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**A Collaborative Case Study of Public Housing Residents'
Evolving Geography of Educational Opportunity in a Smart City**

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Dedication

This dissertation is dedicated to Heather, Sailor and Daisy.
I love you.

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A core premise of this study is that nothing happens in isolation – there is always a complex entanglement of factors at play. The same is most certainly true for this project. From the moment my family and I left Denver to return home to Austin there has been a steady stream of terrific humans who have supported me and helped me to see the world and myself in new ways. My deepest thanks and love and thanks to all of you.

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Abstract

A Collaborative Case Study of Public Housing Residents’ Evolving Geography of Educational Opportunity in a Smart City

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Critical urban scholars and educational researchers have demonstrated that urban planning and economic development strategies routinely restrict the “geography of educational opportunity” in racially and economically segregated communities. Today, city governments across the globe are racing enhance their information and communications technologies (ICT) in order to implement “smart city” strategies as a centerpiece of their economic development and urban planning efforts. Many cities are enthusiastic about the potential for ICT-based technologies and a new ecosystem of “smart mobility” options to enhance residents’ access to virtual and physical resources that enhance one’s opportunities and quality of life. Ideally, these two foundational smart cities strategies should help to enhance geographies of educational opportunity in racially and economically segregated communities. However, to date no empirical studies have examined the impact of ICT-based technologies and smart mobility resources on educational opportunities amongst low income communities. As such, the purpose of this collaborative case study critically examines the relationship between ICT-based technologies and smart mobility assets in Austin’s (Texas) urban core and public housing residents’ geography of educational opportunity. To achieve this purpose, I addressed the following research questions: How and in what ways do public housing residents characterize their experience in accessing educational opportunities in the urban core of a smart city? How do public housing residents describe their experience with ICT-based technologies and smart mobility resources? What relationships can be drawn between the factors influencing public housing resident’s access to educational opportunities and their utilization or avoidance of ICT-based technologies and smart mobility

resources? The findings suggest that for residents: (a) housing is a stabilizing centerpiece within their geographies of educational opportunity, but the benefits derived from housing are counterbalanced by neighborhood gentrification; (b) educational access and opportunities are limited by public systems and supports that are mismatched to residents needs and aspirations; (c) access to ICT-based technologies and smart mobility options are highly variable and often mismatched to the needs of the residents; and (d) mismatches between shared mobility options, ICT-based technologies and residents' needs complicates residents' educational access and opportunities. This study concludes with implications for future research and practice.

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CHAPTER I: OVERVIEW OF THE STUDY

Introduction

In the Spring of 2016, I met with a group of public housing residents (“residents” hereafter) at the W.E.B. Dubois Terraces¹ in Austin, Texas for the first of a series of discussions focused on residents’ experiences accessing city resources and gathering their feedback on new technology-enabled mobility options. Alongside staff from the Housing Authority of the City of Austin (HACA) and a small team of resident “ambassadors” – residents who are paid a stipend to support HACA research and outreach efforts – we lead residents through a series of exercises where they were asked to describe their daily journeys moving around the city. Early on in the first session an African-American single mother observed, “You are asking about how we get to where we need to go every day, but that’s the wrong question. What you should really be asking is where we *want* to go, but can’t.”

She proceeded to tell the group how the location and frequency of public bus routes makes it unfeasible for her to take her preschool-aged son to a variety of seasonal events held at a large park in the center of the city. Another resident nodded emphatically then shared her experience trying to find a faith community, which due to the limited availability of public transit on Sunday mornings is limited to only two options. Others told of their longing to see family on the other side of town or to take their children to see neighborhoods with Christmas lights. Lastly, one grandmother who is raising her grandchildren shared that her oldest granddaughter had been accepted to an elite all-girls school, but that she had to decline her spot because she could not make it across town and back in time to take care of her two younger sibling before her grandmother had to leave for her second job. In story after story, residents described a diverse

¹ I utilize pseudonyms for all housing properties and participants in this study.

combination of spatial, temporal and economic barriers to moving through the city and taking advantage of all that the city has to offer. In times past, these stories might not have seemed so surprising since the DuBois Terraces and most of the other public housing properties in Austin are located in the east side of the city (“Eastside” hereafter), which was intentionally designed to segregate Black and Latinx families and distance them from resources on the west side of town (Zehr, 2015). At the time of our discussion at DuBois, however, most of the public housing units on the Eastside were nested in neighborhoods experiencing rapid racial, cultural and economic gentrification due to the in-migration of college-educated young professionals attracted to Austin’s thriving tech-based economy and globally-renowned cultural amenities (Delco, 2019).

The gentrification of the Eastside has paralleled the city’s efforts to become a “smart city.” Smart cities is an umbrella term describing an assortment of urban development strategies that expand information and communications technologies (ICT) in order to improve city services and support economic growth, environmental sustainability and social equity. Austin’s smart cities strategy focusses heavily on transportation and features a Smart Mobility Roadmap (2017) that includes cloud-based public transportation services, research on autonomous vehicles, investment in infrastructure to support electric vehicles, and the expansion of rideshare options including cars, bikes, scooters and mopeds. As I left the Dubois Terraces that evening, it was striking to me that Austin’s ICT-enabled resources and smart mobility options were hardly mentioned in the residents’ stories. I felt the topic warranted further investigation. A small team of residents and HACA staff agreed and based on our collaboration, I offer the following study².

² This study was a collective effort from beginning to end, but I present the findings here in first person for the purpose of my dissertation. This is in no way meant to diminish the support, wisdom and many hours of work the community advisors contributed to this study.

Problem to be Addressed

This is a study about living and learning in the city. On the one hand, cities have arguably impacted the trajectory human development more than any other factor in the 21st Century (Glaeser, 2011). With their dense agglomerations of people, cultures and ideas, cities create the conditions for innovation, health, higher levels of education and literacy, and improved access to economic opportunities (Florida, 2014; Glaeser, 2012; Montgomery, 2013). However, the benefits within cities are not evenly distributed and vary widely depending on the location of and amenities within one's immediate living environment (Drier, Mollenkopf & Swanstrom, 2004; Logan & Molotch, 2007).

These “spatial inequalities” – the unequal distribution of resources in space (Harvey, 1973) – lead to “spatial injustices” – inequitable access to the institutions, policies and practices that shape physical space and human interaction (Soja, 2008). Urban scholars have shown how the powerful coupling of spatial inequality and spatial injustice are inextricable from racial segregation, educational inequality, food scarcity, chronic health ailments, environmental threats and low economic mobility (Chetty & Hendren, 2018; Drier, Mollenkopf & Swanstrom, 2004; Green, 2015; Logan & Molotch, 2007; Sassen, 2012). This body of research emphasizes that imbalanced social outcomes in cities are neither natural nor accidental, but rather the product of purposeful economic development, housing and urban planning that intersect to intensify and sustain racial, economic and spatial inequality (Massey & Denton, 1993; Rothstein, 2017; Scott & Holme, 2016; Soja, 2015).

Urban inequalities are further reinforced and calcified by differential access to educational opportunities. Educational research has clearly demonstrated how efforts to improve educational opportunities in racially and economically segregated spatial contexts have been

chronically overwhelmed by mutually reinforcing inequalities between other sectors like employment, public health, housing and transportation (Anyon, 2005; Scott & Holme, 2016). Given this historical pattern, scholars have recognized the need for more holistic research practices that account for the whole “geography of opportunity” as it manifests in specific places (Briggs, 2005; Galster & Killen, 1995; Tate, 2008). In this dissertation, I have heeded Tate’s (2008) call to examine the interdependencies between educational processes and the broader geography of opportunity. I reinforce the primacy of education in this analysis by specifically focusing on the “geography of educational opportunity”, which I define as the place-specific relationships between social, cultural, technological and economic factors that impact access to educational opportunities in and out of schools (Anyon, 2005; Green, 2015; Powell, 2008; Tate, 2008).

For the purpose of this study it is critical to situate my analysis against the backdrop of the last century’s worth of economic development efforts, urban restructuring and federal policy in the United States that together have ritually devastated geographies of educational opportunity in poor, non-white communities (Scott & Holme, 2016). The expansion of suburban neighborhoods (“suburbia”) after World War II and inner-city gentrification after the Great Recession in 2008 exemplify this tendency and provide important historical context for this study.

Suburban expansion can be traced back to the 1939 World Fair where General Motors sponsored an interactive exhibit titled “Futurama,” which depicted a vision for the future of cities with vast automated highway systems connecting widely dispersed suburban communities (Montgomery, 2013). By the time U.S. soldiers returned home from World War II, cities across the country were laying the groundwork for Futurama-like urban restructuring with the support

of federal subsidies for highway expansion along with federally-backed 30-year mortgages that incentivized building new housing stock (Massey & Denton, 1993; Montgomery, 2013, Sugrue, 2014). The Federal Housing Administration (FHA) targeted white working class families for the insured 30-year mortgages which prompted “White flight” from inner city neighborhoods and drew the industrial employment base toward suburban communities (Drier, Mollenkopf & Swanstrom, 2004; Massey & Denton, 1993; Rothstein, 2017). Meanwhile, the FHA refused to insure properties in or near Black neighborhoods – a process called “redlining”—so non-White, working class families remained in durably segregating inner city neighborhoods where they were unable to build wealth through home ownership (Massey & Denton, 1993; Rothstein, 2017; Wilson, 1987).

With gutted tax bases and *de facto* racial school segregation policies the entire geography of educational opportunity for non-White children in inner cities deteriorated. Generations of school improvement and reform efforts have failed to disrupt the political economies and inequitable geographies of educational opportunity that were created and sustained by federal policies, urban planning and economic restructuring efforts (Anyon, 2005; Scott & Holme, 2016).

During the last 20 years in the United States, urban planning and economic development efforts have continued to demonstrate the reciprocal relationship between residential housing segregation and the geography of educational opportunity (Frankenberg, 2005). Starting around the year 2000, many red-lined neighborhoods that were once deemed too risky for federally backed 30-year mortgages were the targets the predatory mortgage brokers pushing risky products like interest only and negative amortization loans that were often approved on the basis of one’s ability to make the first artificially low payment (Calhoun, 2018). Rather than serving as

an opportunity to build equity in their home and grow wealth, these loans had a catastrophic effect on low income families who began to default on their homes en masse prompting a global economic crisis and the Great Recession (Calhoun, 2018).

The Great Recession devalued housing markets and prompted many cities across the U.S. to reimagine their economies and the structure and amenities in their urban core. Many cities embraced urban planning and economic policies intended to grow their technology sector and lure highly-educated individuals that the urban studies theorist, Richard Florida, coined the “creative class.” Florida (2005) found that the creative class have particular standards for the physical configuration of cities and desire a specific combination of urban, natural, cultural and entertainment amenities. Cities responded and many adopted post-Recession strategies that have generated rapid cultural, racial and economic gentrification in many inner city neighborhoods that increasingly feature resources and amenities that cater to wealthier (and Whiter) clientele (Cucchiara, 2013; Lees, Slater, & Wyly, 2013; Lipman, 2011; Sassen, 2012).

As high-income individuals and families have gentrified inner city neighborhoods, property values have risen and low income individuals and families have had to either adopt various coping strategies to find secure work and lodging or relocate to racially and economically segregated suburbs and schools that now serve a larger share of students from low income, non-White families (Hochstenback & Musterd, 2018; Orfield & Frankenberg, 2014; Orfield, 2011). The racial composition of schools signals to home seekers about the value of homes in a particular area – a fact not lost on city governments who are increasingly using schools as a key component of their strategy to lure high-skilled workers and grow their knowledge-based economy (Cucchiara, 2013; Lipman, 2011; Sassen, 2012).

Inner city schools are now routinely promoted as key elements of cities' knowledge-based recruitment strategies (Cucchiara, 2012; Lipman, 2011). Market-based education policies designed expand school choice, charter schools, vouchers and high-stakes accountability are complimentary to these efforts as they create the conditions for local school districts to transform schools in a manner that is attractive to future clientele (Pearman & Swain, 2017; Scott & Holme, 2016). While some have touted that market-based strategies will positively disrupt educational inequalities that have plagued the United States for generations (Friedman, 2002; Hess, 2009), evidence suggests that market-based reforms in combination with inner city gentrification have simply reordered racially and economically segregated schools into new spatial configurations (Orfield & Frankenberg, 2014).

It is against this historical backdrop that I have looked towards emergent trends to critically examine the relationship between smart cities – a widely implemented ensemble of technology-based strategies in contemporary urban planning and economic development efforts – and the geography of educational opportunity amongst racially and economically segregated communities. As I previously described, the smart cities model typically involves the expansion of open standards ICT infrastructure (e.g. fiber networks, 5G wireless and cloud services). Expanded ICT enables cities to harness data from the “Internet of Things” (e.g. urban sensors and wearable tech) and environmental sensors (e.g. cameras, sound, environmental emissions,) in order to provide a more accurate and granular picture of the flows of resources and behaviors of people (Nam & Pardo, 2011). Thus, a new urban technology market has emerged to support new urban behaviors and new forms of urban governance.

A robust ecosystem of venture capitalists, private technology firms and intermediary organizations have fueled the expansion of smart cities strategies through peer-to-peer

collaborations and networking opportunities, disseminating smart city policies, case studies and best practices, and connecting private firms with city governments. As of 2017, these efforts help to expand the global smart cities network to 252 smart projects in 178 cities worldwide (Woods & Jung, 2017) with smart technology revenues projected to reach as high as \$1.565 trillion by 2020 (Singh, 2015).

In the U.S., the velocity of smart city implementation has vastly outpaced the research on its impact and efficacy – especially the impact on individuals and communities (Meier & Bolivar, 2016; Colding & Barthel, 2017; de Jong, Joss, Schraven, Zhan & Weijnen, 2015; Ojo, Dzhusupova & Curry, 2016). Given the historical precedent of urban development, I offer this study as a call to action for the educational research community. We know too much about the complex evolution of inequality in cities to sit idly by while a new chapter unfolds. This said, examining the relationship between smart city expansion and educational opportunity in cities like Austin is challenging, because low income families are rapidly being displaced out of the urban core (Way, Mueller & Wegmann, 2018) – the space where the full ensemble of smart city assets are most often concentrated. However, one community of low income individuals and families who are not vulnerable to extreme rises in residential housing prices are public housing residents who can experience “gentrification without displacement” (Pohorelsky, 2019; Shaw & Hageman, 2015). In this context, I argue that public housing residents’ stories and lived experiences offer invaluable insights into how smart city expansion interfaces with existing spatial inequalities and relates to low income individuals’ and families’ geography of educational opportunity. In the following section I describe the collaborative case study that I conducted with the advisement and support of two public housing residents and one HACA staff member in order to examine this critical gap in the smart cities and educational research.

Purpose Statement and Research Questions

“You’re asking the wrong question. What you should be asking is where we would like to go, but can’t.” The evening I received that sage advice at DuBois Terraces I left feeling certain that I needed guidance and a partnership with a core group of residents in order to increase the likelihood that this study would be relevant and impactful. I was blessed to partner with and learn from three incredible individuals from Austin’s public housing community (“community advisors” hereafter): Destiny³ (third-generation housing resident), Reyna (housing resident and resident council president) and Paulo (HACA staff member)⁴.

As I entered into the partnership with the community advisors, I was clear that there were a number of gaps in the empirical literature on smart cities that warranted critical examination. First, while there had been a healthy theoretical debate over the social justice implications of smart cities there was very little research that focused on the impact on racially and economically segregated low income communities. Secondly, the research that specifically addressed the impact of smart city implementation on low income communities did so with largely quantitative studies with little or no resident voice or details on their actual lived experiences. Third, while the smart cities literature routinely centered “smart citizens” as essential elements in the smart city milieu the few studies that referenced education systems directly either (a) advocated for adopting a specific technology product in universities, or (b) focused narrowly on the infusion of smart city approaches into school buildings and instruction – no studies addressed implications for the broader geography of educational opportunity in smart cities.

³ In addition to helping to revise the original interview protocols for this study, Destiny also served as an interviewee as her stories and experiences were germane to the focus of this study.

⁴ The community advisors agreed to be personally identified in this dissertation; however, I opted to use pseudonyms for them as well in order to protect the anonymity of other study participants.

The community advisors were not steeped in the literature, but based on their experiences and relationships at Overton Courts (the study site) they recognized that the study was worth pursuing. We agreed that the residents' stories would provide insights that could support our shared interest of improving educational opportunities for public housing communities while informing the smart cities and educational research establishment. With this in mind we conducted this study in order to address the following questions:

- 1) How and in what ways do public housing residents characterize their experience in accessing educational opportunities in the urban core of a smart city?
- 2) How do public housing residents describe their experience using ICT-based technologies and smart mobility resources?
- 3) What relationships can be drawn between the factors influencing public housing resident's experience accessing educational opportunities, ICT-based technologies and smart mobility resources?

Understanding these research questions is important because as smart city assets like ICT-based technologies and smart mobility resources are being infused into the fabric of urban living, city dwellers' social, physical and virtual realms are becoming more interdependent. As such, the geography of educational opportunity is prone to more complex interrelationships that will increasingly factor into the strategic planning and management responsibilities of educational administrators. In order to administer education in a socially, spatially *and virtually* just manner, we need to know more about how smart city assets relate to educational opportunities in vivo and are experienced within specific communities in specific locations.

With these needs in mind, the community advisors and I opted to focus our inquiry through a case study of how residents from a single, inner-city housing community have experienced the emergence of smart city assets in relation to their educational journeys. The case study approach allowed me to prioritize the experiential and contextual details that surfaced in residents' stories. Once gathered, I analyzed the details of our case using a combination of theoretical precepts that I describe briefly in the next section.

Overview of Theoretical Framework

I realized early on in this study that no one theoretical framework provided a complete-enough toolkit to understand and examine the evolving geography of educational opportunity in a smart city. Instead, I have braided percepts from three theoretical lineages that are especially

well-suited to grappling with the complexity of urban environments. Specifically, this study has been guided by the combination of systems thinking, critical urban geography, and critical praxis. In this section, I briefly describe the core tenants of each and then explain how they come together to form a cohesive whole.

Systems Thinking

You think that because you understand “one” that you must therefore understand “two” because one and one make two. But you forget that you must also understand “and”.

