. 115). Selwyn (2004) found that older adult technology usage is supported by family and friends of all ages. In their research on older

adults using cybercafés in Jamaica, Bailey and Ngwenyama (2011) found that through participating in these intergenerational public computing spaces older adults feel connected to the broader society.

Sometimes this support is also found among other other older adults. The Digital Inclusion Initiative of Senior Service America (2014) found that peer-to-peer computing environments create the supportive conditions necessary for older adults to acquire and extend digital literacy. In a study of an online community populated by older Japanese adults, Kanayama (2003) found that peer-to-peer support formed among older adults learning technology is important because older adults learn together "without experiencing fears or discouragement" (p. 280) they experience in intergenerational settings. Scholars have come to similar conclusions in research in the USA (Boeltzig & Pilling, 2007; Wood et al. 2010), China (Freddolino et al. 2010; Xie, 2007), and Europe (Sayago & Blat, 2010). These case studies show that older adults can and do support each other's digital literacy. Collectively, these findings demonstrate that support for older adult digital literacy can take many forms. Some find support in the family, others in the intergenerational local community, still others in peer-to-peer settings populated by other older adults.

In addition to analyzing how best to support older adult digital literacy, scholars also analyze what older adults do with digital literacy. Attention has focused in particular on how older adults participate with others online. Xie, Watkins, Golbeck, and Wang (2012) found that many older adults prefer the more private space of email to the more public space of social media. Sayago and Blat (2010) also found that older adults prefer email. Bloch and Bruce (2011) came to similar conclusions. On the other hand, a growing percentage of older adults in the USA now use social networking sites on a regular basis (Smith, 2014). Waycott et al. (2013) found

that even those in the "oldest old" group (aged 85 and older) enjoy expressing themselves online in public settings. In my research (Lenstra, 2014a; 2014b), I also found that older adults enjoy creating and sharing content on social media. This evidence suggests that given the right conditions older adults are as capable and as willing to contribute to digital public spheres as any other demographic group.

In summary, social theories of digital literacy represent an alternative to research that assumes older adults will use technology like young people do, or for medical reasons. A growing number of scholars have studied the digital literacy and learning practices of older adults. These scholars find that social support is necessary for older adult digital literacy. Familial, peer-to-peer, and community support are all important. With this support, older adults contribute to digital public spheres. Nevertheless, despite this research and its important findings on how and why older adults use technology, we lack theoretical understanding of the older adult digital literacy as a social phenomenon.

C. Older adulthood is a stage in the human lifecourse

Scholars using the lifecourse approach to study aging find that human life proceeds through a series of stages that are socially shaped and evolving (Cole, 1992). As such, what it means to be old, and thus the boundaries of older adulthood, changes from historical moment to historical moment and from culture to culture. People become old in society—society shapes how and when one perceives oneself, and is perceived by others, to be old.

This section first discusses conceptual ambiguity about old age in past research, then introduces the concept of ageism to illustrate how prejudice against old age shapes how older adulthood is understood. Finally, I introduce and discuss the theory of older adulthood as a

stage in the lifecourse. I focus in particular on research that uses this theory to study older adults using technology.

Terms like older adult and senior citizen have no consistent definition in the scholarly literature. Xie (2011) found that "currently, there is no consensus in the literature regarding the definition of 'older adults'" (p. 936). Xie also found little social consensus regarding when one becomes an older adult. In a study of an e-Health literacy program for older adults in public libraries, Xie (2011) operationalized older adulthood as beginning at age 60. Nonetheless, individuals as young as 52 asked to participate. Similarly, in a study of Canadian public library patrons, Wilkinson and Allen (1991, cited in Williamson & Asla, 2010) found that a significant number of patrons between the ages of 50 and 64 self-identify as seniors.

The ambiguity around the concept of older adulthood influences how scholars of older adults and technology refer to what they are studying. Terms active in the literature include: senior citizens (Burgess, Hasan & Alcock, 2013), seniors (Ito et al., 2001), the grey population (Morris, 2007), older people (Sayago & Blat, 2010), older adults (Xie et al., 2012), the older population (Laguna & Babcock, 1997), the elderly (Kiel, 2005), the retired (Buse, 2009), pensioners (Cimpoieru, 2011), grandparents (Quadrello et al., 2005), the oldest old (Asla, Williamson & Mills, 2006), and those living in the third age (Schull, 2013) or the fourth age (Asla & Williamson, 2015). In addition to being understood through multiple terminologies, older adulthood has also been operationalized in multiple ways. In a systematic review of the international literature on older adults using social networking sites, Nef, Ganea, Müri, & Mosimann (2013) found older adulthood sampled in the following age ranges:

- 41-65
- 50-64
- 50-75

- 55+
- 55-90
- 58-66
- 60+
- 60-82
- 61-75
- 61-83
- 61-89
- 63-86
- 64-91
- 65-72
- 65-97

These heterogeneous samples illustrate the complexity involved in studying older adulthood.

Gerontology, the academic field of study focused on older adults, has grappled extensively with the question of how to define older adulthood. Experts in the field find that this question cannot be answered objectively. Bytheway (2011), a gerontologist with nearly 50 years of experience, found no consensus in the field about when older adulthood begins, even in groups such as the International Association of Gerontology. Similarly, one of the most widely used gerontology textbooks in North America, Hooyman and Kiyak's (2011) *Social Gerontology: A Multidisciplinary Perspective*, now in its ninth edition, states that:

> Although the terms elders, elderly, and older persons are often used to mean those over 65 years in chronological age [in a USA context], this book is based on the principle that aging is a complex process that involves many different biological, psychological and social factors and is unique to each individual. (p. 7)

Scholars of these social factors show that changes in politics, the economy and society shape how this stage of life is perceived and experienced. Gullette (2004) discusses how the political category of senior citizen emerged as a result of intense political debate about entitlements during the Great Depression. Senior citizenship historically began in the USA at age 65. Over time, other official definitions of older adulthood have emerged. The 1967 Age Discrimination in Employment Act barred discrimination on the basis of age for individuals older

than 40 years of age (McCann & Giles, 2004, p. 177). Another Great Society initiative, the Senior Corps program, is open to adults aged 55 or more. The American Library Association (2008) also defines older adulthood as beginning at age 55. Since 1992, the National Institute of Aging has administered the biannual US Health and Retirement Study, which surveys adults in the contiguous USA aged 50 or more (Silver, 2014).

Changes in the economy also influence changes in social and scholarly perceptions of older adulthood. Many adults now work past industrial-era retirement ages (Riggs, 2004), suggesting that retirement no longer operates as a stable boundary between midlife and old age. In this new economy, many older adults participate actively in the formal economy, and many more also actively participate in non-profits. A 2014 survey of American Human Resource professionals found that two-thirds of American companies employ at least one "older worker who retired from other organizations or careers before joining their organization" (Society for Human Resource Management, 2014, p. 4). For an increasing number of older adults, retirement either does not happen, or is no longer the end of work (Buse, 2009; Gergen & Gergen, 2000).

Societal ageism also shapes how older adulthood is perceived and experienced. The concept of ageism was coined by Butler (1969), the first director of the U.S. National Institute on Aging. The term refers to discrimination against any and all age groups. In research and policy, however, it has been used primarily to understand structural and social discrimination against older adults and against the process of growing old (Wilkinson & Ferraro, 2002). Ageism is ubiquitous in the USA. Nelson (2004) stated:

> There is a whole industry in the greeting card business built around the 'over the hill' theme. Such cards are often portrayed as humorous, but the essential message is that it is undesirable to get older. (p. x)

Through discourses such as this one, many people of all ages internalize this message that it is undesirable to age.

Owing to the stigma of being old in our ageist society, many adults do not wish to be seen as older adults (Cox, Abramson, Devine, & Hollon, 2012). Older adults often say they "don't feel old" (Thompson et al., 1990, p. 1), implying there is something wrong with aging and being old. In a culture where old age is symbolically linked to decline, death and obsolescence (Cole, 1992; Gullette, 2004, p. 220), few embrace older adulthood as an identity. Surveys find that fewer than 10% of Americans self-identify as old (Gergen & Gergen, 2000).

Ageism also shapes how older adults use digital technologies. Ageist stereotypes imply that older adults cannot learn new technologies. Birkland & Kaarst-Brown (2010) found that "older adults ... refuse to use a device they see as stigmatizing, even if they comprehend the benefits of using a device" (p. 348). If a device marks them as old, older adults resist using it. This desire to be seen as a normal user of technology may relate to fears of institutionalization. Chatman (1992) found in her information seeking study that residents of a retirement community fear to be seen asking for information. They fear that if their needs are made visible they will be institutionalized. Scholars continue to research the development of assistive technologies to help older adults without an awareness of the stigmatizing effects of these interventions on the older adults these technologies are designed to serve (Bowen, 2012b).

Older adults also cope with ageist discourses that imply that old people cannot use technology fluently. McKee and Blair (2006) found that older adults involved in a computing class at New York City senior center are affected by ageist media portrayals of older adults and technology: "You don't see grandma dancing with an iPod … and the message that technology is for the young is something that many older adults seem to have internalized" (p. 25). In Malta,

Formosa (2013) similarly found that "one prominent barrier to engaging with ICTs included the belief that the internet is the preserve of the young and how they were now 'too old' to use ICT" (p. 25). These findings illustrate that ageism affects how older adults use and learn to use technology.

In the context of this social ageism, both activists and academics challenge prejudicial stereotypes of aging with actual empirical experiences of aging. In a collective biography of older African Americans, Higgins (2000) quoted a man stating that:

> Years ago when I was still in my 30s, an older relative told me "in my twenties, I was clueless as to who I was. In my thirties, I began to understand who I was, but I didn't like myself. In my forties, I accepted myself. In my fifties, I began to celebrate myself. In my sixties, I have blossomed. It can only get better." (p. 5)

In this framework, becoming old is something to value, not something to deny or to hide. Scholars have also contributed to these projects to purge ageism from our understanding of older adulthood. Bowen (2012a) framed her study of individuals in their 80s successfully appropriating digital technologies into their lives as a project to correct ageist images of older adult digital literacy. In her ethnographic work with community elders, Barbara Kirshenblatt-Gimblett (1989) found that "the elderly are more than custodians of heritage. They are people in their own right, active in the present, and experts on what this period in the life cycle is all about" (p. 138). If we want to know something about old age, we need to closely attend to the actual experiences of aging individuals in their communities. By making these experiences visible, we counter social ageism.

The lifecourse approach to the study of older adulthood can be used to make these experiences visible. Since the early 1970s scholars in sociology, anthropology, history, and psychology have developed the lifecourse approach as a theoretical framework for

understanding "how historical time, social location, and culture affect the individual experience of each life stage" (Hutchison, 2014, p. 11). The lifecourse approach is premised on the assumption that a human life consists of a "sequence of socially defined events and roles that the individual enacts over time" (Giele & Elder, 1998, p. 22).

In Western cultures, the events and roles that mark a human's entry into older adulthood include life stage transitions like retiring, becoming a grandparent, joining a senior center, exhibiting health-related physical or cognitive declines, taking on the role of a wise elder, and other roles and events (Cole, 1992). Each generation experiences old age in different ways (Gullette, 2004; Hutchison, 2014), and the boundaries and experiences of older adulthood are always changing.

The lifecourse approach has been used to study older adult digital literacy. Up to now, however, these studies have focused on the individual in isolation, and not on the individual rooted in his or her community. Bowen (2011) studies how the digital literacy of a woman in her 80s builds on a lifetime of literate activity. Silvast (2015) uses an oral history methodology to understand how the digital literacy of Finnish adults relates to exposure to programing education in youth. Birkland (2013) finds that patterns in technology use among older adults relate to their experiences earlier in life, and Selfe and Hawisher (2004) come to similar conclusions in their life history study of adult literacy. Silver (2014) uses national survey data to show that older adults' socio-economic statuses at different stages in the lifecourse relate to how the internet is used in the present. These disparate findings show that the lifecourse approach to older adulthood can productively explain how and why older adults use digital technologies. In this dissertation I contribute to this literature by studying how the digital literacy of the individual relates to the communities in which the stages of life are lived.

In summary, older adulthood does not have one definition, either in scholarship or in society. How older adulthood is experienced and studied is shaped by politics, the economy, and by society. Ageist stereotypes shape what it means to be old, and how technology is used in older adulthood. Scholars and activists challenge these stereotypes through empirical studies of older adults. The theory of the human lifecourse is premised on the idea that older adulthood is a stage of life that emerges in society. The lifecourse approach can be productively used to understand how older adults use technology. This dissertation contributes to this literature by situating the lifecourse of the individual in his or her local community.

D. Community informatics, community agency, and digital divides

Scholars working in the field of community informatics study how local, geographically based communities incorporate digital technology into daily life (Williams & Durrance, 2009). This field emerged over the last thirty years from case studies of the informatization of local communities around the world (Williams, Lenstra, Ahmed, & Liu, 2013). A central concern in the field is to understand and ameliorate digital inequalities. Williams and Durrance (2009) describe the field thusly:

> The field of community informatics, by studying the interaction between transformation and continuity, between information technology and local community, is building up a picture of how the social, historical places we live in are evolving as we move from the industrial age to the information age, with particular attention to social and digital inequalities. (p. 1203)

In this section, I discuss central findings of this field related to the topic of this dissertation. I then discuss research on community informatics and older adults. This review shows that research is indeed emerging on community informatics and older adults, but more research is needed to understand how communities support the digital literacy of their older members.

A consistent finding in the field of community informatics is that socially excluded and marginalized communities have and exert agency in the information society. Clark (2003) found that low-income youth who come to an after-school public computer lab do not use the lab as its funders envisioned. They instead appropriate the space to do with it what they want. Postill (2008) found that people living in a suburb of Kuala Lampur adapt information technologies to fit within an existing repertoire of local social practices. Hampton and Wellman (2001) similarly found that residents of suburban Toronto adopt new technologies through an iterative interplay of online and offline social practices. Alkalimat and Williams (2001) found that public computing resources are used by an African American community to continue the African American freedom struggle. Williams and Alkalimat (2008) then found that other local communities are also using digital technologies to advance community cyberpower. Similar findings have emerged from other fields. In his critical assessment of ICT for development projects, Toyama (2015) found that the communities in which these projects are implemented determine whether or not an ICT project will succeed, and in what form. This research shows that local communities have agency. Local communities shape how digital technologies are appropriated in particular places.

Community informatics scholars also find that public computing empowers communities to learn and to practice digital literacy. In a study of the cybernavigator system in the Chicago Public Library, Williams (2012) found that having supportive people in the library ready and willing to help with technology contributes to enhanced digital literacy in the community. The interactions between these technology helpers and library patrons occurs through what Williams (2012) calls informatics moments, or "the moment when a person seeks help in using

some digital technology that is new to him or her" (p. 47). The local communities in which these informatics moments take place structure and shape them (Figure 3).

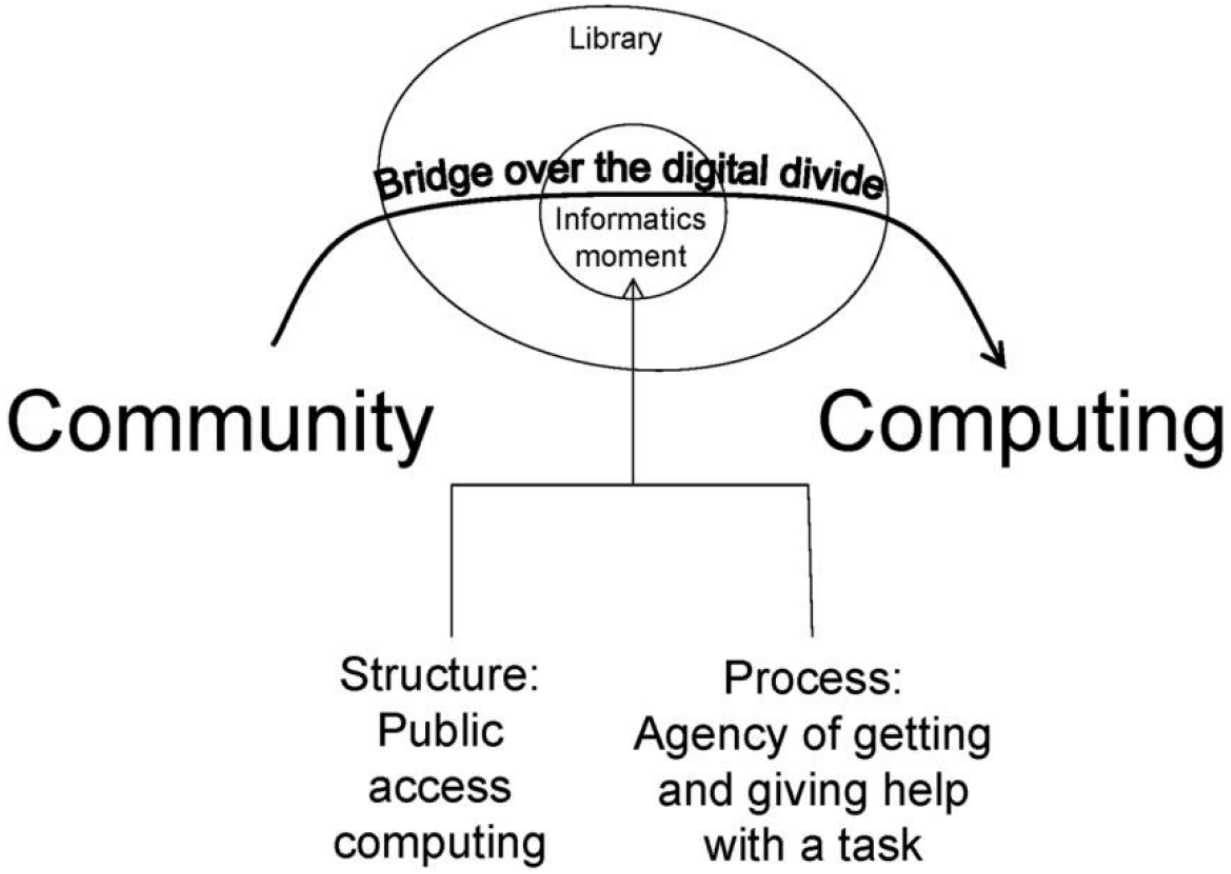

Figure 3: The informatics moment in the public library. Reproduced from Williams, 2012.

Scholars of community informatics also find that digital technologies are unevenly appropriated into local spaces. Through the concept of the digital divide, scholars have analyzed the obstacles that prevent some sectors of society from powerfully integrating new technologies into their daily life (Williams, 2001). More recently, the concept of digital inequalities has also become a common way to discuss and analyze the myriad inequalities of the still emerging information society (DiMaggio & Hargittai, 2001; Williams & Durrance, 2009). Both concepts continue to be widely used in community informatics scholarship (Friemel, 2014).

Community informatics and older adults

Older adults live in communities. Gerontologists have found that local communities shape the lives of older adults (Holstein, Parks, & Waymack, 2011; Scharlach & Lehning, 2015). In contrast, the field of community informatics has been slow to attend to older adult digital literacy and learning in a community context. In 2012, *The Journal of Community Informatics* published a special issue on Community Informatics and Older Persons with 23 research articles on this topic. Gurstein (2012), the editor of the journal, found that:

> Even in the response to our call for papers … we found that the bulk of the papers received were focused on "Informatics" as applied to the circumstance and condition of individual older persons in relation to the health care system, rather than towards older persons in and with their communities. (p. 1)

This focus on older adulthood as a problem to be solved through informatics obscures scholarly understanding of the community informatics of an aging society in general.

Nevertheless, a growing number of scholars in community informatics have begun to study the processes through which digital technologies are appropriated into aging communities. Rosson and Carroll (2003) found that digital technologies can bridge generational divides in local communities. Aziz (2009) found that college students in urban Oman mobilize connections to the communities of their youth to bring technology support to elderly members of rural villages. Xie and Jaeger (2008) found that the community spaces of public libraries support older adult digital learning. Other scholars analyze how digital technologies are appropriated into community spaces populated primarily by older adults. Sperazza, Dauenhauer, and Banerjee (2012) and Linton (2012) found that the cultures of retirement communities shape how residents there use digital technologies. Gardner et al. (2012) found

that technology support services in senior centers help older adults form new friendships and social ties. Chang, Heh and Lin (2012) found that a nursing home in Taiwan shaped the implementation of an eHealth pilot at that facility. Kok, Williams, and Yan (2012) also found that the cultures of an assisted living facility in the USA and a senior center in China shaped how older adults in these two spaces used Skype to communicate across national boundaries. These findings illustrate how digital technologies are integrated into aging communities.

In addition to studying how older members of communities use technology, community informatics also studies the exclusion of older adults in the information society. Brabazon (2005) compared obstacles to older adult digital literacy in Australia and in the United Kingdom to begin an international discussion of what she calls the grey digital divide. Millward (2003) studied the obstacles older adults at a British senior center cope with as they learn technology. Lam and Lee (2006) analyzed how and why older adults in Hong Kong choose to not use public computing facilities.

Recent research on older adults and the digital divide finds that as people age they are at risk of falling behind with technology. Olphert and Damodaran (2013) call this concept digital disengagement. The concept of digital disengagement adds a temporal dimension to the digital divide literature. This concept emerged in the United Kingdom, where in 2004 a governmental Digital Inclusion Panel stated there is a:

> Real risk that in the medium to long term significantly more citizens will migrate from being digitally engaged to being unengaged than the other way round. (UK Cabinet Office, 2004, p. 79).

Olphert and Damodaran (2013) found that digital disengagement occurs among older people in communities throughout the United Kingdom, and possibly elsewhere around the world.

In summary, scholars in community informatics find that local communities structure how technologies are adopted by their members. Communities help their members learn digital technologies, and thus cross the digital divide. Community informatics scholars have only recently started attending to older sectors of communities. More research is needed to understand how local communities support the digital literacy of their older members.

E. The case study methodology and the extended case method

In addition to contributing to the theoretical discussions introduced above, this dissertation also contributes to methodological discussions about how to conduct case study research in community informatics. This section first discusses how case studies have been used in community informatics. Next, I discuss how the particular methods I use in this dissertation have been used in past research. Finally, I introduce and discuss the extended case method approach to case study research.

Since the field of community informatics emerged, the case study has been its dominant methodology (Williams et al., 2013). In community informatics research the case typically studied is the uneven informatization of local communities (Best, Kollaynyi, & Garg, 2012; Castro & Gonzalez, 2009; Clark, 2003; Kvasny, 2006; Odendaal, 2011; Sreekumar, 2011). Within this tradition a wide variety of methodological and theoretical frameworks from multiple academic disciplines have shaped the field (Stillman & Linger, 2009). As a result, many methods and theories have shaped community informatics case studies (Veinot & Williams, 2012).

Throughout these case studies, researchers in community informatics actively participate in the local communities they study. This involvement in communities takes the form of, among others, involved observation (Alkalimat & Williams, 2001), action research (Gurstein,

2003), and community inquiry (Bishop, Bruce & Jones, 2006). As the field of community informatics has grown, scholars also have sought to extend research beyond single cases, to comparative and multi-case studies. These comparative case studies have emerged at the local (Postill, 2008), national (Williams, 2007), and global (Williams et al., 2013) levels.

The case study methodology draws on both qualitative and quantitative methods (Creswell, 2012). Handbooks discuss how researchers use quantitative data in case studies (Boellstorff, Nardi, Pearce, & Taylor, 2012, pp. 126-127; Cerwonka & Malkki, 2007; Hammersley & Atkinson, 1995, p. 130; Lofland & Lofland, 1995, p. 21). Even though case studies are sometimes framed as an exclusively qualitative methodology (Creswell, 2012), quantitative techniques have also been used extensively in case study research (e.g. Ferguson, 1990; Stack, 1975).

The case study methodology draws on diverse methods. Scholars select particular methods based on the perceived utility of these methods to aid in understanding of the case or cases studied. The specific methods used in this dissertation are participant observation, interviews, and document review. Participation observation allows the researcher to see and experience how life is lived in real-time (Hammersley & Atkinson, 1995). Participant observation and ethnomethodology have been used extensively in studies of computer supported cooperative work and computer supported cooperative learning. Since Suchman's (1987) canonical work on situated action, scholars have found that in-depth and up-close analyses of how people use technologies in naturalistic social settings reveal how technology is incorporated into work and into life. Discoveries made with this method are not possible to arrive at through other methods (Blomberg & Karasti, 2013; Hutchins, 1995; Nardi, 1996; Nardi & O'Day, 1999). Participant observation also enables a rich understanding of the digital literacy

of older adults (Ito et al., 2001; Linton, 2012; Sayago, & Blat, 2010). Primary limitations of participation observation are that it is both time intensive, in that it requires many hours of fieldwork in order to perceive recurring patterns and trends in a given culture or setting, and time sensitive, in that it requires working around the schedule of the fieldsite and of those who inhabit it (Boellstorff et al., 2012).

Interviews provide opportunities for in-depth, analytically structured conversations between the researcher and an interviewee. Interviews enable the researcher to analyze the perspectives, feelings, experiences and knowledge of individuals (Holstein & Gubrium, 1995; Kvale & Brinkmann, 2009) and also allow the researcher to understand the backgrounds of individuals interacted with during participant observation (Wood et al., 2010). Interview-based research reveals the complex ways in which older adults learn and practice digital literacy across time (Bowen, 2011; 2012b; Selwyn, 2004). A limitation of interviews derives from the fact that they are actively created in the context of the interview situation. Each interview is unique, making generalizability tricky to achieve.

Document review involves reading and analyzing institutional documents to understand social processes as they play out over time (Hammersley & Atkinson, 1995, pp. 121–140). The benefits of document review derive from the ability of documents to record and transmit information from the past to the present, and the approach has been used to understand how ageist discourses shape social conceptualizations of older adult digital literacy (Bowen, 2012a; Richardson et al., 2005). Documents, however, never totally and transparently represent the social practices they purport to document (MacNeil & Mak, 2007). Created by humans in particular contexts, documents are incomplete and need to be used with as much care as any other data source.

Extended case method approach to case study research. In some case study research, the end product of research is a descriptive analysis of the case (Creswell, 2012). In other case studies, theory is the result of research (Burawoy, 1998). To conduct the latter type of case study, I draw on Burawoy's extended case method approach. Unlike in grounded theory, where scholars create theory out of cases, in the extended case method researchers extend preexisting social theory based on what is learned from one or more cases (Burawoy, 1991; 1998). In *Global ethnography: Forces, connections, and imaginations in a postmodern world*, Burawoy and his students (Burawoy, Blum, George, Gille, & Thayer, 2000) employed the extended case method to broaden and add granularity to theories of globalization, labor, and feminism, among others.

In a summation of the extended case method, Burawoy (1998) elaborates on the uniqueness of this method in relation to other approaches to using theory in empirical research:

> The extended case method applies reflexive science to ethnography in order to extract the general from the unique, to move from the "micro" to the "macro," and to connect the present to the past in anticipation of the future, all by building on preexisting theory. (p. 5)

In the extended case method, all theory changes as it is scrutinized in light of the reality the researcher analyzes. Through research, scholars build on existing theory, elaborating and fine-tuning our understanding of the world. In the extended case method, both research and writing consist of dialogic processes:

> Like other handicaps, the ethnographic condition can be dealt with in one of two ways: containing it or turning it to advantage. In the first strategy, we minimize our predicament by limiting our involvement in the world we study, insulating ourselves from our subjects, observing them from the outside, interrogating them through intermediaries. We keep our feet on the ground by adhering to a set of data collecting procedures that assure our distance. This is the positive approach. It is best exemplified by survey research in which every effort is made to suspend our participation in the world we study. We try to avoid affecting the situation we study, standardize the collection of data, bracket external conditions, and make sure our sample is representative.

> In the alternative strategy we thematize our participation in the world we study. We keep ourselves steady by rooting ourselves in theory that guides our dialogue with participants. Polanyi elaborates this idea in detail, rejecting a positivist objectivity based on 'sense data' in favor of a commitment to the 'rationality' of theory—cognitive maps through which we apprehend the world. This 'dwelling in' theory is at the basis of what I call the reflexive model of science—a model of science that embraces not detachment but engagement as the road to knowledge. Premised upon our own participation in the world we study, reflexive science deploys multiple dialogues to reach explanations of empirical phenomena. Reflexive science starts out from dialogue, virtual or real, between observer and participants, embeds such dialogue within a second dialogue between local processes and extralocal forces that in turn can only be comprehended through a third, expanding dialogue of theory with itself. Objectivity is not measured by procedures that assure an accurate mapping of the world but by the growth of knowledge; that is, the imaginative and parsimonious reconstruction of theory to accommodate anomalies. (Burawoy, 1998, p. 5)

This extended case method approach to case study research shapes this dissertation. Drawing on the long tradition of ethnographic participant observation (Hammersley & Atkinson, 1995), in this study I am an active, involved (Clark, 1965) participant in the fieldsites where I conducted my fieldwork. Ethnographers describe the researcher as one of the study's most important research instruments (Cerwonka & Malkki, 2007). Far from compromising the data, being in dialogue with fieldsites in fact enriches and adds to the scholar's ability to understand the community studied. This understanding, in turn, enables the scholar to make more powerful contributions to social theory.

In summary, the case study is the dominant methodology in the field of community informatics. Many studies include active participation with communities as part of the case study. The particular methods I use in this case study are participant observation, interviews, and document review. The extended case method is the overall analytical approach used in this case study, a method that enables and requires dialogue both with study participants and with academic theory. Through these dialogues, the scholar extends social theory to add to our understanding of the world.

F. Summary

Theoretical understanding of older adult digital literacy is under-developed in part because the institutional dimensions of this phenomenon have not been systematically analyzed. This dissertation intervenes into this situation by drawing on the theory of information infrastructure to understand how older adults as information users contribute to the information systems they use to learn and to practice digital literacy over time. The theory of information infrastructure has been used to understand governance, scholarly communication, and corporate organizations. Our understanding of the information infrastructure of marginalized and vulnerable communities is less robust. Some scholars do find that institutions condition how older adults learn technology, but the relationship between information infrastructure and the digital literacy of older adults has not been closely examined.

Scholars increasingly recognize that digital literacy is a social phenomenon. Nonetheless, although a growing number of scholars have studied how and why older adults learn and use digital technologies in social contexts, assumptions in the literature based on the ideas that (1) older adults should use technology like young people and (2) that older adults should use technology for medical purposes hinder our understanding of older adult digital literacy.

Complicating further this issue is the fact that little scholarly and social consensus exists around the meaning of older adulthood. I draw on the lifecourse approach to suggest that older adulthood be understood as a socially evolving stage of the human lifecourse. This approach has been used to study how older adults, as individuals, use technology. However, more research is needed to understand how digital literacy across the human lifecourse is shaped by the local communities where life is lived.

In order to study older adult digital literacy in this way, I introduce the field of community informatics. Community informatics scholars find that local, historical communities shape how people use and learn to use digital technologies. Although research is emerging on community informatics and older adults, more research is needed to understand how communities support the digital literacy of their older members.

In summary, this dissertation contributes to the research literature in multiple academic disciplines by analyzing the community and institutional dimensions of older adult digital literacy. The extended case method approach to case study research provides the methodological tools necessary to carry out this analysis. Through this investigation, I add to our understanding of how local communities support the digital literacy of their members.

CHAPTER 3. METHODS

In this chapter I describe the methods used to address this dissertation's question. First, I introduce my overall approach to this research project, as well as the background research that led to this approach. Next, I describe how data collection and analysis proceeded. Finally, I discuss the strengths, limitations, and ethics of this research.

A. Research approach

Pilot study

The approach used in this dissertation evolved through a pilot study undertaken in spring 2014.[1] During this pilot, study volunteers and I conducted verbal surveys with older adults before and after we assisted older adults who were interested in learning technology. This pilot study had two rounds, the first occurring in February and the second in May (Lenstra & Williams, 2015).

During the first round, a Seniors and Technology Day was hosted at a local public library. There, 40 older adults participated in one-on-one technology support sessions with library & information science students. After the sessions, students verbally administered a questionnaire. They wrote the older adults' responses on pieces of paper that I then transcribed for subsequent analysis. I identified a few problems in this study. First, some of the questions were not clear to older adults and thus needed to be revised. Second, the method of hand-writing responses was not ideal. The students could not record responses verbatim, and in some

[1] This pilot study would not have been possible without the support of The Community Informatics Research Lab and the InfoCityCU initiative. Volunteers and leaders of these projects offered their time and assistance for the data collection and analysis. Both stages of the pilot study received approval from the University of Illinois Institutional Review Board.

cases the written responses were not legible. More positively, this pilot study revealed that older adults are enthusiastic and dedicated learners. Despite minimal recruitment, I had no trouble filling the workshop slots. Furthermore, all participants who had signed up showed up on time. These findings informed the choice I made in my dissertation to study self-motivated older adults who in the course of daily life seek and find technology support in public libraries and senior centers.

Based on the results of the first round of this pilot study, I organized a follow-up pilot study in May 2014 at a senior center and at a different local library. Thirty older adults participated in this second round of the pilot study. In the second round, the workshops were organized around videochat software. Older adults were asked questions before and after the workshops, and their responses were recorded digitally in a document created for that purpose. The second round confirmed that the method of typing older adults' responses directly into a digital document is a feasible way to conduct interviews.[2] I also identified two problems during this study that I resolved in the final design of this dissertation: (1) too many questions were on the questionnaire; and (2) not enough information was collected on the processes through which older adults learn technologies in their communities.

Too many questions. Only 20 minutes were reserved for the completion of the questionnaire during the pilot study. The February interview script had 24 questions. The May script had 42 questions. I found that there were far too many questions on the script. Trying to get through all these questions made it difficult to elicit and to record the reflections of older adults. When more time was available for older adults to answer questions, they provided richer

[2] This method requires one to be a fast typist.

responses. For instance, this individual who took an exceptionally long time to answer the questionnaire—45 minutes—provided more reflective answers than other participants:

> **Question:** Have you ever taken a computer class or participated in a workshop like this one before? Yes No [If yes] Where and when did this workshop or class take place? **Answer:** Yes, a long time ago when I was at work, when computers first came out. When they started using computers at work. They had workshops to show employees how to use them at work. And that's one reason why I retired when I did because you were getting into a lot of technology and at the time I didn't want to learn all this new stuff, so I said "let the young people do that." So in 2001 that's when things were breaking ground to take off, and there was all this new stuff you had to learn. And I just decided I did not want to get into all of that.

In order to ensure there was time for this type of open-ended response, the final interview script used in this dissertation has only 12 questions (Appendix B). These questions evolved from questions first used and tested during the pilot study.

Not enough information about learning technology in communities. The pilot study also showed that additional methods would be needed to study the community-based information infrastructure that supports older adult digital literacy. The surveys revealed a wealth of information about the backgrounds and help-seeking strategies of older adults, but they did not provide a great deal of information about the relationship between older adult digital literacy and community-based information infrastructure. This limitation led to the multi-methods approach of this dissertation.

Dissertation approach

The research question shaping this dissertation's methods is: to what extent and how does community-based information infrastructure support older adult digital literacy? This question includes two interrelated concepts: community-based infrastructure and older adult

digital literacy. Nonetheless, for theoretical clarity this dissertation separately analyzes these two concepts, and then examines the relationship between them in chapter 6.

This study approaches community-based information infrastructure using the information institution as the unit of analysis, specifically publicly funded senior centers and public libraries in a medium-sized metropolitan area in the Midwest. Since I am especially interested in understanding how and why older adults practice digital literacy, I focused attention on technology support services within these institutions. The units of observation for community-based information infrastructure are a) interactions in the institutions among staff, volunteers, older adults, other individuals, and myself; b) interviews with older adults; c) interviews with staff; and d) the documents from the institutions that I reviewed.

This study defines older adult digital literacy as how older adults use and learn to use digital technologies over time. Here the unit of analysis is the individual older adult. The units of observation are: a) the older adults with whom I participated in fieldwork and b) the older adults I interviewed, a sub-sample of those with whom I participated.

Digital technologies are then understood as digital devices used by older adults in the past and in the present. These include: wifi, printers, desktop computers, laptop computers, mobile phones, tablets, flash drives, mobile hot spots, and a wide range of audio-visual devices (mp3 players, digital cameras, digital camcorders, digital photo frames, etc.). Technology support services are understood as computing facilities and technology helpers that support the public's use of digital technologies.

Although as discussed in Chapter 2 "older adulthood" has poorly defined boundaries, for the purpose of this dissertation it is defined as beginning at age 50. This decision was made based on the fact that all but one of the sites themselves define older adulthood as beginning at

age 50 (the exception has no official age-based boundary for older adulthood).[3] For the purposes of understanding all of the dimensions of older adult digital literacy, the concept of older adulthood is further analyzed in relation to the social class, age, ethnicity, and gender of the individual. Details about these procedures appear in Chapter 5.

Different methods were used to answer different parts of this research question. The specific methods used were:

> **Method 1**: Participant observation (i.e. ethnographic fieldwork) in senior centers and public libraries, with a primary focus on technology support services used by older adults;
> **Method 2**: Interviews with older adults who participate in technology support services in senior centers and public libraries;
> **Method 3:** Interviews with senior center and public library staff responsible for technology support services; and
> **Method 4**: Document review of senior center and public library records.

Table 6 locates each method used in this dissertation under the part of the research question it was used to answer.

Methods	Part 1: Information Infrastructure	Part 2: Digital Literacy
1: Participant observation	Yes	Yes
2: Interviews with older adults		
3: Interviews with site staff		No
4: Document review of site records		

Table 6: Comparison of methods used to answer this dissertation's operational parts.

B. Data collection

Data collection occurred from September 2014 until August 2015. During this one-year period, sampling was carried out at two levels: institutional and individual. Institutions were

[3] More analysis of how and why these institutions define "older adulthood" appears in Chapter 4.

sampled first, followed by individuals from within those institutions. Institutional sampling was comprehensive: all publicly funded senior centers and public libraries located within the metropolitan area where this study took place were included. This sampling strategy led to three public libraries and three senior centers, for a total of six cases.

The administrators of these sites agreed to allow me to conduct research at their institutions because I would be offering services to them. During meetings in summer 2014 with staff from the sites, we agreed I could conduct research at the sites if I volunteered to assist the institutions in technology support services.

My role during fieldwork varied by site. At the three public libraries, I participated in technology volunteer programs managed by librarians. During field sessions I worked alongside staff at reference desks located adjacent to library computer labs to assist patrons with technology. At the senior centers, I helped staff administer drop-in computer classes. At two of the sites, I joined and eventually helped to lead preexisting classes. At one of the senior centers, I worked with staff to start a new technology support program, since none were in place there at that time.

Method 1: Participant observation. From September 2014 to August 2015, I conducted participation observation across the six sites. The only break in fieldwork occurred during a three-week period around the winter holidays. I offered assistance to older adults as I participated in technology support services. I also observed what older adults did with technology at the sites. Field sessions were recorded using a structured fieldnote guide (Appendix B), and fieldnotes were written immediately after leaving the fieldsite. How long it took to write a fieldnote depended on the complexity and duration of a particular field session.

Some field sessions required as many as five single-spaced pages to describe. Others required only one page. My participation in the sites is further analyzed in Chapter 4.

	Number of field sessions	Number of hours spent conducting fieldwork	Interviewees
Tubman Senior Center	127	127	17
Smith Senior Center	31	62	5
Metro Senior Center	22	66	12
Metro Library	21	62	3
Main Library	37	92.5	13
Branch Library	29	58	4
All	267	467.5	54

Table 7: Number of field sessions, time spent in the field, and interviewees, by site.
All names of institutions and individuals studied are pseudonyms.

Owing to different structures in place at different sites, the number and length of field sessions at each site varied from site to site (Table 7). I joined preexisting programs at all but one of the sites. As such, I tailored my field sessions to these programs. Tubman Senior Center[4] had a program in which older adults could come twice a week for an hour at a time to learn technology. Midway through fieldwork, the frequency of this program switched to three times a week. As a result, the number of hours I spent at Tubman exceeds the amount of time I spent elsewhere. I conducted 127 hours of fieldwork at Tubman Senior Center. The technology support program at Smith Senior Center was held once a week for two hours. Disruptions to classes were caused by the building being shut down for renovations for a two-month period midway through fieldwork. I conducted 62 hours of fieldwork at Smith Senior Center. The staff coordinator at Metro Senior Center decided that the new technology support program there would be twice a month for three hours at a time. I conducted 66 hours of fieldwork at Metro Senior Center.

[4] All names of individuals and institutions studied are pseudonyms.

Because of a protracted approval process, fieldwork at Metro Library did not begin until November 2014. I volunteered in the library's technology volunteer program once every other week for three hours at a time. I conducted 62 hours of fieldwork at Metro Library. Main Library and Branch Library also had an approval process that delayed the start of my fieldwork. At Main Library, field sessions were 2.5 hours; at Branch Library, sessions were 2 hours. I conducted 92.5 hours of fieldwork at Main Library, and 58 hours of fieldwork at Branch Library. In total, I conducted 467.5 hours of fieldwork across the six sites.

Individuals self-selected to participate in fieldwork. This sample consists of older adults who in the course of daily life come to senior centers and public libraries and who seek support with digital technologies there. The sample that resulted consists of 209 individuals. Fieldwork also involved building relationships with staff and with older adults who come regularly to the sites. These relationships were drawn upon to recruit individuals to participate in interviews.

In addition to participating in technology support services at the six sites, I also participated in the sites in general.[5] At the senior centers I attended potlucks, meetings of senior center groups, exercise classes, and holiday programs. At public libraries I came to the libraries during a variety of open hours to observe how library patrons use technology there. These less formal field sessions were not written up using a structured fieldnote guide.

Method 2: Interviews with older adults. In November 2014 I started interviewing participants in technology support services across the six sites. The interviewees tend to be more regular participants in technology support services at these sites. It was logistically easier to interview those who come to the sites on a regular basis. Interviews took place as I had time

[5] This portion of participant observation was less formal than my involvement in technology support services. As such, it is not included in the hours recorded in Table 7.

to schedule them and at the convenience of interviewees. The interviews were held on site at the public libraries and senior centers. To expedite data collection and analysis, the interviews were not audio recorded. Instead the responses were recorded verbatim using a laptop and a spreadsheet with one row for each question. The average length of these interviews was 25 minutes. A sample of 54 individuals participated in interviews. The interviewees are not evenly distributed across the six sites (Table 7). Since the primary purpose of these interviews was to study older adult digital literacy, this uneven distribution is not problematic. In this text I refer to the individuals interviewed as interviewees, to differentiate them from the participant sample, which consists of 209 individuals.

Method 3: Interviews with staff. In addition to interviewing older adults, I also interviewed my primary staff contacts at the six sites. These interviews were guided by the semi-structured questionnaire included in Appendix B. Interviews focused on how staff understand their roles, and the roles of their sites, in supporting older adult digital literacy. These interviews were audio recorded and transcribed. Staff interviews tended to be longer than those with older adults. The average length of interviews was 45 minutes. Seven staff participated in interviews.

Method 4: Document review. Finally, throughout fieldwork documents were collected and analyzed. The purpose of document review was to understand the evolution of these institutions over time. As I visited the sites I collected any documents I found related to technology support services at the sites. I also regularly checked the websites of the institutions for information on this topic. I further relied on staff and older adults to help guide me to historical documents on these topics. The documents analyzed varied from site to site. At the senior centers, I reviewed volunteer-maintained scrapbooks that document the history of the senior centers and records of senior center meetings. At the public libraries, I reviewed the

minutes of library boards, as well as statistical reports on the libraries. I also reviewed published and unpublished histories of the libraries. Finally, I regularly reviewed the websites of the six institutions.

In sum, during one year of fieldwork I conducted 467.5 hours of participant observation across 267 field sessions at six institutions. During fieldwork, I interacted with 209 older adults using technology support services. The details of this fieldwork were written up in 559 pages of fieldnotes. I also conducted interviews with 54 older adults, and with seven staff. Physical and digital documents from the sites were also reviewed.

C. Data analysis

During the course of preparing this dissertation, two stages of data analysis took place:

Data analysis Stage 1 (guiding model, Denzin & Lincoln, 2008)[6]
Phase 1 (February – August 2014) – During this phase, I analyzed the pilot study data, which led to this dissertation's data collection approach.
Phase 2 (September 2014 – August 2015) – While collecting data I wrote analytical notes about trends observed across the field sessions and across the interviews.
Phase 3 (September – November 2015) – During this phase I inductively sorted all the data I had collected. I carried out open coding of all of the data. The focus here was on searching for and identifying trends. Early draft chapters formed by these inductive analytical methods were shared with my adviser and with the University of Illinois community informatics research lab, who provided commentary.
Data analysis Stage 2 (guiding model, Burawoy, 1998)
Phase 4 (November 2015 – January 2015) – Here the analytical methods shifted from induction to deduction. Using theories of information infrastructure (Star & Ruhleder, 1996) and digital literacy (Prior & Shipka, 2003), I reviewed the a) data, b) codes, and c) early draft chapters. Through this analytical work I developed theoretically informed findings. During this stage, I wherever possible sorted the data into tables that enabled me to illustrate findings quantitatively.

[6] Denzin and Lincoln (2008) describe their approach to data analysis thusly: "The researcher first creates a field text consisting of field notes and documents .... The writer-as-interpreter moves from this text to a research text: notes and interpretations based on the field text. The text is then re-created as a working interpretive document that contains the writer's initial attempts to make sense of what he or she has learned" (p. 34).

Phase 5 (February – May 2015) – In this final phase of analysis, my focus was on analyzing the data through the process of writing. Here, the theoretically informed deductive findings were sharpened through writing. This work involved collaborations with colleagues in the field. I shared preliminary findings with the community informatics research lab, at conferences (Lenstra, 2016),[7] at meetings with schools where I was applying for jobs, and with my doctoral dissertation committee.

The particular processes involved in data analysis included coding, reducing and sorting the data, and then using both induction and theoretically informed deduction to understand what this data had to say about community-based information infrastructure and about older adult digital literacy. First, I sorted the data into separate spreadsheets organized a) chronologically, b) by individual participant, and c) by fieldsite. Then, I reduced the data by looking for trends that could be reported in tables. For instance, columns in the "chronological" spreadsheet included data on what digital devices were used for what digital projects by which people on what days at which sites. In addition to reducing the data, I also identified trends through the open coding of the data. Here I used inductive, qualitative methods to identify findings across the disparate sources of data collected.

This sorting and reducing of the data in Excel enabled me to identify trends, both inductively and deductively, across the fieldsites. To illustrate how the field session data were both collected and analyzed, Appendix C contains an excerpt from a fieldnote recorded at one of the senior centers in November 2014. Following this fieldnote are tables that illustrate how this fieldnote, and others like it collected during field sessions, were reduced and coded to enable sorting across time, site, and participant.

[7] This research was also informally presented as part of my participation in the 2016 iConference Doctoral Colloquium.

D. Strength and limitations of study design

This study design has three primary limitations, but these limitations are compensated by three strengths. The three primary limitations are:

- This study only analyzes one metropolitan area;
- Not all older adults participate in public libraries and senior centers, and not all older adults who participate in these institutions also participate in technology support services there; and
- A limited amount of time could be spent at each site and with each participant.

The three primary strengths of this study design are:

- Multiple methods were used, enabling the triangulation of findings;
- The findings are grounded in historical time; and
- The findings emerged from within situated relationships.

Only one metropolitan area. This study only analyzes two types of institutions in one metropolitan area. The metropolitan area where this study took place, like all cities, has its particularities. Chief among its particularities is the influence of the local university on culture and politics. However, in many ways the area is typical. It is a college town like others found throughout the country (Gumprecht, 2010). It is a medium-sized metropolitan area that, like many other metropolitan area in the USA, experienced population growth, suburbanization, and exurbanization in the second half of the twentieth century (Elazar & Rothman, 1986; Salamon, 2007). It is also a typical metropolitan area in America's emerging service economy (Buera & Kaboski, 2009), with healthcare, education, and research/technology being the primary employers. Like many other metropolitan areas, this area is characterized by multiple, overlapping governmental units (Hamilton, 2014), such as the different park districts and public library districts that are organized semi-independently from city government itself. Finally, like many other American metropolitan areas, this urban area has experienced multiple waves of migration into the area, both from within the country and from around the world (Blocker,

2008; Salamon, 2007). As a result, the findings from this urban area may be generalizable to other locales.

Not all older adults. A second limitation derives from the fact that this study only analyzes the experiences of older adults already engaged with technology support services at these sites. As discussed in the introduction, public libraries and senior centers do not reach all older adults. Nonetheless, because the study of aging communities in library & information science is still emerging, this study sheds light on the issues faced by local communities as they support the digital literacy of their older members.

Limited amount of time. Finally, limitations to this study derive from the limited time I had available to spend at each study site, and to talk and to work with each older adult. The sites studied are public institutions open to the public for between 30 and 74 hours a week. Working in six fieldsites with 209 older adults demanded that I move regularly but rapidly throughout each site.

Triangulation. This study design also has strengths that compensate for these limitations. First, multiple methods were used to study multiple sites over an extended period of time, enabling the triangulation of findings. Techniques were used throughout data collection and analysis to ensure the validity and reliability of this data, and its analysis. Informal discussions about the research during data collection and during data analysis with participants at the fieldsites give this project validity and authenticity. Furthermore, while analyzing the data, whenever possible I quantified the findings into tables. This mixed-methods approach to analysis gives the findings from this study more reliability (Creswell & Clark, 2010). The reader is presented not only with a qualitative distillation of findings, but whenever possible a quantitative summation as well.

Historical understanding. These findings are situated in a historical understanding of the sites as they evolved over time. The review of documents enables this historical grounding. Furthermore, interviews with older adults focused on their backgrounds with technology. These interviews enable findings on older adult digital literacy to be similarly situated in a historical context.

Situated understanding. Finally, the findings emerged through a situated understanding of the sites. Fieldwork spanned an entire year, enabling me to situate the findings in space and time (Blomberg & Karasti, 2013; Suchman, 1987). This in-depth and up-close ethnographic analysis of how people use technologies in naturalistic social settings reveals how people and institutions incorporate technology into daily life in ways that other methods cannot replicate (Hutchins, 1995; Nardi, 1996; Nardi & O'Day, 1999).

E. Ethics of data collection and analysis

As in all research involving human subjects, careful procedures were followed to ensure the privacy and anonymity of study participants. In this dissertation, and in all publications discussing this research, pseudonyms are used to refer to individuals and institutions. Since these six sites are the only publicly funded senior centers and public libraries in the urban area where this study took place, the identity of this metropolitan area is also anonymized. Details about the urban area are deliberately left vague in order to protect the identity of fieldsites.

This study also followed ethical principles during the course of data collection. All individuals and institutions that participated in this dissertation provided voluntary and informed consent (Appendix A). Letters of commitment from these administrators were included in the Institutional Review Board (IRB) application approved for this study.

Owing to the complexities of conducting fieldwork in public institutions, older adult participants had the option of giving consent orally or in writing. Oral consent was the default, but if participants wished to receive paper documentation about the consent procedure, that documentation was available to them. No pressure or coercion was used to keep individuals or institutions in this study after they agreed to start participating. In the end, no individuals or institutions declined to participate in this study, and no individuals or institutions ceased participation after they started.

Finally, an additional ethical principle for this study derives from the fact that it is community informatics research. In community informatics, research often takes place in marginalized communities. In this field it is the norm for researchers to provide services to communities while conducting research (Williams & Durrance, 2009). This dissertation continues this tradition, and calls it "research reciprocity." In a situation of resource scarcity (e.g. technology support), an ethical researcher gives to the community studied during the process of taking data and knowledge. During fieldwork I not only studied community-based information infrastructure and older adult digital literacy but also provided services to public libraries, senior centers, and the communities they serve. For instance, during fieldwork at public libraries I was a volunteer in library-sponsored technology support services. As such, I offered assistance not only to older adults, but also to individuals of all ages seeking technology support at public libraries.

F. Summary

The methods used in this dissertation developed across two pilot studies organized in public libraries and senior centers in spring 2014. In this dissertation, I study public libraries and

senior centers as community-based information infrastructure. I study older adult digital literacy by analyzing how the older adults that seek and find technology support in these institutions use and learn digital technologies over time. Through this research, I am able to understand to what extent and how community-based information infrastructure supports older adult digital literacy.

This mixed-methods dissertation relies on interviews, participant observation, and document review. I draw on the extended case method approach to integrate inductive and deductive analysis of the data collected through these methods. Like any study, the methods of this dissertation have both strengths and limitations. Ultimately, the situated, in-depth understanding of community-based information infrastructure and older adult digital literacy afforded by these methods outweighs the limitations of this approach. Finally, in addition to following standard ethical procedures, this dissertation further practices the principle of research reciprocity, making a contribution to the marginalized community studied.

CHAPTER 4. COMMUNITY-BASED INFORMATION INFRASTRUCTURE

This chapter analyzes community-based information infrastructure, here operationalized as publicly funded senior centers and public libraries in a medium-sized urban area in the Midwest. The unit of analysis is the information institution. My attention focuses on technology support services within these institutions, in particular, how and why older adults participate in and shape these services. The units of observation for this analysis are a) field sessions at the institutions in which I recorded interactions among staff, volunteers, older adults, other individuals, and myself; b) interviews with older adults; c) interviews with staff; and d) the documents from and about the institutions that I reviewed.

To study community-based information infrastructure, this chapter uses the theory of information infrastructure developed by Star and Ruhleder (1996), extended by Star (1999), and most recently extended by Guribye (2015). To reiterate, information infrastructure consists of the evolving and multiple relationships between information users and information systems. Table 8 displays the findings of this chapter in terms of the theory of information infrastructure. For clarity, in this table two dimensions of information infrastructure are not included: (1) the dimension "becomes visible upon breakdown" is not included because breakdowns in community-based information infrastructure are discussed and analyzed throughout the other findings; and (2) the dimension "has a pedagogical approach" is also not included because this dimension is similarly discussed and analyzed throughout other findings.

The overall findings from this analysis are that:

- Community-based information infrastructure emerges out of and evolves through individual and social struggle;
- Community-based information infrastructure extends across space and time; and
- Ageism structures community-based information infrastructure.

Dimension of information infrastructure	Overall finding	Particular finding
Built on an installed base	Community-based information infrastructure emerges out of and evolves through individual and social struggle	Organized together and with other sectors of their communities, older adults create and sustain information infrastructure
Is fixed in modular increments		The digital divide leads to older adults being framed as service recipients, instead of as community leaders
Links with conventions of practice		Bureaucratic limits fetter agency of older adults
Transparency		Information infrastructure evolves through struggles of individual older adults in information systems
Learned as part of membership		Groups of older adults shape information infrastructure
Embodiment of standards		Older adults and information systems cope together with changing technical standards
Reach or scope	Community-based information infrastructure extends across space and time	
Embeddedness	Ageism structures community-based information infrastructure	

Table 8: Findings about community-based information infrastructure.

Community-based information infrastructure emerges out of and evolves through individual and social struggle. The public libraries and senior centers studied emerged and evolved because, organized together and with other sectors of their local communities, older adults created, led, and advocated for these institutions. In the present, older adults, both as individuals and as part of groups, struggle and succeed to adapt technology support services to meet their needs.

Over time, social struggle has become less common in this community-based information infrastructure. The digital divide leads to older adults being framed in these institutions as service recipients, instead of as community leaders. In the past, older adults led many aspects of these institutions, particularly in senior centers. Second, as senior centers and public libraries became institutionalized, bureaucratic procedures were implemented by

overpressured staff to cope with the challenges of administering these complex institutions. As a result of these two trends, the roles of older adults in shaping these institutions has over time become less pronounced.

Nonetheless, the agency of older adults continues to shape this community-based information infrastructure. Through their communities of practice (e.g. senior center groups), groups of older adults adapt technology support services. Furthermore, individual older adults struggle to find and to form the technology support services and supportive relationships they need to learn technology across time.

Finally, older adults and information systems together cope with the disruptions caused by the still-emerging information society. One manifestation of these disruptions is the changing technological standards released by the consumer electronics mass marketplace into local communities.

Community-based information infrastructure extends across space and time. As they participate in technology support services in the present, older adults draw on and add to memories of these institutions and of the roles these institutions have played in their communities over time. These institutions are rooted in the community, as well as in the lives of older adults. I further found that public libraries and senior centers are not the only sources of technology support older adults rely on. The community-based information infrastructure extends spatially to include other sectors of the local community, including family and friends, businesses, and other public and non-profit institutions.

Ageism structures community-based information infrastructure. Ageism in this community-based information infrastructure appears in practices and policies that:

- Render older adults invisible or unimportant;
- Conceive of older adulthood exclusively as a time of disability and decline;
- Express ambivalence and antipathy toward older adults; and
- Naturalize the idea that young people are the natural tutors of old people.

Community-based information infrastructure, like information infrastructure more generally, is constantly evolving through the changing relationships between information systems and information users. In this chapter I discuss and analyze the dominant tendencies found during this study. I also discuss and analyze counter tendencies that may in the future become dominant. These counter tendencies illustrate the agency of both older adults and staff.

A. Community-based information infrastructure emerges out of and evolves through individual and social struggle

I. Organized together and with other sectors of their communities, older adults create and sustain information infrastructure

As discussed in chapter 1, public libraries and senior centers are institutions in the public sphere. By participating in these institutions, older adults participate in locally-based public spheres. Robust public services require an engaged public sphere that, through struggle, creates the momentum necessary to secure and expand public services (Buschman, 2003). This public sphere that forms in public libraries and senior centers shapes the form of publicly funded services. However, the administrators of publicly funded local institutions are part of local government. Local government is not the same as the public sphere. Local government is composed of professionals making decisions about where and how to allocate resources on behalf of taxpayers. This section shows that older adults organized together and with other sectors of their communities were able to create and sustain senior centers and public libraries.

All six of the public institutions studied were formed out of community organizations that created the structure and momentum for these public institutions (Table 9). Older adults participate in and sometimes lead these community organizations; they played a particularly important role in the community organizations that led to the creation of senior centers in the 1970s.

Organized together and with other sectors of their communities, older adults continue to struggle for robust public services. At senior centers, older adults are organized into membership-based groups. These groups organize to keep the centers going. At public libraries, older adults are a central part of Friends of the Library groups and of community advisory committees. These groups provide public libraries with the community mobilization and advocacy needed to maintain and expand their funding base.

	Tubman Senior Center	Smith Senior Center	Metro Senior Center	Metro Library	Main Library	Branch Library
Community organization began[1]	ca. 1963	ca. 1965	ca. 1967	ca. 1865	1868	ca. 1948
Institution officially began	1978	1978	1976	1874	1876	1972
Institution type	Senior Center	Senior Center	Senior Center	Central Library	Central Library	Branch Library
Organized older adults	Tubman Seniors	Smith Seniors	Metro Seniors	Library Friends	Library Friends	Community Advisory Committee
Annual Budget (FY2015)	$92,000	$18,000	$22,000	$3,300,000	$6,800,000	
Prmiary funding source	Municipal Taxes (Park District)	Municipal Taxes (Park District)	Municipal Taxes (Park District)	Municipal Taxes (Public Library District)	Municipal Taxes (Public Library District)	Municipal Taxes (Public Library District)
Secondary funding sources	Membership dues and donations	Membership dues	Membership dues and donations	Corporate & personal donations, grants	Corporate & personal donations, grants	Corporate & personal donations, grants

Table 9: History and structure of public libraries and senior centers.
[1] These dates are estimates derived from institutional records and the oral memories regarding these sites.

The forms of social struggle in community-based information infrastructure have changed over time. As the senior centers and public libraries became institutionalized, community organizing shifted from instigating for publicly funded community spaces and services to advocating for and supporting professionally staffed institutions. Furthermore, as the local population has aged, more private and non-profit institutions have also emerged to serve local older adults. There are now multiple private and non-profit retirement communities in the local area. Unlike the publicly funded senior centers, these retirement communities require substantial financial resources to join. The paid staff of these retirement communities organize for public services on behalf of their older adults, putting publicly funded senior centers in competition for a limited pool of funds.

This section introduces each of these institutions in the context of these changes. The next section analyzes the emergence and evolution of technology support services in each of these six institutions. In the remaining sections I analyze how in the daily operations of technology support services social and individual struggle shapes this community-based information infrastructure.

Tubman Senior Center. In the early 1960s, a group of older African Americans began meeting at the Tubman Community Center, a multi-purpose institution formed in the 1940s through organizing by the local African American community. The activism of this group of organized older African Americans led to the foundation of the Tubman Senior Center. During the early 1970s, this group of older adults, now calling themselves the "Tubman Seniors" because they met at the Tubman Community Center, became more officially organized. They started electing officers and holding business meetings. The park district hired one of their leaders for a part-time position to administer programs at the Tubman Community Center for

the growing group, and the Tubman Seniors organized events for themselves, such as monthly trips to the grocery store, crafts, and cultural programs. They also organized events for their community, such as an annual community reunion still held every August at a local park.

As the Tubman Seniors grew in size, they struggled for a space of their own. In 1971, the park district acquired a building next to the Tubman Community Center, and the Tubman Seniors pressured the park district to turn it into a senior center. This organized advocacy continued until the Tubman Senior Center officially opened in 1978. When the Tubman Senior Center opened in 1978 there were 86 active members, and by the time of my fieldwork in 2014 and 2015, there were 155 active members. Then and now, African Americans constitute almost the entirety of the group's membership.

Formed out of the social struggle of the Tubman Seniors, Tubman Senior Center is the only senior center in the metropolitan area with its own building.[8] The Tubman Senior Center also has the largest budget of the three senior centers in this study, and the park district funds one full-time and one part-time employee for administration. These facts are a testament to the organized power of the Tubman Seniors in the 1960s and 1970s, a time of intense community organizing and activism in the African American community, locally and nationally, across all ages.

Over the years the park district and the Tubman Seniors have jointly administered the senior center. The Tubman Seniors meet monthly to organize programs. They elect officers annually. The funding from the park district does not provide enough resources for the Tubman

[8]All other senior centers are located in multi-purpose shared facilities. In addition to the three publicly funded senior centers in the local urban area, there are two privately funded senior centers: one of these is located in a hospital clinic and receives funding from the hospital. The other is located in the headquarters of a local printing press and receives funding from a philanthropic organization affiliated with the press.

Seniors to do all they wish to do, so the group organizes to supplement these public funds; every year, the Tubman Seniors hold a Senior Fashion Show to raise funds for the senior center.

More recently, however, the park district has taken more control over the senior center. One woman discussed how in the past the Tubman Seniors were more actively involved in the administration of the senior center:

> Back then the Tubman Senior Center was ours. We ran this place! [Laughs] Anything that happened here, we decided. Now the Park District decides they want to do something. Well, we just kind of have to follow along.

Beginning in the early 2000s, the park district started merging the operations of its two senior centers—Tubman Senior Center and the Smith Senior Center. Historically the two were administered separately, and the two continue to have separate community groups. However, in print and online the park district does not acknowledge that two different groups of senior citizens exist. The park district instead advertises what it calls a 50 Plus! program for local citizens aged 50 and older. Through this top-down integration of the two senior centers, the agency of the older adults who created and who continue to sustain Tubman Senior Center is marginalized. Despite the integration of the administration of the two senior centers, the Tubman Seniors continue to operate as an independent community group.

Smith Senior Center. Smith Senior Center has its origins in a group of older adults who in the mid-1960s informally started meeting at a community center on the west side of the city. Although this group, then and now, is predominately European American, the social struggle of the Tubman Seniors in the African American community directly led to the foundation of the Smith Senior Center in the mid-1970s. The funding for both senior centers came from a 1976 referendum organized by the Tubman Seniors to fund their senior center. The referendum passed only because the park district included in it the allocation of funds for facilities in parts of

town that had larger European American populations. Thus, funds from the referendum were used to create the Smith Senior Center.

Related to this lack of organized advocacy in the past, the Smith Seniors remain informally organized in the present. The group continues to meet informally in the same building where they have met since the mid-1960s, with no elected officers and no independent fundraising. Discussing the history of the group, one member stated that:

> Here at Smith, it was great that the park district created the Smith Seniors. Seniors had been meeting here before, you know, but the referendum made it a part of the center. Now the park district was creating programs for us. You know, the seniors were going on trips and the like. Before the seniors just met here.

Both then and now, key events at Smith Senior Center include potlucks, crafts, cooking, and travel. The group meets weekly for a potluck with an average attendance of 25. The group at Smith Senior Center lets the Park District manage their programs; members simply come together at the center to enjoy shared activities. The park district funds one part-time employee to administer the senior center.

In 2015, the Smith Senior Center had 65 dues-paying members. Participation in the senior center has waned over the last 10 years as aging baby boomers have not joined the center to the degree that earlier generations joined. In its annual reports, the park district notes this declining membership. One effect of declining membership, and of the lack of organized advocacy among the Smith Seniors, has been a marginalization of the senior center within the building where it is located. In early 2015, the park district decided to consolidate all programs and services for people with disabilities (special recreation) into this building alongside the senior services. The Smith Senior Center is now the last trace of the building's past role as a neighborhood community center.

Metro Senior Center. Like Tubman and Smith, Metro Senior Center also emerged out of a group of older adults who started meeting informally at a community center in the 1960s.[9] However, this group of older adults became a senior center through a different route from the other two senior centers: Metro Senior Center was formed through collaboration between the park district and older adults. This process began when the Metro Seniors group officially organized themselves, and they continue to elect officers annually and hold their own programs and business meetings. However, unlike the Tubman Seniors, the Metro Seniors did not need to pressure the park district to create a senior center. The park district was eager to support this community organization.

Metro Seniors continue to meet at the community center where they formed. The core event of the group is a monthly potluck attended by 80 to 90 older adults. The potluck is followed by a cultural program organized by the group, and then a business meeting. The park district manages their budget, organizes trips, and handles outreach. The park district funds one part-time employee to administer the senior center.

Metro Seniors tend to be wealthier than those that at Tubman and Smith. Over time, the leaders of the community organization have been mostly white-collar individuals such as retired bankers and university faculty. The Metro Seniors have organized trips to places like Germany and Australia; no international travel has ever been organized by the other senior centers. Furthermore, among the past members of the Metro Seniors are a wealthy couple who owned a local bank. When the couple passed away, they left a large endowment to the park district "for a senior adult center and programs." This funding enabled the park district to build

[9] Metro Senior Center is located in a separate park district than Smith Senior Center and Tubman Senior Center.

an addition to the community center, where the senior center is now located. The wealth of the individual Metro Seniors means that less funding from the park district is required for their programs. These older adults use their own financial resources to fund programs they desire.

Nonetheless, as a public institution open to all the Metro Senior Center also includes many of more modest backgrounds. The group is very large. During fieldwork, the membership was over 600. As a result, the group is larger and more diffuse than the other two senior centers. The park district makes it very easy for anyone to join the senior center. However, fewer than 100 of these individuals actively participate in programs at the senior center. The remainder participate in trips or joined to receive discounts on other park district programs.

Metro Library. Prior to Metro Library's official beginning, a community organization formed in 1865 to create a reading room. This association depended on annual membership fees and citizen donations. The association donated its books to the city, which founded Metro Library in 1874. With funding from both local businesses and public funds, the library has expanded over the years.

The Friends of Metro Library community organization has been a major platform through which older adults have shaped the history of Metro Library. This organization formed in the mid-1960s. Then and now, retired individuals have been a major part of the Friends of the Library group. One member stated that:

> We are mostly retired people who love the library and want to do what we can to make sure everyone else can share our love.

These Friends advocate for the library. For instance, over the years the Friends have helped to mobilize the local community to pass referenda needed to expand the library building.

The primary library service explicitly for older adults at Metro Library focuses on older adults suffering from disabilities that render them homebound: the library's Home Delivery Service. Even though this service is for homebound patrons of all ages, it has a primary focus on older adults. Promotional materials for the program state that

> Volunteers select books, audiobooks, music, or movies for home delivery participants, and also provide regular delivery to individuals, *nursing homes, and retirement centers*. (italics added)

Promotional materials also prominently feature images of older adults.

As the library developed this program it built partnerships with three privately funded retirement communities, where volunteers and staff deliver and pick up books on a weekly basis. At one of these retirement communities, the library has a very close relationship. Here, a librarian visits the retirement community weekly.[10] This retirement community has also become the library's unofficial partner for all things related to older adults. Staff from the library have made presentations about library services at this retirement community, but not at any other sites or organizations formed around older adults. Similarly, in organizing the library's strategic plan for FY2014–2016, a representative from this retirement community was invited to participate. No other representatives from older adult organizations participated.

Main Library. The history of Main Library has many parallels to the history of Metro Library. A library association formed a small reading room in 1868. In 1876, this association donated its resources to the city to create a public library. Over the years, donations from local businesses and from referenda led to library expansions and new library buildings.

[10] Only volunteers visit the other two retirement communities with which Metro Library partners.

As at Metro Library, the Friends of Main Library group, formed in 1965, is composed primarily of retired older adults. This group has been an important advocate for the library in the local community. The Friends have been especially active between 2008 and 2016. In 2008, the library opened a new library building. The new library has three times the space and four times as many computers as the previous building. However, shortly after the building was completed the economic recession of the late 2000s occurred. This recession led to declining property values. The library struggled, as a result, to pay its debts. To cope with these issues, the library has left 18 full-time-equivalent staff positions unfilled. The library has also reduced its open hours. Three times the library has successfully appealed to the local city council for emergency funding. The Friends of Main Library have filled the city council chambers during these funding appeals. The mobilization and advocacy of these older adults have enabled Main Library to continue functioning.

As at Metro Library, the primary service explicitly for older adults at Main Library is its Home Delivery Service. The service is available to all, regardless of age. Nonetheless, the explicit focus in the program is older adults. Promotional materials prominently feature an older woman with a walker, and state that services are available at nursing homes. A promotional video emphasizes the connection between this library service and older adults, stating that "the home delivery program delivers books to the elderly who are unable to leave their homes to check out their own books and videos." No other users beyond the elderly are mentioned in the video.

During the last ten years, Main Library has started to expand its services for older adults. The library's five year plan for 2007 to 2012 states that a strategic goal is to ensure that "Adult Services will meet the needs of seniors in our community by scheduling at least four programs

per year of interest to older populations."[11] As a means of reaching this goal, the library organized what it calls a Fun After 50 committee. This committee organizes programs both at the library and at a local retirement community.

In developing these programs and services, Main Library has partnered with a privately funded retirement community located in the city's downtown. The retirement communities that Main and Metro libraries have partnered with cost a large amount of money to live in. These private facilities have been better able to secure library services than have publicly funded and non-profit groups such as senior centers and the community groups that meet there.

Branch Library. Like Tubman Senior Center, Branch Library formed out of the Tubman Community Center located in the local African American community. When the Tubman Community Center was organized in the 1940s, one of the center's programs focused on building a library of donated books. The Tubman Seniors were among those in the community who organized to expand and improve this community library. This library was formed because neither the Main Library nor the Metro Library provided adequate library services to the local African American community. In 1970, the library's slogan was "A Black Library for the Black Community." Then and now the library has focused its programs and services on the youth of the community.

Over time, Branch Library has become more fully absorbed into Main Library. In 1975, the independent library officially became Branch Library, a unit of Main Library. In 1996, the Branch became more integrated into Main Library. The branch manager is now a member of Main Library's management team. In the mid-2000s, many programs at Branch Library were

[11] To protect the privacy of these institutions, the specific documents referred to in this text are not cited.

integrated with Main Library. During this time period Main Library occupied a temporary facility while its new building, opened in 2008, was being constructed. As a result, many Main Library programs were held at Branch Library. Today, some programs, such as toddler storytime, are still only offered at Branch Library, not at Main Library. Programs such as these attract a majority European American and Asian American population. In contrast, regulars at Branch Library tend to be almost entirely African American. Branch Library continues to be geographically rooted in a majority African American neighborhood. Branch Library has also been affected by the budget crisis shaping Main Library's recent history. In 2015, the library's hours were reduced to save money for the library system as a whole.

Since Branch Library's incorporation into Main Library's system, older adults have organized and advocated for Branch Library through their participation in a community advisory committee. Older adults have been important leaders in this committee. For instance, in the early 1980s, older adults on the committee organized a community oral history project at the library that recorded the memories of older African Americans. These tapes, now digitized, remain accessible at Branch Library. In recent years, however, this advisory committee has gone into decline. In 2015, the advisory committee had only two members, one of whom was a European American city council member and the other a retired African American woman. The committee did not meet once from September 2014 to August 2015.