- *Sufi teaching story (sited in Meadows, 2008, p.12)*

I take a common wisdom from the Sufi proverb above and the young mother’s observation that I was “asking the wrong question”: they each suggest that the deeper truths lie in the spaces between the more mundane or assumed “facts” of life. For this study, “the spaces in between” have been my focus from the outset. I was inspired to act by the complex inequalities *across* multiple other sectors that have routinely compromised educational opportunities in racially and economically segregated communities (Anyon, 2005; Lipman, 2011; Scott & Holme, 2016; Tate, 2008). With this empirical lineage at my back, my goal in this study was to learn from the residents’ perspective how the expansion of technology-based smart city strategies in a specific context *related* with a landscape of educational opportunity on the Eastside of Austin that has been shaped by historical (e.g. redlining) and emergent (gentrification) cross-sectoral inequalities.

Systems thinking provided a framework for conceptualizing and executing a study focused on complex interrelationships. Systems thinking emerges from an ontological perspective that all natural and constructed facets of the Anthropocene are systemic. The late systems theorist, Donella Meadows (2008), explains that all systems consist of three things: elements, interconnections and a purpose. She notes that (a) the interconnections between

elements inform how the system will behave and (b) that the long term behavioral patterns of the system provide insights into its underlying purpose. Importantly, systems are more than the sum of their parts, because all systems are connected to other systems (Meadows, 2008). Thus, the interconnections *between systems* inform how the larger ecosystem will behave and for what purpose.

Systems thinking is the application of a systems worldview. Lazlo (1972) explains that systems thinking-informed research represents a departure from dominant forms of positivistic research that focus on details and atomistic facts while disregarding the wider structure. By contrast, systems thinkers aim to see wholes by examining interconnections at all levels of magnitude and complexity (Lazlo, 1972; Senge, 1990). Senge advises that systems-based investigations see wholes and grapple with magnitudes of complexity by seeing how they manifest within a specific boundary (1990). Critical urban geography provided further guidance on how to think about urban boundaries as well as a framework for examining complicated the power dynamics undergirding interrelationships within and across systems. I briefly describe the core tenants of critical geography and importance to this study in the following section.

Critical Urban Geography

David Harvey's *Social Justice in the City* (1973) ushered in the critical urban geography movement over 45 years ago and powerfully established that geography is inescapable. Drawing on this lineage, Logan and Molotoch point out that, "All human activity must occur somewhere. Individuals cannot do without place by substituting another product. They can, of course, do with less place and less desirable place, but they cannot do without place altogether" (2007,p. 4). The physical geographies where people live are centered as essential systemic variables in critical urban geography, because the construction and reconstruction of urban spaces are sites where

injustices and advantages are reproduced (Bourdieu, 2003; Harvey, 1973). Put another way, Brenner (2009) notes:

Rather than affirming the current condition of cities as the expression of transhistorical laws of social organization, bureaucratic rationality or economic efficiency, [critical urban geographers] emphasize the politically and ideologically mediated, socially contested and therefore malleable character of urban space—that is, its continual (re)construction as a site, medium and outcome of historically specific relations of social power. (p. 198).

Critical urban geography is not concerned with the atomistic reality of inequitable places in and of themselves, but rather the fact that multiple systems converge in specific spatial locations in ways that allow certain populations to mold space as a resource while others are trapped or limited by the places they live (Harvey, 1973).

Within the context of this study, critical urban geography moved me beyond a generic focus on systemic interrelationships towards a critical examination of the spatial, racial, ethnic, and economic power dynamics that manifest as new smart city systems interface with geographies of educational opportunity that have been durably inequitable for generations. However, I was also cognizant that my epistemological and methodological orientations are also the products of complex systems that are influenced by similar power dynamics (Scheurich & Young, 1997). The tenets of critical praxis provided specific guidance for how to challenge my research practice by constantly asking: Who has the power to describe the systemic relations in this context? And whom must be involved to change the system in a manner that is socially just? I provide a brief overview of critical praxis in the next section and then outline what follows in the remainder of the dissertation.

Critical Praxis

This study draws inspiration from activist scholarship that is participatory, politically engaged, and contributes directly to socially just changes in public policy (Foley, 2008; Hale, 2008; Lipman, 2011). One core value within this rich tradition is that “the best way to understand what any set of institutions, policies, and practices does, is to see it from the standpoint of those who have the least power” (Apple, 2006, p. 12). A common strategy for democratizing social analysis is to privilege personal narratives and stories, which help to develop shared understandings while revealing how social forces are impacting individuals’ lives (Freire, 1970; Westoby & Dowling, 2013). According to Freire, once articulated⁵ the stories lay the groundwork for both personal reflection and change and collective reflection and social change, or, *critical praxis* (Freire, 1970; McLaren, Ryoo & Moreno, 2010).

In this study, participants’ personal narratives have taken center stage. As you will see in chapter four, the residents’ lived experiences reflect East Austin back on itself and speak directly to how complex systems across multiple sectors – including smart city assets – converge with their geography of educational opportunity and in doing so speak back to the theoretical frames I have mentioned here. In the next section I provide a brief overview of the methods I employed in this study.

Overview of Methodology

Given the centrality of stories and lived experience within the lineage of critical praxis, I chose to conduct this study using a qualitative research design. The residents’ stories served as a centerpiece to my research approach, which was a collaborative case study (Gerring, 2004; Stake, 1995; Yin, 2004) focused on how the smart cities phenomenon is manifesting for a group

⁵ Freire’s work took an expansive view on “articulation” and included a variety of mediums beyond spoken language.

of public housing residents at a single property in the urban core of smart city. My goal throughout the study was to extend beyond simply advancing scholarship and to ensure that the research process and findings would provide tangible benefits to Austin's public housing community. In order to increase the likelihood that it would do so, I coordinated with HACA staff to recruit a small team of community advisors (residents and HACA staff) who shared an interest in supporting systemic improvement and were willing to share their grounded insights and wisdom throughout the process.

The community advisors were especially thoughtful about suggesting participants for the study. Through our weekly team discussions, we adopted a purposeful sampling approach (Patton, 2014) to identify residents who would, because of their own or their children's status as students be able to speak to the issues at the heart of this study. In total, the community advisors and I interviewed seventeen residents. I then analyzed their stories by starting with inductive coding (Miles, Huberman & Saldana, 2014) and eventually aligned the themes that emerged across all of the interviews back to my research questions. In order to interpret the themes for each research question, I created thematic maps to visualize the relationships (Castleberry, 2018). Those thematic maps inform the content that follows. In the next section, I describe the flow of the remainder of the dissertation.

Dissertation Outline

In this chapter, I have discussed the historic patterns in U.S. cities wherein urban planning and policymaking have ritually limited the geography of educational opportunity in low income, non-White communities. I then suggested that this historical context presents a call to action for educational researchers to critically examine new trends in urban transformation like smart cities. I then introduced my research questions for this study and briefly described the

methods I employed. In Chapter Two, I provide a review of the smart cities literature with an eye towards highlighting the historical patterns, political economies and private interests that underlie the smart cities movement. I situate and set the context for the literature review by first detailing the germane scholarship that has expanded my understanding of educational opportunity to include consideration of the entire geography of educational opportunity. I then summarize the current landscape of smart cities research and examine the economic and political interests that are driving smart city expansion. I follow by synthesizing the literature that has addressed the implications of smart city expansion for low income people and the numerous ways smart city approaches are directly impacting schools, teaching and learning. I then close by briefly reengaging the literature that inspired my theoretical framework. Taken together, I assert that the literature suggests a need for an expansive educational research agenda in smart cities and in chapter three I describe our team's methodological approach to advancing this much needed research.

In Chapter Four I summarize the details and findings from my examination of the relationship between two essential smart cities initiatives on public housing residents' geography of educational opportunity in the urban core of a single smart city. I then conclude the dissertation in Chapter Five by discussing the key findings in relation to the theoretical and empirical literature and in doing share methodological insights and fruitful pathways for future research.

CHAPTER II: A REVIEW OF THE LITERATURE

Introduction

The conversation with the residents at DuBois Terraces that I described in the introduction truly was the inspiration for this study. Among many other moments from that evening, I continued to reflect on the one grandmother's account of turning down an exceptional educational opportunity for her granddaughter because of entangled barriers around transportation, employment and childcare. I could not get over the feeling that *this should not happen in a truly "smart city."* In this chapter, I trace my process of trying to understand how educational opportunity has been addressed in the scholarly literature on smart cities.

To begin, I explain the approach I took to locate and review literature for this study. I then review research focused on educational opportunity in cities and briefly discuss the migration of educational scholarship towards the focus on geography of educational opportunity. I then discuss how empirical, theoretical and grey literature (literature published outside of the traditional academic channels) have defined smart cities, the political economies and private interests that are supporting smart city expansion, and which topics have received the most attention in the smart city literature to date. I include this literature into my review because it describes the essential elements within smart city systems and highlights key debates over the true purpose of the smart cities model.

I then dig deeper into what research suggests about the implications for individual participation in smart city life. Specifically, I detail how human beings are theorized to behave differently in order to live and participate in smart city life and a small collection of recent research that has examined the impact of smart city ICT-based technologies and smart mobility options in low income communities of color. Based on the new ideals of "smart citizenship", I

then transition to discuss the few studies that speak directly to the implications for educational systems in smart cities. Lastly, I describe this study's interrelated theoretical framework, which includes concepts from systems thinking, critical urban theory and critical praxis.

Literature Review Methodology

To identify literature for this review, I began by using the advanced search features through the University of Texas Libraries to query peer-reviewed smart cities literature from 2008⁶ to the present⁷. I utilized a variety of databases and search engines including, SocINDEX, Academic Search Complete, EconLit, Education Source, ERIC, AveryIndex, PAIS, Dissertation & Thesis Global and Google Scholar. I started my search in 2008 so that I could include and review the empirical research over the past decade (2008-2018). I initially began with the following search terms: “smart city or smart cities” in all fields, “definition” in the subject terms, and removed the highly technical computer science and engineering articles that did not address the human dimensions of smart cities. This yielded only 23 results. I followed the same process and revised the subject terms two times to focus on “citizens or citizenship” (107 results) and “education or schools” (115 results). I conducted searches for these terms because the concept of smart citizens was so pronounced in my initial scans of the literature and I hoped that I would find specific details about how schools have been implicated in fostering smart citizenship.

Based on this initial haul of approximately 220 distinct studies, I engaged in a cyclical process of thinning and growing my literature sample. I first analyzed the relevance of studies for inclusion or exclusion based on their title and abstract and filtered out irrelevant literature. I defined relevant literature as those pieces that contributed or expanded insights into my studied

⁶ 2008 marks the beginning of the Great Recession, the year IBM launched its Smarter Cities initiative, and the year Hollands published his widely-cited critique of the smart cities model.

⁷ I concluded my first phase of smart cities literature collection in early January of 2018. In a few instances, I have included relevant scholarship that I found after my formal review.

concept (Wohlin, 2014). As I identified relevant studies, I began to make connections to frequently-referenced concepts and scholars who I “followed” by snowballing my review process (Lecy & Beatty, 2012). In doing so, seminal texts emerged and altered my standard of relevance, which in turn resulted in excluding more studies that I deemed marginally useful. Concurrently, I added additional texts as I made connections to relevant theoretical lineages (e.g. critical urban theorists).

In total, I reviewed approximately 150 studies on smart cities and other related studies from the first phase of my review and 37 additional references that I located while I was collecting data in the field. Together, the corpus that informs this study includes peer reviewed journal articles, book chapters, urban planning and smart city web sites, and non-traditional grey literature. I included these various sources of literature because of the dearth of research at the intersection of smart cities and educational opportunity. As such, I have organized this review into five strands: (1) evolution toward the geography of educational opportunity, (2) the landscape of smart cities research, (3) factors shaping smart cities expansion, (4) factors impacting urban residents’ participation in smart cities, and (5) implications for educational opportunity in smart cities. Based on these strands, I then reengage the literature that informed my theoretical framework. The following sections detail what we know from the literature in each thread key gaps that will be addressed by this study across these bodies of scholarship.

Strand One: Evolving Toward the Geography of Educational Opportunity

In chapter one I discussed how the troubled historical relationship between urban planning, economic development and educational opportunity fueled my urgency to examine smart cities (Anyon, 2009; Drier et.al., 2004; Scott & Holme, 2016). In this section, I step back briefly to review how educational research has transitioned from conceptualizing educational

opportunity narrowly within the confines of educational systems to a more ecosystemic framing of the whole *geography of educational opportunity* that accounts for the complexity of urban environments.

An appropriate point of departure is the act of learning itself. Sociocultural theorists hold that learning is not contained in the confines of individual minds, but rather occurs in dialogue with other people, objects and our environment (Vygotsky, 1978). This perspective on human learning provides a useful frame for understanding educational opportunity, wherein learners interface with factors in their environment to produce knowledge and skills (e.g. learning to read, earning a credential). Coleman's (1966) foundational treatise on educational opportunity conceptualized this phenomenon within the confines of schooling where students engage with educational opportunities and have academic outcomes. In order to improve outcomes, educational systems need only to change access to quality schools. This conceptualization of educational opportunity has been an axiom in educational research, reform and administration for decades.

During the last 25 years, more and more scholars have recognized that schools (buildings, teachers, curricula, etc.) are essential, yet incomplete components of a person's educational opportunities and that in order to truly understand student outcomes a broader scan of environmental factors are required. For example, Nespor's (1997) case study of 4th grade students at "Thurber Elementary" in Roanoke, Virginia was an early example of shifting currents in the educational research community. He concluded that one cannot truly understand what is going on with learning in classrooms without also understanding the highway systems that have segregated and fragmented the African American community and the day to day realities of life in public housing units. Today, numerous influential scholars in educational research (e.g.

Anyon, 2005; Nogra & Wells, 2011; Renee, Welner & Oakes; 2010; Tate, 2008) have echoed similar assertions and have called for conceptualizing learning environments broadly to include the complex intersections of education, housing, transportation, and health systems (to name a few) that differentially impact learning for specific communities living in specific places. Other scholars have widened their empirical lens still further to consider how transitions in global economies and labor markets intersect with local economic and development policies to impact educational opportunities for children in cities (Cucchiara, 2013; Lipman, 2011). With these exemplars as guides, I entered this study with a wide, holistic lens on *geographies of educational opportunity* which I view as complex and inclusive all of the in- and out-of-school factors that influence learning and wellbeing.

This study is premised on the knowledge that geographies of educational opportunity differ widely based on place. Several studies in the last decade have further legitimized this approach. In 2014, Chetty, Hendren, Kline, and Saez published a study that considered whether or not the U.S. has lived up to its reputation as the “Land of Opportunity”. They analyzed Internal Revenue Service (IRS) and U.S. Treasury Department records for 40 million children and their parents in between 1996 and 2012 in order to analyze the extent to which economic advantages from one generation increase in the next generation. The study found that intergenerational upward economic mobility varies significantly across the U.S. That there would be significant gaps between urban job centers and rural areas seems intuitive, however, significant differences between U.S. cities emerged as well. For example, a child growing up in San Jose, California is 8.5% more likely to transition from the lowest income bracket to the highest income bracket than a child in Charlotte, North Carolina. Orfield’s (2011) study of the 25 largest metropolitan statistical areas (MSA) in the U.S. arrived at a similar conclusion, however

he found more granular disparities within urban areas from suburb to suburb and suburbs to central cities.

Critical urban geographers have found that unequal opportunities penetrate to smaller and more intimate scales including neighborhoods. For example, Sharkey (2013) examined whether segregated neighborhoods – “the inherited ghetto” – would help to explain why Blacks have not achieved equality in the post-Civil Rights era. He traced the trajectories of Black and White children born in between 1950 and 1970 and followed them into adulthood. The study found that both disadvantages and advantages are remarkably durable across generations and accumulate over time. Ladson-Billings (2006) centers the generational accumulation of disadvantage in the educational context in what she describes as “educational debt.”

For the purpose of this study, it is critical to emphasize the tight coupling between housing and educational outcomes. As Mueller and Tighe (2007) found in their review of the housing literature, quality, stable housing has been shown to minimize student mobility (Crowley, 2003), improve access to educational opportunities (Braconi, 2001), and improve educational outcomes (Quercia & Bates, 2002; Rosenbaum, 1991). As we examine educational opportunities in the smart city era, however, educational opportunities are ostensibly decoupled from one’s spatial context.

In the physical realm, market-based reforms have expanded, students are increasingly no longer bound to schools in their neighborhoods (Scott & Holme, 2016). Concurrently, the cyber realm is multifaceted and new technologies and digital media are changing the geography of where students can learn and what they can learn (Leander et al., 2010; Skop & Adams, 2009). Studies suggest that cyberspace can be a powerful tool to support learning and social cohesion as

immigrant children are leveraging virtual space to nourish their cultural identities and maintain their native language proficiencies (Lam, 2009; Lee, 2006; Skop & Adams, 2009).

Despite the “placelessness” of these trends, they have not yet shown to transcend global and local political economies that are inescapably placed (Harvey, 1973; LeChasseur, 2016; Soja, 2008). We see now that by decoupling schooling from neighborhoods, choice systems also create the conditions for inner city gentrification wherein wealthy, college-educated families are no longer bound to long-neglected schools (Pearman & Swain, 2017). As this occurs, urban school district officials champion integration of newly-arrived and longtime families in inner city schools their behaviors often favor attracting and appealing new gentrifying families (Diem, Holme, Edwards, Haynes and Epstein, 2018). Critically, technological literacy and access are equally placed and contribute to spatially-specific manifestations of power (Gilbert, 2010). I turn now to consider the complex intersections between social, cyber and physical systems as they manifest in smart cities.

Strand One Summary

In this strand, I have provided a brief overview of the scholarship on the geography of educational opportunity in order to frame my review and analysis of the smart cities literature. It is clear that learning is a process that transcends individuals and school buildings (Green, 2015; Galster & Killen, 1995; Noguera & Wells, 2011; Tate, 2008) and that inequitable geographies of education not only impact students in the moment, but are durable and extend generationally. However, educational research has not yet addressed how digitally mediated space and learning opportunities interact with these complex, legacy inequalities. The ascendancy of smart cities serves as an urgent opportunity to address this critical gap in the literature. I do so via the study described in chapters three and four, however, first turn to the smart cities literature in order to

examine how that corpus has addressed issues impacting the geography of educational opportunity.