II. The digital divide leads to older adults being framed as service recipients, instead of as community leaders

Starting in 1984, technology support services began to emerge in this community-based information infrastructure, first in public libraries, and later in senior centers. Technology

support services have included access to computers and other digital technologies, access to wifi, and access to individuals willing to help members of the public use technology. The primary agents in the creation and evolution of technology support services have been external: the local university; local, state and federal government; and local businesses, as well as the staff and administration of these institutions.

The digital divide causes older adults to be framed as passive service recipients instead of as community leaders in these technology support services. Older adults were in the past and continue in the present to be active agents in these institutions. The senior centers would not exist in the first place were it not for the organized efforts of older adults, and through involvement in senior center and friends of the library groups, older adults continue to shape both of these institutions. For instance, I found that older adults lead almost all programs at senior centers, organizing potlucks, exercise classes, craft groups, coffee clubs, and many other recurring and special events.

Despite their leadership in the foundation and maintenance of these community institutions, in technology support services older adults are positioned as passive service recipients. This shift has occurred in part because of the digital divide. Older adults cope with digital inequalities that hinder their full participation in the information society and find it difficult to lead technology support services in their communities. This finding illustrates how disruptions caused by the still-emerging information society affect power dynamics between information systems and information users in community-based information infrastructure. I illustrate this finding through narrative histories of the development of technology support services in these institutions.

Tubman Senior Center. The incorporation of technology support services into Tubman Senior Center has relied on external funding and support from the local university. Reliance on the university caused technology support services to not become integrated into the daily rhythms of the senior center. As part of a community networking initiative, in 1997 university students installed four desktop computers at the senior center in a room that has since become known as the computer lab (Table 10). From 1997 to 2005, students from the university came intermittently to the senior center to assist Tubman Seniors learning technology in this lab. When students did not come to help, few older adults used the computers. In 2005, students stopped coming entirely. From 2005 until 2010, the computer lab was largely unused.

A second actor that has shaped technology support services at Tubman Senior Center is park district IT staff. This staff is based in the park district's administrative building. The staff is responsible for managing all technologies in the building. The IT staff have been the primary partners of the university in its community networking initiatives. With funding from the state government, the university worked with the park district IT staff to revamp the computer lab in 2010, and the senior center now has six desktop computers. The Tubman Seniors were not involved in this project.

	Number of public computers	Tech support provider	Wifi available	Hours lab open, per week	Hours help available, per week	Technology helpers	Technology space
1997-2005	4	Park District IT Staff	No	40	1-2[1]	University students	Senior center computer lab
2005-2012					0	None	
2012-2014	6				1	Senior center staff	
2014-present			Yes	30	2	University students	

Table 10: Evolution of technology support services at Tubman Senior Center.
[1]Support only available during times in which volunteers came to the center (see text for details).

The installation of wifi in the building in 2010 also bypassed the Tubman Seniors. As a result, the wifi was not used by the Tubman Seniors until 2014. The wifi was installed as part of a municipal broadband expansion project that received federal funding, and was administered by the local university working with local government. When the wifi was installed at the senior center, none of the Tubman Seniors were aware of its existence. The IT staff did not work with the Tubman Seniors, or even with the Tubman Senior Center's staff, to ensure they could use the wifi. The IT staff further chose to place the wifi behind a password, although when I brought this issue to the senior center director's attention, he convinced the IT staff to remove the password. Furthermore, the speed of the wifi was slower than it should have been because the IT staff chose to use older routers that could not handle the speeds made possible over the high-speed broadband network. This story illustrates how struggles over technology support services at Tubman Senior Center took place behind the scenes, without the involvement of the Tubman Seniors themselves.

Nevertheless, the Tubman Seniors have actively struggled to shape technology support services. It was the Tubman Seniors who organized to bring computer classes back to the senior center in 2012 after a seven-year hiatus. When the center's director retired in 2011, she was replaced by a man in his mid-20s. The Tubman Seniors appealed to him to re-start computer classes, and this pressure led the center's new director to start what he calls a "Computers 1-on-1" program in early 2012. Since 2014, university students, led by me, have staffed this program.

The Tubman Seniors have also struggled to reconfigure their computer lab. When the university students installed the new computers in 2010, they did not install a printer. A group of quilters that met regularly at the center decided in 2011 to install a printer in the computer

lab. This incident is the only instance I found older adults customizing the technical set-up of these six sites. Unfortunately, this accomplishment was not supported by the park district IT staff. When the printer stopped working in 2014, the IT staff refused to support it because it was not owned by the park district. Another Tubman Senior offered to donate a printer he had at his house, but the IT staff would not provide him with the technical access needed to install the printer in the computer lab.

Smith Senior Center. The local university and the park district IT staff, supported by state and federal funds, also established technology support services at Smith Senior Center. The same state grant that enabled university students to revamp the computer lab at Tubman Senior Center in 2010 also enabled university students to install three public computers at Smith Senior Center (Table 11). One of the three computers is an accessibility machine, with a special monitor, keyboard, and mouse to support individuals with physical disabilities. Because no one was trained to use this special machine, no one at Smith Senior Center ever used it.

<table>
<tr><th></th><th>Number of public computers</th><th>Tech support provider</th><th>Wifi available</th><th>Hours lab open, per week</th><th>Hours help available, per week</th><th>Technology helpers</th><th>Technology space</th></tr>
<tr><td>2010-2013</td><td rowspan="4">3</td><td rowspan="4">Park District IT staff</td><td rowspan="3">No</td><td rowspan="4">25</td><td>1</td><td>Senior center staff</td><td rowspan="3">Senior center computer lab</td></tr>
<tr><td>2013</td><td>0</td><td>None</td></tr>
<tr><td>mid-2014 - mid-2015</td><td rowspan="2">1</td><td>University students</td></tr>
<tr><td>2015-</td><td>Yes</td><td>Senior center volunteers</td><td>Back wall of meeting room</td></tr>
</table>

Table 11: Evolution of technology support services at Smith Senior Center.

From 2010 to 2014, the three public computers were located in a room that became known as the senior center computer lab. This room was often locked despite a sign on the door stating the lab was open during hours the building was open. As part of administrative changes

in the park district, in 2015 the computers were moved out of the computer lab to make room for more special recreation staff. The computers were moved to the back wall of a meeting room in the rear of the building.

The wifi at Smith Senior Center was installed in 2010 through the same federally funded program that brought wifi to Tubman Senior Center. As at Tubman, because it was behind a password not shared with the Smith Seniors, the wifi at Smith Senior Center remained inaccessible to older adults until 2015. Older adults at Smith Senior Center were not involved in these decisions.

From 2010 until 2013, the director of Smith Senior Center provided technology support once a week for one hour. These technology support services started because the director was interested in starting them, and not because the Smith Seniors advocated for technology support services. When the director left the senior center in early 2013, technology support services were discontinued. This period of dormancy lasted until mid-2014, when I approached the new director with the idea of re-starting them. When fieldwork ended in mid-2015, a recently retired woman in her late 50s who had recently joined the Smith Seniors decided to continue the program. This incident is the only instance found during fieldwork of a member of a senior center leading technology support services. Unfortunately, this woman has not received much support from the park district. When I talked with her and with the senior center director in November 2015, I found out that the program may be discontinued because of a lack of interest among the Smith Seniors. The older woman who volunteered to continue the program was left to her own devices to figure out how to administer it.

Metro Senior Center. As at the other senior centers, the emergence of technology support services at Metro Senior Center relied on the local university and on external funding.

The building does not have any public computers. The first public technology at the center was wifi, which was installed in 2010 through the same program that brought wifi to the other senior centers.

When I approached staff in summer 2014 with the idea of conducting fieldwork at the senior center, staff did not even know wifi had ever been installed at the building. When the staff at the building needed wifi for meetings, they used a mobile wifi hotspot. The park district paid AT&T for this service. During fieldwork, this wifi hotspot was the device I used to make the technology support services functional, since the wifi was not working. The wifi was not made accessible in the building by park district IT staff until summer 2015, five years after high speed broadband was connected to the building. When wifi became available, the park district kept it behind a password.

	Number of public computers	Tech support provider	Wifi available	Hours help available, per week	Technology helpers	Technology space
2014-2015	0	None	No	1.5	University students	Senior Center lounge
2015-			Yes	1		

Table 12: Evolution of technology support services at Metro Senior Center.

No technology support services had been held at Metro Senior Center prior to this study. During fieldwork, I organized a twice-monthly drop-in technology support service (Table 12). The times for these services were after the monthly potluck, and after the monthly folding of the senior center's newsletter, when Metro Seniors gather to send out their newsletter.

Because Metro Senior Center does not have any public computers, the sessions were organized around a roundtable in the senior center lounge. All technology support took place on the digital devices owned by older adults, or on equipment brought to the senior center by

other volunteers and by me. The director of the senior center promoted the program and ensured that the park district's mobile wifi hotspot was available until wifi became available in 2015. Older adults were not involved in the administrative decisions related to starting and managing these technology support services.

Metro Library. At both Metro and Main Libraries, technology support services explicitly for older adults emerge out of the assumption that older adulthood is synonymous with disability (Table 13). In the late 1990s, the head of adult services at Metro Library participated in a pilot project organized by a university community networking initiative that focused on understanding the needs of older adults in relation to assistive technologies. As a result of this project, since 2000 the library has had what it calls Senior Computer Stations, three computers with large monitors and assistive technologies, such as ZoomText, designed for people with disabilities.

	Technology support service	Service only for older adults?	Description	Technology Helpers	Technology help space
1984-present	Public Computers	No	As of 2015, the library offers access to 64 computers 70 hours a week. Computer help provided by staff and technology volunteers.	University students and Adult Services staff	Adult computer lab
2000-present	Senior Computer Stations	Yes	The library has 3 senior workstations equipped with large-screen monitors, and assistive software.	University students and Adult Services staff	Adult computer lab
2010-2014	Computers 101	No	One-on-one instruction for adults seeking basic computer instruction.	University students	Study rooms

Table 13: Evolution of technology support services at Metro Library.
This table only includes technology support services available to older adults. Other technology support services, such as youth technology programs offered by the library, are not included.

Older adults who come to the library do not only use these Senior Computer Stations. They also use library computers that have been available in some form at Metro Library since 1984. The expansion of technology support services at Metro Library has relied on donations from local businesses. The library's computer area is named after a prominent local business. Currently, the library has 64 public computers located in the building. The library also has free wifi. The wifi does not require a password, but the computers do. One needs a library card or special permission from staff to use library computers.

Library staff provide technology support to patrons using library computers. This support is augmented by a technology volunteer program in which volunteers from the local university help patrons using technology. This program has been in operation since 2010. During fieldwork, volunteers were available on average 12 hours a week, primarily between 9 a.m. and 6 p.m. on weekdays. Volunteers provide patrons with more intensive support than staff, who tend to limit support sessions to a few minutes at a time.

Older adults use technology support services regularly. Although people of all ages request support with library computers, older adults request this assistance with greater frequency than the general population. During fieldwork, 2/3 of those asking for technology support were older adults.

Older adults also participated actively in a Saturday afternoon drop-in class called Computers 101. This class was staffed by volunteers from the local university. According to a student who led the class, over 90% of the people who came to the class were older adults. Two of the most regular participants were in their early 90s. When the class started in 2010 it was offered once a week. Over time, the frequency of the class dropped to once a month. At the end of 2014 the class was discontinued indefinitely because the library could not find volunteers

from the university able to staff it and librarians did not want to take on the responsibility of continuing it. As of spring 2016, Computers 101 has not resumed. Older adults have not been involved in the administrative decisions that shaped Metro Library's technology support services.

Main Library. The history of technology support services at Main Library has many parallels to the history of Metro Library. As at Metro Library, technology support services explicitly for older adults center on assistive technologies (Table 14). Two senior computer stations were installed at the library in 2009.

	Technology support service	Service only for older adults?	Description	Technology Helpers	Technology help space
1988-present	Public Computers	No	Main Library has 51 computers on the second floor for users of all ages, and primarily for adults. 25 of these computers are in the quiet room.	University students and Adult Services staff	Adult computer lab
2008-present	Downloadables Programs	No	Drop-in support programs for patrons seeking to use the library's eBooks and other eCollections.	University students and Adult Services staff	Meeting rooms
2009 - present	Senior Computer Stations	Yes	The library has 2 senior workstations equipped with large-screen monitors and assistive software.	University students and Adult Services staff	Adult computer lab

Table 14: Evolution of technology support services at Main Library.
This table only includes technology support services available to older adults. Other technology support services, such as youth technology programs offered by the library, are not included.

Older adults also use technology support services available to the general population. The Main Library has had these services in some form since 1988. Currently, the library has 51 public computers available to adults. Twenty-six of these computers are located in an open area next to the library's adult services desk. Twenty-five of these computers are located in an adjacent room, named after a local banker who donated money to the library to fund

technology services at the library. Free wifi is available throughout the building. A library card or permission from staff is required to use library computers.

Librarians at the adult services desk are available to help patrons with library computers. This support is augmented by volunteers from the local university. An adult services librarian stated that middle-aged and older patrons are the primary users of technology support services at the library. She said younger adults usually only need briefer assistance with things like the printer or flash drives, but "older customers are the ones who need more intensive help from librarians with technology. I would estimate maybe 75% of those needing a lot of help are 45 or older."

In addition to supporting patrons with library computers, Main Library also hosts programs to help patrons use the library's eCollections (e.g. eBooks) on their personal devices. These eCollections programs have been offered at the library since 2008. Large annual eCollections programs are supplemented by drop-in eCollections programs held regularly during fieldwork on the weekends. Most of the participants in these eCollections programs are older adults. In recognition of this fact, promotional materials for eCollections programs feature an older couple using a tablet device together. Nevertheless, as at the other sites, older adults have not been involved in the administrative decisions that shape technology support services at Main Library.

Branch Library. Unlike the other two libraries, Branch Library has no senior computer stations. Older adults do use public computers at the library, however. Branch Library is open 54 hours a week, and it has had public computers available in the library since 1994 (Table 15). The library currently has 20 public computers, accessible with a library card, along with free wifi. All the technology in Branch Library is administered by Main Library. Like the other libraries, Branch

Library has a technology volunteer program. The program at Branch Library is smaller than at the other two libraries. Only one or two students participate in this program at a time.

With funding from a state grant, in 2011 Branch Library expanded its computer lab. The lab more than tripled in size, expanding from six to 20 computers. The new, larger lab has an explicit focus on helping individuals learn technology to secure employment. Programs on resumes and job applications are offered at Branch Library through a partnership with a local community college. As at the other public libraries, older adults have not been involved in the administration of technology support services at Branch Library.

	Technology support service	Service only for older adults?	Description	Technology Helpers	Technology help space
1994-present	Public computers	No	Branch Library has a computer lab with 20 computers open to the public.	University students and Adult Services staff	Library computer lab

Table 15: Evolution of technology support services at Branch Library.
This table only includes technology support services available to older adults. Other technology support services, such as youth technology programs offered by the library, are not included.

III. Bureaucratic limits fetter agency of older adults

The staff of the senior centers and public libraries studied cope with the many responsibilities they have in their communities by instantiating bureaucratic limits on technology support services. These limits emerge out of the well-meaning goal of providing professional services to all individuals during the institutions' open hours, but the unintended effect of these policies and practices is to fetter the agency of older adults. As older adults seek support with technology in their community, they navigate a complex set of rules that vary from institution to institution. They do this work as individuals seeking help, not as agents in their communities ready and able to shape community-based information infrastructure.

The bureaucratically imposed limits on technology support services include:

- Limits on who can volunteer to help others with technology;
- Limits on times when support is available at the sites;
- Limits on access to equipment;
- Limits on outreach; and
- Limits on staff's ability to support technology not managed by the institution.

The next two sections analyze how both older adults and staff struggle to create practices that circumvent these limits. These counter tendencies may, over time, create new forms of community-based information infrastructure that transcend the limits discussed in this section.

Limits on who can volunteer to help others with technology. In different ways, all six institutions place restrictions on who can help others with technology in an official capacity. Public libraries largely restrict their technology volunteer program to students from the local university, and in particular to graduate students from the university's library science program. The most restrictive site is Metro Library, which explicitly bars all from volunteering except for graduate students from the university's library science program who submit an application, and who go through an interview. Main Library and Branch Library also require applications, and favor graduate students—a sign next to the computer area in Main Library states "Thanks to our volunteers from the university library & information science program." Main and Branch Libraries, however, are also willing to accept into the technology volunteer program any individual who has skills to share. The result of this more open policy is that two recently retired individuals now volunteer once a week at Main Library to help patrons with technology. One of these individuals, a man in his early 60s, stated that:

> For me, it is just a way to give back. I used technology all the time on the job [as a paralegal professional.] On my job, you know, I just saw the need. I saw people needing help with technology. So I was looking for ways to give back when I retired and I saw

> that here at Main Library one way you can help the library is to help people with computers. So I decided that was for me.[12]

Individuals such as this man are rare. During fieldwork I found that almost all volunteers at Main and Branch Library are students from the university's library science program. These volunteers are favored by staff, and the university is the only place where staff recruit volunteers (Table 16). At the senior centers, volunteers are not actively recruited. Although technically anyone can volunteer in senior center technology support services, in practice the lack of recruitment means that all volunteer opportunities are filled by students from the local university.

	Number of hours per week public computers available	Staff support public computers open hours?	Number of hours per week technology volunteers available	Who can volunteer?	How are volunteers recruited?
Tubman Senior Center	30	No	2	Anyone	None
Smith Senior Center	5	No	1	Anyone	None
Metro Senior Center	n/a	No	1	Anyone	None
Metro Library	70	Yes	16	Students from the library science program	Library science program
Main Library	74	Yes	24	Anyone cleared by application process	Library science program
Branch Library	54	Yes	2	Anyone cleared by application process	Library science program

Table 16: Availability of technology support services, by site.

[12] Among possible volunteer roles in the library, Main Library states that volunteers can assist in "helping computer users at the library."

This reliance on university students, and on highly trained graduate students at that, limits the volunteer pool at all six institutions. As a result, the sites continually cope with the challenge of not having enough volunteers available to support all the individuals seeking assistance with technology. Table 16 shows that none of the sites have enough volunteers available to ensure that someone seeking help will find a receptive volunteer during the institutions' open hours.

Limits on times in which support is available at the sites. Since the institutions do not have as many technology volunteers as they need, and since the staff have competing responsibilities, the institutions impose limits on the times in which technology support is available at the sites. The institutions also limit how much time staff will provide to people seeking support, and so technology support is not reliably and consistently available.

At the three public libraries, there exists an expectation of excellence in information services. This expectation leads librarians, library staff and volunteers to provide hands-on support to those using library computers whenever the library is open to the public. At Main Library, even security guards and IT staff—that is, library staff one would not expect to be providing direct assistance to the public—occasionally will help patrons in the computer area when no other staff is available. On the other hand, public librarians also limit the duration of any particular helping episode. If a librarian or library staff member identifies a patron as needing intensive assistance, that is more than a few minutes of help, they will direct the patron to a technology volunteer. Technology volunteers, however, are not always available. Furthermore, the schedules of volunteers are unpredictable, which means that in some instances a staff member may not be able to say with certainty when one will next be available. So staff will often request that patrons needing technology support for more than a few minutes

at a time come back at a later, sometimes unspecified date when someone with more time to help them may be available.

In contrast, at the senior centers, a different convention of practice operates. Here the focus is on excellent programs, and not on excellence in terms of access to information systems. In this model, technology support services are limited to particular programs. Outside of these programs, staff do not regularly provide technology support to older adults. For instance, during the 2014 winter holidays, technology support services were not held at Tubman Senior Center. During this time, a part-time staff member, a young African American woman who grew up in the local area, said that regulars from the technology support services started coming to her for help. She resisted this role. Talking to me about this phenomenon, she said, "I am going to start writing people prescriptions telling them to come see you when you are back next Thursday [laughs], because I do not want to be asked this technology stuff all the time." This staff member's attitude is similar to that of other senior center staff. Furthermore, older adults learn to expect technology support to be erratically available at the senior centers. In this under-resourced environment, new volunteers are constantly joining and leaving, and support sessions are frequently cancelled when volunteers are unavailable, or when the building is closed. In the past, technology support services have stopped entirely for periods of time at both Tubman and Smith Senior Centers.

The effects of these limits on times in which support is available can be devastating for older adults learning technology. In January 2015, an older African American woman in her early 70s told the director of Tubman Senior Center that she was excited to start learning technology. She had arranged her schedule, which was full of medical appointments and family obligations (she was the only person in her extended family who owned a car), so she could come to

technology support services on Monday afternoons. Unfortunately, in February 2015 the time of the technology support service shifted to Tuesday. No volunteers were available on Monday in the spring. As a result of this scheduling shift, this woman was only able to make it to one field session. The director did not offer to help the woman with technology at the times when she was available. Instead, he insisted that the only times in which technology support would be available at Tubman Senior Center were during the officially demarcated technology support programs. The director at Smith Senior Center also turned away older adults who had not signed up in advance for technology support programs at the center.

Limits on access to equipment. The second technique the institutions use to maintain control over technology support services is to limit access to equipment. Mobile devices and peripherals are kept locked away, rules are rigidly enforced, and time limits are imposed. At Tubman Senior Center the director purchased three headsets to better enable Tubman Seniors to listen to music, watch videos, and do videoconferencing in the computer lab. Out of concern for the security of these objects, he kept them in a locked file cabinet, which was in turn in his locked office. As a result, the headsets were never used. Restrictions also shape the accessibility of mobile technology available at public libraries. Main Library has Chromebooks available, but a complex check-out process made this resource virtually inaccessible. When I helped an older patron navigate the check-out process it took over 30 minutes to complete the forms before she was able to start using the device. Similar bureaucratic processes made laptops available at Metro Library mostly inaccessible.

Rules also shape how technology is accessed across the six sites. At Main and Branch Libraries a culture of surveillance sometimes creates an antagonistic atmosphere between staff and users in the library's computer areas. Security staff and librarians use staff computers to

check the names of patrons logged into library computers against the actual individuals sitting at those computers. If any discrepancies are discovered (such as a female patron using what appears to be a man's name), security staff investigate the issue and the patron may be asked to leave. Main and Branch Libraries have a zero-tolerance policy for using someone else's library card to get on the computer. They also insist that patrons have a library card or a temporary computer access card to use a library computer. At Main Library would-be computer users lacking library cards have to go through a complex process to start using a library computer. They have to talk to library staff on two different floors of the library, fill out a form, and display proper identification. The whole process takes between 10 and 15 minutes, sometimes longer, and did not always end in success in those instances when an individual lacked the required photo identification. These procedures took even longer for older adults with mobility issues. An older woman with a walker had to go up and down between the floors multiple times before she could access a library computer. In the middle of winter, another older patron had to go outside to the parking lot to retrieve her photo identification card before the library would let her use a computer.

Another technique used at libraries to regulate access is time limits. The idea behind time limits on public computers is to ensure that those computers are widely available to all. In practice, however, I found that time limits lead to arbitrary limitations on the amount of time older adults and others have to use library computers. At Branch Library an older African American man reported experiencing hostility from librarians because of his non-utilitarian use of technology. He came almost every morning to the library to use the computers. He was new to technology, so spent much of his time exploring how to search the internet and routinely wanted to use the computer beyond the two hours per day allocated to him.

The official policy at all three libraries is that patrons with library cards can use library computers for two hours a day, with extensions granted at the discretion of staff. In practice, extensions are almost always granted at Main Library and Metro Library, but this is not the case at the Branch Library. Oddly, it was also at Branch Library where computers are least used. During field sessions I never saw Branch Library's computers more than 50% occupied, and at certain times during winter mornings there was only one patron using the computers. When asked about the policy of not granting extensions, a librarian at Branch Library confirmed that extensions are reserved for people doing work-related projects, like resumes and job applications. As a result, this older man was repeatedly told that his time on the computer was up, even though there were ample computers available and no one waiting to use them.

Finally, limits to technology at senior centers are imposed by bureaucratic rules about who is a member and who is not a member. At Tubman Senior Center and at Smith Senior Center, technology support services were technically only open to members of the park district's 50+ senior program. Membership costs $20 a year. Non-members are supposed to pay $3 per technology support session. This rule was never enforced at Tubman Senior Center, but at Smith Senior Center the director rigidly enforced the rule. If she spotted someone in the computer lab who was not a member, she would insist they either pay the $3 fee, become a member, or leave.

Limits on outreach. Another means of controlling technology support services is to limit the amount of outreach done about them. The more outreach is done, the more people know that technology support services are available. From the perspective of overpressured staff, this is not always a good thing. The only form of outreach that takes place in all six institutions is face-to-face outreach within the building (Table 17). Staff inform individuals who come up to

them in the building that technology support is available there. The next-most-common outreach is also site-based: flyers or signs located within the building that inform adults of technology support available there. These modalities of outreach only function for those older adults already participating in senior centers and public libraries.

	Smith Senior Center	Metro Senior Center	Tubman Senior Center	Metro Library	Branch Library	Main Library	All
Face-to-face outreach	Yes	Yes	Yes	Yes	Yes	Yes	**6**
On-site signs	Yes	--	--	Yes	Yes	Yes	**4**
Monthly schedules	Yes	Yes	Yes	--	--	--	**3**
Seasonsal program guides	Yes	Yes	Yes	--	--	--	**3**
Local television	Yes	Yes	Yes	--	--	--	**3**
Websites	Yes	--	Yes	--	Yes	--	**3**
Local newspaper	--	Yes	--	Yes	--	--	**2**
Emails	--	Yes	--	--	--	--	**1**
All	**6**	**6**	**5**	**3**	**3**	**2**	

Table 17: Modalities of outreach for technology support services, by site.

In general, senior centers put more effort into pushing technology support services than public libraries. As mentioned earlier, the institution of the senior center orients staff time around programs. As a result, at senior centers outreach is highly routinized and integral to the administration of the sites. The third-most-common modalities of outreach are all only used at senior centers: monthly print schedules, seasonal print program guides, and local television. In addition to printing and distributing schedules and program guides, the senior centers push

technology support services on television. Metro Senior Center also places notices about technology support services in the "For the Retirees" column of a local newspaper.

Public libraries put less emphasis on pushing technology support services in the local community. Because of budgetary stress, Main Library chose to leave the position of outreach/publicity coordinator unfilled. The library saw this position as expendable, one that could be (and was) cut in order to maintain the library's core function of providing access to information systems. During fieldwork, the outreach done by public libraries tended to be ad hoc, not routinized. On one occasion, staff at Branch Library decided to put the hours in which technology volunteers would be available on its website, but staff only posted these hours for three months, after which the practice ceased. Similarly, an adult services librarian at Metro Library occasionally placed notices in the "For the Retirees" column of the local newspaper about its Computers 101 class, but without the regularity of Metro Senior Center. Whether or not outreach took place at public libraries depended on whether or not a librarian remembered and had the time to do it. Outreach is not routinized in the way it is in the work schedules of staff at senior centers.

As a result of this lack of outreach, older adults who do not in their normal course of life use library computers are unaware of technology support services available at libraries. During field sessions at Metro Senior Center I mentioned to older adults that if they wanted technology support beyond the limited hours available at the center (only twice a month) they could go to Metro Library, which is located a half-mile away. None of the older adults I talked to at Metro Senior Center knew technology support was available at Metro Library. Older adults also found what limited outreach public libraries did to be confusing. At Main Library, one man was confused by the library's quiet computer room. To enter the room, one has to go through a door

that has the name of a local bank (which gave the library money for technology) above the words "Quiet Room." This man told me that he went to Main Library to check out some CDs. As he walked through the building, he noticed a sign for technology support by the quiet room. He did not inquire about the technology support service because he thought it was only for people who did business at the local bank.

Limits on staff's ability to support technology not managed by the institution. Finally, these institutions control technology support services by limiting staff to locally managed information systems. This limitation keeps staff from building networks with other institutions, and also with older adults. Each site independently administers its own technology support services, functioning as an island, the only bridges emerging across institutions that share a parent entity (e.g. Main & Branch Libraries; Tubman & Smith Senior Centers). This isolation occurs in the context of close geographic proximity.

	Tubman Senior Center	Smith Senior Center	Metro Senior Center	Metro Library	Main Library	Branch Library
Tubman Senior Center	--					
Smith Senior Center	2.5 miles	--				
Metro Senior Center	1.5 miles	3.5 miles	--			
Metro Library	2 miles	4 miles	0.5 miles	--		
Main Library	1.5 miles	2 miles	2 miles	2 miles	--	
Branch Library	50 feet	2.5 miles	1.5 miles	2 miles	1.5 miles	--

Table 18: Geographic distances among sites.

Table 18 shows that all six sites are located very near to one another—Tubman Senior Center is located just 50 feet from Branch Library. Older adults do go to both institutions; an older adult may go to the senior center, and then stop at the library to see what is going on there. No similar links connect staff between the two institutions, however. The director at Tubman Senior Center had no idea that librarians helped older adults with technology at Branch

Library, and Branch Library staff did not know that technology support services had been in place at the senior center since 1997. A similar disjuncture exists between Metro Senior Center and Metro Library, located 0.5 miles from each other. The staff at Metro Library also were unaware of technology support services at Main Library.

The institutions focus staff time on managing systems owned by the institution. This institutional priority prevents staff from supporting older adults on technology they own and bring into the library. At public libraries, training for technology volunteers explicitly states that volunteers and librarians should not help patrons on personal devices unless the volunteer or librarian considers themselves to be an expert with that device. Volunteers and librarians are also instructed to never touch a patron's personal device. These policies emerge out of two concerns: (1) that the library will be held liable for anything that happens to a patron's device during such a help session; and (2) since patrons' personal devices are not owned by the library, the library cannot promise the same level of support offered for equipment and information systems owned and managed by the library.

Concerns about maintaining professional excellence keep libraries from supporting older adults learning to use their own personal devices. An older woman brought a new laptop to Metro Library to learn how to use it. She initially asked for help at the circulation desk, on the first floor. There she was directed to the adult services desk, on the second floor. There, a librarian told her that she could help the patron get online, but only on the library's computer, not on her laptop. The patron asked the librarian to help her with the laptop, but the librarian refused.

At the libraries, a convention of practice focuses on exposing patrons to library information systems but not always providing them with the support they need use these

technologies. An adult services librarian at Metro Library wants to provide what she calls "technology experiences" for older adults. She wants older adults to know about recently acquired technologies in the library, such as a 3-D printer and other new technologies available in the library's makerspace. Similar conventions of practice focus on exposing older adults to technologies owned by the library, but without helping them figure out how to use them, at the other libraries. Main Library is developing what one librarian described as "a book club but with technology" that would focus on "exposing seniors to new technologies, focused on cutting-edge technologies like QR codes and fab-labs." The goal of the project was to "raise seniors' awareness and exposure" to new technology, but not to teach them how to use them. Budgetary stress has led to an entrenched focus on library information systems at Main and Branch Libraries. Library staff at the adult services desk there are expected to juggle reference duties with work on library collections. At the beginning of their shifts, adult services staff wheel out carts full of books, CDs and DVDs they will process while working the adult services desk. In some cases, librarians are so immersed in these collections that they lose track of what was going on around them. Patrons seeking help would sometimes have to stand in front of the adult services desk for a full minute before they could get the librarian's attention.

IV. Information infrastructure evolves through struggles of individual older adults in information systems

These limits on technology support services are not passively accepted by older adults, nor do all staff embrace them. Changes emerge in community-based information infrastructure through the complex give-and-take that characterizes daily negotiations in these institutions. Some of these negotiations happen behind the scenes among staff, and some occur in the public

spaces of these institutions, and involve older adults. Older adults do not passively use services created for them. They actively seek to adapt these services to meet their needs. Through these negotiations and struggles rules change, and new policies and practices emerge. This section analyzes how struggle in community-based information infrastructure leads to evolving technology support services.

Negotiations in a library eBooks program. Examples of both public and private negotiations appear in this story about the development of a public library program. Since the late 2000s, Main Library has had a series of programs focused on helping patrons use eCollections (such as eBooks) for which the library has purchased licenses. The librarians that administer this program are aware that older adults are the program's primary audience. Librarians are also aware that many of the older adults coming to the programs seek support with their personal devices more generally. They want help figuring out how to use tablet devices, not just to be able to download eBooks, but in general.

On at least three occasions during fieldwork older adults came to eCollections programs seeking general assistance with technology and were turned away by librarians. On the first occasion, an older adult did not own a personal device, but wanted to learn more about tablet devices. On the second occasion, an older adult owned an iPad, but said she needed help getting started with it before starting to use digital library collections. A third woman also went to an eCollections program with her new iPad to figure out how to use it. All three of these individuals were told by librarians that they would have to limit their participation in the programs around learning how to access the library's eCollections.

Aware that the program was not meeting the needs of participants, one adult service librarian attempted to change the focus of the programs. In October 2014, this librarian

attempted to re-brand the program as a "drop-in technology help" program that would help patrons learn whatever they wanted to learn in relation to digital technology. The head of adult services at Main Library rejected this proposal, and the restrictive focus on eCollections continues. Although in this particular instance change did not occur through these negotiations, perhaps a different community-based information infrastructure could emerge in the future.

Staff bend the rules in response to the agency of older adults. Staff who have not fully become socialized into the professional norms of the institutions sometimes develop innovative techniques that nimbly respond to the needs of users. For instance, despite official limits on how much librarians can help patrons with their personal devices, at Main Library a library technician—significantly, not a full librarian—always supports patrons on their personal devices in whatever form they want whenever she works at the adult services desk.

In another case, one part-time employee of the park district who worked at Tubman Senior Center for six months spontaneously started supporting the Tubman Senior Center's quilting group with their smartphones. As they quilt, these women sometimes use their smartphones to show each other things they have found online, and so the part-time employee offered assistance to the women, especially with iPhones, which was the device she owned. Unfortunately, in April 2015, the employee left the senior center, and her practices were not institutionalized. Her replacement did not continue the tradition of offering technology support to the quilters; technology support was not part of her job, so she did not provide it. Nonetheless, through transgressive actions like these, limits are broken and new forms of community-based information infrastructure may emerge.

Older adults endeavor to form supportive relationships with technology helpers. As individuals, older adults also exert their agency by trying, and sometimes succeeding, to form

relationships with technology volunteers. Older adults rely on these relationships to learn technology across time. At the Main Library an older man referred to one of the technology volunteers as "the one I always go to for help. She knows what I need." Similar relationships form at all six institutions.

One of the reasons why older adults develop these relationships with particular technology helpers is that it takes time to identify someone willing and able to provide ongoing technology support. Once such an individual is found, they return to these people over and over again. At Branch Library, one staff member (whose official job title is children's librarian) said that for the last two years she has worked with an older African American woman who comes in every Monday afternoon to work with her to learn to use the computer:

> I can't even remember how that started! She was just coming in all the time asking questions, and I guess after a while we just kind of settled into that routine. Now I know to leave some time on Monday afternoon free because I know she will be in with more questions [laughs].

These relationships result from the agency of older adults.

Unfortunately, these relationships are not always supported or nurtured by the institutions in which they form. Staff at Metro Library stated that these relationships emerge very regularly, but problems arise when a favored volunteer leaves and the patron then becomes frustrated trying to find someone else who will work with them. As a result of this problem, the library is trying to make technology support more anonymous. The library wants patrons to develop relationships with the library as an institution, and not with individual technology volunteers. To achieve this goal, Metro Library has decided to not give volunteers name tags; technology volunteers simply wear a badge that says "volunteer" on it. Nonetheless, older adults continue to endeavor to form relationships with technology volunteers. The library

wants technology support services to operate in one way, older adults want them to operate in a different way. Through situated negotiations the actual technology support services emerge.

Older adults seek support on their personal devices. Change in community-based information infrastructure does not come only from the top-down, it also comes from the bottom-up. In addition to working to form relationships with supportive helpers, I also found older adults increasingly seeking technology support on the personal digital devices they own. Over time, these help-seeking strategies led to changes in how technology support services operate, especially at senior centers. Table 19 demonstrates that a large difference exists between senior centers and public libraries in terms of the technologies older adults use in technology support services. Older adults are more than three times more likely to use lab computers at public libraries than at senior centers. In contrast, older adults are four times more likely to use their personal devices at senior centers than at public libraries. When support for personal devices is available, then, older adults use it.

	Percent used lab computers	Percent used personal devices
Tubman Senior Center	27%	81%
Smith Senior Center	27%	79%
Metro Senior Center	0%	100%
Metro Library	91%	17%
Main Library	88%	18%
Branch Library	91%	17%

Table 19: Use of lab computers and personal devices, by site.
Totals across rows exceed 100% because some participants used both personal devices and lab computers.