Literature Strand Two: The Current Landscape of Smart City Research⁸

In this section, I begin my exploration of the smart cities research by exploring how the model has been defined and how existing smart cities have been researched. An appropriate point of departure is the one topic that both advocates and critics alike tend to agree upon: there is no shared definition of what constitutes a smart city (Albino, 2015; Angelidou, 2014; Hollands, 2008; Nam & Pardo, 2011). The lack of consensus about what makes up a smart city is not around the basic ingredients, but rather, which of the ingredients enables the others (Caragliu, Del Bo & Nijkamp, 2011). Regardless, typical smart cities models incorporate: (a) the large-scale expansion of ICT-based technologies (internet, wireless networks, artificial intelligence, and robotics), (b) the “internet of things” (physical objects with sensors that can connect and exchange data), and (c) creative, highly-skilled citizens who are prepared to both produce and respond to massive new sources of data (Caragliu et.al. 2009; Harrison et.al., 2010; Komninos 2011; Nam & Pardo, 2011; Williamson, 2017).

I define smart cities within these parameters because they are the most commonly referenced in the literature, however I include that smart city initiatives typically involve public-private partnerships that seek to improve environmental sustainability, economic prosperity and social equity (Townsend, 2013). I therefore define smart cities as cities that seek to leverage public-private partnerships in order to expand ICT-based technologies that improve city services, involve citizens and support economic growth, environmental sustainability and social equity.

⁸ Although my study is focused on a smart city in the U.S. I include international studies in this review because the smart city markets have been active longer in Europe and Asia and there is a larger body of critical scholarship focused on those sites.

The idea of infusing “smartness” into urban planning processes traces back to the late 1990s in “smart communities” projects that were narrowly focused on infusing digital assets into particular geographies (Caves and Walshok, 1997). The smart cities concept as it is known today evolved out of a variety of other philosophically similar urban development approaches, such as “innovative cities” (Simmie, 2003), “digital cities” (Aurigi, 2005), “intelligent cities” (Komakech, 2005) “creative cities” (Florida, 2005), “knowledge cities” (Carillo, 2006), and as environmental conditions worsened across the globe, “sustainable cities” (Han, Fontanos, Fukushi, Herath, Heeren, Naso & Takeuchi, 2012).

While there is little agreement about what smart cities are (Albino, 2015; Angelidou, 2014; Hollands, 2008; Nam & Pardo, 2011), there is remarkable consistency around the arguments for why cities need to become smarter. The smart cities literature dependably rationalizes the adoption of smart cities strategies based on projections that the urban population will grow to 6.5 billion by 2050 and to 8 billion by 2100 (United Nations World Population Prospects, 2015). Calls for proactive, “smart” responses to rapid population growth are nuanced. On one hand, urbanization is framed as a threat, because cities’ inadequate or aging infrastructures are said to be ill-equipped to provide equitable, sustainable and effective public services for so many new people so quickly (DeKeles, 2015; Washburn, Sindhu, Balaouras, Dines, Hayes & Nelson 2010). The negative externalities caused by urbanization, such as environmental degradation (Colding & Barthel, 2017), economic inequality and labor market bifurcation (Chetty et al., 2014; Sassen, 2011) suggest that these concerns are warranted. Thus, cities are vital sites for analysis and action if we intend to create a more sustainable, socially just, and economically prosperous future (Gleeson, 2009).

Smart city advocates also embrace urban economic and environmental challenges as opportunities to innovate and create radically different systems and processes for managing and living in cities. Nam and Pardo (2011) suggest that smart cities innovations occur along three main “smart” dimensions that make them *fundamentally different* from traditional city restructuring processes. The first dimension involves technological advancements and improved public services made possible by the large-scale integration of ICTs and sensing technology. Advancements in the technological dimension (e.g. interoperable systems generating real time data at the human level) necessitate improvements in the second dimension where smart city institutions can adopt more efficient and representative governance processes through e-government applications and more sustainable funding structures for public services through innovative public-private partnerships. The technological and institutional transformations in smart cities are said to foster the third dimension –smart citizenship.

Smart cities advocates assert that ICT-enabled open data landscapes create the conditions for an empowered, hyperconnected, entrepreneurial citizenry that can, through the use of technology, engage in the co-production of public services and civic decision-making through new avenues of participatory governance (Degbelo, Granell, Trilles, Bhattacharya, Casteleyn & Kray, 2016; Grosseck, Ivanova, Holotescu & Malita, 2014). Nam and Pardo (2011) stress that if cities intend to prepare their citizenry for smart living, then cities must also be intentional about improving educational systems, and expanding opportunities for social learning. Doing so effectively requires a fundamental rethinking of teaching, learning, curriculum and assessment in the context of new smart environments (Wang & Sng, 2015).

In order to provide a vision for how these three dimensions might come together in practice, the Smart Cities Council developed a *Smart Cities Readiness Guide* (DeKeles, 2015)

that, in addition to providing guidance on the technical and institutional dimensions of smart cities, depicts several moments in the life of a fictitious character named, Josie, who is living her best life as a Smart Citizen:

...when the alarm on her smart wristphone chirps, Josie doesn't reach for the snooze button. "Too much to do today" ...Josie doesn't actually own a bike or car; living in a city with abundant share programs means she doesn't have to...Josie pours a coffee that started brewing when her alarm went off. Between her smart wristphone and smart thermostat, pretty much every creature comfort in her condo is automated... Jumping on her bike, she picks her destination from her favorites list and transfers her phone display to an overlay in her glasses... as she rides past the virtual city hall that occupies a small storefront ... she realizes she can take care of another item on her to-do list..."This is pretty sweet," she says as she sits down in a private "closet" equipped with high-definition video equipment that allows her to interact with a remote city agent (pgs. 5-6).

In Josie's effortless movement through her day the Smart Cities Council paints a picture of smart citizenship wherein human beings fluidly engage with ubiquitous, responsive ICT-based technologies that support reciprocal dialogue between people, the material environment and the institutional operations of the city. Griffiths (2016) suggests that this vision of civic life signals the possibility of a fundamental shift in cities from being, "open looped systems where citizen actions happen and 'that's it', into a closed loop systems where human action is constantly being fed back to the population to inform decisions" (p.36).

However, not everyone shares the optimism that technologically mediated closed loop systems can generate equitable outcomes, especially in education. In the wake of the Great Recession, Robert Hollands (2008) penned his widely-cited critique that the smart city concept –

still in its infancy at the time – was ill-defined, untested and inattentive to the underlying factors that generate and sustain urban problems. He asserted that the lack of a clear definition made it difficult to parse out the difference between truly smart cities and “entrepreneurial cities” that simply function as new sites for capitalist accumulation (Harvey, 2003).

Based on the current landscape of smart city expansion, smart policies and infrastructure are overwhelmingly clustered in areas with a dense concentration of wealth such as San Francisco, London, Barcelona, Dubai and Austin (Caragliu & Del Bo, 2016). This begs the question as to whether or not smart strategies serve and empower all citizens, or simply amplify and accelerate a cities’ ability to provide business service and amenities for middle- and upper-class urbanites are responsive and tailored to their individual needs (Wacquant, 2008)? The following section delves deeper into smart cities research to examine which topics have received attention and how, if at all, it has addressed the more complicated social equity dimensions of smart cities expansion.

Emphasis of Smart Cities Research Corpus

In this section, I examine the smart cities corpus in order to understand where researchers have placed their attention. A number of recent literature reviews suggest that, while the amount of smart cities research increased dramatically between 2008-2018, the cadence of smart city expansion has outpaced the research community’s ability to produce empirical research on the impact of smart urban development (Folke, Jansson, Rockström, Olsson, Carpenter, Chapin, A.-Crépin, *et al.* 2011). For example, in their review of the full spectrum of initiatives that could be housed under the umbrella of urban sustainability, de Jong, Joss, Schraven, Zhan and Weijnen (2015) found that smart cities represented the fastest growing discourse in the field. However, they note that the current smart city corpus is heavily technological in nature and places almost

no emphasis on *actual* ecological sustainability. Two other literature reviews imply that these fundamental gaps in the research literature between smart city implementation and on-the-ground reality may be a part of a larger pattern.

First, Colding and Barthel (2017) found that smart cities represent an increasingly dominant strand in the urban ecology literature, but that the current corpus does not directly address the topics of health, social justice, safety, and education, which are essential elements of any thriving urban ecologies. Similarly, in Meijer and Bolivar's (2016) review of the research on smart city governance, they found very little of the research focused on the actual role local governments should play and no research has focused on the management approaches for successful smart city projects. They suggest that the gap in the smart city governance research is due to the fact that local governments have raced to implement smart initiatives based on largely on descriptive case studies about what other cities are doing – typically involving large-scale ICT deployment – without any critical analysis of how and if they should be doing it (Meijer & Bolivar, 2016).

Several studies help shed additional light on where smart research has and has not focused its attention. In what is the most extensive of the recent smart cities literature reviews, Ojo, Dzhusupova and Curry (2016) found that 100% of the smart cities literature addresses ICT infrastructure while only 30% focused on governance, 6% addressed public engagement, 1% focused on the specific attributes, such as smart citizens, and 0% of the studies focused primarily on education. Anthopoulos' (2015) review of the different smart city “schools of thought” arrived at a similar conclusion finding only one peer-reviewed article focused on education in smart cities.

One explanation for the pronounced gap in literature that deals specifically with education in smart cities is that the theoretical orientation of the majority of the research is focused on computer science and engineering (Ojo et al., 2016). This last finding is consistent with observations that smart cities are fertile ground for ICT business interests and that prioritizing public investments in technological infrastructure is viewed as a necessary first step on the journey to smartness (Hollands, 2008; Söderström, et al., 2014). If this is so, it could be that the gap in smart city research to date is developmentally appropriate and that it simply reflects the current realities of the early stages of smart city implementation – that smart technology creates the conditions for more meaningful and human engagement. Regardless, it is clear that multiple vital dimensions of smart city design and implementation processes have been both under-researched and theorized and this study intends to help fill the gap (Hollands, 2008).

Another empirical gap that is especially germane to this study is the fact that there are very few examples of rigorous, critical research studies designed to better understand existing smart cities and the power dynamics impacting specific places and the people who live and learn there (Ojo, et al., 2014). The place-specific, critical research that has been produced has centered exclusively on economic competition, governance and organizational dynamics and has largely avoided issues of access, power and exclusion (McFarlane, 2011a). Griffiths (2016) contends that these understudied domains are most problematic in city planning processes that are in need of both contextualization and democratic scrutiny.

Datta's (2015) case study on the rapid expansion of smart cities in India echoes this sentiment and calls for more critical ethnographic and participatory methods to ensure that smart city plans aren't just serving corporate interests via new urban markets and expanded technological infrastructure. Questions of whom develops, owns, and benefits from smart ICT

infrastructure is another area that is rich for critical inquiry (Colding & Barthel, 2017). At a more granular level, March (2016) contends that too little is known about the socio-environmental impacts of ICT production and deployment. Most importantly for the purpose of this study, critical smart city literature has yet to sufficiently address issues related to health, social justice, safety and education (Colding & Barthel, 2017).

Strand Two Summary

Based on this strand of literature we know that smart cities are developing rapidly across the globe and are incorporating a common menu of smart components. We know that the adoption of smart initiatives is routinely rationalized as a response to rapid urbanization and framed as a pathway to environmental sustainability, economic prosperity and social equity. Research also suggest that in theory, implementing smart city strategies requires not only an expansion of ICT-based technologies, but also has specific implications for how cities are governed and how residents serve their role as citizens.

However, we know less about is how city governance has actually changed, nor which citizens are being served and with what effect. The current corpus of smart cities research is heavily weighted towards technical topics and has yet to satisfactorily describe the real and actual effects of smart cities on human beings and especially in regard to their educational opportunities. In the section that follows, I dig deeper into the literature to critically examine the economic and political interests that have fueled smart city expansion and the global forces that are increasingly defining the knowledge and skills required to be an effective, smart citizen (Apple, 2006; Thiem, 2009).

Strand Three: Factors Promoting Smart City Expansion

Based on my review of the literature, I found that five factors have driven the expansion of smart cities. The first factor is that cities are still rebuilding their economies in the long wake of The Great Recession. In 2008, IBM (owner of the “Smarter Cities” copyright) held the first of what has now been six⁹ “Smarter Cities Challenges” – a competition for \$500,000 of funding and consultation to cities that have demonstrated that they are committed to implementing smart strategies. In his case study about the initiative, Wiig (2015), quotes the first director of the Smarter Cities Challenge from IBM who remembers that:

[The Smarter Cities Challenge] generated huge interest from cities all over the world, even though we hadn't really begun to explain what the business case was for these things, what the return on investment was going to be, how much money we could help you save. [...] It took us a long time to understand that what was really driving this sort of thing is economic development. Particularly at that time, this was six months after the economic crash, many cities around the world were looking to get their economies going again, and what they discovered in the last several years is that they are in competition with one another in ways that they had not had to compete before.

The former director’s recollections highlight that the smart city “brand” was perceived to be a differentiator for cities engaged in local economic restructuring efforts – becoming “smart” was a way for a city to signal the city was still open for business (Wiig, 2015).

IBM and other technology vendors stood to massively benefit from competition between cities as they raced to join the ranks of smart and innovative cities. This brings us to the second factor driving smart city expansion: technology firms were trying to establish new markets in the

⁹ As of 2018.

wake of the Recession. Paroutis, et al.'s (2014) case study on IBM's institutional restructuring and rebranding initiatives during that period clearly describes this process as the company's leadership used the Smarter Cities initiative to both reconceptualize the company's existing technical solutions and create whole new markets for their smart technological solutions to be deployed. Söderström, et al. (2014) assert that IBM's Smarter Cities campaign not only served to reinvigorate the company and catalyze a new market, but also created what now has amounted to the creation of a whole new model of urban management.

Technology corporations are now racing to define what this new brand smart urban management looks like in order to establish their authority in the market (Söderström, et al., 2014). Despite the fact that companies are competing and do not share a common vision for a smart future (Kitchin, 2015), they have successfully created a consistent tech-based logic that "frames all urban questions as essentially engineering problems to be analyzed and solved using empirical, preferably quantitative methods" (Bell, 2011, pg. 309). The essential quantitative data that a city government would need to truly grapple with complex urban challenges can *only* be harvested by layering smart "digital skin" consisting of ICTs and sensing technology over the built environment (Glasmeier and Christopherson, 2015). Through this framing, smart technology vendors are strategically positioned as "obligatory passage points" for traditional cities who are aspiring to become smarter (Latour, 1987).

The private sector has not operated alone. The third factor driving smart city expansion is a robust ecosystem of intermediary organizations that have emerged in order to guide a city's journey to smart through resources and implementation matrices. The largest and most active smart cities intermediary is the Smart Cities Council (<https://smartcitiescouncil.com/>). The Smart Cities Council maintains a clearinghouse of smart cities resources and serves as a convener for

practitioners, technology vendors, entrepreneurs and consultants. In 2015, they published the *Smart Cities Readiness Guide*, which is designed to help cities assess their readiness for smart innovation based on a comprehensive framework showing how technology enablers (e.g. connectivity, data management, security, analytics) can help to address city responsibilities (e.g. transportation, waste, public safety, human services). Once city leaders have assessed their readiness to become smarter, they can then apply for Smart Cities Council Readiness Grants that include a year's worth of free mentoring, products and services worth hundreds of thousands of dollars, a custom, on-site Readiness Workshop and worldwide publicity (<https://smartcitiescouncil.com/scc-2018-readiness-challenge-info>).

The global visibility and resources attached to the smart cities' development ecosystem has nurtured the forth factor enabling smart city expansion: new "entrepreneurial" forms of smart city governance (Harvey, 1989). For example, Philadelphia, Pennsylvania was one of the first cities to participate in IBM's Smarter Cities Challenge. The city's first smart project, "Digital On Ramps", included a mobile application designed to address the knowledge economy skills gap by connecting citizens with educational and training opportunities aligned to the needs of high-growth employment sectors. In his plenary address to Smarter Cities Challenge participants at IBM's headquarters in upstate New York, the Mayor of Philadelphia pronounced the project a success despite the fact that no one had ever actually used the application (Wiig, 2015). Wiig (2015) observes that the actual implementation of the smart initiative was far less important than the mayor's opportunity to market Philadelphia as an innovative hub for global technology companies.

The number of self-described smart cities has continued to grow at a dizzying pace despite these inconsistencies between the stated and actual reality of smart cities implementation.

This in part can be explained by the fifth and final factor I would like to highlight in this review: smart city initiatives are presented as non-ideological, inclusive, socially just and citizen-centric – a given good for all who are involved (Griffiths, 2016; Colding & Barthel, 2017). Smart cities are increasingly testing grounds for technological advances designed for both profit and to help resource-strained cities provide services for the public good (Townsend, 2013). Examples include: smart ICT infrastructures have created the necessary conditions for innovations such as artificial intelligence assessment systems to track students learning in mathematics by Thinkster Math, walking sticks for the blind developed by Cisco, a web application to help citizens report mobility issues developed by IBM, a mobile app that provides health alerts for women in China by Qualcomm, and educational videogames supporting literacy and numeracy for children in Australia developed by Microsoft (DeKeles, 2015).

In each case, these smart technological innovations provide needed accommodations to individuals while feeding user-level data back into a centralized, open source repository that – in a fully-realized smart city –inform city-level decision making (DeKeles, 2015; Dilawar, Majeed, Beg, Ejaz, Muhammas, Mehmood & Nam, 2018). It is not yet clear how smart city leaders will act upon data that is inherently biased because it is scraped from cities that have defined by social, spatial, and economic exclusion (Greenfield, 2017; O’Neil, 2016). However, it seems likely that despite this critical gap, citizenship, schools and the entire geography of educational opportunity in smart cities will be increasingly mediated through privately developed, technology-based tools.

Strand Three Summary

In this strand, I have reviewed the smart cities literature that has shown that the concept of smart cities in its current form developed out of the Great Recession where both cities and

technology corporations were reimagining their economies and services. We know that the concept of smart cities has been advanced through both federal inducements and an active ecosystem of intermediaries who have situated smart technology as an obligatory passage point for cities that intend to effectively meet the demands of an urbanized future. Research suggests that the smart cities model has spread with little resistance, because so many of the smart technology solutions seek to provide much needed public services. While theoretically enticing, the research has yet to satisfactorily address what these smart technology landscapes mean for actual people in actual places – places that have been shaped by the confluence of inequitable systems for generations. In the next section, I describe a thread of literature describing the factors impacting individuals' participation in smart cities.