Technology support services have changed over time at the senior centers. When technology support services started at Smith Senior Center and at Tubman Senior Center, the services focused exclusively on the senior center computer labs. At both senior centers, a primary obstacle to supporting older adults on their personal devices, as opposed to on lab computers, was the lack of accessible wifi. Even when wifi became available, the staff who administered the technology support services did not feel prepared to help older adults use it.

This lack of support for wifi relates to a lack of staff identification with the information society at senior centers. No senior center staff, when asked, said they feel like a netizen, or a citizen of the information/internet society (Table 20). As a result of their own insecurities with technology, staff at senior centers do not always feel comfortable offering assistance with technology to older adults.

	Identify as Netizen	
	Yes	**No**
Senior centers	0	4
Public libraries	2	1

Table 20: Staff identification as a netizen, by site. n=7.

The ages of the staff had little to do with this phenomenon: the director at Tubman Senior Center was in his mid-20s, and the director of Smith Senior Center was in her late 50s. Both said in interviews that they felt like they barely knew how to use their own personal devices. During fieldwork, both approached me for help with technology. As a result of these insecurities, they did not initially feel comfortable supporting older adults on their devices.

Even after wifi became more accessible at the senior centers, older adults did not suddenly start bringing their personal devices to technology support services. The centers had established a convention of practice focused on the computer lab, and that convention took

time to change. As Table 21 below shows, the percentage of older adults using lab computers at the Tubman and Smith Senior Center dropped during fieldwork as they learned that they could receive support on their personal devices.

	Used lab computers	
	First three months of fieldwork	Last three months of fieldwork
Tubman Senior Center	38%	12%
Smith Smith Center	60%	14%

Table 21: Use of lab computers at Tubman and Smith Senior Centers, during first and last three months of fieldwork.

When older adults learn that someone will help them with their personal device, they enthusiastically take advantage of this opportunity. On four different occasions, older adults came for the first time to technology support services at senior centers without a personal device. They returned later with their device after learning that someone there could help them figure out how to use it. A newcomer to a technology help sessions at Tubman Senior Center—whom I had seen also seeking support at both Main Library and Branch Library—initially assumed that, as at the libraries, he would have to use the lab computers to receive technology support. When he found out that he could get support on his laptop, he started bringing his laptop and never touched a lab computer again.

Nonetheless, the lab computers continue to be vitally important for those older adults who either lack any personal devices or whose only personal device is a stationary desktop computer. Table 21 also shows that even during the last three months of fieldwork between 12 and 14% of older adults who participated in technology support programs continued to use lab

computers. In other words, computer labs remain important for older adults even as the majority shift to using their own personal devices.

Public computers also continue to be important at public libraries. On one occasion, an older woman came to Main Library to receive assistance filling a form out online. She said she could have done it at home on her desktop, but it would have taken her "at least four times longer." Having support at the library, and having access to library computers, was very important to her. Older adults seek support on devices they own, as well as on computers and equipment owned and managed by libraries and senior centers.

Through the situated negotiations and struggles that take place between older adults and the staff responsible for information systems community-based information infrastructure evolves and changes over time. Older adults express their agency in this infrastructure by attempting, and succeeding, to secure the support they need, even if this support is not something the institutions want to provide.

V. Groups of older adults shape information infrastructure

Although older adults have not been involved in the creation and administration of technology support services at the six sites, they nonetheless have shaped this information infrastructure. They have done so in part by adapting technology support services to their group-based communities of practice, especially at senior centers. Senior centers are group-based institutions. One joins a senior center and then becomes part of the group. With support, these organized groups of older adults learn to help each other with technology.

The presence of group-based communities of practice in senior centers can be seen in the fact that older adults are more than three times as likely to socialize while using technology

support services there, compared to public libraries (Table 22). At Metro and Tubman Senior Centers, older adults socialized together while using technology during 94% and 78% of field sessions, respectively. At Smith Senior Center, 42% of field sessions featured older adults socializing.[13] This type of socializing is much rarer at public libraries. At public libraries the norm was the individual patron using library technology by themselves, only talking when asking a librarian or a volunteer a question.

	Percentage of field sessions in which older adults socialized while using technology	Number of field sessions
Metro Senior Center	94%	22
Tubman Senior Center	78%	127
Smith Senior Center	42%	31
Main Library	14%	37
Metro Library	13%	21
Branch Library	3%	29
All	53%	267

Table 22: Older adult socializing in technology support services, by site.

Newcomers to senior centers learn they are expected to become part of the group. In March 2015 a European American man who had recently retired from a blue-collar job at the university starting coming to technology support services at Tubman Senior Center. He came back 27 times during fieldwork. In an interview he stated:

[13] The lower frequency of socializing at Smith Senior Center relates to the fact that the computer lab was smaller, having only two regular desktop computers (and one special computer with assistive software and peripherals), and thus on some occasions only one older adult participated at a time.

> You know, when I first came I didn't know what to expect …. So, I got here and everyone was talking. Everyone seemed to know everyone, and they were talking about things, like, you know, growing older [laughs]. And that one guy, he said he worked for the university, in my unit! I didn't know him. I don't think our times overlapped. But, we knew a lot of the same people. And, we talked. And it was great, you know, making that connection. It really helped me feel like this is a place I could belong, even though I'm not Black, you know. This place is really welcoming to everyone.

In this quote, this man reveals the process by which he moved from being a peripheral participant to a full member in this community.

Those already part of the group refresh and reinforce membership while participating in technology support services. Two older African American men participated in more than 50 field sessions at Tubman Senior Center. The two asked questions about how to do things with their devices, while also socializing together about their lives and experiences. Visits to senior centers for technology support services also overlap with social visits to the center. At Smith Senior Center older adults often came to the computer lab for a few minutes after another program ended, such as a potluck or a game of cards. Others would come to the computer lab and then stay around the center until another program began.

The expectation of being part of the group also extends to technology helpers at the senior centers. Older adults invite volunteers to join them at their potlucks. Older adults also invite volunteers to their homes, and to other events in their lives. At Tubman Senior Center one of the regular participants in technology support services is an older musician in his late 70s. He formed a strong relationship with one volunteer. This relationship was strengthened when this volunteer and her husband attended one of the musician's concerts. When the director at Tubman Senior Center got engaged, he invited the Tubman Seniors to his engagement party, saying, "You are all my family." He later held his wedding reception at the senior center.

The group-based culture of senior centers is related to but distinct from the phenomenon of being a regular at an institution. This distinction can be seen in the comparison between Table 22, above, and Table 23, below. This comparison reveals that even though Branch Library has the highest percentage of regulars among the six institutions (88%, Table 23), it also has the lowest rates of socializing while using technology (3%, Table 22). At Branch Library regulars routinely greet librarians at the door, in some cases even hugging them, but they did not socialize with other patrons. In other words, regulars at Branch Library have strong relationships with librarians, but not with each other. There is no group of patrons in the same way there are groups at the senior centers. At the other public libraries, which had lower percentages of regulars than the senior centers, interactions both among patrons and between patrons and librarians tended to be anonymous.

	Tubman Senior Center	Smith Senior Center	Metro Senior Center	Metro Public Library	Main Library	Branch Library
Regulars	76%	66%	54%	43%	38%	88%
Non-regulars	24%	33%	46%	57%	62%	12%
All (100%)	51	15	52	23	81	17

Table 23: Regulars and non-regulars in technology support services, by site.
The total n in the "All" column exceeds 209 because older adults participated in multiple sites. Due to rounding, columns do not sum to 100%.

Nevertheless, in some cases groups of older adults do use public libraries together. On Tuesday mornings an informal group of 3 or 4 older women meets at Metro Library to get coffee, catch up with each other's lives, look at new books, and use library computers. They go to the computers together and quietly discuss some of the things they look at. Occasionally one of the women will ask a librarian for help, but usually they work together on their own.

Collaborative learning in senior center groups

At Metro Senior Center, the group-based community of practice formed there led to the development of collaborative learning of technology among older adults. I only found this type of learning at this institution. In this section I analyze how this unique phenomenon emerged.

Table 24 shows that Metro Senior Center had both the highest level of socializing among older adults using technology (94%) as well as the highest level of older adults helping each other with technology. During 89% of field sessions at Metro Senior Center, older adults helped each other with technology. At no other institutions was collaborative learning so common. During 20% of the field sessions at Tubman Senior Center, and 19% of the field sessions at Smith Senior Center, older adults helped each other with technology. At the public libraries, less than 10% of field sessions found older adults helping each other with technology.

	Percentage of field sessions in which older adults socialized while using technology	Percentage of field sessions in which older adults helped each other with technology	Number of field sessions
Metro Senior Center	94%	89%	22
Tubman Senior Center	78%	20%	127
Smith Senior Center	42%	19%	31
Main Library	14%	8%	37
Metro Library	13%	6%	21
Branch Library	3%	0%	29
All	53%	21%	267

Table 24: Collaborative learning among older adults, by site.

The reason that Metro Senior Center fostered more collaborative learning among older adults than the other institutions relates to the history of technology support services there. At all the institutions except Metro Senior Center, technology support services were organized around the model of one-to-one teaching and learning. In this model, a staff member or a volunteer would assist an older adult learning technology. At Metro Senior Center, on the other hand, technology support services were instead started with the idea that older adults could help other older adults learning technology. During announcements for the program at the monthly potluck, the director of the senior center said that older adults could receive assistance from me but that older adults could also come and help each other.

Nevertheless, collaborative learning among older adults did not spontaneously start taking place at Metro Senior Center. It needed support. When I came to the senior center for field sessions I found older adults patiently waiting for me. It was only after I arrived that older adults got out their digital devices and started asking me questions. After they had asked me questions, they started talking amongst themselves, and eventually started helping one another. The older adults only felt comfortable helping each other with technology when a young person was in the room they could turn to if and when obstacles arose. One participant said that she liked knowing that I was there in case they needed someone to "bail us out if we get in over our heads [Laughs]."

Collaborative learning at Metro Senior Center took two forms: (1) older adults helping older adults on their devices, and (2) open discussions about technology involving all participants. In terms of the former, older adults visibly struggling with a new device unfamiliar to them were supported by other older adults in the room. Older adults saw someone in need and spontaneously started helping them. In some cases, older adults even offered support on

devices they had never used before. An older European American man brought his iPhone to a technology support service. He had owned the device for a year, but said he could not use it for more than making and receiving phone calls. Seeing the man having difficulty operating his iPhone, an African American woman sitting adjacent to him spontaneously started supporting him. This woman had an Android smartphone and had never touched an iPhone before. Nonetheless, the two of them started figuring out the unknown device together.

Older adults would also overhear what others were doing during technology support services and then start discussing the issue together. After someone said they were thinking about buying a new phone, the group of older adults discussed the benefits and limitations of their own phones, as well as what they had heard about other phones. Through these discussions older adults learn together how to navigate the information society. Other spontaneous small group conversations at Metro Senior Center focused on how to secure one's device, how to avoid digital scams, how to find books that explain how to use technology, and the frustrations of children who are not patient enough with them as they learn technology.

The physical set-up of technology support services facilitated this collaborative learning. Unlike Tubman Senior Center and Smith Senior Center, where the rooms are set up in such a way that older adults naturally look away from each other and towards their desktop computers, Metro Senior Center simply has a round table and chairs for technology support services. In this open environment, older adults sit around the table, face each other, and help each other. Group-based communities of practice already exist at senior centers. Senior centers form around community groups that meet regularly. These groups can facilitate the development of collaborative learning of technology among older adults. This collaborative

learning does not emerge on its own, but it can be supported through thoughtful policies and practices that empower older adults to help each other.

VI. Older adults and information systems cope together with changing technical standards

This section concludes this analysis of how community-based information infrastructure emerges and evolves through struggle by widening the focus of analysis. Thus far the focus has been on older adults (information users) and local government (information systems). In addition to these local forces, community-based information infrastructure is shaped by global forces. In particular, both information users and information systems cope with the changing technologies released in the global electronics consumer marketplace. This coping occurs when:

- Information systems work to maintain and extend the accessibility of public technologies; and
- Information systems and information users work to stay up-to-date with the myriad devices, models, and applications available in the global marketplace.

Information systems cope with changing technological standards. All six institutions cope with challenges related to maintaining wifi networks and/or public computers. After wifi became available at the three senior centers, the staff there did not know how to make it accessible to older adults, and so years elapsed between the time the wifi was installed and the time when older adults started using it at the senior centers. The time it took to make this wifi accessible relates to the challenges senior center staff face as they reconfigure their institutions to support older adults using and learning technology. Many employees at both senior centers and public libraries are ambivalent about being asked to cope with the challenges of this role. Discussing the fact that much of her time at the adult services desk is spent helping patrons use library computers, a librarian stated that this type of work "is not why I came to library school."

Times in which systems had to be upgraded proved to be especially difficult for staff. During fall 2014, all 70 public computers at Metro Library ran on the Windows XP operating system. Microsoft had stopped supporting Windows XP on April 8, 2014. The library had not yet upgraded its public computers because staff could not figure out how to make library software run on the new operating system. The library further lacked the technical support necessary to launch into a lengthy upgrade process.[14] Because the public computers were using out-of-date standards, many programs (especially Internet Explorer) did not run well, or broke down without explanation. Staff coped with these challenges as best they could, helping patrons work around these problems by suggesting alternative programs. This example illustrates how the staff at these institutions cope with the challenges of maintaining public access to technology in the context of frequently changing technological standards. Importantly, this work is done behind the scenes, prior to the arrival of the public into these spaces. The other institutions coped with similar, if less extreme challenges when technological standards changed.

Information systems and users cope together. As more and more older adults bring their personal devices into public libraries and into senior centers, the staff of these institutions cope with the challenge of supporting all the diverse technologies available in the electronics marketplace. Table 25 displays the types of devices older adults brought to technology support services. Laptops were brought by 49% of the older adults in this sample. Other devices brought include: tablets, 29%; smartphones, 26%; A/V devices (e.g. digital cameras, mp3 players), 19%; flash-drives, 17%; flip-phones, 8%; and even printers, 1%.

[14] This in-house expertise has since become part of Metro Library. In Spring 2015, and in part because of the challenges related to upgrading public computers, the library hired its first Technology Manager.

	Percent of older adults that used during field sessions
Laptops	49%
Tablets	29%
Smartphones	26%
A/V devices	19%
Flash drives	17%
Flipphones	8%
Printers	1%

Table 25: Personal devices used in technology support services. n=209.
***Total percentage exceeds 100% because older adults brought multiple devices*.**

Many of the devices and/or software belonging to the older adults were quite old. The oldest technology encountered during field sessions was an Apple PowerBook from 1997, which the owner continues to use on a weekly basis to check her email. She brought the laptop to Smith Senior Center because she wanted help using it to browse the internet. Laptops, mp3 players, and digital cameras more than 10 years old were also brought in for support. Some older adults also wanted help using programs like Microsoft Works and WordPerfect X3, software which has not been updated or supported by its developers since 2007 and 2008, respectively.

When staff and volunteers attempt to provide support for these diverse devices, obstacles arise because of incompatibility among devices and operating systems. One man wanted to migrate his music collection from an older Windows XP laptop to a new Windows 7 laptop. In this process, he and a volunteer confronted numerous obstacles: (1) some of the Windows Media Player audio files (WMA) would not play on the new laptop because Microsoft identified the files as pirated (they were not); (2) he could not integrate his older music files into a growing mp3 collection he had started to manage in iTunes; (3) he had further difficulty

incorporating new mp3 files he purchased through Amazon into his music collection. A volunteer at Tubman Senior Center tried to help him cope with these challenges over a period of months, but some of the obstacles (such as getting the older WMA files to play in the new operating system) could not be surmounted.

In addition to coping with diverse devices and applications available in the electronics marketplace, older adults and information systems also cope with diverse log-in systems**.** Passwords proved to be particularly challenging. The fact that so many sites and services have different password requirements compound this challenge. One woman said, "My fridge is covered in passwords! I have post-it notes everywhere. Otherwise I would be lost. I am hoping to find a better system. Surely, there is a better way!"

In addition to helping older adults with password creation and management, staff and volunteers frequently help older adults navigate password recovery systems. In this process, the staff and volunteers learn alongside the older adults. In an email to me, one volunteer discussed a technology support session she had with an older adult at Main Library: "When she shared her method for creating and remembering passwords. I wrote it down and thanked her multiple times for the tip! It was really great …. We hugged at the end."

Coping together with technological change: An autoethnographic reflection

During fieldwork I found that older adults and technology helpers can cope together with these and other challenges involved in navigating the still-emerging information society. I include here an autoethnographic reflection on my experience coping with older adults during a year of fieldwork in technology support services. During this time, I worked with older adults on

devices and programs I had never used before. Together we tried new things and learned together about the diversity of programs and devices available in the marketplace.

I first met Ledora in October 2014 at Tubman Senior Center, where she was a regular. She said that she wanted help transferring pictures from her smartphone to her Windows 7 laptop but did not know where to start in this process. Her children had bought her a smartphone earlier in the year, and she had since used it primarily to take photographs in addition to making and receiving phone calls. When I first met her she had more than 800 photographs on her phone, and the number of photographs increased during the time we worked together. She had owned the laptop for two years, but she said she almost never used it. There were many other things Ledora wanted to learn about technology during the technology support sessions in which we interacted, but she kept coming back to the problem of how to get the photographs off her phone. She was concerned that if she could not transfer them to another device she would lose them if her phone broke.

From October 2014 to March 2015, she, other volunteers, and I worked together to try to figure out how to transfer these photographs. We tried connecting her phone to her laptop, we tried connecting her phone to a lab computer, we tried connecting her phone to a volunteer's laptop, we tried using Dropbox, we tried syncing the phone and the laptop via wifi, we tried special apps designed to sync phones and laptops. We could not get any of these procedures to work. After doing some research we found out that many other people encountered similar problems with this type of phone.

Finally, in March 2015 we found something that worked. After researching the problem online, we decided to try transferring the photographs via Bluetooth. Through trial-and-error we were able to establish a Bluetooth connection between the two devices and transfer the now-

more-than-1500 photographs from her smartphone to her laptop. Ledora wrote detailed notes about how to use Bluetooth so that she could continue to transfer new photographs as she took them. This story illustrates the challenges older adults, volunteers, and staff face as they cope together with frequently changing technological standards. I was not tutoring Ledora in how to use the technologies she learned to use. Rather we learned together, on the fly, over an extended period of time how to do things neither of us had attempted before.

During fieldwork I found that many staff and volunteers do not share this attitude toward technology support. Public libraries have policies that restrict staff and volunteers from helping patrons with devices with which they do not have expertise. Although there are no rules against it, senior center staff are not always willing to work with older adults learning new technologies, instead re-directing them to times when volunteers from the university are available.

Unfortunately, university students are also uncomfortable supporting older adults on devices unfamiliar to them. During the pilot study that led to this dissertation, library science students participated in a Seniors & Technology Day at a local library in which they helped 40 older adults with whatever they wanted to learn about technology. The workshop was structured around the personal devices of older adults. For many students, this day was their first experience interacting with the devices older adults brought to the library. In anonymous feedback students vented their frustration about being asked to support devices and applications that were unknown to them. This complaint appeared in 70% of the students' comments.

My experience during fieldwork shows that older adults and information systems can productively cope together with challenges that arise because of the changing technologies

released in the consumer marketplace, and this experience suggests an alternative way to structure community-based information infrastructure. In this alternative, older adults, staff, and volunteers would work together collaboratively to learn technology. While in the current model, staff and volunteers support older adults learning technology new to the older adults, but which staff and volunteers feel like they have some expertise using, some staff are already embracing the new collaborative model, such as the library technician discussed above who always provides support on whatever devices older adults want to use. Community-based information infrastructure continues to evolve through the identification and nurturing of these counter tendencies, which emerge in part through the individual and social struggle of older adults.

B. Community-based information infrastructure extends across space and time

As they participate in technology support services in the present, older adults draw on and add to memories of these institutions. These institutions are rooted in the community, and in the lives of the older adults who use them. As such, the community-based information infrastructure extends across time. I also found that public libraries and senior centers are not the only sources of technology support older adults rely on. The community-based information infrastructure extends across space to include other sectors of the local community, including family and friends, businesses, and other public and non-profit institutions.

Institutions rooted in lives of older adults. Many older adults have been going to public libraries throughout their lives. Many also have lifelong connections to senior centers formed through networks of family and friends. The rootedness of these institutions in the lives of older

adults shapes how older adults use these institutions as sources of support with digital technologies in the present.

More than two-thirds of older adults interviewed have lived for more than 30 years in the local metropolitan area (Table 26). Half of all participants have lived their entire lives in the regional area, and over a quarter have lived their entire lives in the urban area. This tendency is more pronounced at the senior centers than at the public libraries, and is strongest at the Tubman Senior Center, where 100% of those interviewed have lived in the urban area for the last 30 years, and nearly 50% have lived their entire lives in the metropolitan area. This is a population deeply rooted in the local community. Public libraries and senior centers are institutions rooted in these communities, and in the lives of these older adults.

	Lived more than 30 years in metro area	Lived entire life in region (90 mile radius of city)	Lived entire life in metro area
Tubman Senior Center	100%	71%	47%
Smith Senior Center	80%	60%	20%
Metro Senior Center	50%	33%	16%
Metro Free Library	33%	33%	33%
Main Library	46%	38%	15%
Branch Library	50%	50%	25%
All (n=54)	67%	50%	28%

Table 26: Length of time older adults have lived in local area, by site.

Some older adults have been going to these particular public libraries throughout their entire lives. Memories of past library participation structures participation in the present. One older adult at Metro Library stated that “I can’t remember a time I didn’t come down here to the library for one reason or another.” Another older adult who comes regularly to the Main Library describes herself as a “lifelong library patron.” Having used the library throughout their lives, these older adults now turn to the library to support their digital literacy in the present.

Even though older adults now use these spaces differently than they did in the past, fond memories of past participation lead them to continue coming to them. Older adults often discuss memories of bringing their children to the libraries when they were younger. One man said:

> When my son was little I brought him down to Metro Library for storytime all the time. I guess you could say it was important to me that he be learning something in the summer, and not just doing nothing. Anyhow, whenever I come in I remember that, remember when he was young. And I was young too!

Memories and community connections also shape how older adults engage in senior centers. To reiterate, all three of these senior centers grew out of multi-purpose community centers. At Metro Senior Center, one woman discussed how comfortable she felt learning technology there because of memories she has of the space. During a field session she and another woman shared memories of the center. They talked about bringing their children to the community center's gym, and about the changes in the building and the surrounding community over the years. Older adults draw on and add to these memories as they participate in technology support services in the present.

The institutions cultivate and draw on multi-generational community ties for their continued vitality. At all three senior centers, older adults mentioned that they decided to join the senior centers because they had older relatives who had been part of the senior center in the past. Others said that they joined because they have friends who joined the senior centers and who encouraged them to join as well. Multiple generations of families also participate within senior centers: I found mothers and daughters participating together at all three senior centers.

Even those older adults who have not lived extensive periods of time in the local area draw on fond memories of public libraries and senior centers as they turn to them for support with technology in the present. An older couple new to the local area turned to Main Library for help with technology because of a generally positive attitude toward public libraries. Similarly, some members at Metro Senior Center were new to the area. They joined because they had participated in a senior center in their former home and were looking for a similar environment in their new home. These particular institutions thus connect to a public sphere formed in public libraries and senior centers across the nation.

*African American counter-public sphere***.** For some African American older adults, participation in public libraries and senior centers constitutes participating in an African American counter-public sphere. One woman in her late 80s talked about how her mother was one of the founders of the Tubman Seniors back in the 1960s. She remembered that when she was younger

> Mama always had me help down at the center. She put me to work [laughs]. I was always down here at the Tubman Center for something, serving food, calling people. I always helped Mama with the Tubman Seniors. And now I'm a Tubman Senior!

Similarly, an older African American man remembered working with the Tubman Seniors in the early 1970s, when he himself was in his 30s. As part of his participation in the African American community he volunteered to help with the Tubman Seniors' annual Thanksgiving dinner. These memories led him to join the senior center later in his life.

Shaped explicitly by local activism in the African American community during the 1960s and 1970s, Tubman Senior Center and Branch Library are sites that trigger potent memories of community organization and struggle. An African American woman who comes regularly to Branch Library said she chooses to go there instead of Main Library, geographically closer to her

home, because of memories she has of the library. She said, “When I am here I just feel like: ‘This is ours.’” Similarly, a woman in her late 80s who has been coping with health issues nonetheless came to an event sponsored by the Tubman Seniors. She explained that “I would do anything for the Tubman Seniors.” This level of participation is formed through deep investment in the sites, and thus in the African American counter-public sphere they embody.

These stories collectively illustrate that when older adults participate in technology support services in public libraries and senior centers, they actively draw on and add to memories of these institutions. The rootedness of these institutions in this community took years to form, and it is an asset of this community-based information infrastructure that enables it to support the digital literacy of older adults.

Public libraries and senior centers complement other sources of technology support. This study operationalized the concept of community-based information infrastructure as public libraries and senior centers. I found that this community-based information infrastructure extends across space to also include families, friends, businesses, and non-profit institutions. From these people and in these places older adults also seek and find technology support. Public libraries and senior centers supplement and complement these other sources of support.

*Institutions rooted in broader support networks***.** Some older adults who go to one of the six institutions for technology support also sometimes go to other institutions. I interacted with 16% of the 209 older adults at multiple institutions (Table 27). Since I was only at these institutions for a limited amount of time, it is probable that the actual cross-linkages formed across the institutions by older adults seeking technology support is in fact much denser. This table nonetheless illustrates the fact that many older adults seek support for technology from multiple institutions in their community. In particular, older adults who seek technology support

at Branch Library, Metro Senior Center and Metro Library are more likely than those who seek support at Tubman Senior Center, Smith Senior Center, and Main Library to also seek support from another public institution.

	Tubman Senior Center	Smith Senior Center	Metro Senior Center	Metro Library	Main Library	Branch Library	All (n=209)
Participated only in this institution	84%	73%	65%	61%	79%	59%	84%
Participated in other institutions	16%	27%	35%	39%	21%	41%	16%

Table 27: Older adult participation in technology support services at multiple institutions.

Older adults learn about and are reminded of technology support services through their connections in the community. At Tubman Senior Center, a man came to a few support sessions in fall 2014, and then stopped coming for a few months. He decided to come back after a woman from his church reminded him that technology support was still available at the senior center. Friends sometimes coordinate with each other to ensure they will be at technology support services together.

Older adults also encourage their friends to start coming to technology support services. After coming to two technology support sessions at Metro Senior Center, a man brought his friend to learn with him. At the Tubman Senior Center's annual senior fashion show and dinner, I sat at a table with a man who came regularly to technology support services there. He was sitting with friends, none of whom were members of the senior center. During the dinner one of the men started talking about difficulties he was having with his new smartphone. The regular from the computer class strongly encouraged him to start coming down to the senior center to

learn how to use it. He said, “Everything I know, I learned at the center.” A month later the man with the smartphone came to the senior center to participate in a technology support session. Later he and his wife joined the senior center.

	Family & Friends	Company	Public institution	None
Older adults' consistent source of technology support (n=54)	43%	7%	7%	43%

Table 28: Consistent sources of technology support, among interviewees.

Older adults who participate in technology support services at public libraries and senior centers also find other sources of support in their community. Family and friends are especially important sources of support (Table 28). Forty-three percent of interviewees said that a family member or a friend was a consistent source of technology support for them. Seven percent found consistent support from a company or in a public institution. One older adult always receives technology tips from his barber. Another always asks for help from the employees at McDonald’s, where she regularly goes to drink coffee and use the wifi. Retired employees from the local university continue to go to campus for help using their university email accounts. Most older adults who have a consistent source of technology support, however, find it among their family and friends.

*No one source of support is enough***.** Although older adults frequently turn to family and friends for technology support, these experiences are not always positive. Indeed, discussing the topic frequently evoked feelings of frustration and shame among older adults. A frequent complaint centered on children giving older adults technology, but not providing them with the support they needed to use it. An older woman in her late 60s who participated regularly at Smith Senior Center said that her children

> get frustrated if I don't pick it up the first time …. My one daughter is pretty good but she explains once and she'll say "well I showed you that!" She's not very patient [laughs] …. My daughter thinks I should get it on the first try, and if not, oh she just gives up!

Many older adults seek technology support in their families, but not all find what they need there. As a result of this fact, some see technology helpers in public libraries and senior centers as surrogate children. One woman at Smith Senior Center described me to her friend as "like a patient grandson." Similarly, a woman at Metro Senior Center suggested I start a company called "grandsons" that would provide technology support for local older adults. She said older adults like her would be willing to pay for the support they want from their families, but were not finding there. These incidents show that older adults sometimes frame supportive helpers they find outside of the family in familial terms. These incidents further illustrate that older adults assume that technology support should be part of positive, loving, and intimate relationships.

Community-based information infrastructure includes families, friends, public libraries, senior centers, and other sectors of local communities where older adults seek and find technology support. When older adults do not find all the support they need in one place they look for it elsewhere. In this way, through their diverse help-seeking strategies older adults construct a community-based information infrastructure that is in fact more connected than the isolated information systems managed at each individual public library and senior center. Through their actions and memories, older adults extend this community-based information infrastructure across space and time.

C. Ageism structures community-based information infrastructure

Ageism shapes both community-based information infrastructure and older adult digital literacy. This section analyzes how public libraries and senior centers frame both older adult digital literacy and older adults in general in ageist ways. This will also be addressed in Chapter 5, which analyzes how older adults internalize ageist values that shape how they see themselves and their own digital learning and literacy.

To reiterate, ageism refers to the stereotyping of and discrimination against individuals and groups on the basis of their age. Ageism shapes this community-based information infrastructure in four ways:

- Rendering older adults invisible or unimportant;
- Conceiving of older adulthood exclusively as a time of disability and decline;
- Expressing ambivalence and antipathy toward older adults; and
- Reinforcing the idea that young people are the natural tutors of old people.

These ageist values, however, are not uncontested. I identified two counter tendencies: (1) older staff working with older adults in technology support services, and (2) older adults insisting on visibility in community-based information infrastructure.

Rendering older adults invisible or unimportant. One manifestation of ageism in these institutions are policies and practices that render older adults invisible or unimportant. At Branch Library, no programs or services of any sort are explicitly for older adults. Furthermore, policies and practices actively work against older adults seeking support with new technologies. In summer 2014, Branch Library acquired six new iPads, which it decided to reserve exclusively for youth. A sign at the circulation desk encourages patrons to "ask about checking out an iPad," but if a patron were to ask about this service they would learn that only those under the age of 18 can use them. This focus on youth and innovation at Branch Library also appears in program

statistics. On an average month, only 30 adults participate in adult library programs at Branch Library. By comparison, in an average month 730 youth participate in programs. Although older adults do come to Branch Library to use computers and wifi, their presence is not marked or acknowledged at an institutional level.

Conceiving of older adulthood exclusively as a time of disability and decline. When older adults are made visible in these sites, ageism often shapes this institutional portrayal. At Metro Library and Main Library services for older adults are a) homebound delivery services, b) assistive technologies in the computer lab, and c) partnerships with retirement communities. All three services frame older adulthood as a time of disability and decline. It is of course important that public libraries serve the disabled and the shut-in, but to conflate these situations with older adulthood is ageist. Confirming the idea that these libraries see older adulthood as a time of disability and decline, during a discussion about this dissertation with an adult services librarian, she said the primary thing the library wanted to know was what assistive technologies should be purchased to make it easier for older adults to use library computers.

Expressing ambivalence and antipathy toward older adults. The staff of these institutions also express ambivalence and even antipathy towards older adults. These attitudes shape how staff interact with older adults. The director at Metro Senior Center discusses changes she has seen at the center over the years:

> I would say the biggest change I have seen relates to the baby boomers. I hate to say this, but they are just more pleasant to work with. Before the boomers started retiring, and I hate to say this but it is true, those seniors used to be, well, grumpy, and sometimes just not pleasant to be around. They just wanted to play cards all the time, or crochet, and were very resistant to change. They just wanted things their way. Now the boomers they want to stay active and engaged in society. I like being around them. They are fun!

Similarly, a librarian at Metro Library vented her frustration about what she calls "curmudgeonly" older adults complaining about unwelcome changes they see in the library.

These ageist attitudes sometimes lead staff to discontinue programs used by older adults. At Smith Senior Center the director complained that older adults use the computer lab for what she sees as trivial purposes. Discussing why technology support services were discontinued there before I started my fieldwork, she stated that "just a few people used the technology, and they mostly just wanted to look up trivia for things like crossword puzzles. It just wasn't worth our time to continue the program." That is, she and other staff in the park district decided that what older adults were doing with the senior center's computer lab was not important enough to support and foster. A similar incident occurred at Metro Library when the Computers 101 class was discontinued in December 2014, despite being very popular and widely used among older adults. In both cases, ageist assumptions about the digital literacy of older adults led to the cessation of technology support services used by older adults.

Reinforcing the idea that young people are the natural tutors of old people. All six institutions rely on young university students to serve as technology volunteers, a structure that reinforces the idea that young people are the natural technology tutors of old people. This reinforcement is illustrated in one older woman's discussion of why she does not help other older adults with technology outside of technology support services at Metro Senior Center:

> I'm old! They [other older adults] don't want help from me! I get by with technology …. And if I get stuck I can figure it out. Usually. [Laughs] When it works it works. But when it doesn't. [Laughs] Help someone else here at the center? No, no, no. That is for you [young people] to do. You know this stuff in and out. What could I add?

The structure of relying on young technology tutors for older adults leads to bottlenecks when the number of older adults seeking support far exceeds the number of young people

available to assist. During an average technology support service at Tubman Senior Center, five older adults participate. In contrast, on average only two volunteers are available. Since older adults are socialized by the structure of technology support services to seek support from a young person, this situation leads to bottlenecks in which the supply of volunteers does not meet the demand. On especially busy days, when up to ten people came in for support from only two people, help sessions devolved into chaos as volunteers rushed from person to person, trying to make sure everyone received at least some support during the hour. In contrast, on one slow day at Tubman Senior Center only one older adult participated. She exclaimed "Thank God I have you to myself today!" I heard similar remarks at other senior centers, and at public libraries, when on slow days older adults did not have to compete for the time of young technology volunteers.

Counter tendency 1. Older staff working with older adults. A counter tendency occurs when older library staff support older patrons with technology. At Metro Library an older woman came to the adult services desk and started chatting with a librarian, who was herself an older adult who had retired from the local university and now works part-time as a reference librarian. During their conversation, the two older women discussed the frustrations they have had trying to stay up-to-date with phones. The librarian shared with the patron some of the tips she has used to learn to use her new smartphone. At Main Library a similar interaction took place between an older library technician (who retired mid-way through fieldwork) and an older patron. These examples illustrate how the aging library workforce (American Library Association, 2009) could in fact play a pivotal role in changing ageist attitudes through participation in technology support services.

Counter tendency 2. Older adults insisting on visibility. A second counter tendency emerges when organized older adults insist on visibility in community-based information infrastructure. This insistence can be seen in the organized agency of older adults who formed senior centers in the 1960s and 1970s. Through their actions, these older adults advocated for their interests at the level of the local municipality. They organized for equal public services against an ageist narrative that rendered them invisible.

All three senior centers grew out of multi-purpose, multi-generational community centers that, in practice, focused primarily on the needs of local youth. Older adults frequented these spaces because they too need public space. A newspaper article on the Tubman Community Center from 1971 quotes a leader of the Tubman Seniors stating that "we have all ages—8 to 80—crammed into this building. And when the youngsters arrive hollering and screaming, sometimes the senior citizens have to cut their activities short." This leader goes on to discuss how older adults feel pushed out of the building as young people enter and take it over. Similar tensions led to the creation of Smith Senior Center and Metro Senior Center. In these actions, older adults organized themselves against an ageist narrative that renders older adults and their needs invisible. Even though ageism shapes community-based information infrastructure, this structure is contested through the actions of older adults and others in their community who in large and small ways resist and counter ageist stereotypes.

D. Summary

In this analysis of community-based information infrastructure I found that older adults organize together and with other sectors of their local communities to create, advocate for, and participate in senior centers and public libraries. Far from passive users, older adults are active

agents in community-based information infrastructure. Older adults adapt technology support services at senior centers to their group-based communities of practice, and they insist upon support for personal devices at public libraries and at senior centers. In contrast, the staff of these institutions attempt to control technology support services by imposing bureaucratic limits that fetter the agency of older adults. Compounding this issue, older adults coping with digital inequalities find it difficult to lead these institutions into the information age.

Community-based information infrastructure is not limited to technology support services in these six institutions. It extends spatially to encompass other sectors of local communities where older adults find technology support and temporally to encompass the memories older adults have of these institutions. Over time, older adults have led and advocated for these institutions. The diminution of this leadership and advocacy in the present may lead to less robust public institutions. The effects of this transformation could affect not only older adults, but the entire communities in which they live.

The roles of older adults as leaders in their communities are rendered partially invisible by ageist structures that shape this community-based information infrastructure. Ageist structures led staff to frame older adults and their needs as unimportant. The structure of young people helping older adults with technology further reinforces the idea that young people are the natural technology tutors of old people.

On the other hand, Information infrastructure is forever evolving through the evolving and multiple relationships between information users and information systems. Counter tendencies I identified in this study, and which may become dominant tendencies in the future include:

- Older adults customizing computer labs;
- Older adults helping other older adults with technology;
- Older adults learning collaboratively with staff and volunteers;
- Staff bending and breaking rules in response to the agency of older adults;
- Older adults insisting on visibility against ageist narratives and structures; and
- Staff and older adults coping together with new technologies released in the global electronics marketplace.

These negotiations over community-based information infrastructure are important because through them a different form of community-based information infrastructure may emerge in the future. By recognizing and articulating these counter tendencies, shaped by older adults, this dissertation challenges deficit models of aging premised on the assumption that older adults need services created for them by younger individuals. In contrast, I found that with the right support, older adults are ready and eager to contribute to the development of technology support services. This eagerness extends the past involvement of older adults in these community institutions. I discuss the theoretical import of these findings in more detail in chapter 6.

CHAPTER 5. OLDER ADULT DIGITAL LITERACY

In this study of older adult digital literacy I found that older adults are determined and creative learners who with support integrate technology into the diverse rhythms of their lives. This reality can best be understood as what I term an *informatics lifecourse*. Referring to how a person learns technology through the stages of his or her life, this concept advances our understanding of digital literacy among older adults, and in general.

The informatics lifecourse is a portmanteau concept that combines the concept of the informatics moment (Williams, 2012) with the concept of the lifecourse (Hutchison, 2014). To reiterate, the informatics moment is "when a person seeks help in using some digital technology that is new to him or her" (Williams, 2012, p. 47). The lifecourse is "how historical time, social location, and culture affect the individual experience of each life stage" (Hutchison, 2014, p. 11). The informatics lifecourse is populated by many informatics moments, episodes of seeking, getting and offering help with technology. The accumulation of these moments over time affect how individuals experience each stage of their lives, and thus how life is lived.

Many informatics moments take place throughout life because digital literacy requires learning a changing array of technologies and digital applications. In the pre-digital age one could learn to read and write, that is, practice literacy, and then continue to read and write many years after having initially learned these procedures. In the digital age, however, literacy requires learning technology over time. An individual who learns Windows 3 in the workplace in the 1990s and then stops using technology upon retiring may then find that using a smartphone in the 2010s is quite challenging. Even those older adults who do not stop using technology for a period of time cope with the challenges associated with learning new digital technologies as they emerge.

The concept of the informatics lifecourse also informs our understanding of digital inequalities and the digital divide. For some individuals, informatics moments are a routine part of daily life. These individuals have digital literacy: They have integrated technology into their lives to the point that they are able to learn new technologies as they emerge by finding and getting whatever help they may need to learn how to use them. Other individuals, in contrast, have fewer informatics moments throughout their lives. For these individuals, digital literacy is more halting. They may use a particular technology with some fluency, for some period of time. When technologies change, or when their lives change, digital literacy is not maintained. Still others have not had the opportunity to learn technology until late in their lives. The concept of the informatics lifecourse illustrates the temporal dimensions of digital literacy and digital inequalities. To be digitally literate during one stage of life does not guarantee digital literacy at a subsequent stage.

To analyze older adult digital literacy as the informatics lifecourse, this chapter begins by discussing the commonalities found in the informatics lifecourse of participants in this study. I then discuss the diverse demographics found in this sample, and how this diversity affects the informatics lifecourse of older adults. I then discuss how in the many informatics moments of their lives older adults construct learning styles that they use to learn technology across time; these digital learning styles testify to the determination, creativity, and agency of older adults. Finally, I discuss how the informatics lifecourse is shaped by the stage of life called old age, arguing that retirement and ageism condition how technology is used in this stage of life.

This analysis of the informatics lifecourse concludes in chapter 6. There I answer this dissertation's overarching research question by illustrating how the informatics lifecourse is shaped within community-based information infrastructure. When community-based

information infrastructure is robust, older adults find ways to continue, or to begin learning technology. When this infrastructure is less robust, periods of digital disengagement occur, creating difficulties both for older adults and for social inclusion more generally.

A. Common tendencies in the informatics lifecourse of older adults

The sample in this study of older adult digital literacy consists of 209 older adults (Table 29), all of them participants in technology support services in three public libraries and three senior centers in one Midwestern metropolitan area. Through participant observation recorded in fieldnotes, I studied how older adults learn and use technologies in these spaces. I also interviewed 54 of these 209 older adults. Those interviewed are here referred to as "interviewees" to distinguish them from the full sample. The data from interviewees enables me to contextualize what I learned during participant observation within the life histories and backgrounds of these individuals.

	Older adults
Interacted with during fieldwork, interviewed	54
Interacted with during fieldwork, not interviewed	155
All	209

Table 29: Sample of older adults.

The course and shape of the informatics lifecourse of older adulthood found in this sample features many commonalities, including:

- Most older adults own at least one digital device;
- If an older adult has a consistent source of technology support, it tends to be a family member or a friend; and
- Communication and cultural practices shape the digital practices of older adults.

Most older adults own at least one digital device. Older adults own and use a diverse array of digital devices. Table 30 displays the devices that the sample owns and used at senior centers and public libraries during fieldwork. In addition to owning desktop computers located in their residence, at least one quarter (26%) of the sample owns a laptop, 15% own tablets, and 14% own smartphones. Others own audio-visual devices such as mp3 players or digital cameras (10%) and flip-phones (4%), while 9% own flash-drives. At least 1% owns a printer. Table 30 represents a conservative estimate of the devices these 209 older adults own; it only represents the digital devices that older adults used during field sessions at the six institutions studied. This sample most likely owns other devices not used during fieldwork.

	Percent of older adults that used during field sessions
Laptops	49%
Tablets	29%
Smartphones	26%
A/V devices	19%
Flash drives	17%
Flipphones	8%
Printers	1%

Table 30: Personal devices used in technology support services, in sample. n=209.

Among interviewees, all 54 older adults own at least one digital technology. Ninety-four percent own a digital mobile phone, 81% own a computer, 54% own an audio-visual device, and 44% own a tablet device (Table 31). These findings illustrate that for most of these older adults, access to and ownership of technology is not a hurdle to participation in the information society.

	Percent of older adults that own (n=54)
Phones	94%
Computers	81%
A/V devices	54%
Tablets	44%

Table 31: Personal devices owned, among interviewees.

If an older adult has a consistent source of technology support, it tends to be a family member or a friend. Family and friends are the most consistent source of technology support among older adults. Forty-three percent of interviewees say they have a friend or a family member they can consistently turn to for support with technology (Table 32). Companies (e.g., technology support divisions of companies like Best Buy, AT&T, and Verizon) and public institutions (e.g., senior centers, public libraries, and community colleges) are primary sources of support for 7%. Forty-three percent of interviewees say they have no consistent source of technology support.

	Family & Friends	Company	Public institution	None
Older adults' consistent source of technology support (n=54)	43%	7%	7%	43%

Table 32: Consistent sources of technology support, among interviewees.

Communication and cultural practices shape the digital practices of older adults. The most common digital practices observed among older adults in this sample center around communication and culture (Table 33). Fifty-one percent of the sample uses digital technologies for communication purposes. The second-most-common digital practices are cultural pursuits (42%), such as photography, travel, and cooking. The third-most-common practices center on

economics (17%), including finding jobs, managing finances, and buying and selling online. Finally, the least common practices center on medical issues (3%), such as looking for information on nutrition and diabetes, as well as browsing personal medical files made available online through hospitals and clinics.

	Communication	Culture	Economics	Medical
Focus of older adults' digital practices	51%	42%	17%	3%

Table 33: Focus of digital practices, in sample. n=209.
Percentages exceed 100 because older adults did multiple types of things with technology during fieldwork.

Tables 34 illustrates the most common ways this sample integrates technology into their lives. These frequencies are conservative estimates and represent observational data collected during fieldwork; it is likely that larger percentages of older adults use technologies for these purposes. Nonetheless, the trends revealed show some of the more and less common tendencies in the digital practices of older adults. The most popular practice, email, was found to be used by 41.1% of participants. More than twice as many older adults use technology for email than for any other purpose. This finding affirms other scholars, who have found that email is very popular among older adults (Sayago & Blat, 2010). After email, the next most popular practices involve photography (17.2%), word processing (14.8%), Facebook (14.8%), jobs and employment (10.0%), buying and selling online (10.0%), music (8.1%), and managing finances (7.2%). In addition to these practices, older adults were found to use technology for a diverse array of other activities. Other digital practices found among older adults during fieldwork include:

- E-mailing a home-made Christmas card;
- Creating a book of favorite recipes;

- Working on memoirs;
- Digitizing photograph and slide collections;
- Researching family, local and national histories;
- Creating church newsletters;
- Researching quilting patterns;
- Connecting with friends on Facebook; and
- Collaborating with community groups on projects.

Digital practices	Older adults (n=209)
Email	41.1%
Photography	17.2%
Word processing	14.8%
Facebook	14.8%
Jobs/employment	10.0%
Buying/selling	10.0%
Music	8.1%
Managing finances	7.2%
Videochat	6.2%
Maps	6.2%
eBooks	4.8%
Videos	6.7%
Recipes	3.3%
Medical information	3.2%
Games	1.9%
Genealogy	1.9%
Bible	1.9%
Weather	1.4%
Quilting	1.4%
Digitizing	1.4%
News	1.0%
Translating	0.5%
Movie making	0.5%
Searching library catalogs	0.5%
Finding housing	0.5%
Sports	0.5%

Table 34: Things older adults do with technology, in sample.
Older adults often do multiple things with technology, hence the percentages exceed 100%.

Photography was the second most popular digital practice found among older adults. I found that older adults enjoy taking, sharing, and accessing digital photographs. One older woman uses a digital camera she has meticulously maintained since she purchased it in the mid-2000s. When she does not use it, she places the camera back in the box it came in. She initially bought the camera to take pictures at a relative's wedding, but has since used the camera to document many facets of her daily life. She took many photographs of her dog, the only companion at her house for the last ten years. When her dog passed away, she wanted to learn how to organize her photographs so she could see all the photographs of her dog together. After learning to tag photographs, she launched a slideshow of photographs of her dog that she watched over and over again. She especially enjoyed seeing those photographs that included both her dog and her great-grandchildren together. For this woman, photography connects her to her family and adds to her memories of the past. In this way, photography helps her maintain connections to her culture over time.

Photography also plays a role in her communication practices. Now that she has learned to manage her digital photographs, she brings her laptop to the house of an older sister, who does not use digital technology, to show her images of family and friends. Other family and friends regularly email her new photographs, which she then integrates to the digital photography collection she maintains on her laptop. Through these practices, this woman has found creative ways to integrate technology both into her own life, and into the lives of those around her. This narrative illustrates the common theme of older adults finding creative ways to integrate technology into cultural and communication practices.

B. Older adults are diverse

Both in this sample and in the USA in general, older adults are diverse. The American Library Association (2008) states that: "The current population of older adults is the most heterogeneous in U.S. history" (p. 1). Older adulthood in the USA includes individuals of diverse ages, ethnicities and social class backgrounds. These different backgrounds shape how older adulthood is experienced and lived. As a result, these differences affect the shape and texture of the informatics lifecourse.

In the field of library & information science, the dominant approach to understanding diversity in older adulthood has been to segment this population by age and ability. Williamson & Asla (2010) study what they call the fourth age, those very old individuals coping with issues of dependency and disability. Schull (2013) instead studies active, aging baby boomers born between 1946 and 1964. Rather than focus primarily on these dimensions of older adulthood, I instead focus on how social class and ethnicity, along with age and gender, shape the informatics lifecourse.

Both in the sample, and among interviewees, there were more women than men. Women accounted for 69% of the full sample, and 70% of those interviewed. This fact may relate to the fact that women live longer than men in the USA (U.S. Census Bureau, 2010). The gender balance in the sample and among those interviewed reflects the demographics of public libraries and senior centers. According to membership lists, women constituted 79% of the membership of the senior centers studied. In a study of how gender affects public library use, Applegate (2008) found that women constitute 68% of the library-going public. This baseline suggests that the gender balance of this study reflects the gender balance of those who participate in public libraries and senior centers.

In the sample, 59% were European American, 38% were African American, and 3% were Asian American (Figure 4). No people of Hispanic or Native American descent participated. Since the primary ethnic difference found was between African Americans and European Americans, that difference is focused on in this chapter. In the sample, European Americans were older (average age 74), and African Americans younger (average age 70).[15] The overall average age was 72. Most participants (74%) were in their 60s and 70s, with the largest part of the sample (27%) composed of those aged 75–79. A smaller number of individuals aged 85 and older (4%), and aged 59 and younger (9%), also participated in this study. To understand how age relates to other dimensions of diversity among older adults, I follow researchers in the Pew Internet & American Life Project (Smith, 2014) and for analytical purposes divide the sample into the young old, those aged 50 to 74, and the older old, those aged 75 and older.

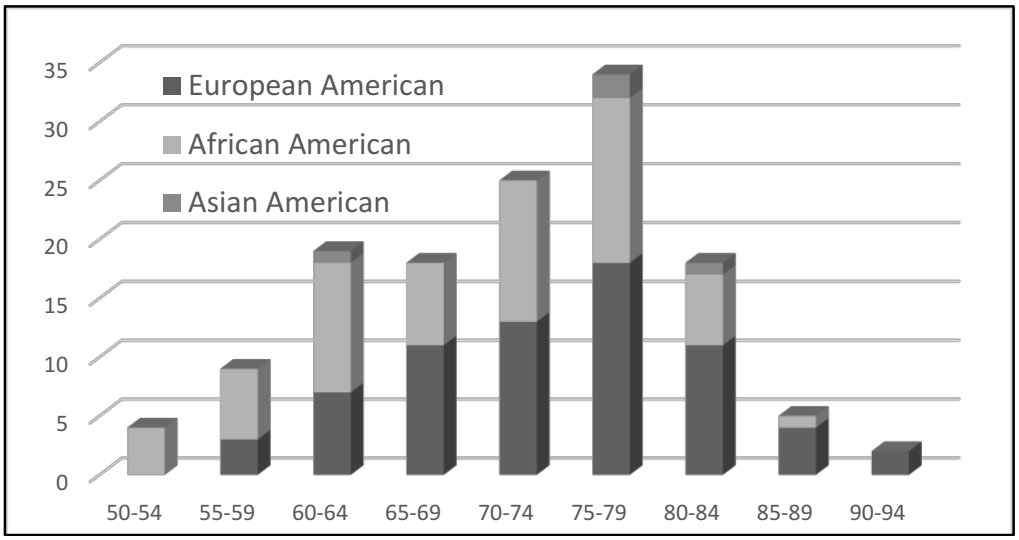

Figure 4: Ages and ethnicities in sample. Age not collected from 74 participants, n=135.

[15] Due to the complexities of fieldwork, the ages of participants were not collected from all in the sample. "Age" was only collected from 135 of the 209 individuals who participated in fieldwork. The averages reported in this paragraph, and in figure 4, report on the 135 individuals who provided me with their ages.

Sub-dividing the population of older adults by age needs to be done with caution. In a parallel study conducted by the Community Informatics Research Lab in fall 2015, we found that residents in a local retirement community tend to be older than the sample in this dissertation. Most individuals there were in their 80s and early 90s (Figure 5). Figure 5 shows that especially between the ages of 75 and 85 there is substantial overlap between the two samples, suggesting an overlap between the population of older adults who live in retirement communities (who tend to be older) and the population of older adults who participate in public libraries and senior centers (who tend to be younger). More research is needed to understand the different life stages that may be emerging within the older adult population in the USA.

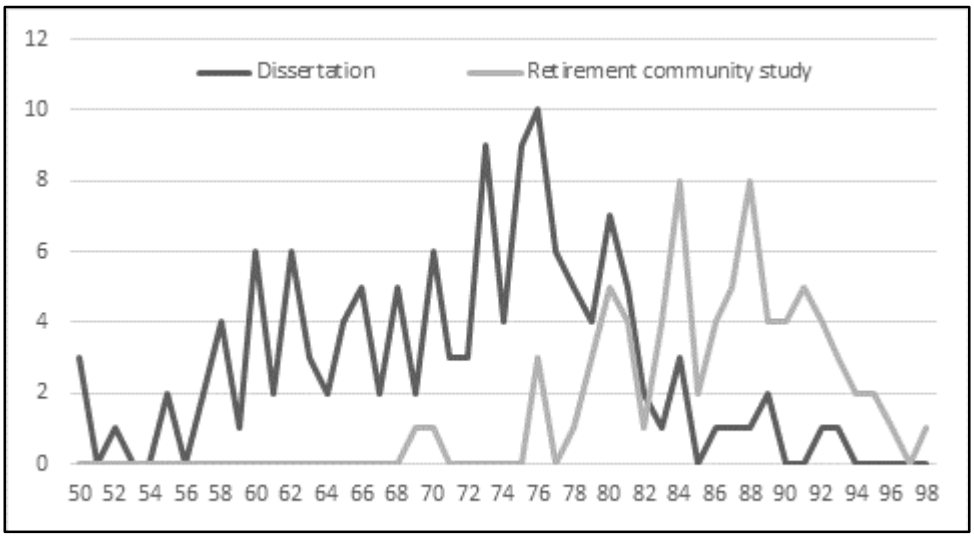

Figure 5: Ages in samples of two studies of older adults. Dissertation sample, n=135, against sample from retirement community study, n=76.

National level data suggest that social class is also a key determinant of how older adults access and use digital technologies (Silver, 2014; Smith, 2014). Using the framework of intersectionality (hooks, 1994), I frame social class as intersecting with and overlapping with other dimensions of social difference. For instance, ethnic differences intersect and overlap with class differences. In this study, I operationalize social class as the work background of the

individual. In interviews, older adults said what their job was. All 54 interviewees worked in the paid workforce. Their answers were reduced to the categories of blue-collar, pink-collar, and white-collar, based on the typology used by Van Horn and Schaffner (2003) to discuss work and social class in the USA. Blue-collar jobs are those that center on skilled and unskilled manual labor, including manufacturing, other factory work, custodial, construction, and cooking. Pink-collar jobs are those that center on the service industry, usually involving interpersonal interactions in office, educational, retail, and nursing environments. White-collar jobs are those that involve professional, managerial, or administrative work.

Seventeen percent of interviewees have blue-collar backgrounds, all but one of them African American (Table 35).[16] Thirty-one percent of males, but only 11% of females, have blue-collar backgrounds (Table 36). Table 37 shows that blue-collar workers tend to be younger than those of other backgrounds: all but one of the blue-collar workers is in the younger old group. The absence of older blue-collar individuals among interviewees may relate to a lower life expectancy of these individuals. Researchers have found that people with blue-collar backgrounds tend to die before their peers (Geronimus, Bound, & Colen, 2011). In the USA, furthermore, the average life expectancy of African Americans is 74 years, against 79 years for European Americans (U.S. Census Bureau, 2010). The intersection of these two trends (social class and ethnicity) may have contributed to the absence of older blue-collar individuals in this study: There were less of them to interview because of differences in how long people live in the USA.

[16] Discussions with older adults during fieldwork suggest there were at least a half dozen European Americans in the sample of 209 that also had blue-collar backgrounds. For instance, some discussed careers in construction, the manual trades, and in the military. One older European American man was also looking for a part-time job as a delivery person for a pizza chain.

	Blue-collar	Pink-collar	White-collar	n
African American	35%	57%	8%	23
European American	3%	53%	44%	30
Asian American	0%	0%	100%	1
All	17%	54%	30%	54

Table 35: Ethnicity by social class, among interviewees.
Percentages in rows does not sum to 100% because of rounding.

	Blue-collar	Pink-collar	White-collar	n
Male	31%	13%	56%	16
Female	11%	71%	18%	38
All	17%	54%	30%	54

Table 36: Gender by social class, among interviewees.

	Blue-collar	Pink-collar	White-collar	n
Younger old (50-74)	29%	46%	25%	28
Older old (75+)	4%	62%	34%	26
All	17%	54%	30%	54

Table 37: Age by social class, among interviewees.

Fifty-four percent of interviewees have pink-collar backgrounds (Table 35). Among interviewees, 71% of women had pink-collar backgrounds while only 13% of men had such careers. Historically, pink-collar jobs have been filled by women, which is why the term "pink" has been applied to this type of work (Van Horn & Schaffner, 2003). African Americans and European Americans are equally likely to have a pink-collar background.

Thirty percent of interviewees have white-collar backgrounds. There were slightly more white-collar workers in the older old group than in the younger old group. Only 8% of African Americans had white-collar careers, while 44% of European Americans had this background. The one Asian American interviewed, a woman, had a white-collar job. Fifty-six percent of men, but only 18% of women, had white-collar careers. These findings suggest that among older adults

there is class disparity both in terms of gender and ethnicity. White males are the most likely among interviewees to have had white-collar backgrounds.

C. Diverse lives lead to differences in the informatics lifecourse

Patterns of diversity in the lives of older adults lead to differences in the informatics lifecourse of this sample. Three areas of difference emerged as particularly salient:

- Diverse patterns of device ownership;
- Diverse patterns of technology support; and
- Diverse digital economic and medical practices.

Diverse patterns of device ownership. Among interviewees, African Americans tend to have more audio-visual devices (mp3 players, digital cameras), while European Americans tend to have more tablets (Tables 38). This finding may relate to the fact that European Americans tend to have greater financial capital than African Americans in the USA. It is possible that European Americans have been better able to transition from the increasingly obsolete technologies of audio-visual devices to the increasingly standard multi-purpose tablet technologies (Smith, 2014), which include the functions of diverse audio-visual devices.

	Phones	Computers	A/V devices	Tablets	n
African American	100%	83%	74%	26%	23
European American	93%	80%	40%	60%	30
Asian American	0%	100%	0%	0%	1
All	96%	81%	54%	44%	54

Table 38: Device ownership by ethnicity, among interviewees.

Age, gender, and social class also relate to patterns of device ownership. Across all device types (except audio-visual devices), the younger old have more technologies than the older old (Table 39). This tendency suggests that baby boomers have been better able to stay up-to-date with technology than older cohorts. Men tend to have more phones and computers

than women (Table 40), but women tend to have more audio-visual devices than men. Blue-collar individuals have the least access to tablet technologies (Table 41) and are also less likely than both pink-collar and white-collar individuals to own computers.

	Phones	Computers	A/V devices	Tablets	n
Younger old (50-74)	100%	89%	54%	46%	28
Older old (75+)	88%	73%	54%	42%	26
All	96%	81%	54%	44%	54

Table 39: Device ownership by age, among interviewees.

	Phones	Computers	A/V devices	Tablets	n
Male	100%	94%	31%	44%	16
Female	95%	76%	63%	45%	38
All	96%	81%	54%	44%	54

Table 40: Device ownership by gender, among interviewees.

	Phones	Computers	A/V devices	Tablets	n
Blue-collar	100%	66%	44%	0%	9
Pink-collar	93%	83%	62%	48%	29
White-collar	100%	88%	44%	63%	16
All	96%	81%	54%	44%	54

Table 41: Device ownership by social class, among interviewees.

Diverse patterns of technology support. Although all older adults interviewed have access to technology they own, they do not all have access to consistent support with that technology. Forty-three percent of older adults do not have someone they can turn to consistently for help with technology, with men being less likely than women to have someone who fulfills that role (Tables 42). This discovery may relate to the fact that older men live more socially isolated lives than older women (Steptoe, Shankar, Demakakos, & Wardle, 2013).

	None	Family & Friends	Company	Public Institution	n
Male	56%	25%	19%	0	16
Female	37%	47%	3%	13%	38
All	43%	43%	7%	7%	54

Table 42: Primary source of technology support by gender, among interviewees.

	None	Family & Friends	Company	Public Institution	n
Blue-collar	67%	33%	0%	0%	9
Pink-collar	40%	48%	0%	14%	29
White-collar	38%	38%	25%	0%	16
All	43%	43%	7%	7%	54

Table 43: Primary source of technology support by social class, among interviewees.

Those with blue-collar backgrounds are the least likely to have someone they can consistently turn to for support with technology (Table 43). No major variations emerged in relation to ethnicity and age. These findings suggest that older adults navigating digital inequalities cope with the challenge of finding technology support. Among older adults, accessing technology support is more of an issue than accessing technology. Furthermore, the diverse lives of older adults relate to the accessibility of technology support. Those with blue-collar backgrounds, and men, are less likely than those of other social class backgrounds, and women, to have consistent sources of technology support.

Diverse digital economic and medical practices. Although less than culture and communication, economics and medicine also shape the digital practices of older adults. No major variations based on ethnicity, class, gender or age were found to shape how older adults use technology for culture or communication. Variations were found, however, in the digital economic practices of older adults. How these practices develop relate to differences in gender, class and ethnicity. Older African American women, mostly of blue-collar backgrounds, were found to look for, and to need, paid work in retirement. In contrast, older European Americans,

mostly of white-collar backgrounds, were found to use technology to manage personal finances (Table 44). Eighty-one percent of those in the sample using technology to search for jobs were African American, while only 7% of those using technology to manage finances were African American.

	Jobs (n=21)	Finances (n=14)
European Americans	19%	93%
African Americans	81%	7%

Table 44: Economically oriented digital practices by ethnicity, in sample.

Older women with blue-collar backgrounds play important roles in extended families that continue to rely on them for economic and social sustainability. One African American woman aged 69 is the only person in her extended family who owns a car. She is responsible for transporting multiple generations of her family to appointments and to work. A 74-year old African American woman is the primary caregiver for her 11-year-old grandchild. A third African American woman, aged 73, is the only person in her extended family who owns her home. When economic pressures become insurmountable for those in her family, they turn to her for temporary housing. All three of these women have blue-collar backgrounds. In contrast, those managing finances tended to have white-collar backgrounds, and tend to be European American men.

Issues related to medicine and engagement in the healthcare system also shape the digital practices of some older adults. After communications, culture and economics, medical practices were the least common practices found among older adults. Some older adults search for information related to conditions like diabetes. Two older adults were told they could access medical files from a local hospital's website. They wanted help accessing these medical files. At

Main Library, an older couple new to the area came there for help searching on the classifieds website Craigslist for an apartment to rent. They said they would be living in the urban area temporarily for at least six months because the husband had a stroke and would need intensive monitoring and physical therapy. They were currently staying at a motel but could not afford to stay there the entire time they would be living in the city. They needed an inexpensive apartment that was accessible for people with disabilities, but they did not know how to find one online.

Although the research literature related to older adults and digital technology focuses on developing assistive technologies to help older adults cope with their supposedly declining minds and bodies (Bowen, 2012a), most older adults in this sample are capable of using technology without assistive technologies. Assistive technologies include devices such as special mice for people with difficulties controlling their hands and special software for people with difficulty interacting with digital interfaces.

Although not common in this sample, some older adults do require assistive technologies. Three individuals had caregivers accompany them to the sites. A man in his early 90s came to Smith Senior Center with his full-time caregiver. Another man in his late 60s came to Metro Senior Center with a part-time caregiver. A third older man in his early 90s came to the Main Library with his caregiver. All three required assistive technologies to help them use digital technologies. They used special mice and keyboards, as well as ZoomText software, to make standard consumer technologies easier to use. No other individuals in this sample of 209 older adults, however, were found to require any assistive software or peripherals.

That being said, many older adults do not require but utilize and benefit from non-obtrusive assistive technologies. Especially common and popular were styluses designed to

make it easier to interact with touchscreens without having to use one's fingers. One woman who had recently been given an iPad by her children for Christmas purchased a stylus as soon as she heard about it. She said that the stylus made it much easier for her to use the device. This finding also illustrates how older adults integrate technology into their diverse lives. A small minority of older adults in this study required and utilized assistive technologies. Other older adults no not require, but nonetheless decide to use some assistive technology, such as styluses, that enable them to use new technology with greater fluency. With support, older adults find and learn to use the assistive technologies that make sense to them in the context of their lives.

D. Through informatics moments older adults develop digital learning styles

Older adults are determined and creative learners. They learn technology on diverse devices, and through diverse procedures. Older adults draw on notes and manuals to supplement the many informatics moments of their lives. They use these tools to remember and to repeat procedures. Furthermore, as the informatics lifecourse proceeds, older adults apply learning practices developed earlier in life to learning technology in old age.

Learning technology by learning tasks and activities. Older adults learn technology by learning a diverse array of tasks and activities. Table 45 displays the tasks and activities older adults learned to do during informatics moments in which I participated. The most common activity was simply starting with a new device the older adult had not used before, or had used minimally. This activity was seen among 43% of the sample. No major variations emerged based on gender, age, ethnicity, or social class.

After older adults start using a new device, they learn to do a diverse array of computing processes on them (Table 45). Twenty-five percent of the sample learned how to search and

browse for information online. Sixteen percent learned about passwords and account management issues. Other common tasks and procedure learned include how to connect to wifi networks (12%), how to manage files (11%), and how to manage programs and applications (11%). Others learned about syncing devices (8%), texting/voicemail (6%), computer vocabulary (5%), how to type and use a mouse (3%), cybersecurity issues (3%), data plans (1%), and calendars (1%). Table 45 is a conservative estimate of the frequency of these types of tasks and activities learned among older adults, as it only reports on what was observed during field sessions. The table does not report on all the learning activities older adults undertake in daily life. Nonetheless, this table suggests some of the more common computing tasks and activities older adults learn as they integrate technology into their lives.

Tasks and activities older adults learned in informatics moments, as observed during fieldwork	**Older adults (n=209)**
Starting with new device	43%
Browsing online	25%
Passwords and account management	16%
WiFi	12%
Managing files	11%
Managing programs	11%
Syncing devices	8%
Texting/Voicemail	6%
Learning computer vocabulary	5%
Typing/Mouse	3%
Cybersecurity	3%
Data plans	1%
Calendars	1%

Table 45: Tasks and activities older adults learned in informatics moments, in sample.

In general, learning to find information online, connect to wifi, and manage passwords, files and programs are common digital learning activities among older adults. Also notable is the fact that only 3% of older adults were learning basic procedures like typing or using a mouse, suggesting that many older adults have moved beyond these basics and are now coping with issues involved with device and account management and ownership.

Notes and manuals supplement informatics moments. As older adults transition from one device to another device, they cope with the fact that most recently released digital devices do not come with print manuals. In the past, older adults frequently utilized print manuals when learning something new. Technology manuals and handbooks are highly valued among older adults. During 46 field sessions I heard older adults say they wished their devices came with print manuals. In an interview, one participant said:

> Sometimes I make notes and I love the manuals. But now the manuals are all online. But then you have to turn off the instructions to do things on the computer. And that's crazy! Who can do that? I love the paper in front of me and I love the little manuals.

Older adults cope with the fact that new devices do not come with print manuals by seeking substitute manuals. When they cannot find these manuals they create them through their note-taking practices. At Metro Senior Center older adults discussed techniques they use to find handbooks when devices do not come with their own manuals. These strategies included going to bookstores and libraries to look for them. One woman said that, based on the recommendation of a friend, she started looking for handbooks in the children's department of her library. She said that she finds handbooks in the adult department assume too much prior knowledge of technology. These older individuals value print instructions that explicitly spell out step-by-step procedures, without assuming any prior knowledge of the topic discussed.

Older adults also take notes as they learn technology in informatics moments. When asked what helps them learn technology, 30% (Table 46) said that taking or having notes is helpful. Six percent also find that understanding the conceptual foundations of processes helps them. To understand these conceptual foundations older adults also frequently turn to books, and make notes on new concepts discussed during informatics moments.

	Percent stating (n=54)
Practicing processes learned	60%
Taking or having notes of processes	30%
More one-on-one help	14%
Understanding conceptual foundations	6%

Table 46: What helps older adults learn technology, among interviewees.
Percentages exceed 100% because multiple answers were given. Categories reduced from open-ended responses of interviewees.

Beyond seeking and creating print instructions for technical procedures, older adults also value the opportunity to practice using technologies in safe and supportive places. Sixty percent of interviewees said that being able to practice processes helps them learn. Fourteen percent also said one-on-one support aids their learning process. One woman stated that:

> Before someone sat down and helped me with my iPad, it just sat in the closet. My daughter bought it for me. She went over some things over Christmas, but then she left, and I couldn't do anything. I wanted to, but the thing you have to realize is that for seniors… We need to go over things multiple times. Once isn't enough. It is great having someone to practice with.

One man said that he thought it would be a great idea to start a group of older adults who could practice together with new technologies:

> I wish there was some kind of network of seniors, people like me. If we could get together and practice these skills. It is great to have the opportunity to learn how to do things like Skype, but if you don't practice it, it's gone. Use it or lose it. That is true, you know. And my kids just don't have patience.

Six other interviewees also independently said “use it or lose it” in response to a question about their approach to digital learning, suggesting this idea has become a common part of the repertoire of popular thinking among older adults about digital learning.

Older adults value print instructions, and when they do not exist, they create them through note-taking practices. Older adults also value being able to practice with technologies, and they are especially appreciative of supportive spaces in which to practice these processes.

Informatics moments lead to the development of digital learning styles. Through practice, older adults integrate pre-digital learning practices into digital learning styles. One of the most frequent participants in this project, a 78-year-old African American man who came 69 times to technology support services at the Tubman Senior Center, developed over time a note-taking style that worked for him. He would first ask a volunteer to help him understand a new task, such as how to create a table of contents in a digital document. He would have the volunteer show him the process, usually at least twice. Then on his own he would write down all the steps involved in a notebook. He would use his own language in a form that made sense to him. After confirming that his instructions worked by trying them out, he would then type these instructions into a document on his laptop. This document contained all his instructions for procedures he had learned. He would then, on his own, follow the instructions he had typed into the document to confirm that they made sense to him. If he could not figure out how to do a procedure based on his notes, he would call a volunteer over to him. He developed this note-taking strategy because he said that when he first started coming to technology support services he would forget everything he learned between sessions: “If I don’t write it down, it’s gone. Tomorrow I will wake up and try to do what we discussed, but I won’t know where to start.”

Other frequent participants in technology support services developed different learning styles. Larry is a man in his early 60s with a blue-collar background who started learning technology for the first time in his life in retirement. He came at least 45 times during fieldwork to Main Library and to Tubman Senior Center to learn how to use a smartphone purchased for him by his daughter in winter 2013. When Larry started learning to use his smartphone his approach to learning was similar to that of Monty, a man who used to use a desktop computer on the job, but who stopped using technology when he retired. Describing Monty's learning style during his first field session at Smith Senior Center, I wrote in my fieldnotes that

> *At one point he said he wanted to know what EVERYTHING in internet explorer symbolizes, every button and every option on the drop-down menus. We then talked for a bit about needing to see selectively online - tune out ads, tune out irrelevant things, to just focus on what he wanted to do, didn't need to know what EVERYTHING did to be able to successfully use computer.... But that left him feeling a bit anxious and disoriented*. (Appendix C)

When Larry first started coming to technology support sessions, this description of Monty's learning style encapsulates his approach to learning technology then. Larry's learning style evolved over time as he learned to trust his own ability to figure things out without having someone walk him through every step and without having mastery over the entire technological environment. During a three-month period in early 2015, he came more than twice a week to Tubman Senior Center and to Main Library to work with volunteers and with staff at the library to learn how to use his smartphone. He made a trip out of town for a month in early April, and when he came back he said that the break away from technology support services really helped him learn. He said, "You know, that time when y'all was not available because I was out of town, that time was really important. I learned to figure some things out for myself. I couldn't before, but now I feel like I can do what I need to do." Previously, whenever Larry got stuck he would

turn to the sites. Now, Larry feels comfortable enough to figure things out mostly on his own. He still comes to the sites for support, but he has also developed a digital learning style that enables him to learn independently as well.