Strand Four: Factors Impacting Individual Participation in Smart Cities

The previous strand described the diverse ensemble of interests and players driving the expansion of smart cities strategies. Expansion processes have been decentralized and largely driven by the technology sector which has recast cities as testing grounds for socially, economically and environmentally oriented solutions. In this section I pivot to focus on the factors impacting individuals' participation in these emergent research and development-driven urban landscapes.

There is general agreement in the smart cities literature that smart city innovations will fundamentally transform the living and working contexts of *some* individuals (Hollands, 2008). The question is which citizens and to what ends? The literature I described above suggests there are two answers: first, serve all individuals well by improving social inclusion and participatory decision-making, and second, attract new individuals with the engineering, creative or design

skills whom are the “currency of the age” in the global economy (Coccoli, et.al., 2017; Ojo, et.al., 2016).

Regardless, smart citizens are expected to benefit from new services and *contribute* to the (re)formation of smart cities via new channels of participatory urbanism that broadcasts data back to city governance processes (Pereira, Macadar, Luciano & Testa, 2017). This technical recalibration of citizenship and governance has been theorized to necessitate new skills, new ways of engaging with information, new values, and new ways of living in a world governed by smart systems based on neurocomputational processes (Sol, et al., 2013; Brynjolfsson and McAfee, 2012; Williamson, 2017).

However, in its current state, computational programming language creates a distance between citizens and actual civic decision-making processes (Engelbert et al., 2018). Smart city data systems themselves frequently don’t require or accept subjective feedback from citizens, but rather ICTs with predetermined criteria simply monitor and prompt behavioral changes (Granier and Kudo, 2016). For Gabrys (2014), the “performance of smart citizenship represents a new form of neoliberal governance wherein citizenship and democratic participation are not expanded, but narrowed to a smaller subset of centralized metrics” (p. 45). What’s striking about the smart cities movement, however, is that by the time critiques such as Gabrys’ are conceptualized and published the public-private research and development ecosystem will have moved the target. In this instance, an ensemble recent studies reveal a migration away from limiting computational metrics and towards more humanized technology interfaces.

Human-Centered Trends in Smart Technology Development

Again, smart cities *need* technologically-proficient human beings to address challenges and support improvement efforts (Dekeles, 2015; Ojo et al., 2016) and to work effectively with

ICT and Artificial Intelligence-enabled technologies in order to personalize their own experience and prototype new city services for the public good (Coccoli et al., 2017; Marsal-Llacuna, 2017). There is a growing body of research that suggests social and technical trust is a key mediating factor shaping ICT-based technology adoption.

Trust is multidimensional and operates at the individual, organizational, and inter-organizational levels (Lewicki & Bunker, 1996). In the context of smart cities, some scholars have advanced this notion suggesting that sociotechnical systems—systems that integrate social, cyber, and physical systems with ICT infrastructure—are organized along complex trust relationships (Chopra, Paja, & Giorgini, 2011). In this context, interpersonal trust co-exists with trust in new technologies, trust in the institutions that design and manage the technologies, and trust in the data being produced (Riveni, Truong, & Dustdar, 2015).

The private sector has taken notice. Leading-edge research and development (R&D) efforts in vehicle cloud computing and ambient environmental sensing environments are recognizing the need for trust-enabled services that are responsive to diverse users' needs as they move through different environments (Könings, Schaub, Weber, 2016; Tyagi & Niladhuri, 2016). The mobile banking sector is especially attuned to issues of social and technical trust and has detailed the linkages between interpersonal, technical, and institutional trust at the point of adoption when users' perceptions of risk shape their willingness to engage in virtual banking environments (Sanayei & Noroozi, 2009). Similar trust dynamics have been shown to be pivotal in the development and adoption of ICT-enabled e-government (Welch, Hinnant & Moon, 2005) and e-health applications (Kamalrudin, Winarsih, & Sidek, 2018).

The emphasis of these trust-focused studies has largely focused on improving trust relationships between individuals and technologies. Other recent studies have shown that ICT-

based tech adoption transcend the human/technology trust dynamic and can draw on or strengthen relationships in the social sphere. For example, ICT-technology adoption in elderly and poor rural communities have been linked to the presence of trusted family members who are using the technology (Liu & Meng, 2013; Mariscal Aviles, Benitez Lurghi, & Martinez Aguayo, 2016). Other studies have made direct linkages between mobile application adoption and the development of social capital among poor communities in the Boston area (Irannejad, Bisafar, Pannada, Shamekhi, & Parker, 2017). Hsiao and Dillahun (2018) found comparable social benefits in a recent immigrant community wherein ICT-mediated connections helped to build social capital and ease settlement processes. Similarly, Kameswaran, Cameron and Dillahun (2018) found that ICT-enabled rideshare services are potentially an untapped source of social capital as both rideshare drivers and low income passengers in their study reported rich cultural, emotional, informational and resource exchanges (Brewer & Kameswaran, 2019; Dillahun & Veinot, 2018). While promising, these studies examine sociotechnical relationships in isolation from the broader context in which they occur. Other studies have shown that the potential positive benefits of human-centered technologies can be undercut by legacy political economies that ritually advantage specific segments of the population.

The Broader Context of Smart Technology Adoption

Smart city resource deployment and adoption does not happen in a vacuum. A body of recent research on smart mobility options has shed light on the political and spatial complexities that smart resources encounter once deployed in city contexts. Ghertner's (2011) study on the relationship between gentrification and civic participation technologies offers one extreme example. He found that in creating new ICT-enabled channels to access local government the resources overwhelmingly advantaged the new middle-class in Dehli, who used the tools to

mobilize a large-scale slum demolition resulting in the displacement of millions of inner city poor. Importantly, city governance dynamics also impact smart technologies that should explicitly benefit low income communities. For example, scholars from the Greenlining Institute in Oakland, California (www.greenlining.org) found that: (a) smart mobility options are potentially transformative for low income communities as they provide reliable, efficient and safe connectivity to employment, education and other services, but that (b) cities lack the necessary planning, policymaking and governance structures to ensure that smart mobility options actually benefit low income communities of color (Creger, Espino & Sanchez, 2018).

While more intentional city-level decision-making is certainly necessary to realize smart synergies, systemic barriers transcend beyond the purview of the public sector. Aaron Golub and his colleagues at Portland State University have been especially active in this space (Golub & Satterfield, 2018a; Golub, Serritella, Satterfield & Singh, 2018b; Golub, Satterfield, Serritella, Singh & Phillips, 2019). In their various studies focused on smart mobility access in low income communities they have found that access to banking, affordable internet and reliable cellular plans pose the biggest barriers to low income communities, but each are controlled by entities in the private sector. Similarly, in Detroit, the affordability, physical accessibility and spatial availability were all barriers to smart mobility access, yet none could be easily augmented by city officials in order to meet the needs of low income communities (Dillahunt and Veinot, 2018).

This mismatch between smart mobility options and low income communities' needs was evident in the Federal Reserve Bank of Cleveland's findings that ridesharing had an impressive return on investment for its users, but again, the system overwhelmingly favored highly educated high wage workers in the region (Barkley, Pacetti & Bailey, 2018). What we see then is a pattern wherein the socially just and human-centric aspirations for smart technologies are changed and

become something fundamentally different once deployed in complex urban contexts. In the next section, I consider how this phenomenon has (or has not) presented in educational contexts.

Strand Four Summary

In this strand, I have summarized the theoretical and empirical literature showing how the concept of smart citizenship has emerged wherein individuals are expected to leverage smart technologies in order to inform city-level decision-making and in turn improve city services such as public-private smart mobility ecosystems. However, to date, research has shown that “civic participation” is not yet a subjective or democratic phenomenon in smart cities, but instead, citizen behaviors are largely just fed back through sensing technology. In the few studies that have described more comprehensive citizen participation, we find clear evidence that smart city processes can potentially deepen inequality and in extreme cases accelerate negative externalities (e.g. gentrification and displacement). More human-centered R&D studies highlight the centrality of sociotechnical trust in smart technology adoption and that low income users can also derive social benefits from their use. However, these advances are counterbalanced by a lack of intentional planning and policymaking structures to ensure that smart city resources meet the needs of low income communities and communities of color.

What is clear is that these issues –especially in the context of technology adoption and smart mobility – are complex and transcend social and interpersonal spaces, cross over multiple sectors, and are subject to different priorities in public and private governance. However, the glaring gap in this complex milieu are the voices and perspectives of low income individuals as they experience the expansion of smart resources in context. This study provides much needed insight into these experiences and how smart resource deployments related to complex geographies of educational opportunity. In the fifth strand of this literature review I synthesize

the paucity of smart cities literature that has dealt specifically with potential implications for educational opportunity and then revisit by theoretical framework in light of the smart cities landscape.

Strand Five: Educational Opportunity and Smart City Expansion

It is long established that education systems play a critical role in the development and operation of cities (Tyack, 1974). Schools are essential sites for cultural assimilation, identity formation, and the construction of citizenship (Dewey, 1916; Ferguson, 2010; Valenzuela, 1999). Therefore, understanding educational opportunities in the context of smart cities is imperative. At a Smart Cities NYC¹⁰ plenary in May 2018, Chicago Mayor Rahm Emmanuel stated, “There’s no such thing as smart cities...I’ll probably get kicked out of here for saying this, but technology doesn’t matter . . . There are only smart people” (Personal notes, 2018). These are not simply some rogue sentiments of a big city mayor who got off script, but rather are consistent with smart cities literature that uniformly positions educated people as the most important ingredient of the smart city model (Chourabi, 2012; DeKeles, 2015, Nam & Pardo, 2011; Ojo & Curry, 2016).

The Smart Cities Council (nd) suggests that people in smart cities need (*and want*) easy, open access to diverse sources of data so that they can help to design a more effective and efficient city. Smart citizens, we are told, believe in the power of technology and take personal responsibility for managing their city and it is the city’s role to harness their collaborative actions (Datta, 2015; Laitinen et al., 2017; Ratti & Townsend, 2011). Smart citizens are able to develop symbiotic “relationships” with machine learning environments supported by artificial intelligence (AI) enabled decision algorithms (Coccoli et al., 2017), because they are “T-shaped

¹⁰ Smart Cities NYC is an annual conference for city officials and technology vendors from around the globe.

people” with wide knowledge and skills and deep technology-based expertise that enables them to contribute to crowdsourcing and E-participation platforms (Foth, Brynskov & Ojala, 2015). Thus, as I referenced in the previous strand, in the evolution of smart citizenship we see humans and technology working together to actualize an ideal laid out in Harvey’s (2003) “right to the city” wherein humans remake their environments and are thus remade.

A number of the institutions that have been most active in the development of the smart cities concept have begun to actively engage in the process of human learning and are producing resources that support the reconceptualization of schools as a smart social institution situated in coded urban infrastructures (Kitchin & Dodge, 2011). In this ubiquitous technologically-mediated space, it is said, cities can improve the access to great coursework and accreditation for all citizens (Davidson, et.al., 2016), create innovative learning networks (McKenna, 2016), and more effectively harness the city’s intellectual capital (Komninos, 2011). However, educational systems cannot manage such a transformation with their existing resources.

Coccoli, et.al. (2017) assert that traditional education systems can better meet the demands of smart cities through robust collaborations with the private sector. Leahy et al., (2016) echo this sentiment and suggest that public-private partnerships are essential if smart educational environments ever hope to harness the full potential of ICTs, IoT and smart mobility. Large technology vendors have readily embraced this role and are now stepping in to help create smart educational systems.

Again, IBM has been instrumental in shaping the smart discourse in education and have charged that educational institutions, “must deliver a better student experience...[by] improving teaching, assessment, feedback and preparation for the world of work and taking more responsibility for social mobility” (Linday, 2013). IBM and Microsoft have been the most active

advocates for using coded urban and school spaces and adaptive machine learning to create smart learning environments (Williamson, 2015). One recent offspring of the IBM smart cities portfolio is a new high school model called “P-TECH”, which seeks to leverage the latest advancements in computational intelligence to track student behaviors with real-time data, provide predictive analytics about future outcomes, and assign content and pedagogical interventions based on these needs (Gomede et.al., 2018; Williamson, 2015). The goal of P-TECH is, “to build for schools what an operations center is for cities: a single system for collecting, aggregating and analyzing data from students and teachers alike, then writing algorithms to prescribe how to cope” (Linday, 2013, n.p.). At the time of this review, there were 56 active P-TECH schools across the United States and no peer reviewed research publications on the model’s impact.

What’s striking about the paucity of research that has been published specifically about smart education innovations is how frequently the findings champion a specific technology solution from a specific company. For example, Coccoli, et al. (2017) examined the impact of IBM’s Bluemix cognitive computing software on student performance in a computer science course at the University of Naples. In the experiment, the 120 student participants first received instruction on a project from IBM’s Bluemix software and then broke up into teams to complete different aspects of the same project. Once complete, students were asked to rate their overall experience on a scale of one to five. Based on instructors’ observations and an exit survey about the students’ self-perception of their own experience, the authors declare that IBM’s Bluemix platform, “can greatly improve the students’ performance...[they] gain core competencies faster and they do it in a work-like environment” (p. 99).

Based on these findings, the authors go on to conceptualize smart universities as places that (a) embrace the way cognitive computing and big data can impact learning processes, (b) respond to student needs through social media, (c) partner with companies to help them make sense of the enormous amounts of data , and (d) attract “the best students who, in turn, will receive the best formation in a virtuous cycle generated by the collaboration between universities and companies” (Coccoli, et.al., 2017, p. 100).

These findings suggest a trend wherein the systems and processes that support individual and environmental data collection and big data analytics in smart cities are being grafted onto educational settings. Like the smart cities model, smart learning environments such as the ones IBM envisions in the P-TECH model will utilize algorithmic cognitive computing applications to guide individuals’ cognitive and social development processes (Williamson, 2017b).

This explicit connection to students’ mind and their behaviors suggest that the combination of smart cities and smart schools – once fully realized – have the potential to alter the geography of educational opportunity in ways that are fundamentally different from previous eras of urban change as the relationship between city transformations and human transformations are more comprehensive, immediate and personal. This study aims to break new ground in critical educational research by providing an empirical examination of the potential pitfalls and opportunities associated with such a relationship.

Strand Five Summary

In this strand I summarized the paucity of smart cities literature that has centered educational systems, teaching and learning. In doing so I found theorized new learning opportunities beyond school walls along with new pathways for cities to learn from their citizenry. Public-private partnerships are positioned as pivotal in these new learning

environments. As such, new school models have emerged to serve as testing grounds for emergent teaching, learning and assessment technology solutions that are aimed to prepare students for participation in sociotechnical environments. However, like several of the studies I mentioned before, smart education solutions have been studied in controlled environments and have not accounted for complex systemic contexts and none have examined the impact in low income communities. Importantly, the experiences and voices of students and parents have not been prioritized in the research thus far, yet they must if we are to avoid the inequitable traps of previous generations of urban and educational reform. This study advances educational research by centering the voices of low income individuals in the context of educational opportunities in a smart city.

Through this scan it is clear that the trajectory of smart cities expansion is complicated by aspirations to concurrently provide better, more equitable access and services to existing residents while recruiting new “desirable” smart citizens. We see this tension laid bare as human-centered technologies routinely miss their social justice imperatives once deployed amongst complex urban political economies. Findings that smart city innovations privilege the already privileged sit in parallel with scholarship mapping smart infusions into educational systems, teaching, learning and cognition. As such, it is of profound and urgent importance that educational researchers become more engaged in this space. Lastly, the voices and experiences of low income individuals are strikingly absent on all fronts and especially with reference to their evolving geographies of educational opportunity. These gaps justify the multi-pronged theoretical framework I have adopted for this study. In the next section, I revisit my theoretical framework through the filter of the smart cities research I have reviewed thus far and then pivot

to detail the methods the community advisors and I used to fill a number of critical gaps in the literature.

Theoretical Framework

This study draws on theoretical framework that includes concepts from systems thinking, critical urban geography, and critical praxis. I describe these frameworks and the tenets that inform my theoretical approach in this study, all within context of smart cities and the geography of educational opportunities. In Table 1, I provide a brief description of each framework and how I apply its major concepts to this study.

Table 1

Summary of Theoretical Frameworks

Theoretical Frame	Description	Contribution to this Study
<i>Systems Thinking</i>	Focusses on interrelationships and patterns rather than static snapshots of particular elements within a given system or context (Senge, 1990).	<ul style="list-style-type: none"> • Provides ontological grounding in that the “real world” is made of complex systems. • Provides methodological focus on interrelationships and patterns.
<i>Critical Urban Geography</i>	Asserts that urban space is continuously (re) constructed through historically specific power relations and that more socially just forms of city-making are possible (Brenner, 2010).	<ul style="list-style-type: none"> • Emphasizes that interrelated systems produce differential benefits over space, and thus provides rationale for place-specific analysis.
<i>Critical Praxis</i>	Seeks to examine and change the world through authentic dialogue about the social reality in which people exist (McLaren, Ryoo, Crawford & Moreno, 2010).	<ul style="list-style-type: none"> • Grounds the study by privileging the experiences and perspectives of the individuals living within a specific context.

Systems Thinking

I first draw on concepts from systems thinking to inform the theoretical framework for this study. Systems thinking is an approach to understanding phenomenon by focusing on interrelationships and patterns rather than static variables within a given context (Senge, 1990). The sustainability literature has long acknowledged that social, economic and environmental systems constantly affect one another (Brundtland, 1987; McKelvey, 2002; Meadows, Meadows, Randers & Behrens, 1972). In the context of smart cities, scholars extend this notion by

theorizing sociotechnical systems—systems that integrate social, cyber, and physical and environmental systems via ICT infrastructure (Chopra, Paja, & Giorgini, 2011). In this context, systems change occurs through interconnections between systems and new innovations are the product of co-evolving systems (de Haan & Rotmans, 2018; Freeman, 1982).

The pace of smart city adoption described in the previous strands signals the rapid confluence of both systems change and innovations. Batty (2009) describes such dramatic systemic transitions as “systems emergence.” During systems emergence, systems dynamics are altered, and unexpected outcomes emerge (Batty, 2009; Patorniti, Stevens & Salmon, 2018). When rapid co-evolving systems produce unsustainable and inequitable outcomes they are not easily disrupted, because they are enmeshed in mutually reinforcing dynamics (Savaget, Geissdoerfer, Kharrazi & Evans., 2019). This also explains why new innovations that are designed to alter unsustainable and inequitable outcomes (e.g. smart mobility options) struggle to do so when swimming against the current of other, more influential dynamics.

The challenge then as a researcher in what I argue is a moment of complex systems emergence is to walk towards and describe complexity rather than artificially engineering it out of my study (Ostrom, 2009). Systems thinking provided an ideal frame for honing my eye towards emergent and existing systemic interrelationships whilst examining the geography of educational opportunity in relation to smart city resource implementation. Critical urban geography provides additional guidance on where and how to examine the intersection between complex urban systems.

Critical Urban Geography

The late Jane Jacobs (1961) first surfaced the perspective that cities should be conceptualized as problems of organized complexity. Harvey (1974) extended this notion by

calling out the inborn power differentials within complex urban environments that shape the opportunities and outcomes of those living in particular places. Known as critical urban geography, this theoretical perspective holds that urban space is continuously remade through historically specific power relations and that more just forms of city-making are possible (Brenner, 2010). Oden (2010) helps to clarify the mechanics of this process. Referencing Walzer's (1983) concept of complex equity, he writes:

It is not inequalities within individual spheres that constitute the principal problem of equity, rather it is inequalities in one sphere spilling over and shaping distributions in another sphere...in the US, for example, the problem of equity is not economic inequality per se, but the fact that highly unequal wealth distribution strongly influences distributions of educational opportunity, political access and power...[which results in the exclusion of a] significant numbers of citizens...undermines liberal democracy...[and] sharpen[s] the differences between people and make[s] them more durable (p. 36).

Scholars across multiple disciplines that have provided ample evidence of how these systemic spill-overs operate in practice. For example, critical urban studies have shown how gender differences increase vulnerabilities in other domains such as literacy (Findlay, 2005). In the health literature we see similar findings wherein inequities in education (e.g. dropouts) are entangled with imbalances in the urban environment and health outcomes such as teen pregnancy and premature death (Cohen & Schuchter, 2013; Harding, 2003). City planners have detailed place-based initiatives wherein housing status (renting versus ownership) translated into exclusionary decision-making and ultimately residential displacement (Mueller & Dooling, 2011).

From critical educational research, we know that access to public transportation systems impacts how and whether different communities' access educational and community assets (Anyon, 2005; Miller & Hafner, 2008). We also know that students' long-term educational outcomes are impacted by the spatial ecosystem of literacy (e.g. access to libraries; Jocson & Thorne-Wallington, 2013). Lastly, we know that students' residence and the schools they attend differentially expose them to dangerous environmental factors and that these factors correlate with the students' educational outcomes (Akom, 2011). Critically, none of these complex systemic issues happen in the abstract – they are inescapably grounded in place (Logan & Molotch, 2007).

Critical urban geography, therefore, benefits this study by providing an emphasis on power and place. It is inherent within Harvey's (1974) conceptualization of "The Right to the City" that people play a critical role in altering systemic power differentials as they manifest in a specific place. The theoretical precepts within critical praxis offer a way to conceptualize and operationalize such a process.

Critical Praxis

Critical praxis is an approach to examining and changing the world through authentic dialogue about the social reality in which people exist (Freire, 1970; McLaren, Ryoo, Crawford & Moreno, 2010). This approach runs counter to tendencies in the smart cities movement to frame "all urban questions as essentially engineering problems to be analyzed and solved using empirical, preferably quantitative methods" (Bell, 2011, pg. 309). This singularly quantitative approach is misguided in three critical ways. First, a number of studies from a previous strand demonstrate how quickly technology-based engineering processes can miss the mark of their original intent once deployed in the context of urban political economies (e.g. Golub et al.,

2018a; Golub et al., 2019). Secondly, quantitative methods do not describe capture the nuance of how complex systemic inequalities are experienced on the ground in particular communities (Ridder, 2019). And third, complex urban challenges cannot be solved by engineers and technocrats alone. They need the wisdom and creativity of those who stand to benefit most from systemic improvement (Freire, 1970).

Given the gaps in the current smart cities literature I have braided my systems thinking and critical urban geography frameworks with the core tenants of critical praxis. With its emphasis on critical reflection, individual action and collective action, the concept of critical praxis urges my study to move beyond mere analysis and instigate change (Freire, 1970; McLaren et al., 2010). I draw inspiration from Paulo Freire's collaborations with historically oppressed indigenous groups in Brazil during the late 1960s (Freire, 1970). He was deeply suspicious of both state technocrats and socialist revolutionaries alike who would arrive in oppressed communities with more answers than questions, and so, he collaborated with those whose voices were less heard in order to analyze and ultimately change their context (Herr & Anderson, 2015). Unlike Freire's emancipatory pedagogy, this study is not primarily concerned with fostering a transformative or liberatory experience for the participants.

Rather, my aim was to create the conditions for residents' stories and lived experiences to surface important conversations and inspire local action. Critical praxis is a common thread throughout numerous research traditions that have explicit orientations towards social action: participatory action research, participatory rural appraisal, advocacy research, activist research, and emancipatory praxis. Regardless of the methodological brand there is general agreement across each of these traditions that research should be "done *by* or *with* insiders to an organization or community, but never *to* or *on* them" (Herr & Anderson, 2015, pg. 3).

For this study, the public housing residents' stories and lived experiences take center stage. Their language and descriptions deliver much-needed specificity to the research on smart cities by intimately showing how systems converge differentially in place. In doing so, it is my hope that their words will serve as a centerpiece for future reflection and collective action. Indeed, this study represents the beginning of a conversation, not the end.

Chapter Summary

In this chapter I began my review with research on the geography of educational opportunity, transitioned to emergent research on smart cities and then returned to consider implications for the geography of educational opportunity in smart cities. The research on the geography of educational opportunity clearly demonstrates that academic and curricular learning occurs across a diverse assortment of social and environmental contexts. Therefore, when cities change through alterations in policy, infrastructure or the built environment, so do educational opportunities. This process ritually occurs in a manner that is highly inequitable, especially for low income communities of color. The research on educational opportunity also reveals the importance of virtual worlds in students social, cultural and academic lives. However, it is unclear from the research as to how virtual learning opportunities impact or potentially disrupt educational inequities that are spatial in nature and generational in scope.

The smart cities literature forecasts that more scrutiny of the sociotechnical dimensions of the geography of educational opportunity will be needed as smart city strategies are expanding at a dizzying pace. It is also clear that access to ICT-enabled smart city innovations in low income communities is enabled or hampered by social and technical trust, city-level policy and planning, and continuity of services across the public and private sector. These gaps are troubling given the centrality of technology in the future of civic life and accessibility of the geography of

educational opportunity. Ultimately, it is clear that educational researchers must be much more engaged with the evolution of smart cities. The study I describe in the next chapter has been designed to shed light on a variety of the issues that have surfaced in this review as I examine the geography of educational opportunity amongst a low income community in the urban core of a smart city.

CHAPTER III: METHODS

Introduction

The purpose of this study is to examine the relationships between ICT-based technologies and smart mobility options through the stories and experiences of public housing residents. To recap, I examine the following research questions: (1) How and in what ways do public housing residents characterize their experience in accessing educational opportunities in the urban core of a smart city? (2) How do public housing residents describe their experience with ICT-based technologies and smart mobility resources? (3) What relationships can be drawn between the factors influencing public housing resident's access to educational opportunities and their utilization or avoidance of ICT-based technologies and smart mobility resources? In this chapter, I discuss the research design and methodological approach that I, along with a small team of community advisors, took to conduct this study. In the spirit of collaboration, I explain how the community advisors contributed to this study, which included two longtime public housing residents (Destiny and Reyna) and one HACA staff member (Paul). Next, I describe the participants that were involved in the study, the research site and the context of the study. Then, I detail my data collection and analysis processes. Finally, I conclude with by discussing my positionality as a researcher, the steps I have taken to ensure trustworthiness, key ethical considerations and the limitations of this study.

Research Design: Rationale for Conducting a Qualitative, Collaborative Case Study

I discovered that a qualitative, collaborative case study was one of the best methodological fits for this study given my theoretical framework and goals. Specifically, I wanted to distance this study from the quantitative bias that undergirds most of the current research in the smart cities space (Bell, 2011). An explicitly qualitative study would allow me to

privilege participant perspectives above all else (Denzin & Lincoln, 2004), and in doing so, offer a novel and needed gaze into understudied territory.

While elevating and illuminating participant voice, qualitative methods were also more appropriate for capturing the complexity of smart city expansion, because they are better suited to “comprehend [the] complexity, dynamic relationships, and ambiguity of social processes” (Ridder, 2019, p. 79). I initially worried that my explicit focus on complex systems in this study would cause me to focus too singularly on macro-level phenomenon. The rich description provided by residents was invaluable in this regard in that it helped to ground my systemic analyses and imbue it with relevancy and meaning (Ridder, 2019).

Framing this dissertation as a case study, helped me to further ground this study and to become clearer about my underlying goals and objectives. As I mentioned before, by centering the broader geography of educational opportunity in the smart cities literature I was venturing into new territory. My hope was to begin to describe the contours of this space and to start a conversation, not end it. The case study approach was especially useful in this regard as it is best deployed as an exploratory tool, emphasizes description over causality, and values internal validity over external generalizability (Gerring, 2004; Stake, 1995; Yin, 2004).

Beyond these relevant purposes, I also found that the case study approach fit the phenomenon at the heart of this study. Ridder (2019) suggests that case study research has a number of common characteristics that are germane here. Specifically, case studies: (1) focus on real life phenomenon; (2) provide in depth analysis of phenomenon that are not well understood and have complex and involve dynamic processes; (3) create spatial and temporal boundaries around the case in question; (4) aspire for holistic descriptions of social contexts; and (5) focus on patterns and relationships.

While these five characteristics of case studies felt custom made for this dissertation, I was also aware that one of the shortcomings of case studies is that they are often prone to bias (Yin, 2004). With this in mind, my decision to focus exclusively on participants' stories and lived experiences and to conduct the research alongside an embedded advisory team felt all the more important. In the next section I introduce the study participants and explain their various roles.

Case Study Participants

Given the critical praxis approach to this study that honors the perspectives, lived experiences and voices of people on-the-ground, I worked collaboratively with a team of people in the field. To be clear, while the community advisors provided critical guidance and support in this project, I lead every aspect of the research design, data analysis and interpretation that you will encounter in this dissertation. However, the community advisors' role should not be understated – they were instrumental in recruiting a sample of seventeen public housing residents from Overton Heights in East Austin, which I discuss later. I first describe the community advisors and explain my positionality within the study.

Selection of Community Advisors

Prior to proposing this study, I met with administrators from the Housing Authority of the City of Austin (HACA) in order to discuss my research interests and my hope that a core group of residents and/or HACA staff might help to collaboratively conduct the research. HACA leadership was enthusiastic about this approach and agreed to support the effort by providing hourly stipends for those who participated.

We discussed a variety of possible criteria for selecting community advisors and ultimately agreed that members needed to be enthusiastic about the topic and be available to

support data collection efforts that would likely last 5 to 7 months. In this sense, my orientation with working with community advisors was purposeful (Patton, 2014).

At the time, HACA had already assembled a cadre of approximately fifteen “digital inclusion ambassadors” who were helping to investigate and support issues related to technology access as a part of the *Unlocking the Connection* program administered by HACA’s non-profit subsidiary, Austin Pathways (<http://austinpathways.org/unlocking-the-connection/>). The HACA administrator leading the effort suggested that the digital ambassadors were a natural pool of candidates, so she and I co-drafted an email to the digital inclusion ambassadors to explain the focus of the study and invite interested parties to a 30-minute conference call to discuss next steps (See Appendix A for copy of email invitation).

Ultimately, three individuals came forward to support the project: Reyna, Destiny and Paul. Each brought diverse experiences and invaluable insights to the project, and because of my theoretical framing I viewed them of co-constructors of knowledge. In practice, the central focus of our collaboration and co-construction was strategic and focused on participant recruitment. Before discussing their additional contributions to the project, I offer a brief introduction of each member of the team.

Reyna

Reyna (see full personal bio in Appendix B) is a Latina female in her late sixties who has lived at Overton for the last eight years. She is a Senior Ambassador for Digital Inclusion and a Smart Cities Ambassador, currently serves as the President of the Resident Council at Overton Heights¹¹, and has served as the Resident Commissioner representing all 18 HACA properties for the last two years.

¹¹ I vacillate between referring to the study site as Overton Heights and Overton throughout the remainder of the study, but am always referring to the same property.

Destiny

Destiny (see full personal bio in Appendix C) is an African American female in her early twenties. Destiny grew up living in public housing properties in East Austin where the majority of her immediate family still lives today. Destiny currently serves as Digital Inclusion Ambassador and Senior Smart Cities Ambassador and is on track to graduate with an associate's degree in Computer Science from Austin Community College (ACC) in May of 2020.

Paul

Paul (See full personal bio in Appendix D) is a Latino male in his early thirties. He currently serves as a Career Coach in the Jobs Plus program at Overton Heights where he connects residents to educational and workforce development opportunities. Paul has worked in a variety of service-related roles in East Austin since arriving in Austin in 2012. He holds a bachelor's degree in social work from the University of Texas and a master's degree from Texas State University.

The community advisors and I began meeting in Paul's office at Overton Heights – the most central of the family-serving HACA properties – every Friday afternoon beginning in August of 2019. We spent our first three meetings discussing the focus of the study and revised the research questions and interview protocols based on their keen feedback. As we did so, they began brainstorming lists of their neighbors who they wanted to contact because they were engaged with their own or their children's education. I will continue to highlight specific moments where the community advisors shaped this dissertation study throughout the following sections and will begin by discussing their central role in shaping the study sample.

Sampling, Selection Criteria, and Participants

I initially attempted to collect data from public housing residents in six family-serving HACA properties as well as Housing Choice Voucher (HCV) recipients who would be more geographically disperse. However, the collaborative approach I adopted necessitated that I approach the study with fluidity from the beginning. I learned (and am still learning) that trying to control a study is a fool's errand and to trust that the study will emerge as intended *through the collaboration*. Through this open and flexible perspective, I became keenly aware of the importance of trust in collaborative research (Herr & Anderson, 2014). This was especially evident as I followed the community advisors' logic for recruiting the study sample.

The community advisors explained to me early on that in order to examine experiences with ICT-enabled technology and smart mobility as they relate to the geography of educational opportunity in public housing would require a wide lens on education extending from early childhood to workforce upskilling and potentially senior learning and enrichment. With this in mind, Reyna and Paul took the lead using a purposeful sampling approach (Maxwell, 2012; Patton, 2014) to recruit HACA residents who would be able to best address our research questions. Purposeful sampling is a technique used in qualitative research to target the recruitment of study participants based on the characteristics of individuals and the objective of the study (Patton, 2014). Applying a purposeful sample to this study was imperative because we needed to speak with residents who (a) lived in inner city public housing and (b) were pursuing educational opportunities for themselves or their children.

This selection criteria ensured that I would learn more about public housing residents who were currently experiencing the expansion of ICT-based technologies and smart city options while engaging with their geographies of educational opportunity. By focusing on public housing

residents, we would automatically be connecting with individuals or families earning between 30% and 80% of the median income for the Austin area. Additionally, according to HACA's 2017-2018 annual report, public housing residents are disproportionately Black and Latino compared to the total population of the City of Austin and the demographics of their rapidly gentrifying neighborhood.

As the community advisors began their outreach to the public housing community we originally imagined that they would play active roles in recruiting the study sample, but that they would not be involved in the interviews or focus groups. After our fourth interview we recognized that this was not the case, because the community advisors wanted to be present and would frequently make valuable connections or ask keen follow up questions during the course of an interview. We had discussed participant protections, ethics and the institutional research board (IRB) requirements in our first team meeting and agreed that their role had elevated to a state that necessitated they complete the IRB coursework.

During a three week pause on data collection, the community advisors completed their IRB certificate and reviewed the transcripts from our first four interviews. I asked that they simply highlight the phrases during the interview that either addressed one of our research questions or just seemed important to them for any reason. After our three-week hiatus we reconvened on a Friday afternoon to walk through one of the transcripts together.

I mention this moment, because it seemed to me that the combination of four interviews, IRB training and transcript review served to clarify the focus of the study. In addition to refining our interview protocol and adding in some additional visuals (which I will discuss shortly in instrumentation), it was clear that Reyna and Paul were beginning to really own the participant recruitment process. Rather than creating a comprehensive list in advance of residents we would

like to interview, our sample developed organically during our weekly Friday meetings. After the interviews, it became like clockwork that Reyna and Paul would turn to one another and discuss whom we might interview next. While still purposeful in that we were only targeting participants who we thought would illicit rich responses the process itself more closely resembled a snowballing sampling strategy (Babbie, 2013; Patton, 2014).

Prior to the study I had anticipated that the sample would snowball, but assumed that the sample would spread across numerous HACA properties and that the participants themselves would suggest whom we should talk to next. In reality, rather than spreading across housing properties, the study evolved based on Reyna and Paul's relationships and our inquiry opted for depth over breadth as we narrowed our focus on the experiences of 17 housing residents at Overton Heights. Within this sample, 18% were under 18, 35% were 18-44, 35% were 45-64 and 12% were 65 and up. 18% of the study participants were African-American, 6% were Asian-American, 70% were Latinx, 6% were White, and in total, 88% of participants were female and 12% were male. This included 52% who were students, 24% who were parents and 24% who were both parents and students (see Table 2 for the demographic breakdown of study sample). In the next section, I discuss the history and current context of Overton Heights where all of the residents in this study reside as well as the broader context of social and economic changes that are currently remaking the landscape in East Austin.