Developing these learning styles takes a long time, many informatics moments, and considerable trial-and-error. An older adult in his late 50s often came to Branch Library in the mornings to use the computers. He describes himself as "semi-retired, but looking for a job to make ends meet." While working on a project to print and compile track-listings for albums he owns in his record collection, he tried over and over again to come up with a definitive list of instructions. He had very little experience with internet browsers, word processing, or the computer in general. As a means of coping with this unfamiliar environment, he tried to record all the steps involved. When I first met him, he had a handwritten list of instructions a staff member at the library had helped him put together the previous week. Whenever an obstacle arose that required him to diverge from the list of instructions, he did not know what to do.

Over time, and with lots of practice and reassurance from myself and from other staff both at Branch Library and at Metro Library (where he also went regularly), he became less reliant on his notes. Through trial-and-error, he learned that no one list of instructions would definitively prepare him for the challenges of finding track-listings online, copying-and-pasting them from the internet into a word document, formatting the information to fit on a single page without any extraneous information, and then printing it. Over time, as he became more familiar and comfortable with browsing the web and word processing he became less reliant on his notes and more capable of performing his project on his own. The notes, combined with the support he finds at the libraries, provide the reassurance he needs to continue integrating technology into his life.

Another story illustrates the diverse learning styles older adults develop. Similarly to Larry, Emma started learning technology for the first time in her life in her early 60s after she retired from a blue-collar career as a cook. Learning that technology support was available at her senior center, she came to three field sessions in fall 2014 to learn the keyboard and mouse. Having learned these basics, she felt satisfied and did not return to another technology support session until March 2015, when she decided to start learning more. After an open discussion about what she could do with technology, she decided to try using Facebook. Facebook is now the one and only thing she does with technology. She enjoys getting on Facebook at the senior center, and she relies on volunteers to turn on the computer for her and to log her in. Once on Facebook, she has learned that by pressing the "down" button on the keyboard she can scroll through recent information posted to the social networking site by her friends. Emma learned the minimal skill needed (how to press "down" on the keyboard) to be able to use technology in a way that fits into her life. She is content with this level of digital literacy, and has decided that for the time being this activity is what she wants to do. This story reminds us that digital learning does not need to lead to a pre-conceived outcome, but will rather take diverse forms based on the backgrounds and interests of older adults.

Informatics moments in the informatics lifecourse: The story of Delores. To illustrate and extend the findings discussed above, this section on informatics moments and learning styles concludes with an in-depth analysis of the informatics lifecourse of a particular individual. Delores is an African American woman aged 73. This narrative formed across 35 interactions I had with her during field sessions at Tubman Senior Center and at Branch Library. I also interviewed her in July 2015. I continued to hear updates about her life during informal visits to the senior center in fall and winter 2015.

Delores worked as a secretary in a local school district until 2005. As part of her job she learned how to use a Windows desktop computer, primarily for word processing and for data entry. This learning was structured by on-the-job training, beginning in 1995. Her learning of computers was structured by her use of a typewriter prior to the introduction of digital technologies into her workplace. She said she used computers as part of her job "almost every day" from 1995 to 2005.

During this time period, Delores never purchased a computer or used technology outside of her paid employment. When she retired from her career in 2005, she stopped using technology entirely. She said she "wanted to put that part of my life behind me." For her, technology was not a source of pleasure. She said that between 2005 and 2014 she "never touched the computer, didn't wanted to touch the computer, didn't want anything to do with the computer."

In her retirement, Delores lives alone in a senior public housing building. She is active in a residents group based in her apartment building as well as in the Tubman Seniors, in a book club based at Branch Library, and in her church. She also volunteers throughout her community, including as an elections monitor. She has no living children; her one daughter died in her early 20s.

In early 2014, Delores learned that in the fall she would have to use a laptop to fulfill the duties required of an election monitor. This work involves checking people in to vote at polling places. Worried about her inability to use the laptop, she started coming to Tubman Senior Center in September 2014 to learn what she called "the basics. I felt like I had to start over." I wrote in my fieldnotes during the first field session I had with Delores:

> *Delores said she remembered using the keyboard and the mouse when she worked. But that was years ago. She said she didn't feel ready to do the monitor duties. She said wanted to start over from the beginning. I could not assume any prior computer knowledge. We had to go over everything - how to hold the mouse, how to type, how to turn on the computer. She wanted to go over it all.*

Because it had been so long since she used technology, Delores felt like she had to learn technology as a novice. Over a two-month period, she came once a week to the senior center. She did not own a car, so she got a ride from a friend or took the bus. During that two-month period she focused exclusively on online typing exercises. She used an online typing program for an hour during each session. Once in the program, she could work independently. However, she found the procedures required to access the program difficult to implement. I wrote in my fieldnotes after one session:

> *Delores was having great difficulties getting logged in - the procedures continue to confuse her and she was having trouble typing in the passwords as written. Once she gets into the typing program she does just fine - I don't need to offer any help really.*

After another session I wrote:

> *Delores needed a lot of hand-holding to get logged in and it was a bit frustrating and trying when she continually failed to enter the right password or figure out how to type an address into the browser.*

The experiences of these informatics moments were frustrating for Delores as well. One day when I arrived I found Delores and her friend talking "*about the importance of having an attitude of wanting to learn and keep pushing forward with technology*." In order to push past the frustration that came from having to learn technology all over again, Delores summoned and sustained a determined attitude as part of her learning style.

In November 2014, Delores used her digital literacy when she fulfilled her duties as an election monitor. I talked with her during a field session after the election and wrote in my fieldnotes that

> *Delores was extremely pleased with herself for being able to use the computer at the election polling place she worked - and indeed her typing was quite good - she had really learned a lot about typing.*

Bolstered by this success, she decided to purchase her first electronic device. She went to Best Buy and bought a laptop a week after the election. However, after the purchase she felt paralyzed. She said, "I did not know where to start. I just could not get the courage to open that box. It sat in my closet for months."

It was not until March 2015, four months after she purchased the laptop, that Delores started learning to use it. The turning point came when Delores heard about a seniors and technology workshop to be held at her senior center and run by students in a community informatics course at the local university. The students would work one-on-one with the Tubman Seniors for two hours to help them with whatever they wanted to do with technology. When Delores heard of this workshop, she said to herself "OK, now is the time. I need to do this. And I will do this." After working with a student for two hours to get started learning her laptop, Delores started coming regularly again to the senior center to learn how to use it.

This learning process was difficult and full of frustration. She had trouble accessing the wifi available in her apartment building. She was not able to access that wifi until May 2015. She also wanted to learn how to set up and use email, how to search for information, how to print, and how to play DVDs and music on her laptop, as well as other applications.

As a well-connected woman in her community, Delores turned to many sources of support as she learned to use her laptop. One friend from church came to her apartment to help her get on the wifi. This friend also helped her set up her printer. Another friend from church put together a CD full of mp3s of music she liked, and helped her figure out how to use Windows Media Player to listen to it. This friend could not give her all the support she needed to

use the CD, so Delores brought the CD to the senior center for more help. Nonetheless, despite all this support Delores did not feel like she was making progress. She felt that the people trying to help her were not willing or able to sit down with her and go slowly multiple times over how to do things with her laptop. She said that she needed "someone to just sit down with me and help me go over things. I can't get it just in an hour. I need more than that."

After one of the informatics moments I had with Delores in spring 2015 I wrote that:

> *She had brought in a piece of paper she had printed from her email (a spreadsheet) that came out all wonky - She had a printer at home but was having trouble printing the file - I tried to explain that she first needed to download the file and open it in excel before printing it – I walked her through the steps of downloading from email, opening the file, and printing it - but she needed to go very very slow and write down all the steps - and she was having trouble absorbing it all. She needed to know step by step or she was lost -- it was pretty overwhelming for her - after going over it a few times and she writing down the steps she seemed to get it and said would practice it at home. She did know how to shut down and seemed excited about continuing to learn how to use laptop. But she was also clearly feeling overwhelmed and like there was a lot to learn.*

At that particular field session six older adults came to participate in a one-hour technology support session. There was one other volunteer, but even still, with eight people in the room the atmosphere was chaotic.

Delores was back the following week, still working to learn how to print her email:

> *With Delores the first thing we did was run through a few times how exactly to open and print the spreadsheet - it was not easy. The first hurdle was the fact that the internet was going insanely slow on her computer. I wasn't sure if it was the wifi, or her computer, or Internet Explorer, or what... Worked fine on other computers.... Anyhow when we finally got it to work I walked her through the steps (she did the clicking) then I had her do it again - and then we did it two more times later in the session* [again the room was packed so the other volunteer and I were working across multiple participants] *.... She said something about feeling like she was in kindergarten. The process took a long long time, and was exacerbated by the internet issues.... She was quick to blame herself and/or the laptop for the slow-downs (her first impulse is to think she did something wrong, not to blame the tech!!). She also asked a few times if the slow speed of the internet could be because the laptop was not plugged in. She also thought James's* [another older adult in the room] *laptop's wifi may have been working while hers was not because maybe he had a better computer (even though her computer*

> *was newer and probably faster!) She said her internet worked fine at home - had never had a problem there... Anyhow she had written out detailed steps for how to download the file and print it* [from last week]. *But apparently was having trouble following the steps she had written out, so today she was trying to do it without referring to the steps - to internalize the process… She was having a lot of trouble. She emphasized to me that it had been nearly a decade since she used computers regularly - and she was clearly struggling to make sense of it all.*

This issue of learning to print an email attachment was one of dozens of procedures Delores wanted to learn all at once during technology support sessions. There was so much to learn, and Delores wanted to learn it all.

During this time period, Delores became very frustrated by the busyness at the senior center. In spring 2015 the number of older adults in technology support sessions exceeded the number of volunteers, often by a ratio of 3 to 1. As discussed in Chapter 4, the older adults at Tubman Senior Center generally do not help each other with technology during technology support sessions, instead turning only to the university students for assistance. As a result of this situation, Delores looked elsewhere in the local area for technology support. She turned first to a local community college, which has a beginning computer class. She found the pace there to be too fast. She could not keep up with the instructor or the other students. She said it was "too much. What I really needed then was someone to sit down with me for a long time, and that is not what they do there." Second, she turned to the Best Buy Geek Squad. This option, however, did not work for her because she was "afraid to have people come into my apartment." Furthermore, because she does not own a car it made it extremely difficult for her to bring her laptop to the area of town where Best Buy was located.

Finally, she found a helper that fit her needs at Branch Library. One of the students who had volunteered at the Tubman Senior Center in fall 2014 was now serving as a technology volunteer at Branch Library. Delores found out that the student had shifted from the senior

center to the library, and decided to go there to get support throughout summer and fall 2015. At the library, few people come for technology support services (in part because very little outreach is done about the program—Delores found out about the program from a friend, and not from the library). As a result, Delores found that she could work with the student at the library for one to two hours, almost completely uninterrupted. When the student left in November 2015, Delores struggled to keep learning without her.

Delores did not feel that she had yet integrated her laptop into her life. She knew she needed more support to keep learning. One of the librarians offered her a little assistance after the volunteer left in November 2015, but Delores said the librarian was not able to give her more than a few minutes of support at a time.

Describing her determination to learn to use her laptop, Delores said that:

> I am committed. And when I commit I do not give up. I stopped using technology once before. But now I see that this [technology] is, it is where things are at. You need it for everything. I am struggling but I am determined. I am determined I can do this.

Her background in earlier stages of her life conditions the digital learning style she has developed and nurtured across the informatics moments she has participated in. First, she worked in education, and she continues to have strong support for education. This firm belief in the power of education shapes the perseverance and dedication Delores brings to her own digital learning. Second, Delores was involved and connected to the civil rights and Black power movements in the 1960s and 1970s, when she was a young adult in her 20s and 30s. Her participation in this social movement adds momentum to her learning in the present. Delores is a proud person who believes she can learn technology, and this pride in her capability grew through involvement with civil rights and Black power activism earlier in life.

Discussion of Delores's informatics lifecourse. This story reveals a great deal about informatics moments, the informatics lifecourse, and community-based information infrastructure. The first informatics moments of Delores's life took place at her workplace. Through these informatics moments, Delores developed a learning style built on the premise that technology learning is utilitarian and task-oriented. In retirement, Delores could not count on the external pressure of the workplace to help her continue digital learning. As a result, she stopped using technology.

She brought this workplace learning style to the informatics moments she participated in at Tubman Senior Center in fall 2014. There she came once a week to use a typing program. She did not want to do anything except get into this typing program and systematically move through its lessons. This learning style served her goal of refreshing herself with the keyboard, which she had not used for nearly a decade.

At the same time, this task-oriented learning style did not prepare Delores for the challenges of navigating online applications, passwords, and programs in a Windows 7 laptop environment. Delores found that she had to develop a new learning style to continue her digital learning. This new digital learning style is premised on persistence and determination. It consists of an attitude to learning that Delores maintains as she seeks diverse sources of support, despite the many frustrations she has encountered along the way.

It took Delores months to summon the determination to begin learning to use her laptop. In this vulnerable state, she found the hectic atmosphere of technology support services at Tubman Senior Center overwhelming. That atmosphere worked for her when she worked mostly independently on a single task, but no longer proved conducive to her digital learning when her goals became more intensive, open-ended, and diffuse. Delores found herself wanting

and needing to know a great deal of procedures all at once. She wanted to do a lot with her laptop, but was having trouble figuring out how, or even where, to begin. She said she felt like she was in kindergarten.

As a result of this situation, Delores looked elsewhere for support, eventually finding a conducive environment at Branch Library, and in particular working with a technology volunteer there whom she knew from earlier work at the Tubman Senior Center. As a result of the slower-pace of technology support services there, the volunteer at Branch Library had more time to dedicate to Delores.

Delores's story is not finished. Delores has lost her favored helper, and is not sure if she will find another. She may have to now learn technology more independently than she has in the past. On the other hand, Delores may draw on multiple sources of support for less frequent informatics moments, as opposed to coming once a week to work with the same person over and over again. As a persistent and determined learner, Delores's learning style has already evolved and will continue to evolve as she continues to integrate digital technology into her life. The evolution of her learning style has not been an internal process taking place solely within her mind. Rather it has been a social process, unfolding across many informatics moments in senior centers, in public libraries, and elsewhere in her community.

E. The informatics lifecourse is shaped by the stage of life known as old age

Two social structures and arrangements, retirement and ageism, shape the informatics lifecourse of old age. Retirement leads to a certain rhythm of life, which leads to different patterns of using and learning technology than those patterns found earlier in life. For instance, travel in retirement shapes many of the digital practices found among older adults in this

sample. Retirement also leads to losing workplace-based technology support; as a result, older adults must look elsewhere for that support. Ageism affects the informatics lifecourse because many older adults deny and devalue their own digital literacy. Ageism also leads older adults to deny their own aging process as they seek to avoid stigmas associated with being old. I also identified a counter tendency of older adults resisting these ageist values through the development of confident approaches to digital learning and literacy.

Retirement conditions the informatics lifecourse of old age. For most older adults, the rhythm of daily life is shaped by retirement. For many older adults, digital learning is one of a variety of projects they undertake in retirement. For instance, in March 2015 I talked with a woman at Main Library whom I had worked with during December 2014, but whom I had not seen since then. I asked her if she had been able to use any of the things we went over during our previous technology support service. She said she had been too busy with her quilting projects and with other commitments in her family and in her community to devote time to using technology. The rhythms of daily life in retirement are shaped by the many self-motivated activities of older adults.

For some older adults, digital practices unfold over years. Cynthia has been working intermittently since 2012 to create video slide shows of her international travels to places like Senegal and South Africa. She knows that many of her friends in the Tubman Senior Center cannot afford such international travel, so she started the project to share her travels with others in the community. She started the project with a staff member at the Tubman Senior Center and has since been working with volunteers to create the videos in Windows Movie Maker on her laptop. After an intensive period of weekly support for two months in which she needed assistance getting started on the project, she now comes to the senior center irregularly

when she encounters a hurdle in her work. She said she works on the project whenever she has free time: “sometimes I will spend all afternoon on it [laughs]. Other times, I may not touch it for a month. But I get into trouble then [laughs]. Oh, it takes a while to get back into it after taking that much time off. I try not to, but sometimes I get so busy. But I know I will always come back to it.” She completed DVDs for her trips to South Africa and Senegal in spring 2015 and donated the DVDs to the senior center. She is now working on a DVD of her trip to New Zealand. Asked why she didn’t focus more time on the project, she said, “well you know, I have other things in my life. The thing you need to know is that seniors have busy lives [laughs]. I have so much going on [laughs]. I get side-tracked and forget about it. Out of sight out of mind, I guess [laughs].”

This story reveals two things about the informatics lifecourse of retirement. First, the pacing of life in retirement leads older adults to extend projects over a large period of time. Second, retired individuals have rich lives. The individuals that participated in this study lead active lives, much of which has been spent in the local community. As such, they are densely woven into multiple institutions and social networks. The rootedness of these individuals in their communities shapes how they use technology in the present.

Older adults tend to use digital technologies for travel. Although densely woven into their local communities, older adults also value opportunities to travel and to explore new areas of the nation and world. As the story of Cynthia above illustrates, some older adults then share their travels in their communities, enabling others to vicariously participate in their explorations.

Table 47 shows that, beyond the residence and beyond the community-based information infrastructure, travel is the most common “place” where older adults use digital technology. When asked where, beyond the home and beyond public libraries and senior

centers, they use digital technologies, 39% of interviewees said they use technology while at hotels, on the road, on buses, on ships, and in related places. Forty-one percent do not use technology in other places beyond their residence and beyond public libraries and senior centers. Eight percent use digital technology in the homes of family and friends. Six percent use technology at businesses. These people use their digital devices at restaurants and at cafes. Six percent said they use their devices at their church.

	While travelling	Residence of family or friend	Business	Church	No other place
Older adults (n=54)	39%	8%	6%	6%	41%

Table 47: Other places where older adults use digital technology, among interviewees.
Excludes the home of the older adult, as well as public libraries and senior centers.

The frequent use of technology for travel illustrates how older adults integrate technology into the rhythms of life in retirement. For many older adults, retirement is a time of life in which travel occurs more frequently than earlier in life. During earlier life stages, work and family commitments precluded the possibility of travel for many older adults interviewed. Furthermore, older adults enjoy travelling—trips are among the most popular activities at the senior centers—and also documenting their travels through technology. They want to share these experiences with others, as well as remember them. Digital technology in general, and photography in particular, adds to these cultural and communication practices.

At senior centers older adults talk together about their trips and travels. Members of Tubman Seniors and the Smith Seniors traveled to New York City and to Niagara Falls during the fieldwork period. After the trips ended, older adults came in with their smartphones and digital cameras to learn how to manage and share their photographs. At Metro Senior Center, the big

trip of the year was to Australia. Before the trip, one woman came in to learn how to use a digital SLR camera she purchased for the purpose of documenting her trip. Afterwards, older adults came to Metro Senior Center to learn how to manage and share their digital photographs.

I also found that, in addition to photographing trips, older adults use technology as an aid to travel in general. Some individuals use GPS devices in their cars. Others use mapping apps on smartphones. For instance, although she has lived most of her life in the local city, Ruby has relatives and friends spread throughout the country, and primarily in California, Michigan, and Tennessee. She said that now that she is retired she is "on the road more than I am not, it seems like." During field sessions at Smith Senior Center, Ruby learned how to use the maps app on her smartphone to better coordinate her travels. Describing an informatics moment I shared with her during one field session, I wrote in my fieldnotes:

> *Ruby said she had successfully printed her labels* [a project from a previous week we worked on together] *and wanted to know if she could use the same process to print other things (such as tickets for airplane trips). I said yes and we ran down the process again - she seemed satisfied with that.*
> *But she was still having trouble using the "maps" app on her phone. So we worked on that for a while - the interface is not very intuitive - full of pictures without much text so can be hard to figure out what is going on or orient yourself, but we went over a few times how to map directions to someplace from current location and also changed her "home" address from Chicago. She wasn't sure how that got put in because she had never lived in Chicago - to her actual home address in the southeast of the city...*
> *She tried searching for a few addresses. Another thing that threw her off was where to put in the place she wanted to go. I explained that she needed to press "google" to start inputting her address. She was expecting something that said "search" or was more intuitive...*
> *I figured it out just by poking around. But she did not seem comfortable with that...*
> *She did, however, state that on one of her recent trips she and a friend were able to use the phone to find a nearby restaurant. They found out after poking around on the app that the restaurant was very near to where they were. She laughed about that. She said they figured it out by accident, and afterwards she wasn't sure what happened, so couldn't do it again to find another place.*

She also used the app to find out where a particular street in the city she had not heard of before. She said she thought she knew all the streets since she had lived here so long, but she found a new one.

For this woman, technology serves as an aid while planning trips (printing airplane tickets), looking for known locations (the restaurant she and her friend were looking for), and for exploring her community (discovering an unknown street). In older adulthood, many individuals seek to travel both to experience new places and to visit family, friends, and locations from one's past. Digital literacy is used among older adults to contribute to reaching these goals.

Transition from work to retirement. A third factor shaping the informatics lifecourse of retired individuals is the transition from work to retirement. For many older adults, the process of learning technology began years, even decades ago. Some older adults learned technology first on the job. Others started learning in retirement. After learning started, it has not always proceeded continuously without interruption. Periods of digital disengagement punctuate the informatics lifecourse of many, causing difficulties when digital learning is resumed at a later stage of life.

Among interviewees, 39% first started using digital technology between 1960 and 1989 (Table 48). Only 11% started technology usage after 2010, and 50% started with technology between 1990 and 2009. This pattern varies by social class. All the participants who started using technology since 2010 have blue-collar backgrounds. Among pink-collar and white-collar participants, around 45% started using technology between 1960 and 1989 and 55% started using technology between 1990 and 2009.

	Blue-collar	Pink-collar	White-collar	All (n=54)
1960-1989	11%	45%	44%	39%
1990-2009	22%	55%	56%	50%
2010-	67%	0%	0%	11%

Table 48: Decade in which technology first used by social class, among interviewees.

These differences make sense in relation to different patterns of technology usage on the job. Only 11% of blue-collar workers used technology on the job (Table 49). The opposite is true among pink-collar and white-collar workers, where almost all (97%) of pink-collar and a large majority (88%) of white-collar workers learned and used technology on the job. For many interviewees, paid employment structured their introduction to and learning of digital technologies. On the other hand, some older adults have just started learning technology for the first time in their lives. This population includes even those who are in their 50s, especially if they have had blue-collar careers.

	Blue-collar	Pink-collar	White-collar	All (n=54)
Used technology on the job	11%	97%	88%	80%
Did not use technology on the job	89%	3%	13%	20%

Table 49: Technology use on the job by social class, among interviewees.

What unites these interviewees is the fact that they are searching for support with technology in community-based information infrastructure in retirement. But even among these persistent learners, who take the initiative to seek support with technology in their communities, periods of digital disengagement occur. Digital disengagement refers to a period of life in which there is a cessation of learning and using technology (Olphert & Damodaran, 2013). The factors causing digital disengagement are many, and include life stage transitions such as retirement. The effects of digital disengagement are also myriad, and include difficulty later in life when the learning of technology resumes, which it did for all older adults in this sample.

	Constantly used after started using technology	Stopped for a while
Blue-collar	66%	33%
Pink-collar	52%	48%
White-collar	44%	56%
All (n=54)	52%	48%

Table 50: Digital disengagement by social class, among interviewees.
Due to rounding, rows do not always sum to 100%.

For many participants, digital learning is a sporadic feature across the lifecourse. Episodes of digital learning are followed by episodes of digital disengagement, followed by further episodes of digital learning. As table 50 shows, digital disengagement is a social phenomenon that shapes the informatics lifecourse of many older adults. Fully 48% of the interviewees stated they had stopped using technology for some period of their lives. The phenomenon is more common among pink- and white-collar individuals than among blue-collar individuals (Table 50). The reason for disparity relates to the longer life histories of white- and pink-collar workers with technologies (Table 49). They have used technology for longer periods of their lives, so are more likely to have had episodes of digital disengagement. No major differences emerged related to ethnicity. Digital disengagement is more common among the older old (75+) than among the younger old (50–74): 62% of the older old experienced digital disengagement versus 36% of the younger old (Table 51).

	Constantly used after started using technology	Stopped for a while
Younger old	64%	36%
Older old	38%	62%
All (n=54)	52%	48%

Table 51: Digital disengagement by age, among interviewees.

Digital disengagement is less a product of the declining minds and bodies of older adults and more a product of our society. A major reason for differences found among interviewees relates to their life histories. The older old, especially those of pink- and white-collar backgrounds, learned technology on the job, and as such learned to associate technology with workplace culture. When they retired, many older adults had never used technology outside of a workplace, and as a result, leaving the workplace meant leaving technology. Sixty-two percent of those who disengaged from technology gave retirement as a reason for ceasing technology usage for a while (Table 52). When asked why he stopped using technology, a 73-year-old white man stated that after retirement, he "didn't want to be bothered with the computer anymore. I didn't want to be attached. I had been attached for 20 years. It was enough."

	Number of older adults that stopped using technology for this reason	Percent of older adults that stopped using technology for this reason
Retirement	16	62%
Changes in technology	10	38%
Cost of technology	9	35%
Health-related issues	3	12%
Moves	2	8%
All	26	100%

Table 52: Reasons older adults disengage from technology, among interviewees.
Note that percentages exceed 100 because participants could give multiple reasons for disengaging from technology.

The changing nature of digital technologies also contributes to digital disengagement in the informatics lifecourse of older adults. The second-most common reason offered to explain digital disengagement are changes in technology (38%), such as the shift from mainframes to personal computers (PCs), and, more recently, shifts from desktops to

laptops/tablets/smartphones, as well as from one operating system to another. When discussing this issue, one woman stated simply that it "feels like I am always starting over with technology" as new devices and upgrades to applications cause her to continuously learn new procedures. The cost of technology (35%) also leads to digital disengagement among older adults. Staying up-to-date with technology requires purchasing new digital devices over time. Some older adults stop purchasing new technologies, and as a result over time disengage from technology. Older adults also stated that health-related issues (12%) and moves from one place to another (8%) led them to stop using technology for a while. Those that gave health as a reason for stopping technology usage indicated that things like scheduling dialysis appointments or caring for an ailing loved one consumed so much of their time that they did not feel they had the time to stay up-to-date with technology.

In any case, when asked if she had constantly used technology or stopped for a while, this 67-year-old European American woman gave a detailed answer that expresses her and other older adults' frustration with changes in technology and with the cost of staying up-to-date with technology:

> I stopped using the iPod [the primary technology she used after she retired] because they upgraded them and I could not keep up with the upgrades. They also added too many features. I read that people want to buy devices with more features but then they don't know how to use them. I know which features I need but they give you all these extra features I don't want and I don't think anyone wants. But that makes them more prone to having problems. So then you need to keep buying new stuff to fix the problems they have!
> The copier had all these features, but it was mostly used to run copies. But it broke because people would hit the wrong button. I felt like I could not use it. The librarian helped me but she was hitting all these buttons and I felt like I could not use it. It's ridiculous that I can't simply make some copies. I can't use my iPod only for music; it has to have internet, etc. etc. It's nice that the iPad [she bought an iPad to replace her iPod shortly before this interview] has picture and video features and I would like to make a video of my dog, but I don't know how to make it. And I would like to upload things to YouTube, but I don't know how to do that either. They make it so complex so that you

> have to hire someone to come and help you. Those geek squad people. I see them on TV. If they made technology better you wouldn't need them.
> Everything I know about computers I owe to my dogs. [Laughs] I have kept up and learned to use listservs because I wanted to talk to other people who have the same type of dogs as I have. I would like to be able to make videos and share them. I have gotten books to learn to do things but they [the books] just sit there. I find visual learning more helpful. I usually need someone to help me.

In discussing an episode of digital disengagement, this woman rejects the ageist narrative that the problems she has learning technology emanate from her supposedly declining mind and body. Instead she states that "if they made technology better you wouldn't need" all this technology support. Unfortunately, as I will show momentarily, this attitude is not common among older adults, who tend more often than not to blame themselves when things go wrong.

Ageism conditions the informatics lifecourse. This section discusses some of the ways in which ageism shapes how older adults think about and discuss the informatics lifecourse of retirement. Ageism, as it is internalized by older adults, leads them to denigrate and devalue their own digital literacy. Ageism further leads some older adults to express ambivalence about, and to avoid the social stigma of, being "old." On the other hand, when older adults successfully practice digital literacy and learning they feel a sense of pride and accomplishment, which contributes to overturning ageist ideas about older adults and digital technology. Furthermore, some, like the woman quoted above, resist the planned obsolescence of the contemporary technology economy, situating problems with technology in society instead of in her own mind or body.

Devaluing and denying their own digital literacy. Throughout fieldwork I again and again found older adults devaluing and denying their own digital literacy. How ageism shapes the informatics lifecourse can be seen in the following story from the Tubman Senior Center. This story involves two members of the Tubman Seniors: one in her late 60s helping another in her

late 80s with technology. The younger woman retired from a job as an instructor at a community college. She helped the older woman type her biography for a community celebration of local African American women aged 80 and older. This help-giving episode took place because the two women have known each other for years. The episode took place outside the senior center. When the two women participated in technology support services at the senior center, they did so as older individuals seeking assistance from young university students. The younger older adult did not offer to help other older adults learning technology there. When I asked her why she does not also help other older adults with technology, the woman said she does not feel like she knows enough to help others. She said she helped her friend because her friend asked for assistance. But she does not feel like she knows enough to offer assistance to others outside of occasions when close friends informally ask for her support. I found this woman to be highly competent with technology, with a lot of skills to offer. Through our conversations at the senior center I determined that internalized ageism leads her to deny and devalue her own digital literacy.

Ageism also shapes the interactions of older adults. Two regulars at Smith Senior Center maintain a running joke in which they laugh about how ridiculous it would be for them to help each other with technology. Their joke, a variant of the "blind leading the blind," centers on the assumption that older adults do not, and never can be good enough with technology to help others. Nonetheless, both men are in fact quite proficient with a number of programs and procedures on their laptops and smartphones. The two could have shared their skills with each other, and with others, but the ageist idea that they would forever be backwards in their technology skills stood in the way.

Even those older adults who do feel confident with their own capacity to use technology express ageist stereotypes. When I asked a woman at Metro Senior Center who I had seen helping other older adults with technology if she thought she could lead technology support services at the senior center on her own, she responded:

> No, I'm old! They don't want help from me! I get by with technology …. And if I get stuck I can figure it out. Usually. [Laughs] When it works it works. But when it doesn't. [Laughs] Help someone else here at the center? No, no, no. That is for you [young people] to do. You know this stuff in and out. What could I add?

Many older adults have internalized ageist stereotypes that assume young people know more about technology than older people. This ageist belief shapes how older adults conceptualize their own digital literacy.

One of the consequences of this ageist belief is that many older adults interpret breakdowns that arise when they are using technology as emanating out of their supposedly declining minds. One of the challenges older adults face while learning technology is that when they see others doing something with technology they say that it "seems like magic," as one woman stated. Another woman remarked on "how easy it was to do something after you figure it out, but before you know how to do it, it is terrifying." Family members add to these feelings by making technology seem mystifying and out of reach, and by acting in ways that shame older adults for their lack of understanding about contemporary digital technologies. When asked about people in his life who help him with technology, an older man in his late 70s stated that:

> Sometimes I got my daughter or one of my grandkids who know what I'm doing … like my little granddaughter who is about 6 years old …. She said "Y'all don't know that? I know that!" And she's only 5 or 6 years old! So these younger kids know a whole lot of this stuff and what these apps mean. We don't.

The man said that he does not spend much time learning technology in retirement because he feels it is a losing venture. He said he feels like he will always be behind, so he would rather use his retirement for other purposes.

Ambivalence about aging. A second way in which ageism shapes the informatics lifecourse of older adults has to do with ambivalence about the aging process. Five of the six institutions have policies and procedures that officially define older adulthood as beginning at age 50 (Table 53). Table 53 also shows that many eligible to participate in senior centers do not join them. The average age of participants in technology support services in senior centers was 74, and no individuals younger than 58 participated in technology support services.

	Average age of sample	Age range of sample	Older adulthood as defined by the institution
Tubman Senior Center	73 (n=46)	59-93	50 and over
Smith Senior Center	72 (n=13)	58-89	50 and over
Metro Senior Center	75 (n=44)	66-88	50 and over
Metro Library	66 (n=21)	50-94	Not specified
Main Library	68 (n=72)	53-92	50 and over
Branch Library	58 (n=13)	50-76	50 and over

Table 53: Ages in sample against official definitions of older adulthood, by site.

In contrast, more of the younger older adults took advantage of technology support services at public libraries, where one did not have to declare oneself "old" and thus one was able to avoid the stigma of being an older adult. At public libraries, the average age of participants was 66, and individuals as young as 50 participated in technology support services. During four separate field sessions at public libraries, when I explained my research to older patrons who would beconsidered older adults by the official designations they were surprised and slightly offended to hear that the libraries consider them to be older adults. This finding illustrates the social complexity involved in identifying oneself, and identifying others, as older

adults. Far from an objective social category, this term is loaded with ageist assumptions. Because of the stigma of aging, older adulthood is an identity many seek to avoid.

Counter tendency: empowerment and confidence. A counter tendency to these ageist ideas appears in instances of older adults developing confidence and pride in their digital literacy. Older adults express excitement about showing children digital skills they have learned. At Metro Senior Center an older woman received an iPad from her son for Christmas. She said her son became frustrated because she could not figure out what to do with it. After coming to Metro Senior Center for technology support on six occasions, she said she could not wait to show her son what she had learned to do. For this woman, a key motivation driving her acquisition of digital literacy was being able to show her children, and her son in particular, that she could use digital technologies.

A woman at Tubman Senior Center had a similar experience. For her birthday she received an iPad from her children, who lived in Texas and California. She said they tried helping her get started with this technology over the phone, but she could not follow their instructions, and they were getting frustrated with her. She said that she wanted to learn how to use these technologies to show them she was capable of being digitally literate, and more generally to show them, and herself, that she was still a valid, capable individual. After five technology support sessions she felt comfortable doing things like opening her email on her iPad, sending text-based emails, and taking and sending pictures. She said it makes her feel good to know that she can communicate with her family through the iPad, both because it is nice to be in communication with them, and because she is pleased to be able to participate in digital society.

Digital literacy also contributes to the self-confidence of older adults. At Main Library, a woman in her early 80's said she felt "proud to have done it herself" after she used the library's

online catalog for the first time to find items relevant to her interest. On another occasion, a woman at Smith Senior Center said that in-between technology support sessions she had independently installed iTunes on her windows laptop. She said "I am proud of myself because I have never installed a program." Another man at the Tubman Senior Center spent approximately two months learning the word processing, digital photography, and email skills necessary to create and send a pdf Christmas greeting to his contacts. When the card finally went out, he said: "People like my card. I feel proud … That was rewarding to see." The pride of digital literacy contributes to breaking down the interlinked ageist stereotypes that being old is synonymous with a) being on the wrong side of the digital divide, and b) being in a period of decline. These examples illustrate that digital literacy has multiple benefits for older adults. It contributes to their ability to integrate technology into the diverse rhythms of their daily lives, and it contributes to their sense of self-sufficiency in the information age. At a broader social level, the digital literacy of older adults contributes to ameliorating ageist stereotypes held by older adults and by others in their communities.

F. Summary

This chapter showed that older adults are determined and creative learners who with support integrate technology into the diverse rhythms of their lives. To understand these findings, I coined a new concept, the informatics lifecourse. The informatics lifecourse refers to how a person learns technology through the stages of his or her life. Digital literacy requires learning technology over time, since the technology taken to be normal in the information society has thus far tended to change often and dramatically. This learning proceeds through informatics moments, or seeking, getting and providing help with new technology over time.

Common tendencies identified in the informatics lifecourse of this sample include: (1) most older adults own at least one digital device, (2) consistent sources of technology support tend to be found among family and friends, (3) digital practices tend to orient around communication and culture, and (4) the structures of retirement and ageism shape the informatics lifecourse of old age. As older adults participate in informatics moments across time, they construct digital learning styles that build on how they have learned in the past. With support, older adults develop new and powerful ways to learn technology in the present.