Table 2***Demographic Breakdown and Summary of Study Sample***

Pseudonym in Study	Age Range¹²	Race/Ethnicity	Gender	Role
Destiny	18-44	African-American	Female	Student
Shirley	45-64	African-American	Female	Student
Barbara	65 and up	African-American	Female	Student
Emily	45-64	Asian-American	Female	Student
Soledad	18-44	Latinx	Female	Parent
Ruben	18-44	Latinx	Male	Student
Danielle	18-44	Latinx	Female	Both
Amy	18-44	Latinx	Female	Both
Luz	45-64	Latinx	Female	Parent
Sally	45-64	Latinx	Female	Parent
Evelyn	45-64	Latinx	Female	Both
Monica	45-65	Latinx	Female	Student
Julio	65 and up	Latinx	Male	Parent
Maribel	Under 18	Latinx	Female	Student
Selena	Under 18	Latinx	Female	Student
Alexandria	Under 18	Latinx	Female	Student
Violet	18-44	White	Female	Both

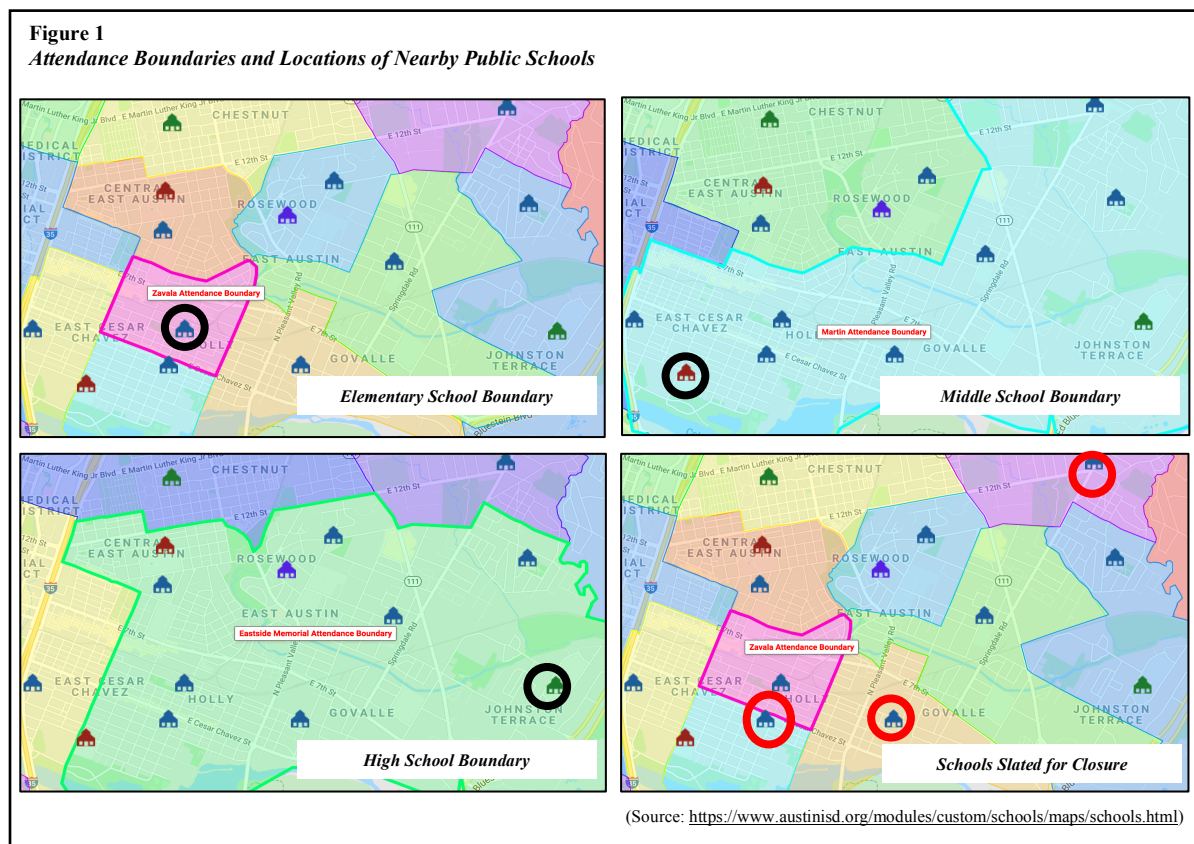
Research Site and Context of Study

Austin has a special place in the history of public housing in the United States. The Austin City Council established its housing authority in December of 1937 and was the first agency in the country to receive funding through the United States Housing Act, which stemmed out of Roosevelt's New Deal. The city utilized the federal funding to create three housing properties in East Austin: Sanchez Place for Latinx families, DuBois Terraces for African-American families, and Overton Heights for White families. However, each property was desegregated in the wake of the Civil Rights Act of 1968 (Moore, 2014).

¹² In order to protect the residents' identities I opted to use the wide age ranges that are standard in the U.S. Census.

According to the 2018-2019 HACA Annual Report, HACA currently serves over 20,000 individuals through their Housing Choice Voucher (HCV) program and 18 subsidized housing properties. Each of the housing properties predominantly cater to specific populations such as families, seniors or individuals with disabilities. Overton Heights residents represent each of these groups. For the purpose of this study it is important to note that Overton is the closest family-serving property to downtown Austin, the central business district, Austin City Hall and the Texas Capital Complex.

Overton Heights is one of several public housing properties near downtown Austin that are located in close proximity to a variety of educational resources. Figure 1 below depicts a map of the public school ecosystem surrounding in that area. In the interest of maintaining anonymity I have not specified Overton's location. However, I have indicated Overton's elementary, middle



and high school boundaries along with the schools residents would be assigned to attend. In addition, I have highlighted the three schools in Overton's surrounding neighborhood that are currently slated to be closed by the Austin Independent School District (AISD) despite fierce opposition from the community and the district's Chief Equity Officer (McInerny, 2019).

For older students, the University of Texas is 1.9¹³ miles away from Overton Heights and ACC has three locations in close proximity: ACC Eastview (1.2 miles), Rio Grande (2.2 miles) and Highland (5.4 miles). Additionally, Capital Idea, one of the city's largest and most effective education and workforce development support programs is 1.2 miles from the Overton property. Regardless of the school or program, students of any age can access technology and academic resources at one of several public library branches: Terrazas Branch (0.7 miles), Carver Branch (0.9 miles), and Main Branch (1.9 miles).

The neighborhoods around Overton's many nearby educational assets has changed considerably in recent history. Specifically, as detailed in the 2018 report by the University of Texas detailing patterns of residential displacement in Austin's gentrifying neighborhoods shows that Overton Heights sits at both (a) the center of the "eastern crescent" of social disadvantage and (b) amongst the census tracts with some of the highest levels of housing appreciation and most intensive levels of gentrification immediately east of downtown across Interstate 35 (Way, Mueller and Wegman, 2018). Increasingly, Overton and other nearby HACA properties represent some of the last places that low income people can live in nearby East Austin without threat of displacement.

¹³ I utilized Google Maps (<https://www.google.com/maps>) in order to determine the distance between Overton and Eastside educational assets.

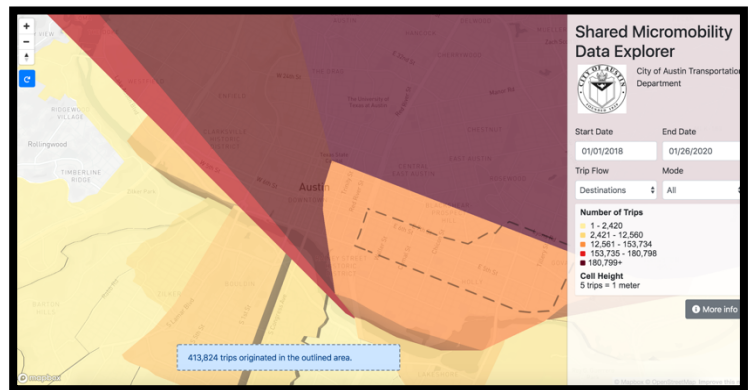
The gentrification processes around Overton Heights have paralleled a growth in the availability of key smart city assets such as expanded ICT infrastructure and smart mobility options in and around Overton Heights. For example, from 2015 to 2018, HACA's non-profit subsidiary, Austin Pathways, launched the first phase of its partnership with Google Fiber, which committed to providing free basic internet for every HACA property. Overton was one of three HACA properties nested in the eastern crescent to register new families during the first phase of the partnership and according to residents in our interviews they now receive regular solicitations from other broadband providers like AT&T offering affordable internet and cellular plans.

Concurrently, the City of Austin has begun to implement its Smart Mobility Roadmap (2017) which seeks to expand shared, electric and autonomous transportation options (2017). Through this effort an ensemble of private sector and non-profit vendors have entered the market to create a diverse ecosystem of smart mobility options in Austin's urban core. Ostensibly, Overton Heights should have exceptional access to these new mobility options. However, I was not able to find any place specific rideshare data on the frequency and availability of rideshare pickups in the eastern crescent. Regardless, due to its close proximity to downtown and the convention center, I assert it is safe to assume that Overton residents can access rideshares from Uber, Lyft or Ride Austin (a local non-profit) with little wait time.

The City of Austin's Shared Micromobility Explorer (<https://micro.mobility.austin.gov/>) offers an open data platform that paints a clearer picture of electric scooter and bikeshare availability and usage in the neighborhoods surrounding Overton Heights. Based on the available

data, at the time of this writing, from January of 2018 to January 26, 2020, there were 413,824 scooter or bike trips that originated and 411,083 trips ended in the few blocks surrounding Overton. The overwhelming majority of these micro-transit commutes were into the

Figure 2
Snapshot of Austin Micro Mobility Tracker



downtown area directly to the west of the Overton property. Figure 2 shows a snapshot of the City of Austin’s Micro Mobility Tracker with the area surrounding Overton Heights.

Importantly, the City of Austin (COA) recognizes that their smart mobility implementation must be complimented by other outreach efforts in order to improve access for all residents. Austin’s City Council directed the City Manager to create and implement a digital inclusion strategy to ensure that every Austin resident has “and opportunity to be fully engaged in digital society, accessing and using digital and communications technology” (City of Austin Digital Inclusion Strategic Plan, 2016). In addition, HACA staff and ambassadors regularly collaborate with COA staff to make certain that public housing residents are included in smart mobility and digital inclusion planning and implementation efforts.

For example, through its work with Austin Pathways, HACA co-hosted a recent event¹⁴ at Overton Heights with Lyft and COA staff leading the digital inclusion effort in order to share information and discuss opportunities and barriers in cross-functional teams that included Smart City Ambassadors. The community advisors and I attended this event after having conducted our final interviews for this study. As I watched a group of residents riding electric scooters for

¹⁴ January 25, 2020

the first time I felt more confident than ever that Reyna and Paul's instinct to stay focused on Overton had been the right move. With its location in the urban core of a smart city, robust access to ICT and smart mobility options, and active support from HACA, COA and the private sector, if ICT-enabled technology and smart mobility were going to enhance the geography of educational opportunity for low income residents it seems that it would be here. In the following section I describe the data collection processes we used to examine how smart resources are interfacing with living and learning in and around Overton.

Data Collection Process

The community advisors and I collected data for this study for over five months between September 2019 and January 2020. To answer the research questions for this study, I (along with the community advisors) conducted seventeen semi-structured interviews (Patton, 2014) with the Overton residents Reyna and Paul recruited (See the full interview guide for this study in Appendix E). The semi-structured interview approach was appropriate for this study because it provided a general framework and order for the questions I wanted to ask and topics I wanted to cover, but also allowed for flexibility (Patton, 2014). This structured flexibility was important, because we only had one hour with each participant, needed to address the specific topics at the heart of this study, but also needed to flex as the participants' storytelling often took the discussion in new and unexpected directions (Bochner & Riggs, 2014; Patton, 2014).

Instrumentation

Herr and Anderson (2015) suggest that a key trade-off of choosing a collaborative research process is that one has to relinquish control over some decisions about methods and instrumentation (Herr & Anderson, 2015). Personally, I experienced this "trade-off" not as a

relinquishing of control, but rather an openness to new ideas and insights from either the community advisors or participants.

While open to new tools and approaches, the core aspects of this study's instrumentation remained consistent. All of the interviews were scheduled for one-hour and were conducted in Paul's Jobs Plus office at Overton Heights. At least one member of the community advisors joined me for each interview and we would sit with the participant at a circular kitchen counter that has been modified to accommodate wheelchairs. After meeting the participants, I would lead them through the key details in the informed consent document (See Appendix F) and would ask for their permission to record the interview. I recorded every interview using a Yeti USB microphone by Blue Designs, which I plugged into my MacBook Pro to record the interview using the Voice Recorder Pro application.

Once complete, I would save the audio files in the "Dissertation Interview" folder on my MacBook Pro and then we would conclude each session by reminding participants where to find my contact information on their copy of the informed consent document and giving them each a \$10 gift card to HEB (a local supermarket). After the interviewees exited, the participating community advisors and I would discuss the interview, revisions for the interview process (if necessary) and ideas for whom to interview next. During that discussion, I would typically upload the audio file of the interview into Rev.com (www.rev.com) and would pay for the transcription service. Once received, I checked each transcript for accuracy using the Rev.com playback feature that allows for live editing the transcript during audio playback.

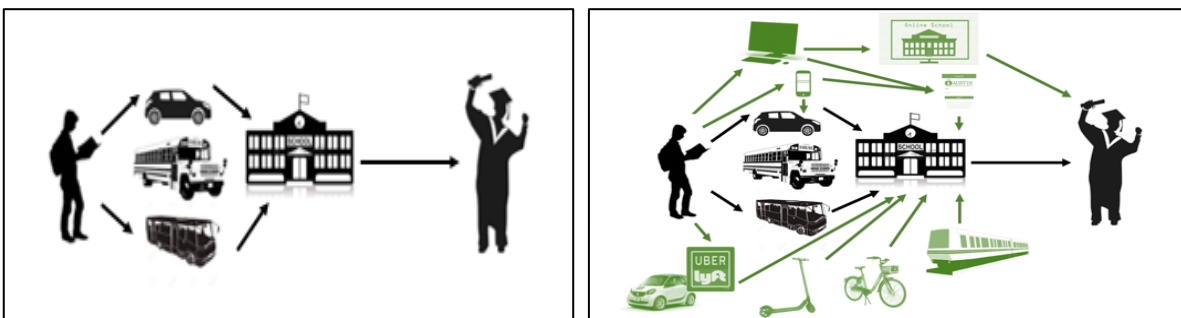
While the general mechanics of the interview process remained consistent throughout the study, the team and I regularly adjusted the framing of the questions and manipulatives based on lessons learned from the interviews. For example, in our first review of the interview protocol

Reyna and Destiny observed that we were trying to leap into a discussion about educational opportunity without having established what the participants hopes, and aspirations were for their own or their children's education. Based on this feedback we added two questions to the front end of the interview protocol: What are your dreams for your child's education (if applicable)? And, what are your dreams for your own education?

After our first two interviews we asked the participants for feedback on the interview itself and they each said that they appreciated these two questions and especially the question about their own education. They pointed out that even though they were parents, there were specific knowledge and skills they needed in order to be able to support their child/children's education, which was a dimension of the geography of educational opportunity I had captured in my original ensembled of questions. Some examples of these questions included: When you think of your/your child(ren)'s educational journey, what things have supported you and helped you accomplish your goals? When you think of your/your child(ren)'s educational journey in the time you have lived at Overton, have there been any barriers that have made it hard for you to access educational opportunities and accomplish your goals?

Framing the concept of the geography of educational opportunity, smart cities, ICT and smart mobility was complex and proved to be more complicated than I had anticipated. The

Figure 3
Examples of Visuals Developed to Support Interviews



community advisors' insights proved invaluable in this regard. In several of our post-interview debriefs we would discuss possible adjustments to the questioning or support materials. Based on the team's feedback I would work to improve the language or tools and we would implement them the following week. Figure 3 represents one of the supporting visuals I developed after we noticed we were spending too time trying to explain the transition from the traditional landscape of educational opportunity to the geography of educational opportunity in the context of smart cities.

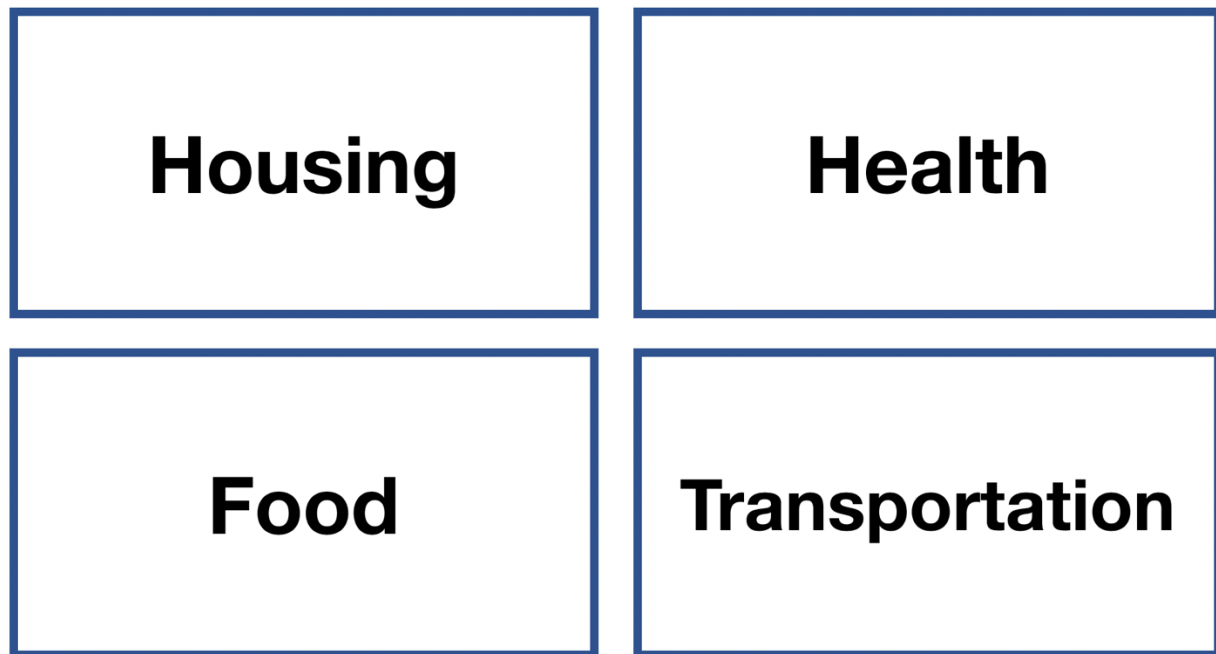
I printed these visuals on 11x17 paper and would give participants a Sharpie pen so that they could write on the document and add any details that I may have missed (e.g. One of our last interviews added tablets to the technology options and a COA rideshare service that I was not aware of to the smart mobility options). According to the team and participants, these visuals were helpful and the quality and specificity of the feedback suggested this was the case; however, as I continued to review transcript I found myself wanting more specificity about the supports and barriers (i.e., the experiences) that were currently impacting participants' access to the geography of educational opportunity in and out of school.

To help unearth these stories in the last few interviews, I conferred with Reyna and Paul and developed a series of simple cards (see Figure 4) that I would spread around the table all at once that included various factors that literature has shown can impact one's educational journey (Akom, 2011; Anyon, 2005; Green, 2015; Noguera & Wells, 2011). In addition, I provided a stack of blank cards and a Sharpie so that participants could add their own factors had I not captured their experience. As we integrated these cards into the final series of interviews we discovered that while we had long since reached a point of saturation with the themes that were emerging from the data, the cards reinforced some key themes specifically in the public school

space that we had not gathered with such precision in previous conversations. In the next section I describe the data analysis process that I utilized to analyze these conversations.

Figure 4

Sample of Geography of Education Cards



Data Analysis Process

As I mentioned in an earlier section, after having conducted four interviews the community advisors and I read through the transcripts in order to identify key passages and quotes that aligned to the research questions or just felt important to one of the team members. We discovered through this process that the complexity and time commitment required for the community advisors to engage in in-depth data analysis was not going to be feasible for the 15 to 20 interviews we hoped to conduct. Thus, we agreed that I would conduct the remainder of the in-depth analysis alone, but would continue to check in with the team in post-interview sessions about patterns that seemed to be emerging.

In addition to maintaining tight communication loops with the community advisors, I continually reengaged the literature during the data collection and analysis processes using the constant comparative method (Glaser, 1965). This cyclical engagement included key pieces from my original review as well as new pieces that I collected based on patterns in the data. The mechanics of deriving patterns from the data involved converting the Rev.com transcript files into Microsoft Word so that they could be loaded into Nvivo qualitative data analysis software. Once in Nvivo, my coding efforts evolved into two major coding cycles (Miles, Huberman & Saldaña, 2014).

First Cycle Coding

Based on the central importance of language and stories in critical praxis (Freire, 1970; Freire & Macedo, 1987) I opted to let the participants experiences take the lead. Rather than bringing preconceived ensemble of codes to the data, I began my analysis using an inductive coding process during the first cycle wherein I either assigned simple labels to key passages in the data, or created “In Vivo” codes based on specific phrases from the participants (Miles, Huberman & Saldaña, 2014).

After the first four interviews the passages that the community advisors and I identified laid the groundwork of first cycle codes that all subsequent interviews built upon. As I would engage with new interviews and patterns began to emerge I would revise the title of codes to match the pattern. So for example, the first interview we conducted included a description of the participant’s ex-husband. She said, “he’s violent.” Based on this utterance I established a code called, “He’s violent.” After several more interviews, similar references? were made and I changed the code to “Domestic Violence.” This labelling sufficed until the last five interviews in this study where it became clear that “Gender Violence” was the more accurate code. Thus,

the original coding structure was iterative ¹⁵and entirely built upon the topics emerging from the participants language.

Second Cycle Coding

The “He’s Violent” example above illustrates how the first cycle inductive coding naturally dovetailed into second cycle coding processes that involved identifying the patterns and organizing them into overarching themes or categories (Miles, Huberman & Saldaña, 2014). After my first pass with each interview I revisited the content in each code in order to reorganized the content based on key categories and themes, causes or explanations, relationships (Miles, Huberman & Saldaña, 2014). This process typically involved consolidating two or more codes into an overarching code that described the theme they had in common or reassigning passages to other codes that were more descriptive. Once I felt confident that the code titles were descriptive and the language within each code was in the right place, I sorted the codes into overarching codes for each of the three research questions. Using this final configuration of codes, I reengaged the themes and relationships within each research question and began to visualize the relationships between themes by creating thematic maps.

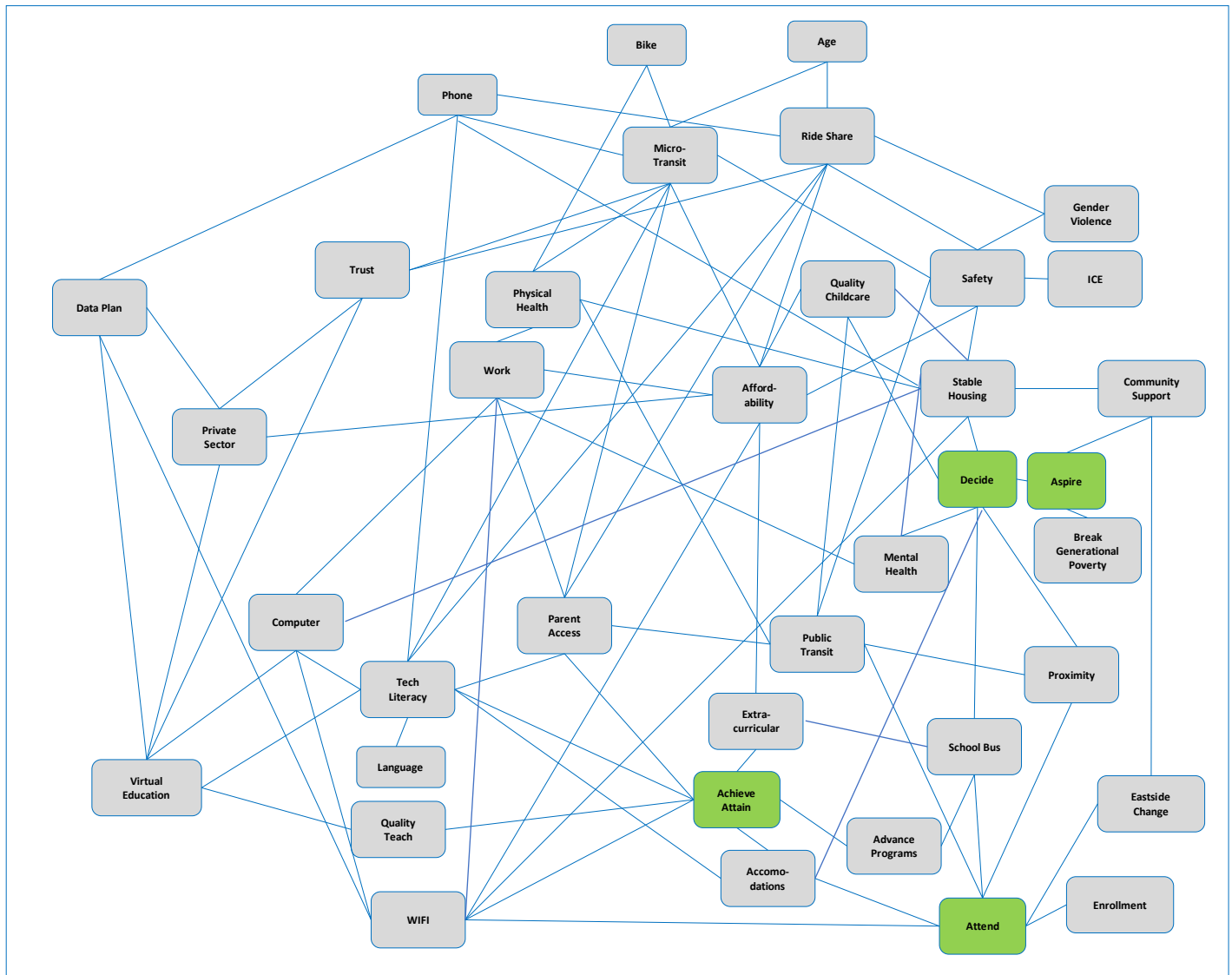
Thematic Mapping

As I have stated several times in the previous sections, my core intent in this study was to critically examine the complex, systemic relationships between residents’ geography of educational opportunity and core smart city assets from the perspective of the residents. After two waves of coding and numerous conversations with the community advisors, I felt confident

¹⁵ Nvivo simplifies this process by displaying each passage that has been assigned to a specific code into a single view.

Figure 5

Forecast of the Summary Thematic Map



that I could name a variety of relationships between themes. In the final stage of my analysis I took the themes within each research question and began constructing thematic maps for each.

Thematic maps are visualizations of the relationship between codes and themes in qualitative data (Castleberry, 2018). They provide additional rigor to qualitative analysis by providing a networked visualization of how themes interconnect in relation to specific research questions and more global interrelationships across the whole landscape of the case (Kuchartz,

2014). Methodologically, the thematic mapping process moved me beyond describing patterns towards the global interpretations and conclusions I describe in chapters four and five (Kuchartz, 2014). Figure 5 shows the final thematic map that I have constructed to inform my interpretations and conclusions. Before transitioning to the content and findings for this study, I briefly discuss my positionality as a researcher and the steps I have taken to ensure that this study is trustworthy and ethical.

My Positionality in this Research

Collaborative, action oriented research such as this aims to forge synergies between insiders and outsiders (Herr & Anderson, 2015). As a White, middle class, English speaking, technologically proficient male I no doubt fall into the latter category. What is also true, however, is that I have been engaged with the housing authority for years and have spent over twenty years as a practitioner in public education and currently work on numerous state and local projects focused on disrupting patterns of systemic inequity.

Herr and Anderson (2015) point out that a researcher's positionality doesn't cleanly land in insider/outsider polarities, but rather falls on a continuum. In this research I have tried at every step in the process to ensure that this study has been a reciprocal collaboration (Bartunek & Louis, 1996). I have been engaged with HACA's ambassador program on and off for approximately three years. During this time I collaborated with HACA staff to co-design the participatory methods I described in chapter one and helped to conceptualize the Smart City Ambassadors program. Most recently I helped the digital ambassadors and HACA staff administer the City of Austin's digital inclusion survey at all 18 public housing properties. Through this process, I helped to design the data collection strategy and arranged pro-bono

support from my employer, the American Institutes for Research (AIR), to provide a digital platform for data entry.

Concurrently, each of these efforts stand to benefit me in specific ways. For one, completing this dissertation will support my career and will be a meaningful consideration when I am engaged in future salary negotiations. In addition, the experiences I have had with HACA and the ambassadors have informed and continue to inform new projects and funding sources I have secured in other cities. I feel that it is important to state these individual benefits publicly so that I am reminded that I am indebted to Reyna, Destin, Paul and all of the Overton Residents to stay engaged with the issues that surface in this study and to leverage the benefits it has conferred to continue fighting for collective change. In the next section I discuss how I have maintained trustworthiness in the interim.

Ensuring Trustworthiness of Findings and Impact

I share the belief that there is no point in doing research that doesn't confront social justice issues (Steinitz & Mishler, 2001). As such, the aim of this study was not to establish external validity, but rather sought trustworthiness and findings with localized impact. Based on guidance from Miles, Huberman and Saldaña (2014), I took five intentional steps in order to ensure that the community advisors and participants felt confident in the results that will be published and disseminated.

The first step was to establish and maintain an active partnership with the community advisors. Secondly, the community advisors and I engaged in a reflective member checking process (Carlson, 2010; Turner & Coen, 2008) after I completed the thematic mapping wherein I presented my core interpretations and they indicated I had captured the important themes and

relationships that emerged.¹⁶ Third, I have continuously reengaged the literature undergirding my theoretical framework throughout the data collection and analysis process, which allowed me to continuously recenter the work in the tenants of critical praxis. And lastly, by using the thematic mapping technique, I have tried to present my findings in a manner that is easy to understand, coherent, and logical (Charmaz, 2006).

Beyond working to make certain that the findings are internally trustworthy, I hoped to ensure the impact validity of this study. Impact validity (Massey & Barreras, 2013; Maxwell, 1992) is determined by whether or not my findings result in either political, social or programmatic change. This study has been collaborative, and the research questions, methods and analysis processes have been focused on a place-specific set of opportunities and challenges. In order to prompt action in the diverse content of large smart city, I have worked diligently to translate our process and findings into a format that is intellectually, linguistically and physically accessible to potential users (Maxwell, 1992). It is my deep hope that end users such as the smart city ambassadors, public housing residents at other sites, city officials and private sector partners will develop actionable and socially just insights as they engage with our findings. In the next section, I discuss the steps I have taken to ensure that this study is ethical in every aspect of its design and implementation.

Ethical Considerations

The socially just goals of this study are for naught if the process is unethical. Ensuring that the study was both ethically and morally sound is especially complicated in collaborative research processes such as this one. Therefore, a number of safety measures were put in place to ensure that the study did no harm. The first safety measure was that the community advisors and

¹⁶ Unfortunately, the member checking process was conducted virtually due to the COVID-19 outbreak and due to schedules the team had to provide feedback asynchronously.

I were trained on the standards and expectations of the University of Texas Institutional Research Board (IRB). Second, all participants who engaged in this study did so voluntarily and signed their informed consent and those participants who were under 18 were granted permission to participate by their parent or guardian whose signature is also included on the informed consent form. Third, no participants are referred to by name in the publication of this study and findings. Fourth, all participants received a \$10 HEB gift card for their time and contribution to the study. Last, and most importantly from my perspective, HACA received a grant that ensured that Reyna and Destiny were monetarily compensated for their time and Paul received additional incentives in the form of travel and professional development opportunities. Like all other aspects of this study, I trusted that an open, inclusive process would result in a study that is impactful, ethical and just. In the next section I describe a number of the limitations to this study.

Limitations

Again, I did not seek generalizability in conducting this study. Instead, my aim was to provide rich, contextual accounts of how the geography of educational opportunity has been impacted amongst residents at Overton Heights in the context of rapid gentrification and the expansion of ICT and smart mobility options (Geertz, 2008). Thus the study is limited by the fact that (a) I have only studied these phenomenon and relationships at one housing project in one neighborhood in one city, (b) Overton Heights residents live in a specific spatial context and do not represent the whole of public housing residents in Austin, and (c) the experiences of public housing residents living in stable housing such as Overton Heights are significantly different than those of low income individuals that are using HCVs, are housing vulnerable or homeless. Despite these limitations this study brings significance to both smart city and educational research, which I detail in the concluding section of this chapter.

Chapter Summary

I discussed how the case that the expansion of smart cities warrants the critical and comprehensive engagement of the educational research community. I have based this argument on the fact that educational opportunities have been ritually compromised when cities transform their economies, infrastructure, or both. Based on my review of the research, I have shown that smart cities incorporate both infrastructural and economic dynamics and well as explicit expectations for how citizenship and human learning will change to meet the needs of future cities. Therefore, it is urgent that educational researchers of conscience interrogate the intersections between smart cities, educational opportunity and low income communities such as those found in public housing.

In this chapter, I detailed the methods, instrumentation, analysis processes and safeguards we have put in place for this qualitative, collaborative case study. I believe that this study stands to advance the fields of education, urban planning and public policy by providing human-centered evidence of how ICT-enabled technologies and smart mobility options impact the geography educational opportunity amongst low income individuals living in a smart city. In the next chapter, I will discuss this study's findings.

CHAPTER IV: THE STUDY

In this chapter, I present the findings to my research questions. To recap, in this study, I examine the following research questions: (1) How and in what ways do public housing residents characterize their experience in accessing educational opportunities in the urban core of a smart city? (2) How do public housing residents describe their experience with ICT-based technologies and smart mobility resources? (3) What relationships can be drawn between the factors influencing public housing resident's access to educational opportunities and their utilization or avoidance of ICT-based technologies and smart mobility resources? To answer these questions, I draw on data from interviews with seventeen residents at Overton Heights, an inner city public housing property.

Overall, my findings suggest that stable housing is a cornerstone within residents' geographies of educational opportunity, but the stabilizing benefits are counterbalanced by neighborhood gentrification processes. Next, while the geographic context of residents' lives is changing, their educational access and opportunities are still limited by public systems and supports that are mismatched to their needs and aspirations. Regarding smart city assets, I found that residents' access to ICT-based technologies and smart mobility options is highly variable and often mismatched to their needs. Lastly, the data suggests that the mismatches between shared mobility options, ICT-based technologies and residents' needs complicate residents' educational access and opportunities. The following sections unpack each of these findings in turn.

Key Findings of Research Question One:

Residents' Experiences Accessing Educational Opportunities in a Smart City

In this section I address the first research question in this study, which was how and in what ways do public housing residents characterize their experience accessing educational opportunities in the urban core of a smart city? Based on the literature I discussed in chapter two, I recognize that the process of accessing education begins long before one is directly engaged with an opportunity. There is a complex journey in between and I found for residents at Overton the journey begins at home and is impacted by changes in the surrounding neighborhood.

Home is a Stabilizing Factor within Residents' Geography of Educational Opportunity

In the seventeen interviews at Overton Heights, the public housing property itself emerged as a key characterization of how residents accessed educational opportunities. Further, the findings suggest that housing was also an enabling factor influencing residents' educational journeys. For many residents – especially women and mothers who have experienced chronic homelessness and domestic abuse – housing has provided a safe and stable space to regroup, support their children and recalibrate plans for their own education. For example, Violet, an on-and-off student at ACC and mother of a three-year old described her journey to Overton saying, “I’ve struggled with homelessness...I was on the list to get a place for four years...I've continued to seek stability and stick to what's going to work for me so I can contribute to society.” Other residents described similar long, excruciating waits for housing and that their educational journeys started once they had their own home.

While waiting for housing, Monica, a single woman in her forties remembered, “I didn’t go to school...I was homeless. I ran away from home and lived on the streets for about a year.”

Emily, a single woman in her thirties, shared a similar experience noting:

I had a lot of issues with unemployment and homelessness and I was struggling like, I guess they call it chronically... it was really good news when I got the notice that I might have a stable housing, and be able to come here and like just maybe just level out and regroup.

Numerous residents noted how disruptive chronic homelessness had been for them as well as for their children. For example, Evelyn needed a space to regroup as well after her divorce when she and her three children spent several years bouncing from living with her father, her mother, her sister and eventually the homeless shelter where she and her children lived for five months. Upon arrival into public housing, Evelyn and children achieved not only a higher degree of housing stability, but also a level of domestic safety, which improved the conditions for learning for the children and adults alike.