Digital inequalities among older adults relate to differences in the informatics lifecourse of this sample. Diverse patterns of device ownership and technology support, and diverse digital economic and medical patterns in this sample relate to differences in terms of age, ability, ethnicity, gender, and social class. These digital inequalities form over time through the informatics lifecourse. Older adults of blue-collar backgrounds have had less opportunities to learn technology than those of white- and pink-collar backgrounds.

n the next chapter, this chapter's findings on older adult digital literacy are contextualized in relation to chapter 4's analysis of community-based information infrastructure. Through this analysis, this study's overarching research question—to what extent and how does community-based information infrastructure support older adult digital literacy—is answered. This dissertation concludes with a discussion of the implications of this answer in relation to theory, practice, and teaching.

CHAPTER 6. DISCUSSION AND CONCLUSION

This dissertation asks to what extent and how does community-based information infrastructure support older adult digital literacy. Chapter 4 analyzed community-based information infrastructure, operationalized as three public libraries and three senior centers. In that chapter I focused in particular on technology support services in which older adults participate. Chapter 5 analyzed older adult digital literacy, operationalized as 209 adults using and learning digital technologies over time. In this chapter I now integrate the findings from the previous two chapters to answer this dissertation's research question.

In answering this question and discussing the implications of this answer in terms of theory, practice, and teaching, this chapter has the following structure:

A. A summary of the findings from Chapters 4 and 5.
B. The answer to the research question.
C. A discussion of this answer in relation to theories and models introduced in Chapter 2's review of the literature.
D. Future research directions suggested by this study.
E. The implications of this study for practice and teaching.

A. Summary of findings

The findings from Chapters 4 and 5 are that:

- Community-based information infrastructure emerges out of and evolves through individual and social struggle;
- Community-based information infrastructure extends across space and time;
- Ageism affects both community-based information infrastructure and older adult digital literacy; and
- Older adults are determined and creative learners who with support integrate technology into the diverse rhythms of their live; this reality can best be understood as the *informatics lifecourse*: how a person learns technology through the stages of his or her life.

Community-based information infrastructure emerges out of and evolves through individual and social struggle. Organized together and organized with other sectors of their

local communities, older adults create, lead, and advocate for community-based information infrastructure. Older adults played important roles in the community organizations that started all six of the institutions studied in this dissertation.

As senior centers and public libraries moved away from their community roots to become institutionalized, overpressured staff implemented bureaucratic procedures to cope with the challenge of administering these complex public institutions. This institutionalized bureaucracy has limited the agency of older adults as, over time, they have been marginalized from the administration of these institutions. On the other hand, older adults continue to be responsible for portions of these institutions. Older adults lead senior center and friends of the library groups. Through these community organizations, older adults continue to shape and advocate for these public institutions.

Digital inequalities affect these power dynamics. Older adults coping with new technologies are framed by the institutions as passive service recipients instead of as community leaders capable and ready to contribute to shaping these programs. When older adults seek support with technology in these institutions, these help-seeking episodes, or informatics moments (Williams, 2012), are often structured by what Durrance (1983) criticizes as the "anonymous professional-client encounter" (p. 278). As a result of this structure, older adults are not recognized in relation to their experiences in the local community. They are rather seen as anonymous individuals requiring professionally administered technology support.

Nonetheless, both as individuals and as part of community organizations, older adults continue to shape this community-based information infrastructure. For example, older adults adapt technology support services to the group-based communities of practice that exist at

senior centers. Furthermore, through individual agency older adults attempt and often succeed in adapting technology support services.

Information infrastructure reflects the ever-evolving relationship between information systems and information users. In community-based information infrastructure that relationship is shaped by social struggle. The dominant tendencies discovered in this study, summarized above, co-exist alongside counter tendencies that could in the future become dominant, given the right support. For example, one counter tendency consists of older adults and information systems coping together with the challenge of staying up-to-date with new technologies released by the marketplace into their local community. Other counter tendencies identified in this study include:

- Older adults customizing computer labs;
- Older adults helping other older adults with technology;
- Staff and volunteers learning technology alongside older adults;
- Staff bending and breaking rules in response to the agency of older adults; and
- Older adults insisting on visibility against ageist narratives and structures.

By making these counter tendencies visible, this dissertation showcases the agency of older adults and staff creatively reconfiguring senior centers and public libraries.

Community-based information infrastructure extends across space and time. The community-based information infrastructure of public libraries and senior centers extends across space to include older adults' other sources of technology support. Older adults seeking technology support in these institutions also seek support elsewhere in their communities and families. This broader network of technology support shapes how older adults participate in technology support services based in public libraries and senior centers.

This community-based information infrastructure also extends across time since older adults have participated in these institutions, or institutions like them, throughout their lives.

These institutions are rooted in the lives and in the communities of older adults. This rootedness shapes how and why older adults participate in technology support services in these institutions in the present.

Ageism affects both community-based information infrastructure and older adult digital literacy. To reiterate, ageism includes prejudice and discrimination against older adults, and, more generally, against the process of growing old. Public libraries and senior centers reinforce ageist values when they: a) frame older adulthood as invisible or unimportant, b) conceive of older adulthood as a time of disability and decline, c) express ambivalence and antipathy toward older adults, and d) naturalize the idea that young people are the tutors of old people learning technology. These ageist tendencies are resisted, however, by older staff working alongside older adults in technology support services and by older adults insisting on visibility in these public spaces.

It is not just the infrastructures that reflect ageism; many older adults have also internalized ageist values, which affect how they conceive of their own digital literacy. Ageist values appear when older adults deny or denigrate their own digital literacy. This phenomenon occurs when older adults who use technology with some fluency express the belief that they are incapable because of their age of helping others with technology. Ageism also leads older adults to express ambivalence about the aging process, which occurs when they avoid self-identifying as old because of stigmas associated with being an older person in the USA. On the other hand, when older adults learn technology they experience empowerment and confidence, discovering they are as able as any other individual to participate in the information society. This discovery and its dissemination contributes to dismantling ageist values.

Older adults are determined and creative learners who, with support, integrate technology into the diverse rhythms of their lives; this reality can best be understood as the informatics lifecourse. Digital literacy emerges through technology learning across time. Unlike with traditional literacy, reading and writing, if one does not continue to learn new technologies as they emerge, one falls behind and may eventually find oneself unable to participate in the information society. To understand the digital literacy of older adults, I found it necessary to coin a new term. The informatics lifecourse is a portmanteau concept, combining the concept of the informatics moment with the lifecourse approach to studying society to describe how a person learns technology through the stages of his or her life.

To reiterate, scholars of the human lifecourse study "how historical time, social location, and culture affect the individual experience of each life stage" (Hutchison, 2014, p. 11). Each stage of the lifecourse is shaped by a "sequence of socially defined events and roles that the individual enacts over time" (Giele & Elder, 1998, p. 22). The most basic stages of life are: early life, adult life, older life, though a given culture may have more fine-grained stages based on the particularities of its culture, for example, student, worker, and retired.

The "informatics" half of this concept builds on the concept of the "informatics moment" (Williams, 2012). The informatics moment is "the moment when a person seeks help in using some digital technology that is new to him or her" (Williams, 2012, p. 47). The informatics moment is also:

> A phase in the transition of a society or a social sector to the information age, with all the dislocations and transformations that are entailed in introducing digital tools and infrastructure. (Williams, 2012, pp. 47–48)

The concept of the informatics lifecourse extends the concept of the informatics moment, in that it comprises the accumulation of informatics moments across time. It consists, in other

words, of learning technology across time, through the stages of life. Ageism and retirement are two social structures that shape the informatics lifecourse of old age in the USA. More generally, the concept of the informatics lifecourse adds to our theoretical understanding of digital literacy the idea that digital learning and literacy emerges across time, and in the diverse lives and communities of diverse individuals.

In this study of older adult digital literacy, I identified common tendencies in the informatics lifecourse of old age. These tendencies include: (1) Communication and culture shape the digital practices of many older adults; (2) email and photography are the most popular digital practices; (3) all the older adults who participated in interviews own at least one digital technology; and (4) the structures of retirement and ageism condition the informatics lifecourse during this stage of life.

Older adults are highly diverse, and so, too, is older adult digital literacy. Older adults integrate technology into their lives in diverse ways. Some older adults have used technology intermittently since the 1960s; others are starting to use technology for the first time in their lives. Some older adults own the latest technologies as soon as they are released, while others use older devices that, although no longer supported by their manufacturers, are still functional in their lives. One example illustrates how older adults integrate technology into the diverse rhythms of their lives: Some older adults (more white-collar, more European American, more men) have money they are managing with technology; other older adults (more blue-collar, more African American, more women) are trying to find ways to make money through technology.

As older adults learn technology in the present, they draw on learning techniques developed in the past, such as consulting handbooks and manuals as they learn something new.

On the other hand, the learning styles of older adults evolve. With support, older adults develop creative new ways to learn technology in the present. When older adults find a sustainable source of support, they turn again and again to that individual, institution, or group. This support enables older adults both to learn technology and to develop new ways of learning across time.

B. Answering the research question

The overall finding from this investigation is that community-based information infrastructure is indeed supportive of older adult digital literacy. Nonetheless, this support is not as robust as it could be. To provide a detailed answer to this dissertation's research question—to what extent and how does community-based information infrastructure support older adult digital literacy—I first analyze the strengths and weaknesses of this infrastructure in terms of how it supports the digital literacy of older adults. I then use findings from this study to extend the concept of the informatics lifecourse to encompass community-based information infrastructure. This discussion illustrates how the digital literacy of the individual relates to the community-based information infrastructures the individual participates in over time.

Strengths and weaknesses of community-based information infrastructure in terms of how it supports older adult digital literacy

I first analyze aspects of this infrastructure found to support older adult digital literacy. I then analyze aspects of this infrastructure that are sometimes supportive, but not consistently. I finally discuss aspects of a supportive infrastructure not found to be present in this particular community-based information infrastructure but that would support older adult digital literacy.

	Tubman Senior Center	Smith Senior Center	Metro Senior Center	Metro Library	Main Library	Branch Library
Supports individual older adults learning alone who work within limitations set by sites	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**
Rooted in the lives of older adults	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**
Adapts in response to agency of older adults	*In part*	*In part*	*In part*	*In part*	*In part*	*In part*
Supports development of digital learning styles	*In part*	*In part*	*In part*	*In part*	*In part*	*In part*
Supports diverse ways of using digital technologies	*In part*	*In part*	*In part*	*In part*	*In part*	*In part*
Support available in some form during all open hours	No	No	No	**Yes**	**Yes**	**Yes**
Supports well-maintained information systems	No	No	No	**Yes**	**Yes**	**Yes**
Older adult digital literacy is an institutional priority	*In part*	*In part*	*In part*	No	No	No
Supports groups of older adults learning technology together	*In part*	*In part*	**Yes**	*In part*	No	No
Supports older adults leading technology support services	*In part*	*In part*	No	No	No	No
Connects to other sectors of community-based information infrastructure	No	No	No	No	No	No
Counters ageist narratives of older adult digital literacy	No	No	No	No	No	No
Sustains relationships between technology helpers and older adults learning technology	No	No	No	No	No	No

Table 54: To what extent and how does community-based information infrastructure support older adult digital literacy?

Strengths of this infrastructure. All six sites support individual older adults who learn technology alone and within the limitations set by the sites (Table 54). Older adults use and benefit from this support. This finding relates to the fact that all six institutions are rooted in the lives of older adults. Older adults come to these institutions for technology support because they and people they know in their communities have been participating in these institutions for

years, if not decades. The rootedness of these institutions in the community contributes to how they support the digital literacy of older adults.

Somewhat supportive, but not consistently. The next three aspects of supportive community-based information infrastructure in Table 54—adapts in response to agency of older adults, supports development of digital learning styles, and supports diverse ways of using digital technologies—all relate to how the sites respond to the agency of the older adults that come to them for support with technology. I found that all six sites partially support this agency. In an ad hoc fashion, individual staff members and volunteers go beyond official processes and procedures to flexibly support older adults on their terms. For instance, at Main Library a library technician helps older adults on personal devices unfamiliar to her because they ask for that help, even though the library officially prohibits this type of assistance. Older adults form relationships with volunteers and staff willing to bend the rules. These relationships in turn enable older adults to develop digital learning styles. These learning styles take time to develop, and this process is aided when digital learning emerges in the context of supportive relationships. Furthermore, technology volunteers support whatever older adults want to do with technology and in general spend more time with older adults than staff do. These tendencies illustrate how this infrastructure partially supports older adults adapting the institutions to learn and to practice digital literacy. Nonetheless, this support is not consistently available at all times from all people.

In some aspects, public libraries are more supportive than senior centers, while in others, I found senior centers more supportive than public libraries. Public libraries are more supportive in terms of maintaining and supporting public access to information systems. Senior centers are more supportive in terms of maintaining and supporting organized groups of older

adults. All three public libraries have long hours, and staff will provide at least some level of technology support during all open hours. All three public libraries also support well-maintained information systems with dedicated staff responsible for maintaining public computers and wifi. As a result, at public libraries an older adult can expect to be able to access wifi without a password, log into a library computer (if they have a library card or a photo ID), and use the printer and scanner. An older adult can also count on someone being available to help for at least a minute or two with these procedures.

Despite the availability of technology, supporting older adult digital literacy is not an institutional priority across public libraries. In contrast, senior centers have made this topic more of a priority. Senior center staff use diverse media (television, internet, newspapers, mailings, word-of-mouth) to spread the word about technology support services at senior centers; no comparable levels of outreach exist at public libraries. Nonetheless, older adult digital literacy is not always an institutional priority at senior centers. Although staff enthusiastically do outreach for technology support services, they are less willing to offer these services themselves. Senior centers instead rely on volunteers to offer technology support during officially demarcated times. Outside of these times, technology support is not routinely available in senior centers.

Senior centers also support older adult digital literacy by supporting groups of older adults who learn technology together there. This collaborative learning of technology happened the most at Metro Senior Center, but also occurred with less regularity at Smith and Tubman Senior Centers. I also found one group of older adults who learn and use technology together at Metro Library, suggesting this phenomenon may organically arise in public libraries. In any case, two senior centers also support older adults leading technology support services. The director of Tubman Senior Center allowed a group of quilters to install a printer in the computer lab,

although he and other park district staff did not provide support for the printer. The director of Smith Senior Center allowed a woman who had recently joined the Smith Seniors to start leading technology support services there, but this volunteer was not provided by the senior center with the support she needed to sustain the services across time.

In general, then, public libraries provide more robust information services, managed by professional staff and professionally-trained volunteers. Senior centers, in contrast, rely on volunteers and donated equipment that is not always kept up-to-date. They are, on the other hand, more open than public libraries to supporting the agency of older adults interested in shaping and leading technology support services.

Support not available. Through my study of older adult digital literacy, I identified three aspects of a supportive community-based information infrastructure not present in any of the institutions. These include: (1) connects to other sectors of community-based information infrastructure, (2) counters ageist narratives of older adult digital literacy, and (3) sustains relationships between technology helpers and older adults learning technology.

Older adults rely on multiple sources of support as they learn technology across time. Sources of support include family members, friends, businesses, public institutions, and non-profit institutions. None of the six sites studied connects to, or has tried to connect to, this broader community-based information infrastructure. The institutions have not devoted energy or time to building or connecting to networks around technology support.

Neither do any of the sites counter ageist narratives of older adult digital literacy. In fact, some sites reinforce ageist stereotypes through "senior computer stations" that differ from regular computers only in that they have assistive technologies for people with disabilities, thus reinforcing the idea that old age is synonymous with physical decline. Furthermore, the

structure of young people helping old people with technology may reinforce the ageist idea that young people are the natural technology tutors of the old.

Finally, none of the institutions endeavor to sustain relationships between technology helpers and older adults. In fact, these relationships are sometimes actively discouraged by policies. When these relationships do emerge, they tend to be ephemeral and ad hoc, lasting as long as the technology helper has time to sustain it. These ephemeral relationships are supportive while they last, but they do not add up to a community-based information infrastructure that supports learning technology throughout the stages of life.

The informatics lifecourse: connecting digital literacy and information infrastructure

Having discussed the strengths and weaknesses of this community-based information infrastructure in terms of how it supports older adult digital literacy, I now answer this dissertation's research question at a more conceptual level. Community-based information infrastructure supports older adult digital literacy only to the extent that it is rooted in the informatics lifecourse of older adults (Figure 6).

In Chapter 5 I analyzed the informatics lifecourse of the individuals that participated in this study. Here, I analyze how the informatics lifecourse of these individuals relate to the community where they live. Breakdowns in the digital learning of the individual relate to breakdowns in community-based information infrastructure. Therefore, individual lives and communities are intertwined and interdependent.

To be able to continue to do things with technology across time, older adults need to learn new technologies as they emerge. When this learning stops, so too does the ability of the older adult to do things with technology. Older adults are mostly retired from the paid

workforce. In the context of retirement, older adults turn to the public institutions of senior centers and public libraries to start or to continue learning technology. Through technology support in these and other institutions, older adults learn technology across time.

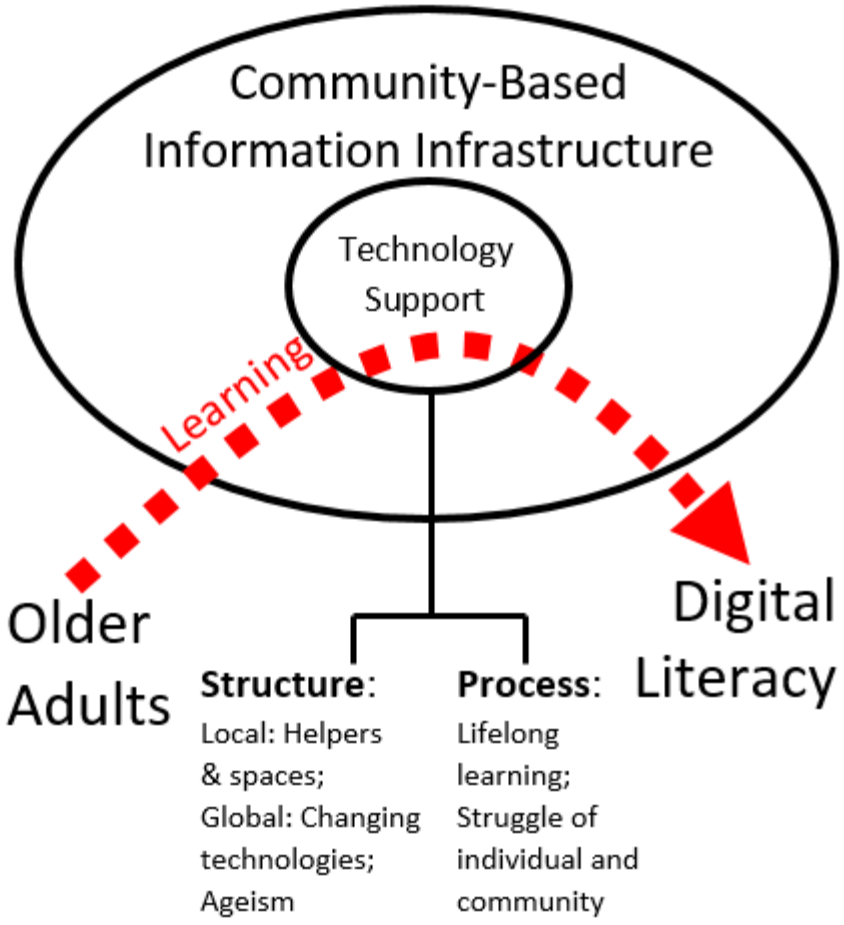

Figure 6: A model of the informatics lifecourse in community-based information infrastructure. Figure adapted from the model of the informatics moment, Williams, 2012.

The informatics lifecourse is not always supported or even recognized in community-based information infrastructure. The institutions studied do not recognize that decisions they make about starting, stopping, or adapting technology support services affect how the informatics lifecourse of older adulthood proceeds. The dotted line in figure 6 represents the fact that digital disengagement often occurs in the informatics lifecourse of older adults. These

periods of digital disengagement relate to periods in which community-based information infrastructure is not as supportive as it could be.

This process is shaped by struggle, both at the level of the individual and at the level of the community. Older adults insist that people in their community help them with technology. This process is also shaped by the structure of community-based information infrastructure. This structure includes, at the local level, the helpers and spaces available in community-based information infrastructure. At the global level, community-based information infrastructure is structured by the changing digital technologies released in the consumer marketplace. Ageism shapes all aspects of this structure. We live in a world where innovation and technology are virtually synonymous with youth. As a result, the innovations and creativity of older adults learning technology are not always recognized or valorized.

The informatics lifecourse in the community-based information infrastructure. I now illustrate these findings through an example of how the informatics lifecourse intersects with community-based information infrastructure. Hester is an 89-year-old African American. This is the story she gave in response to questions about her life history using technology:

> **Noah:** Do you remember the first digital device you ever used?
> **Hester:** Yes, I used the mainframe [computer] at the county government office. It was one of the very first ones! I took classes at the university, learning to program, you would say, tapes and punch [cards] way back when. I learned how to wire a mother board! The professor drew diagrams and we put it together in back of the employment offices at night in the early 1960s. But I lost track of [computers] when they switched from mainframes to PCs. I quit using all of that when I retired in 1986.
> **Noah:** When did you start up again with digital technology?
> **Hester:** Well, I took a course on the PC in the, I can't remember when, sometime in the early '80s, before I retired. They wanted everyone to know how to use the PC. But it was too different, and I was about to retire. I did do a little with the PC then, but not very much. But I still have the notes from those classes!
> **Noah:** You didn't use the PC after you retired?
> **Hester:** No, not that I can remember. But then–oh yes, back in the late 1990s, I can't remember exactly when or so… I bought a digital camera. My granddaughter, she was

getting married! I got it just to take pictures and I wanted to take pictures of my granddaughter's wedding. But I could not figure out how to use it [laughs]. What to do with the pictures after I took them! I got some help from some university students here at the Tubman Senior Center. I figured out I better buy a computer so I had some place to put my pictures. [Laughs] I just didn't realize you needed a computer if you used a digital camera. [Laughs] They never tell you what all you need, and it seems like you always need something else. So, anyhow, I bought a desktop, with XP, in 2000, 2001, something like that. I can't remember exactly when. I still have that computer. It is at home. I still use it. But it is getting old. I guess I'm getting old too [laughs]. Some of the university students at the senior center helped me figure out how to use it. I have my notes from those classes too! [Laughs] I just keep everything. I'm a packrat, I guess.
Noah: Tell me about what you have been doing with technology since then.
Hester: Since then? [Laughs] Not much. I was using my desktop a little bit, now and then, but less and less as time went on. The university students stopped coming to the senior center, I can't remember when, but sometime. And then without them here to ask questions, I guess I just used the computer less and less. Oh, I got on it from time to time. And I take pictures now and then with my digital camera. I took a lot of pictures of my dog. I am glad I have those now that he is dead. But it just became less of a priority for me, I guess.
Noah: When did you buy your laptop? [Hester brought a laptop into the senior center to learn how to use it during fieldwork, beginning in winter 2014.]
Hester: Oh, this? [Refers to the laptop] I got it in 2013, I think. My son bought it for me. He thought my desktop was getting too old. It has Windows 7. Now that I have this laptop I am figuring out how to use it. I can print, finally. You don't need to connect a wire to your computer anymore to print. It always changes. [Laughs] I guess that is how it is.

This life story illustrates how the informatics lifecourse of the individual intersects with community-based information infrastructure. During the stage of life in which she was working full-time, Hester relied on her employers to provide her with the training she needed to practice digital literacy. This process lasted from the 1960s until the mid-1980s. After Hester retired from her job, and embarked on a new stage of life—retirement—she lost her technology support. She now had to find technology support in her community.

In retirement, a stage of life that has already lasted nearly 30 years, Hester found technology support in her family and in her senior center. Her family motivated her to acquire her first digital device in the mid-1990s. Her family also purchased a laptop for her in 2013.

Nonetheless, her family has not always provided Hester with the support she needs to learn to use these technologies. For this support, Hester has turned to her senior center. She joined the senior center shortly after she retired because the senior center was rooted in her community. Many of Hester's friends participated in the senior center; her mother was a leader in the group in the 1970s. Through participation in this senior center, Hester started participating in technology support services. Beginning in 1997, university students volunteered intermittently at her senior center to help older adults learning technology. When this support stopped, however, Hester's technology learning did too. Her digital practices also stopped. When support was present, though, Hester continued to learn technology and continued to find creative ways to integrate technology into the rhythms of her life.

Gaps in Hester's digital learning relate to gaps in the supportiveness of this community-based information infrastructure. These gaps in digital learning have made it difficult for Hester to use technology fluently throughout the stages of her life. When I first met Hester in winter 2014 I had no idea she had this rich background with technology. She was then coping with the challenge of learning the diverse functions and programs on her laptop. She was learning how to use the touchpad and USB ports, as well as word processing programs, internet browsers, and email. Hester described herself as "just beginning" with her laptop, and not knowing where to begin. When I first met her she said she was so happy to have someone help her with her laptop. In my fieldnotes from that first meeting I wrote, "*She was so appreciative and at the end she said she wanted to know how long I will be coming*." During a year of fieldwork, Hester came to 55 technology support sessions at the senior center. Through these sessions, Hester worked with other volunteers and with me to learn how to use her laptop.

Hester fitted technology learning into the richness of her life. Hester lives a very active life in retirement and as a result could not always adjust her personal schedule around the senior center's schedule of technology support services. Hester came to as many technology support sessions as she was able, but during one month Hester did not come to a single session. She said afterward that during this period she had to babysit for her great-granddaughter because the child's mother could not afford daycare. This instance serves as a reminder of the fact that older adulthood is not a stage of life in which one lacks familial and community obligations. Hester continues to contribute to her community, both through her family, and also through her church and senior center. She relies on her community for support learning technology, and they in turn rely on her. She is also often called by reporters during Black History Month to talk about local African American history. Hester's life is rich, and she has much to offer, and it is unfortunate that she has not always found the support she needs to be able to use technology in retirement to contribute to her community. Furthermore, Hester is not a passive user of technology support services. Rather, she is an active agent. The persistence of individuals like Hester inspired other technology volunteers, the staff of the senior center, and me to work hard to support her digital learning across time.

Hester's story illustrates how the informatics lifecourse of older age intersects with community-based information infrastructure. The two phenomena are interconnected and intertwined, just as individuals and communities more generally are. In other words, the informatics lifecourse reveals something new and important about digital literacy, about old age, and about the communities where life is lived throughout time. The concept suggests that rather than study these phenomena independently, we instead seek to holistically understand how digital literacy and learning emerge across time in the communities where daily life is lived.

C. Contributions to theory

Having answered this dissertation's research question, this section now discusses the contributions this research makes to the theories and concepts introduced in Chapter 2's review of the literature. I first discuss the contributions this dissertation makes to theories and concepts in the field of community informatics. I then discuss the contributions made to multi-disciplinary theories and concepts of older adulthood, digital literacy, and information infrastructure. Although each of these four areas—community informatics, older adulthood, digital literacy, and information infrastructure—is discussed individually, the contributions this dissertation makes span these and other areas. As such, across these four sub-sections I weave together concepts and theories to illustrate the contributions this dissertation makes to theory in general.

Community informatics. This dissertation shows that older adults adapt digital technologies and technology support services to the diverse rhythms of their lives. This is an important finding for the field of community informatics. Michael Gurstein (2012), the editor of *The Journal of Community Informatics*, wrote in his introduction to a special issue of that journal on older adults:

> We found that the bulk of the papers received were focused on "Informatics" as applied to the circumstance and condition of individual older persons in relation to the health care system, rather than towards older persons in and with their communities. (p. 1)

This dissertation contributes to developing the community informatics of an aging society by closely analyzing how older adults learn technology in their communities. I found that older people are active agents in their communities. Most older adults do not need (or particularly want) informatics solutions applied to them. Rather, they want support with technology in their communities so that they can continue to contribute to those communities in old age.

A second contribution of this study to the field of community informatics is the concept of the informatics lifecourse, which builds on the model of the informatics moment (Williams, 2012). The informatics moment has a double meaning, referring both to that moment when a person seeks and gets help with technology and to the moment in society when we transition from the industrial age to the information age. The informatics lifecourse extends the informatics moment concept by illustrating that life in the information age consists of an accumulation of informatics moments. Participation in the information society requires learning new digital technologies as they emerge and become normalized parts of society.

The informatics lifecourse, like the informatics moment, also has a double meaning. At one level, the informatics lifecourse refers to the learning of technology through the stages of one's life. At a more abstract level, the concept illustrates that the transition from the industrial age to the information age is not a moment in time. The information revolution began in the 1960s, and continues today, with no clear end in sight. This revolution and its long duration can be seen in the informatics lifecourse of individuals who have lived through it.

These lives are not lived alone. Rather, life is lived in communities. The informatics lifecourse of an individual older adult is structured and shaped by the relative supportiveness of community-based information infrastructure. This finding affirms community informatics research that shows that local communities shape how their members use and learn to use technology (Alkalimat & Williams, 2001; Clark, 2003; Postill, 2008).

Older adulthood. Older adulthood is not an absolute state of being. It is a relative one. One grows old in particular social and cultural contexts. These contexts shape how old age is experienced, as well as its boundaries (Cole, 1992; Gergen & Gergen, 2000; Giele & Elder, 1998;

Hutchison, 2014). This dissertation contributes to our understanding of the social shaping of older adulthood by illustrating how this stage of life is shaped in local communities.

Older adults negotiate the boundaries of old age through their participation in community-based information infrastructure. The institutions studied presume that older adulthood begins at age 50. Many adults do not agree with this definition of old age, and delay participation in senior centers until they are 60, or older. For many, older adulthood is less tied to an absolute age, and more tied to lifecourse transitions, such as retirement, that are not tied to a particular age. I found some individuals who had fully retired in their mid-50s; I found others who continued to work full- or part-time jobs in their late 70s. Furthermore, increasingly retirement is not the end of work. I found some older adults who had retired from one job, and were looking for another. I also found other older adults who had retired, and who continue to work through unpaid leadership positions in community organizations. In any case, this lifecourse transition shapes the informatics lifecourse. Retirement was the most common reason interviewees disengaged from technology for a period of time.

The incorporation of digital technology into community life also affects the social shaping of older adulthood. As a result of the disruptions of the still-emergent information society, older adults are recast by these institutions from community leaders to passive service recipients who receive help with technology from individuals 30 to 70 years younger than them. This structure reinforces ageist ideas about the capacity of older adults in the information society. Through its practices and policies, community-based information infrastructure contributes to shaping both how older adults see themselves and how society sees older adulthood.

These findings suggest a different way to think about and to study older adulthood. In library & information science, the dominant approach to the study of older adults has been to think about older adults as a "user group," that is, a group of users presumed to practice similar types of information behavior. For instance, Asla and Williamson (2015) studied the information behavior of information users in the fourth age, or those oldest individuals suffering from disability. In contrast to this approach to studying old age, I instead show that it can be productive to study older adults as active agents in their communities, and in their community-based information infrastructure. Here the focus is on agency rather than on use. From the vantage point of intergenerational communities, older adults do not consist of a collection of information users. Rather, older adults are those occupying a stage in the lifecourse all members of communities pass through, if life is not cut short. We are all either old or on our way to becoming old.

Some scholars have started to use this lifecourse approach to study how literacy at one stage of life relates to digital literacy at subsequent stages (Birkland, 2013; Bowen, 2011; Selfe & Hawisher, 2004; Silvast, 2015; Silver, 2014). This dissertation contributes to this literature by situating the informatics lifecourse of older adults within the local community. Understanding older adulthood in the information age requires attending both to the informatics lifecourse of the individual, and to the social shaping of that lifecourse in the communities where life is lived.

Digital literacy. This dissertation contributes to theories and concepts of digital literacy in two ways. First, the findings from this dissertation counter trends in the literature: a) that older adult digital literacy is reducible to declining minds and declining bodies, and b) that the digital literacy of youth is synonymous with digital literacy in general. Second, through the concept of the informatics lifecourse this dissertation contributes to our general theoretical

understanding of digital literacy. This concept suggests that digital literacy emerges across time. To understand digital literacy requires attending to how it emerges through the diverse rhythms of people's lives.

a) Countering the idea that older adult digital literacy is reducible to declining minds and bodies. The study of older adult digital literacy has been partially shaped by ageist assumptions that older adulthood is synonymous with declining minds and declining bodies (Bowen, 2012a). Studies from research groups such as MIT's AgeLab learn about how older adults may use technology by placing young students into immersive environments with artificial handicaps. These projects are based on the assumption that if young people understand the disabilities assumed to take place in old age they can design technological tools to help old people compensate for their supposedly declining minds and bodies (Bowen, 2012b). This assumption also appears in research literature premised on the idea that older adults will (or should) naturally use technology primarily for medical purposes (Heart & Kalderon, 2013). In these formulations, older adulthood is virtually synonymous with patient-hood.

This dissertation counters this conceptualization of old age by highlighting the active agency of older adults. Older adults are creative and determined learners who, with support, integrate technology into the diverse rhythms of their lives. Older adults also are active in their communities, contributing to and shaping community-based information infrastructure.

b) Countering the idea that older adult digital literacy is a lesser form of digital literacy. This dissertation also contributes to countering what Bowen calls the "age bias" in digital literacy research (Bowen, 2011). Past work on digital literacy has assumed that how young people use technology is how all people use or will use technology. This assumption sometimes shapes the research literature on the digital literacy of older adults (e.g. Bloch & Bruce, 2011). In

this dissertation I counter this idea by showing the richness and diversity of digital learning and literacy among older adults.

It is a truism that much can be learned from listening to one's elders. Nonetheless, we do not look to our elders to understand digital literacy. Many older adults have been using technology for longer than many of the young people helping them have been alive. Furthermore, even those who are just now starting to learn technology have lived through the disruptions of the still-emergent information society. Through their experiences in this society, older adults have much to teach us about what it means to be digitally literate. By learning with and alongside older adults navigating this new society, we can create more inclusive communities that work for us all.

The informatics lifecourse and digital literacy. At a more general level, the concept of the informatics lifecourse coined in this dissertation contributes to developing theories of digital literacy. How we use and learn to use technology over time is conditioned by the stages of our lives, which are diverse, and differ from culture to culture. By studying digital literacy in the informatics lifecourse we resist ideas that people in a given stage of life (e.g. youth) are inherently more digitally literate than people at a different stage of life (e.g. retirement). Furthermore, with this concept we can begin to explore how people in different stages of life integrate technology into their lives. We can, in other words, begin to study how digital literacy is shaped by the diverse and changing rhythms of our lives.

In past work on older adults learning technology, research has focused on what types of environments best support learning. Some find that intergenerational environments are supportive (e.g. Bailey & Ngwenyama, 2011). Others find that peer-to-peer environments are supportive (e.g. Kanayama, 2003). This dissertation finds that this question is not an either/or

one. Rather it is a both/and question. Older adults seek and find multiple sources of technology support in their communities. These communities include multiple generations. Older adults sometimes find support among other older adults. At other times, older adults find support from both younger and older generations.

Many theories of digital literacy are premised on the assumption that digital literacy and learning are social and collaborative (Gee, 2010; Prior & Shipka, 2003; Twidale, 2005). This dissertation contributes to these theories by showing that digital literacy extends beyond a particular situation to encompass entire lifetimes lived in communities. The concept of the informatics lifecourse encapsulates this finding.

Information infrastructure. Finally, this dissertation contributes to theories and models of information infrastructure. This dissertation carried out what Bowker and Star (1999) call an infrastructural inversion, which they describe as:

> A struggle against the tendency of infrastructure to disappear …. It means learning to look closely at technologies and arrangements that, by design and by habit, tend to fade into the woodwork (p. 34)

In this infrastructural inversion of older adult digital literacy, I found that older adults actively create and contribute to the technology support services they rely on in old age to begin and to continue learning of technology through the stages of their lives.

These findings contribute to work already underway to study and to create a socially just information infrastructure. In the opening article of a special issue on Infrastructure Studies in the *Journal of the Association for Information Systems*, Edwards, Jackson, Bowker, and Williams (2009) found that:

> Questions of distribution, power, and justice need to be addressed urgently and systematically by our field. How can claims on, through, and against infrastructure be formulated, organized, and heard? What constitutes adequate representation or

> participation in the process of infrastructural change and development? Under what conditions can rival interests in infrastructure (large and small, modest and profound) be acknowledged, addressed, and accommodated, in ways that enhance the legitimacy, appropriateness, and long-term efficacy of infrastructural change? (p. 372)

In this excerpt, Edwards et al. (2009) asked, "What constitutes adequate representation or participation in the process of infrastructural change and development?" (p. 372). I found that answering this question requires making space in our theories to understand how information "users" actively shape the information infrastructure upon which they rely.

Edwards et al. (2009) further ask questions about legitimacy and appropriateness in information infrastructure. They ask, in other words, what constitutes an ethical and socially just information infrastructure. This dissertation adds to these discussions by bringing a sharper focus on social struggle in the shaping of information infrastructure. As it has developed up to now, the concept of information infrastructure has been used to understand the work of governance, science, and corporations. Past literature mentions in passing that social struggle contributes to information infrastructure, but this insight has not led to social struggle becoming central to our understanding of information infrastructure. For instance, in their work on information infrastructure in museums, Star & Griesemer (1989) mention in passing that marginalized populations, such as lower-income backwoodsmen, contribute to shaping the museum (p. 396). In general, though, when the concept of information infrastructure is used to study environments outside the workplace, focus has primarily gone to those in positions of social power, and not to marginalized populations (Bowker & Star, 1999).

By closely analyzing how diverse older adults contribute to shaping their community-based information infrastructure, this dissertation suggests a different way to think about information infrastructure in general. Much is to be gained through research that considers

people in their daily lives as active agents in information infrastructure. Older adults do not simply use services created for them. By seeking support on their own devices at public libraries (even when librarians resist this trend), and by organizing to create and to sustain senior centers in relation to the invisibility of older adulthood in public services, older adults actively shape information infrastructure to meet their needs. These findings suggest that our conceptualization of information infrastructure could better address issues of social justice by theorizing information infrastructure as a product of social struggle.

Information infrastructure is an evolving theory. To this theory, this dissertation contributes the idea that social struggle, which emerges out of structural inequalities in society, shapes information infrastructure. This struggle takes place first at the level of the local community, where daily life is lived.

D. Implications for future research

This dissertation opens many new directions for research on the community informatics of an aging society. Two directions are discussed in this section. First, our understanding of aging in the information society could be enriched by understanding the informatics lifecourse of other individuals, at other stages of life, in other communities. A second direction opened by this study is the analysis of other community-based information infrastructure, in other places.

Study the informatics lifecourse. Future research could study how technology learning and literacy at one stage of life shapes technology learning and literacy at other stages. For instance, future research could investigate in more depth how technology learning on the job relates to technology learning in retirement in community-based information infrastructure.

Research could also investigate how technology learning among young people at school relates to technology learning at later stages of life.

Such a research project could have intergenerational components. Aging societies consist of multiple generations; it is becoming more and more routine to live into the 80s, 90s, and even beyond. As a result, one may find as many as five generations of a given family co-existing in a particular community. One could study how the informatics lifecourse of one generation in a particular local community differs from the informatics lifecourse of different generations. This research could illustrate how and why different generations relate to different computing paradigms in different ways over time.

In the library & information science and in the adult education literatures, the concept of lifelong learning has recently become an important topic of investigation (Borg & Mayo, 2005; De la Peña McCook & Barber, 2002). By studying the informatics lifecourse of diverse populations, one could study learning as it takes place over time. As this study showed, digital literacy and the informatics lifecourse are built on learning technology over time. One cannot be digitally literate without practicing learning across the stages of life, since the digital technologies taken to be normal in society have up to now been constantly changing. As such, future research on lifelong learning could be built around the informatics lifecourse concept.

In addition to understanding technology learning, studies of the informatics lifecourse could enrich our understanding of the information society in general. Theorists of the information society like Manuel Castells (1989) base their analyses on the operations of governments and the economy. Studying the informatics lifecourse in this way could amount to a people's history of the information society. Through the collective and comparative analysis of the informatics lifecourse of diverse populations a new vision of the information society from

the bottom-up could emerge. Such a project could include an archival component. Oral histories could document the informatics lifecourse of diverse populations. These recordings could add to the archival record in an important way and illustrate that ordinary people through their digital learning and literacy over time have actively shaped, and continue to shape the information society.

Study other community-based information infrastructure. This study analyzed a year in time in the complex, publicly funded institutions of senior centers and public libraries in a particular city in the USA. I found through this study that public libraries and senior centers indeed support the digital literacy of older adults. This support is not perfect, and more could be done, but there is a solid base in these institutions upon which future work could be built. Future research could extend this study by using similar methods to analyze how public libraries and senior centers in other communities support the digital literacy both of older adults and of individuals at other stages of life.

Not all older adults participate in senior centers and public libraries, and even fewer participate in technology support services. This study focused on older adults already engaged in technology support services in senior centers and in public libraries. Future research could extend this research by continuing the tradition in library & information science research on nonusers (Lange, 1988), or of individuals who do not participate in public libraries or in senior centers. Do these individuals find other means of learning technology across time? Or are they disengaged from technology? Why? Extending this dissertation by asking these and other questions could enrich our understanding of to what extent and how community-based based information infrastructure supports digital literacy.

Future research could also examine these publicly funded institutions in relation to other sectors of community-based information infrastructure identified in this study. These other sectors include families, local businesses, non-profits, and other educational institutions like community colleges and universities. Furthermore, in addition to the place-based information infrastructure that has existed in local communities for decades, new virtual information infrastructure is also emerging because of the affordances of digital technologies. In past research (Lenstra & Alkalimat, 2012a; Lenstra, 2014b) I found that social networking sites like Facebook are becoming vital community-based information infrastructure for aging populations. In future research, scholars could extend our understanding of the community informatics of aging societies by attending both to physical and to virtual community-based information infrastructure. How do these physical and cyber-spaces collectively compose the information infrastructure that sustain local, intergenerational communities across time?

E. Implications for practice and teaching

This study adds to practical work already underway that seeks to:

- Reframe older adults from passive service recipients to active agents;
- Counter ageism;
- Develop library services for aging communities; and
- Develop embedded librarianship.

Furthermore, this study adds to curricular work already underway that seeks to:

- Prepare students to integrate technology support into their lives and careers; and
- Prepare students to lead our aging society.

Implications for practice

Reframe older adults from passive service recipients to active agents. In projects around the USA older adults lead technology support services. The federally-funded Digital Inclusion Initiative (Senior Service America, 2014), the Computer Club hosted by the Otsego County (Michigan) Commission on Aging (Woodward et al., 2011), and the ShepNet Computer Center for Seniors in Greensboro, North Carolina (ShepNet, 2016) all have older adults leading programs for other older adults learning technology. These projects illustrate work underway to reframe older adults from passive service recipients to active agents in their communities.

More work of this sort could be done in and around public libraries and senior centers. Such practice could start with those organized older adults already deeply engaged in these institutions, such as friends of the library groups and senior center groups, and then extend outwards. By better utilizing the agency of older adults, these overpressured public institutions may find they can do more with less money while simultaneously empowering older adults to contribute to their communities.

This research found older adults have much to offer their communities. Some of these skills could be used in technology support services. Other skills could be mobilized in other ways. For instance, one regular at a senior center is a jazz guitarist who has performed regionally for the last 60 years. His experience is an incredible asset that could be better utilized in his community. Figuring out how to more fully support the agency of older adults could lead to a more resilient community-based information infrastructure, and thus to more resilient communities.

Counter ageism. In the 2000s Chicago Public Library started a "Not What You Think" campaign to counter stereotypes of public libraries. One of the images released features an

older woman operating a turntable with the words “Not What You Think (Get Your Beats Where Granny Gets Hers)” under it (Figure 7). Through humor, this campaign reminds us that both public libraries and older adulthood are not what we think they are. They require revision from the stereotypes we associate with them.

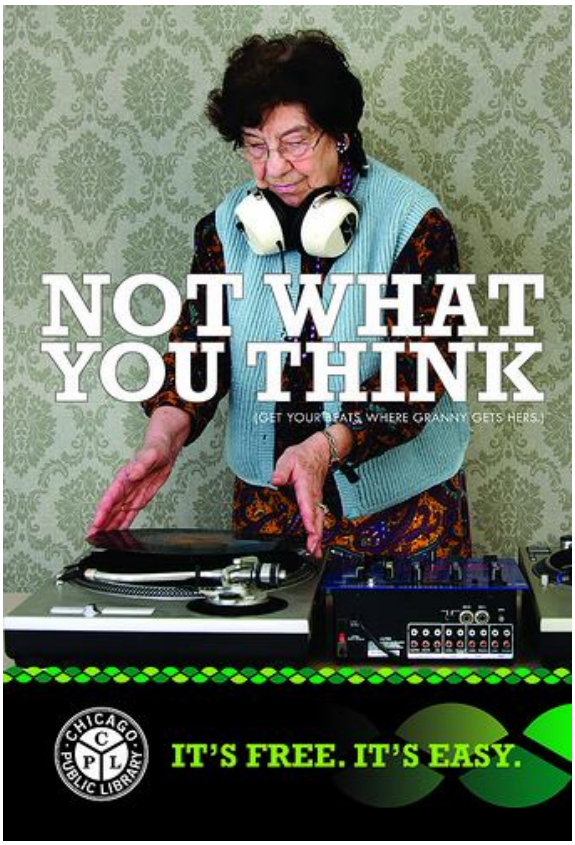

Figure 7: ‘Not What You Think’: Countering ageism at Chicago Public Library. Chicago Public Library, 2008.

One implication of this dissertation is that public libraries, senior centers, and other institutions could do more to counter ageism. Ageism is deeply ingrained in community-based information infrastructure, older adult digital literacy, and society more generally. Ageism affects how we study older adulthood, and it also affects how older adults are framed in the policies and practices of senior centers and public libraries.

At a practical level, ageism could be countered in multiple ways. First, public campaigns and programs could bring attention to the diverse and changing experiences of growing old in the USA and around the world. Second, public libraries could hold more dialogues about aging, fostering intergenerational conversations about what it means to grow old. Intergenerational programs of this sort have been found to counter ageism in communities (Peacock & Talley, 1984). The value of this type of work can be seen in the fact that the American Library Association (2008) includes intergenerational programs as part of its recommended library services for older adults. Third, continuing education could be organized to retrain the library and senior center workforces to be sensitive to ageist attitudes that they may unthinkingly draw on as they design and implement policies and services.

Develop library services for aging communities. Locally and nationally, some vanguard institutions and individuals are reconfiguring libraries for aging communities (Rothstein & Schull, 2010; Schull, 2013). These efforts could be supported by more attention to this topic within the American Library Association (ALA). Currently only one body within the ALA hierarchy discusses issues related to aging and older adults. That group is the Library Services to an Aging Population Committee, part of the Reference Services Section (RSS) of the Reference and User Services Association (RUSA), which is in turn a division of ALA (American Library Association, 2015). In other words, the only national body for librarians interested in discussing library services for aging communities is a committee nested within a section, nested within a division. In contrast, the national infrastructure for discussing and supporting library services for young people is very robust. The American Library Association maintains two entire divisions focused on library services for young people: The Association for Library Service to Children and the Young Adult Library Services Association.

Public libraries, like other public educational institutions formed in the modern era, are premised on a large number of young people and a small number of older people. As global aging continues into the future, more work will be needed to reconfigure library services, and public libraries more generally, for aging communities. Working within the American Library Association to create a more robust space for discussing this topic could be one means of developing this area.

At the local level, more work could also be done to develop partnerships and collaborations between public libraries and other institutions that serve and are composed of older adults. One implication of this dissertation is that more could be done to build networks between senior centers and public libraries. In a time of declining public funding, we as a society cannot afford to ignore the overlaps of our public institutions, which include public libraries and senior centers, as well as schools and universities. Work to knit together senior centers and public libraries, as Cimpoieru (2011) found already taking place in Romania, could lead to library services that better support their aging communities.

Develop embedded librarianship. A final practical implication of this dissertation is that more could be done to develop embedded librarianship. In the field of public librarianship, the concept of embedded librarianship refers to integrating librarians into community organizations based outside of the library (Long, Galston, Huber, & Johnson, 2012). This dissertation found that public libraries and senior centers are already deeply rooted in the lives of many older adults. Unfortunately, I also found that the staff of these institutions struggle to get beyond the systems they are charged to administer. Much of their time is focused on managing and providing access to library systems and to senior center programs. As a result, staff cannot easily get outside of the buildings in which they work.

In the context of the multiple pressures associated with managing public institutions, developing embedded librarianship is not a trivial matter. One means of developing this model of librarianship is to empower older adults, and others in local communities, to take a more active role in the libraries in which they participate. Currently, many older adults already advocate for public libraries through their involvement in and leadership of friends of the library groups. This energy could be mobilized to develop embedded librarianship by encouraging and supporting these older adults to become official liaisons of the library in senior centers and in other community organizations. Through these "citizen librarians," the library could become more embedded and rooted in the community it serves.

A second means of developing embedded librarianship suggested by this dissertation could be to develop practices and policies that work to eliminate what Durrance (1983) criticizes as the "anonymous professional-client encounter" (p. 278). I found that older adults through their determination form and maintain relationships with individuals they find to be supportive in public libraries and senior centers. Public libraries and senior centers could work to better support these relationships through different policies than those that are currently in place. These supportive relationships, if sustained across time, could contribute to reducing the phenomenon of digital disengagement and could also contribute to the library and the senior center becoming more embedded in the communities they serve.

Implications for teaching, and for educational institutions more generally

Prepare students to integrate technology support into their lives and careers. The findings of this dissertation suggest that we as teachers need to better prepare our students to integrate technology support into their professional and personal lives. I found public

institutions imposing bureaucratic limits to reduce the amount of time and forms in which they help members of the public learning technology. I also found library & information science students resisting the idea of supporting an older adult on a technology they themselves had never used before.

One lesson to be learned from the informatics lifecourse of older adults is that digital technology has changed continuously, and will most likely continue to change continuously into the future. As a result, we all need to learn new technology across time to remain active citizens in the information society. We could prepare our students both to practice and to teach this learning of technology across time by immersing them in experiences where they are expected to support diverse people learning diverse digital technologies, some of which they have never used before.

This work is already emerging in courses on community informatics at the University of Illinois (Williams, 2014), as well as in library & information science courses at other universities (Roy, Bolfing, & Brzozowski, 2010), and in programs outside of library & information science (Bowen et al., 2014). Through experiential learning assignments that place students as technology volunteers in local libraries and in other community institutions, students learn what it means to support the informatics lifecourse by supporting the informatics moments of daily life. Students also learn how persistent and pervasive digital inequalities continue to be in our society.

Preparing students to integrate technology support into their professional and personal lives will also prepare our students to create a more inclusive information society. Students could learn to do this work not only as part of their careers, but also as part of being a responsible citizen in the information society. At the University of Illinois, undergraduate and

graduate students volunteer every Friday to help residents at a local retirement community learn technology. This volunteer work helps students realize the challenges and benefits of integrating technology support into their personal lives. In other words, this type of teaching could and should be practiced in any environment.

Prepare students to lead our aging society. Students could also be better prepared to lead our aging society. This work could be accomplished through curricular modules that inspire students to interrogate ageist assumptions they may hold about older adults, and about aging more generally. Students could undertake projects that have them working alongside older adults in local communities. For instance, students learning about technology support in libraries could work with older adults at a senior center to develop and foster a culture of collaborative learning of digital technology across the two institutions.

Through projects like this one, students could learn to see older adults in their communities as active agents, ready and capable of contributing to their communities. Older adults need and want support with digital technology. They also want and need to support each other, and other sectors of their local communities. Being a leader in an aging society involves being able to recognize and mobilize this agency. Through projects that involve students working and learning alongside older adults in their communities, students could learn to become leaders in our aging society.

F. Conclusion

The information society is also an aging society. This means that as digital technology becomes densely woven into the fabric of everyday life, the median age of humanity continues to rise. The participation of older adults in the information society is often seen as dependent on

how they cope with their supposedly declining minds and declining bodies. In this study I reframed this phenomenon by studying the digital literacy and learning of older adults in the context of the communities where they live.

By studying older adults in their communities, I found that digital literacy unfolds across time. Learning to read and write is, at a basic level, analogous to learning to ride a bike. One can learn to read and write at a young age and be able to read and write throughout life, even if long periods of life occur in which reading and writing does not take place. The same is not true about digital literacy. Digital literacy requires learning new technologies and new technological applications as they emerge and become integrated into social life. The stage of one's life shapes how this learning process takes place. How someone working full-time learns technology is different from how a retired older person learns technology because their stages of life are different. This dissertation introduced the concept of the informatics lifecourse to analytically describe this phenomenon.

The informatics lifecourse is shaped by the relative supportiveness of community-based information infrastructure. Older adults who are retired cannot count on technology support at school or in their workplaces. When this infrastructure is not as supportive as it could be, older adults sometimes disengage from technology. Older adults actively endeavor to change this situation. Through their agency, older adults created senior centers, and they continue to advocate for both senior centers and public libraries.

When older adults find support learning technology in community-based information infrastructure they are able to contribute to their communities. Public libraries and senior centers are overpressured, publicly funded institutions. By embracing the agency of older adults, these institutions could reconfigure themselves for an information society that is also aging.

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APPENDIX A. INSTITUTIONAL REVIEW BOARD DOCUMENTATION

UNIVERSITY OF ILLINOIS
AT URBANA-CHAMPAIGN

Office of the Vice Chancellor for Research

Office for the Protection of Research Subjects
528 East Green Street
Suite 203
Champaign, IL 61820

September 15, 2014

Kathleen Williams
Library & Information Science
112 LIS Bldg
M/C 493

RE: *The Community Informatics of An Aging Society: A Comparative Case Study of Public Libraries and Senior Centers*
IRB Protocol Number: 15109

EXPIRATION DATE: 09/14/2017

Dear Dr. Williams:

Thank you for submitting the completed IRB application form for your project entitled *The Community Informatics of An Aging Society: A Comparative Case Study of Public Libraries and Senior Centers*. Your project was assigned Institutional Review Board (IRB) Protocol Number 15109 and reviewed. It has been determined that the research activities described in this application meet the criteria for exemption at 45CFR46.101(b)(1 & 2).

This determination of exemption only applies to the research study as submitted. Please note that additional modifications to your project need to be submitted to the IRB for review and exemption determination or approval before the modifications are initiated.

We appreciate your conscientious adherence to the requirements of human subjects research. If you have any questions about the IRB process, or if you need assistance at any time, please feel free to contact me at the OPRS office, or visit our website at http://www.irb.illinois.edu.

Sincerely,

Rebecca Van Tine

Rebecca Van Tine, MS
Assistant Human Subjects Research Specialist, Office for the Protection of Research Subjects

c: Noah Lenstra

telephone (217) 333-2670 • fax (217) 333-0405 • email IRB@illinois.edu

Oral consent script (waiver for written consent)

[Note: This script was used as a template for informal interactions with older adults at public libraries and senior centers with whom I interacted during fieldwork, to ensure they were aware of my presence as a researcher.]

Hello! My name is Noah Lenstra and I am a technology volunteer here at [name of site]. I am also a PhD student in library & information science from the University of Illinois. While volunteering here I also research how local institutions help people, such as you, with technology. I particularly want to know how local institutions help older adults with technology. With your permission I would like to write a few notes after this help session ends about how it went. These notes would not include your name or any identifying information. If you don't want me to take any notes, or if you don't want to participate in this research, that is totally fine, I am still more than happy to help you with whatever you'd like to learn. If you have time later today, or on another day convenient to you, I would also like to ask you a few questions about your background and your experiences with technology. This interview is totally optional, and in no way required for you to receive technology help today or in the future.

Written consent form

[Note: If requested, older adults could review and sign this consent form waiver. The waiver had to be signed prior to interviews, but a signed waiver was not required for the participant observation portion of this study]

Consent form / The Community Informatics of An Aging Society: A Comparative Case Study of Public Libraries and Senior Centers

In accord with rules about informed consent, this document explains what research we're doing, informs you of your rights, and asks for your voluntary consent to participate.

We are studying how local institutions, in particular senior centers and public libraries, support the digital literacy of older adults. We want to know how this process works currently, and how it could be improved. The research is led by Dr. Kate Williams and Noah Lenstra of the University of Illinois at Urbana Champaign Graduate School of Library and Information Science.

By participating in this research, you are helping to create a better understanding of how the local area and the nation are entering the digital age. This document is to ask if I can make notes on what happens during the technology help session today, and if you wish and if you have time, I would like to ask you some questions about your experiences with digital technology.
The materials from this research will be used for research presentations and publications. Your identity, participation, and answers will all be kept confidential by the research team, safeguarding your privacy.
We don't foresee any risks to this research beyond those of daily life. Benefits of the research include that you can learn about new digital technologies and connect with other people. We hope that what we all learn will make communities stronger.
The questions we ask will not be intrusive. But at any point you can skip a question. You can also stop participating in the research. The decision to participate or not, or skip a question, will have no effect on your or anyone's grades at, status at, or future relations with the University of Illinois, or on your ability to participate in the workshop.

If you have any questions regarding the research, please ask. You can also email or call the lead researchers collect at any time (Noah Lenstra and Kate Williams, katewill@illinois.edu or 217-244-9128). If you have any questions about your rights as a participant in this study or any concerns or complaints, please contact the University of Illinois Institutional Review Board at 217-333-2670 (collect calls will be accepted if you identify yourself as a research participant) or via email at irb@illinois.edu. A copy of this document will be given to you.
□ I understand the above and voluntarily agree to participate in this research.

Please indicate which parts (if any) of this research you voluntary agree to participate in:
□ Technology help session
□ Short questionnaire

Signature: _____

Printed name: _____

Date: _____

Staff Consent form

The Community Informatics of An Aging Society:
A Comparative Case Study of Public Libraries and Senior Centers

In accord with rules about informed consent, this document explains what research we're doing, informs you of your rights, and asks for your voluntary consent to participate.

We are studying how local institutions, in particular senior centers and public libraries, support the digital literacy of older adults. We want to know how this process works currently, and how it could be improved. The research is led by Dr. Kate Williams and Noah Lenstra of the University of Illinois at Urbana Champaign Graduate School of Library and Information Science.

By participating in this research, you are helping to create a better understanding of how the local area and the nation are entering the digital age. This document is to ask if I can make notes on what happens during my time volunteering at the library.

The materials from this research will be used for research presentations and publications. Your identity and participation will be kept confidential by the research team, safeguarding your privacy.

We don't foresee any risks to this research beyond those of daily life. Benefits of the research include your ability to understand how other local institutions are supporting the digital literacy of older adults. We hope that what we learn will make communities stronger.

You can also stop participating in the research. The decision to participate or not, will have no effect on your or anyone's grades at, status at, or future relations with the University of Illinois, or on your ability to count on my assistance as a volunteer at this site, now or for the time period of this project.

If you have any questions regarding the research, please ask. You can also email or call the lead researchers collect at any time (Noah Lenstra and Kate Williams, katewill@illinois.edu or 217-244-9128). If you have any questions about your rights as a participant in this study or any concerns or complaints, please contact the University of Illinois Institutional Review Board at 217-333-2670 (collect calls will be accepted if you identify yourself as a research participant) or via email at irb@illinois.edu. If you choose to receive one, a copy of this document will be given to you for your records. Copies will also be available at this site. If you choose, you may sign and return this form to me.

□ I understand the above and voluntarily agree to participate in this research.

Signature: _____

Printed name: _____

Date: _____

APPENDIX B. DATA COLLECTION INSTRUMENTS

Fieldnote Guide

To be filled out by researcher after fieldwork at research sites
Note: Use only pseudonyms when referring to people.
1. Site:
2. Particular spaces within site:
3. Date:
4. Time:
5. What happened during fieldwork? Write a chronological narrative in as much detail as possible from moment arrived at site to moment left site.
6. What technologies (digital and analog) were being used? How? By who?
7. How were older adults visible or invisible at the site today? Was this visibility/invisibility positive or negative?
8. Who were participants in technology services today?
9. Did I identify any regulars or were most of the people here new faces? What was the feeling of the place (e.g. everyone knows everyone / no one knows anyone / or somewhere inbetween)?
10. What struggles did participants [using technology services] have (if any)?
11. What breakthroughs did participants have (if any)?
12. What struggles did I have (if any)?
13. What breakthroughs did I have (if any)?
14. To what extent and how did participants help each other?
15. How did I interact with staff today?
16. How did staff interact with each other? With participants?
17. How did today differ from previous days at this site?
18. How was it the same?
19. How did today differ from previous days at other sites?
20. How was it the same?
21. What worked well today?
22. What needs to change in the future?
23. What roles did I play at the site today?
24. Additional observations and notes
25. Analytical notes based on today and theory of information infrastructure
26. Analytical notes based on today and theory of digital literacy
27. Analytical notes based on today and theory of older adulthood
28. Analytical notes based on today and theory of community informatics

Semi-Structured Interview Guide for Older Adults

A. Site name:
B. Participant's first name and last initial:

1. Tell me about the digital technologies you own or have at your residence.
   [Use devices below to prompt, as needed]
   Computer
   Laptop
   Digital television
   GPS
   "Smart" phone
   Basic cell phone
   Digital camera
   Tablet computer (iPad, Kindle, etc)
   eReader
2. Have there been any periods in your life in which you stopped using digital devices, or have you constantly used digital technologies since you first started using them?
   Stopped
   Constantly used
3. If stopped, tell me about what caused you to stop? And why did you start again with technology?
4. Tell me about your personal history with computers and other digital technologies? Possible follow-ups to include a) What is your oldest memory of using computers? b) What are some of the places you have learned technology?
5. Have you ever used digital devices as part of your paid employment? Yes No
6. Do you have someone you can count on to help you when you get stuck with technology? Yes No [If yes] Who?
7. Tell me about what helps you learn technology.
8. Where else, besides your home and [name of public library/senior center] do you use technology?
9. Based on the following classifications from the United States Census, how do you describe your ethnic origins?
   White
   Black or African-American
   Asian-American or Asian
   Hispanic Origins
   American Indian and/or Alaska Native
   Native Hawaiian and/or Other Pacific Islander
   Other – please specify:
10. Are you retired? [If yes: Before you retired what was your job, or jobs?] [If yes? When did you retire?] [If no: What is your current job?]
11. How long have you lived in the local area? Which city/town do you live in? Where else have you lived?
12. If you don't mind me asking, how old are you?
13. [Don't ask, but make a note of their gender and circle one:] Male or female

Semi-Structured Interview Guide for Site Staff

I. Introductory questions
1) How long have you been involved with [name of site]?
2) What are some of things you have done at [name of site] over the years?
3) [Probe as needed to understand their involvement in the site over time]
4) If you had to define the term, how would you define "older adults"?
5) If you had to define the term, how would you define "digital literacy"?
6) Do you consider yourself to be a netizen?

II. Role of site as community-based information infrastructure in lives of older adults
1) From your perspective as a leader, what types of services/programs are the most popular among older adults at your site?
2) From your perspective as a leader, what types of services/programs are most needed among older adults at your site?
3) If you had to generalize, how would you describe the older adults that utilize [name of site]?
a. Probes if needed: Are they older or younger senior citizens? More active or less active? More well off or less well off? Any generalizations about ethnicity or gender?
4) Do you use digital technologies in your work as a leader at this site?
5) If yes, can you tell me some of the ways in which you use technology to lead?
6) If no, can you tell me some of the other media (such as land-line telephone, paper-and-pencil, word-of-mouth) you use to lead?
7) How has your [site's] use of technologies changed over time?
8) If at all, how do you or your staff communicate with older adults that participate at your site? Face-to-Face, Phone, Postal mail/Newsletters, Newspaper ads, Email, Text, Other
9) In general, how do you see [name of site] using digital technologies in its operations (such as administration, communication, outreach, fundraising, etc.)?
10) If at all, how have digital technologies changed how [name of site] operates?

III. How is older adult digital literacy acquired, supported, and used?
1) Do you see some older adults using technologies more than others at [name of site]?
2) If yes, why do you think these differences exist?
3) Do you know any older adults, at your site or elsewhere, who you think are really on the ball in terms of staying up-to-date with digital technologies?
4) If yes, can you tell me a little about this person or people? What do they do with technology that impresses you?
5) Now let me ask you the opposite question: Do you know any older adults, at your site or elsewhere, who really do not know digital technology?
6) If yes, Can you tell me a bit more about this person or people?

IV. What are the relations between community-based information infrastructure and older adult digital literacy?
1) Have you ever helped an older adult with technology at your site?
2) If yes, can you tell me about this one or a few of these help-giving episodes?
3) If yes, how often do you do this type of work? What happened and how did it go?

4) Do you see older adults interacting with [name site] through digital technologies? Example could include things like emailing you or someone else from [name of site], using your website or other online resources (such as newsletters) provided by [site], or other things?
5) If yes, can you tell me about this use?
6) Have you ever struggled communicating with older adults because older adults at your site do not know digital technology as well as you?
7) What would help you or [name of site] do more to support older adults learning digital technology?

V. Demographic questions
1) Based on the following classifications from the United States Census, how do you describe your ethnic origins?
White
Black or African-American
Asian-American or Asian
Hispanic Origins
American Indian and/or Alaska Native
Other – please specify:
2) If you don't mind me asking, how old are you?
3) [Don't ask, but make a note of their gender and circle one:] Male or female

APPENDIX C. AN EXAMPLE OF HOW DATA WERE COLLECTED, CODED, AND SORTED

Data recorded in response to fieldnote Prompt #5 "What happened during fieldwork? Write a chronological narrative in as much detail as possible from moment arrived at site to moment left site."
Note: Inductive codes developed from close reading of fieldnotes appear in bubbles next to relevant text. The codes that emerged from the inductive analysis of this and other fieldnotes and interview transcripts were synthesized by assembling and sorting the codes using Excel. For instance, codes on "troubleshooting strategies" and "note-taking strategies" were synthesized into the more general concept of "learning techniques."

… I talked with Gloria from 12:30-12:40
we talked about how much time older adults need. She said that in the past Computers 101 limited older adults to half-hour blocks, and only one at a time
Gloria said sometimes ppl want other times beyond those scheduled, but it was difficult for the staff to be available whenever older adults wanted help. kept things to the schedule. only certain times for help. she said something about it is hard for seniors to stay on schedule - that they want to do things on their time, not on anybody elses, but the senior center keeps a tight schedule to maintain order

she said she wasn't sure how the 1/2 hour blocks came to be the norm for the Computers 101 program - she agreed that hour makes more sense
she said ppl usually sign up for the computer class at the weekly potluck, and that next wednesday is a senior center trip (july 22) so probably no one will come
....
Monty [a pseudonym] signed up for 1-1:30 today according to sign-up sheet [he ended up staying until 2]
[director] said probably no one would want to stay in the comptuer area after 2 because they have some kind of event at the senior center
Monty came in right around 1 - while talking with [director] about the process and giving her his phone number, he revealed that he also has a residence in kansas city - he lives part there and part here - he told me he retired from honeywell and used their internal computers, but because of security couldn't access internet - he said he had used windows 98 for a while, and has a windows xp desktop, and got this windows 7 laptop a few years ago, but had only used a few times - he said he signed up for geek squad but they said they could only give him 10 minutes of help at a time, which was far less than he needed

he had a lot of questions and i found that he approaches the laptop as a total novice would - he didn't know how to get online or on wifi, or what these terms really meant, he didn't know what start button/windows orb did, didn't know how to open or use internet explorer. On the other hand he did have a bit of computer vocab - recognized the taskbar at the top of IE as a taskbar. He knows some digital terminology, but appears to be totally lost with this operating system. he said since he bought the windows 7 laptop he had used it at most a handful of times. he said he got disoriented and tried getting help from the geek squad, but it wasn't enough, so he just put it away in a closet. when he found out about help at the senior center he decided to try it out.

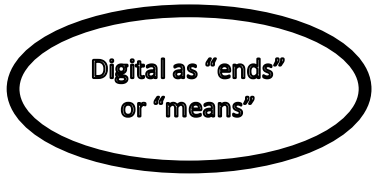
he was also struggling with the touchpad on his laptop - it was hard for him to figure out - he thought his screen was a touchscreen - a few times he tried touching the screen - he took notes for everything and frequently used pictures to help him remember - for almost everything i had him actually do the steps - he did not have projects he wanted to work on. he said he just wanted to figure out this laptop. i first i had him connect to the wifi - starting with clicking on "connections" staircase box, then put in the password (he typed it in wrong the first time so i did it for them) then i showed him how to open up internet explorer - he wanted to switch homepages from msn to aol so i walked him through that and had him do that - then i helped him log in to his aol email - which he had had since 2007 but he said he had not checked in years - there were almost 6000 unread messages, mostly mass marketing from different companies - i was going to show him how to select all to delte without doing individually - but after doing some poking i couldn't find a way to limit the preview to, say, 20-100 messages - it was literallly selecting all 5728 messages... so i told him he could select all and then unselect messages he wanted to keep - he said he would try doing it at home

in general he expressed feeling overwhelmed multiple times - but he had enough computer background to not be totally helpless... but not enough to feel confident or capable

he also complained that when he got into the windows help program it was too small to read, and that the laptop didnt come with instruction manual - i showed him how to get into windows help and i also showed him how to open up control panel to change windows default font size

we also did quite a bit of introduction to the start menu - he also wanted to know best way to shut down computer so we went over that - he was confused about difference between (start->shut down and just pressing the power button).

...



at one point he said he wanted to know what EVERYTHING on internet explorer symbolize, every button and every option on the drop-down menus. we then talked for a bit about needing to see selectively online - tune out ads, tune out unrelevant things, to just focus on what he wanted to do, didn't need to know what EVERYTHING did to be able to successfully use computer... but that left him feeling a bit anxious and disoriented

he said he would be back next week [Note: In fact, Monty did come back next week.] - *i asked him how he heard about the class and he said he had called around to try to find something like it (he was not a member of park district seniors or either senior center - but sounded like may become a member to take advantage of classes) - before we started he emphasized that he needed someone to be patient with him as he is learning*

... around 1:30 connie [a pseudonym] came in. [she had been here twice before, so we said hi and then she started telling me about what she was working on. connie had a computer for a while but it was broken and she sent it to her son in georgia who said motherboard was fried - so she decided she could just do what she wanted on tablet, but was overwhelmed by the # of emails she had] she wanted to use the lab computer at the senior center because it seemed easier for her to go through her emails on the lab computer as opposed to on her tablet (which she was just starting to learn). - it appeared to be signed up for a few lists that were daily bombarding her - first i helped log her in - this was a challenge b/c although she said she knew her email address and password it wasn't working - she and monty than chatted for a while about the difficulties of passwords - she tried a few times logging in - finally connie realized the problem was that she wasn't entering right email address - sbcglobal was her primary address - she was entering a different email address (att). with this shift email worked fine - she said she hadn't logged in in 3 months, but she seemed pretty adept - she said she used computers/emails while working but now that she was retired and her friends were in their 70s, 80s and 90s, no one used email so there wasn't a need anymore... almost her whole inbox seemed to be junk mail - we spent most of the next 30 minutes deleting all her emails (while she scrolled down - she could do this mostly on her own). she was capable on a desktop and worked independently after i helped her get into her email - i also showed her how to unsusbscribe from the messages - i showed her once - she tried it once with my support and then she unsubscribed from others by her own - she was pretty saavy with email and using internet explorer - she also had a handwritten piece of paper in her purse with her log in information on it.

Date	Location	Time at site (unit=hour)	Attendee 1	Technology used	Subject of digital practices	Attendee 2	Technology used	Subject of digital practices	Attendee 3	Technology used	Subject of digital practices
12-Nov-14	Smith Senior Center	2	Monty	Windows 7 laptop	wifi, getting set up with device, email, finding computer help on computer, internet explorer	Connie	lab computer	email, account management, unsubscribing from emails	Lois	android smartphone	email, attachments, email app versus gmail app (app management), spam texts and emails (texting)

Table 55: Example of fieldnote sorted by site and by time.
For brevity "Lois" does not appear in this excerpt.

Dates interacted with	Location	Name	Number of sessions	Interviewed?	Regular at senior center?	Age	Gender	Ethnicity	Technology used	Subject of digital practices	Reduced codes for digital practices	Nubmer of practices
11/12/2014, 11/19/2014, 12/10/2014, 1/4/2015	Smith Senior Center	Monty	4	No	Yes	73	Male	European-American	Windows 7 laptop	wifi, getting set up with device, email, finding computer help on computer, internet explorer	getting started, email, wifi, help-seeking	4

Table 56: Example of fieldnote sorted by participant.