Violet and Shirley had similar experiences in this regard. Referring to her child’s father, Violet said, “Her father is absent and he’s abusive. So that’s another barrier, by the way, that’s been holding me back [from going to school].” Shirley felt held back in a different sense as she remembered, “I was homeless and on drugs...then getting beat up by boyfriends and then falling, hitting my head.” She continues to feel the effects of her past now that she is stable and enrolled in adult education classes, “it’s really, really even harder for me,” she said. While it’s not easy, Shirley is doing it, and stable housing created the conditions for her to do so. However, beyond the walls of Overton the surrounding neighborhoods in East Austin are transforming and

residents' stories suggest that the change is altering residents' geography of educational opportunity.

Gentrification is a Disruptive Factor in Residents Geography of Educational Opportunity

Participants described that the changing landscape of East Austin and in most cases the loss of community touchpoints resulted in adjustments to their educational access and opportunities. For example, Amy mentioned a friendship she developed with a former community member that helped her support her children's education after her divorce. She remembered:

She's a little older than I am, and she has grandchildren that were going to Zavala with my kids. I remember when I was out of a vehicle and it was cold she would pick us up so we could take the kids to school together since we're close by and near the school.

It is clear that relationships such as these – between Overton residents and neighbors from the community – are likely diminishing. Monica explained what she has seen in the neighborhood of late: “something new comes in and then just, you know, taxes spike up and they can't afford it, so they have to move on.” Sally, who grew up in East Austin, has seen this process play out for years. Describing her sense of personal loss, she said:

It just feels kind of strange to me to be honest because I wasn't used to all these beautiful apartments and condos and I was used to the old little houses and tortilla factory that we use to have here...you know, they knocked down the tortilla factory to make these apartments across the street...it feels different to me, you know, like everything is gone.

Evelyn, another East Austin native, longs for the old neighborhood as well. Gesturing towards the street she remembers, “I used to hang here with friends...I never thought I'd see the day some

Anglo girl is going to be running at six in the morning for exercise.” For Evelyn, this scene was jarring due to an unfamiliar combination of race, gender and place.

For the purpose of this study, however, it’s important underscore connections a couple of the residents made to the influx of their new neighbors and access to local schools. Again, Evelyn offered an enlightening assessment of the situation:

They're here with their dogs and they're trying to close down schools. And I'm thinking, you know, you love your dogs, I understand that you love your pets, but eventually y'all are going to have children...where are your kids going to go to school?

While Evelyn wondered where gentrifying young adults might send their future children, Monica voiced the frustration she has seen amongst her neighbors in Overton and in the surrounding community:

I don't know the reasoning behind the school closures. I just know that they're closing and parents are just frustrated because they're so used to the community and maybe they sent their college kid there and now their grandkids are going there. So it's like a generation...I wouldn't have want to have to run halfway across town just to take them to school...I would want to put them in a school that I was familiar with and that more of my neighbors go to.

These stories present an important juxtaposition at the heart of residents’ geography of educational opportunity. On the one hand, public housing provides the safety and stability needed to support their educational journey. Meanwhile, neighborhood gentrification processes have introduced a break with the familiar and uncertainty about future educational options. In the next section, I trace the residents’ experiences into the act of choosing and accessing educational opportunities in a city that is changing.

Educational Opportunities are Still Hampered by the Mismatch of Foundational Supports

Despite the influx of wealth and resources into East Austin, residents' stories about accessing education for themselves or their children reveal a geography of opportunity that is still impeded by a constellation of mismatched systems and supports. Frequently, resources may be available, but they are often not a fit for the residents' needs or circumstance. In this section I discuss participants characterized how this mismatch surfaced in regard to childcare, educational guidance and accommodations, and transportation.

Lack of Affordable, Quality Childcare Limits Educational Opportunities

As participants described their experience accessing educational opportunities the lack of affordable, quality childcare emerged as an important barrier. "I had a lot of things going on in my life and then children," Amy recalled thinking back to when her children were toddlers and her marriage was falling apart. "It was just a whole slew of things. I didn't really think that I can do it." Amy's experience fits a pattern amongst a third of the participants in this study: (1) a young mother with young children breaks from a domestic relationship, (2) she and her children experience a stint of economic and housing vulnerability, (3) they secure housing at a HACA property, and (4) the young mother suspends or postpones her education to care for her children. Violet, for example, when asked if she was still pursuing her degree in a tech-related major at ACC replied, "Not anymore. I have a daughter now, and it's just me raising her too."

For several residents, their decision to pursue (or continue) their own education has been predicated on the availability of childcare. Evelyn's reenactment of her inner monologue as she grappled with the reality of becoming the legal guardian to her pre-school aged grandchild captures the complexity of the trade-offs between care for self and care for others. Remembering the early days of her new life, she said:

I prayed and prayed and prayed. I was like, okay, first get him into school...get him the clothes he needs, get him on the lease, get him in the school, get him to school, get him from school... So it's like, okay, now grandma can focus on grandma...once I get this going, we'll see if I can get some education going.

Evelyn is currently managing to attend an evening course to improve her skills with Microsoft Office applications, but has to leave her grandchild with her sick, septuagenarian father because the class does not offer childcare and the Boys and Girls Club at Overton doesn't accept children for aftercare until they are six. She is unhappy with this arrangement and noted that it is not a viable long term option and she is wrestling with what to do for the next three years.

Violet, by contrast, is navigating this issue by herself. "I do not have family support," she said...I don't have stable people." When asked about childcare options, Violet laughed out loud, "No, not in my price bracket. No." Maribel is only 16 and doesn't have children of her own, but sees this same issue amongst her friends at the neighborhood high school. "I feel like childcare should be in all schools," she said. Danielle was one of those young mothers less than five years ago. After the school transferred her into a night school program for truancy related to her pregnancy she struggled to continue her studies. Finally, her father gave her an ultimatum, "You either take care of the baby and get a job or you go to school." She opted for the former and is now expecting her second child and mulling her educational options.

In each of the scenarios above, the lack of quality, affordable childcare left single mothers with a binary choice: education or full-time parenting. In the next thread within this finding, residents' stories suggest that educational options continue to be limited once students are school-aged due to the lack of quality, consistent counseling and advisement.

Access to Quality Guidance and Advisement is Variable and Shapes School Experiences

Interviews with parents and students about choosing school options revealed a variable and picture of guidance and advisement systems. For example, Amy is currently grappling with future school options for her oldest child who she describes as “bright” and “into technology.” When asked what schools they were considering, she stated that her child “mentioned, Kealing, I’m just needing to find out what I need to do to get them in there.” Kealing is a highly-regarded magnet school that feeds into a competitive magnet high school called the Liberal Arts and Science Academy (LASA), which is regularly ranked as one of the top high schools in the United States by U.S. News and World Report. During the interview I mentioned to Amy that Kealing has an enrollment process. She was not exactly sure who she could talk to for more information. “I’ll probably talk to someone at the school,” she said.

At the high school level, Maribel’s middle school counselor recommended that she attend LASA. “I’ve always had good grades,” she said. However, as Maribel and her mother got deeper into the enrollment process she decided to attend the neighborhood high school instead – a high school that has been under sanctions and threat of closure for the majority of the No Child Left Behind era. Maribel was turned off by the competitive enrollment process and asked, “why do you need to take a test in order to go into a school?” She indicated that no one at her school had explained what the test was for.

This theme of parents having incomplete information about school options and services surfaced in several other interviews wherein parents discussed their process of securing accommodations for their children. For example, Evelyn is one year away from enrolling her grandchild into elementary school. “I think the one they were telling me that the [University of

Texas Charter], they do a lottery,” she said weighing her options. “Then they have that IDEA [charter school] where, you know, you have some of those children that have some difficulties.”

Some residents echoed this sentiment of sending or keeping their children at a particular school because they were receiving accommodations. “We’ve had him at Blanton [Elementary] because he has like speech problems,” Monica explained when asked why she sent her grandson to a school over five miles away. “The speech therapist is there, so she knows what to look for with him, you know, and that’s really why we haven’t really moved him from Blanton.” Amy’s experience with her son at the neighborhood school suggests that school-based services may also help to minimize the complexity of other factors in some parents’ lives. Amy shared that her son “does his speech therapy through the school instead of me having to get him to appointments. And that’s been a major help too, especially when my car has been out.”

Other parents and students have not experienced the same consistency and satisfaction with school-based accommodations for their children. In two cases, the school’s expectations for the pace of advancement were misaligned with the parent’s perspectives of what their child needed. Evelyn, for example, struggled to find the right combination of supports for one of her older children after multiple school transfers:

The problem was his behavior, you know, he needed a smaller class, more structure and special ed had that and that’s what he needed for his ADHD...I wasn’t going to medicate my son...we ended up transferring him to Rodriguez...We had some problems with him, but they still wanted to pass him. And when I looked at him and I looked at his grades, I was thinking, are y’all just trying to get rid of this kid?

Sally had a similar experience with her oldest child when he was attending a high performing high school in west Austin. She recalled the phone call she received one day from the principal of the school:

He called me and said, “I need to speak with you about your son. He's too old to be here.”

So I went and had a meeting with him. I said, “Okay, so you're discouraging my son from graduating?” And he goes, “Well, he's already too old.” You know, my son wanted to continue and finish school gradually. So anyways, he got out of Anderson [high school] and then he was going to a center down in Westlake. Anyways, he got his GED there...no, he dropped out in the 11th grade. I'm sorry, no he didn't graduate.

This last anecdote from Sally caps off a scan through the local K-12 public school system where quality advice, and support seem to be hit or miss. Several residents’ experiences at ACC provided a striking contrast in that they didn’t always have the answers, but had a trusting adult they could go to for information. Monica, for example, is in the process of researching school options and said, “I don't even know how to enroll. I have no idea of anything about ACC.” When asked how she would go about finding information she turned without hesitation to one of my community advisors and said, “I'm gonna get with Paul to help me direct me there.” Violet, also has a reliable source for information and has routinely utilized ACC’s Student Accessibility Services (SAS) during her on-and-off tenure at ACC. “I worked with them,” she said. “They're very supportive at the school. They've got professionals in there.” Monica’s relationship with Paul and Violet’s relationship with SAS highlights how trusted educational supports and learning accommodations positively impact one’s willingness to take the necessary steps to access education. However, accessing education is neither simple nor strait forward. In the next section I discuss a variety of ways in which publicly run transportation systems are foundational to

residents' mobility and limit their ability to access educational options and the whole of the geography of opportunity.

Public Transportation Mismatched with Geography of Educational Opportunity

Participants described their experiences using public transportation systems (including public school busing systems) to access educational opportunities and a number of critical themes emerged. First, many residents are dependent on public transit, but the schedules, locations and modes are mismatched with their needs. Secondly, some residents are worried for their personal safety while riding public transit or waiting at stops. And lastly, school bussing systems are mismatched with schedules and schools across geographic distances. In this section, I unpack each of these themes in relation to how participants characterized their impact on educational opportunity.

Public transit schedules, locations and modes are mismatched with resident needs.

In Austin, the city's public transit system consists of busses and a single-line, 26-mile rail system that runs from downtown to Leander, a suburb northwest of the city. A few of the residents such as Barbara, were unequivocal about the role public transit plays in their lives. "I ride public transit," she said. "That's the way I get around."

Not all residents were as glowing about their experiences on public transit. "The transportation on the ground, is bullshit, this is not enough," Julio contended sighting superior transit infrastructures in Europe. "They have to do something more, because the city is growing so fast. It's a necessity," he said. While city busses can get you to most corners of the city it seems that "getting there" is rarely simple or timely. Emily captured the spirit of what numerous residents experience when she observed that, "if you have a bus ride that's more than one bus, it can take so, so long." She described the steps involved in what seemed like a fairly strait forward

journey to north central Austin. “If you're going to do that from [Overton],” she said, “you have to go downtown, and you have to catch the 17 and go downtown and sit right there. Then you would either wait for the number 10 to come...and then you have to leave an hour or so early so it's just a mess.”

For two residents in their early 20s, there were times that the time commitment required for multiple transfers presented a barrier to accessing their education. Ruben is 19 years-old and mentioned that he has recently had some issues with his attendance at ACC. When asked why, he explains that he owns an old vehicle that he says is often broken down. Inconsistent access to his car means that Ruben frequently has to string together rides between his brother and city busses.

For Danielle, the demands of navigating the bus system ultimately contributed to her decision to drop out of school shortly after having had her first child. “I would have to be on the bus back and forth with a big stroller and a car seat,” she explained. “It was real hard. I had just had a c-section done too, so it was even harder. Having to take two buses just to get home was too much.” Danielle’s experience illustrates that the challenges associated with accessing childcare are not merely economic in nature, but rather also entangled with obstacles to efficiently navigating public transportation.

Additional obstacles that emerged for residents was the location and sequence of bus stops. Several participants referenced the city’s recent decision to reduce the number of bus stops so that they could increase the frequency of pick-ups. The implication for Overton residents has been that there is no longer a stop immediately next to the property.

Barbara attended a session with Capital Metro staff just prior to the location and frequency changes. She recalled, “they say to make this, so people, they could cut the time down to like every 15 minutes get you where you going quicker and faster.” She went on, “So they said

that way you can commute faster, but then you making us walk farther and you taken away a lot of the bus stops...It's so far in between to get to the other bus stop.”

According to a few of the respondents, the impact of additional distance between bus stops is especially pronounced for residents with children or compromised physical health, which each have implications for educational access. Monica described the scene for some of her neighbors who is a parent and now has to orchestrate a complicated process where they, “carry the little baskets...or carry a backpack to walk three or four blocks. And if you have three or four kids behind you, come on!”

Evelyn is now one of those residents since she has taken custody of her grandchild and noted, “I mean, I know he's not that far, but you know like people that have aches and pains like I do with my neuropathy, like arthritis. I have to walk way over there slowly but surely, stop for a minute, then keep on walking, then stop for a minute...” Again, the convergence of multiple issues is further complicated by systems that are designed out of sync with residents’ lives. In the previous section the residents’ stories suggested that educational opportunities are limited by variable advisement and in this section there are clear indicators that public busses now further constrain residents’ options. As Monica succinctly put it, “you know, I don't think Capital Metro really thought it out, especially around housing, where it was utilized the most.”

The issue with the bus schedule is technical and could be reengineered for the better rather simply. However, a few of the female residents shared that there are deeper issues surrounding public transit that are adaptive and connected to the broader transformations in East Austin.

Public Transit Culture is Increasingly Perceived as Unsafe by Some Residents. In addition to the time and effort required to maneuver across town via multiple transfers, a number

of residents indicated that the process also generates safety concerns. “I get on the bus and I’m completely worn out,” Emily explained. Frequently, she said, “somebody else on the bus wants to give you a hard time or joke with you in a rough manner or whatever. If you as a single woman don't handle that just right, it can quickly turn to whatever kind of harassment.”

Harassment, it seems, now occurs more frequently while waiting for the bus for several Overton residents. “To me it's been about that gotten worse the last seven years,” Sally said pointing down the street towards a number of newly erected homeless encampments. “They took over the bus stop,” she continued, “it had a seat and a roof, and they would sleep there. So, if we want to take the bus, you'd have to move several feet down away from them.” Several of the female residents mentioned that because of the environment around stops and on bussed that they no longer ride the busses alone. For Selena, the implication is that she cannot ride the bus alone to access other schools or programs. Luz, her mother just shook her head and said, “no, no, no. She’s my princess!” For Selena then, her geography of educational opportunity is entirely dependent on the public school busing system. I describe hers and other residents’ experiences with that system in the next section.

School Bus Routes are Mismatched to School Programs and Schedules

Students in Austin who are zoned to attend low-performing schools (according to Texas’ state accountability rankings), which are densely concentrated on the Eastside are able to transfer to higher performing schools, which are typically in west Austin. Of the two high school students who participated in this study, Maribel opted to stay at her neighborhood school and Selena chose to attend an academy at a large west Austin high school. Each, however, stated that they are dependent on AISD bussing in order to get to school.

“My mom works, and my dad can't really drive cause he can't see that well,” Maribel explained. “So it would be kind of like a problem...if I didn't have transportation I wouldn't go to school at all.” Maribel’s comment suggests that there is also little room for error when it comes to regular school attendance. Her high school experience also illustrates that for those Overton youth who are dependent on school bussing, the choice of where to attend is limited.

For example, Selena originally wanted to attend an International Baccalaureate (IB) program at a west Austin high school. “I wanted to take German class,” she recalled, “but the problem was that transportation probably, they're like, they won't give me transportation for my school over there, but there was like a 50% chance they would cancel my bus.” She then explained how she ended up choosing the school she is currently attending, “Austin High School was the only place giving me transportation for free.”

Hearing Selena’s story I was transported back to DuBois Terraces: “What you should really be asking is where we *want* to go, but can’t.” And what are the implications? In Selena’s case, she not able to attend an IB program and instead is in the Academy for Science and Innovation (ASI) at Austin High where she is earning college credit and working towards a nursing license. There is no way to know what the long term economic implications are for having been steered in one direction and not the other. All we can say for certain is that it was not her first choice, nor was it a choice at all.

What Selena did choose was the medical track within ASI. The ASI nursing classes are located at another training campus further to the west. Selena’s mother, Luz, mentioned that they are encountering some issues with the program. “She and her friend are in the program,” she said, “but they are having a hard time getting there. I'm not sure where it located, but the issue is with the bus getting back and forth on the bus.” She continued:

The nursing classes conflict with her school schedule. She can't attend her classes at Austin High because she has to leave classes early in the middle of the day and try to get back before the end of the day.

This story exposes a logistical design and planning challenge that is important to highlight here. Austin High has implemented a school model with multiple smaller academies on a shared campus. The academies share a physical plant, cafeteria, and electives like sports and music, so the master schedule is highly constrained. In addition to campus-based academy classes, ASI has college-bearing courses at another location. The schedules at the other campus are coordinated with the academy classes, but do not accurately account for the variability of bussing that is coordinated with other bussing routes serving hundreds of schools across the district. This dynamic isn't isolated to ASI. Recall that Maribel opted to attend her local Eastside high school. She wanted to play basketball, but can't – "there's no bus at night", she explained.

Thus, as Maribel and Selena transition into their last years of high school their decisions about what classes to explore and what extracurriculars to participate in will be determined by their ability to access an AISD school bus, not what they *want* to do. In the context of Eastside gentrification, bus access for Overton youth may become even more complicated. As Emily observed:

I mean now that they're going to start closing schools, there's going to have to be some other kind of transportation for these students or parents to have to get them, you know, cause supposedly six closed schools are going to close by next year.

The residents' experiences paint a picture a geography of educational opportunity that is entangled and evolving. Within these entanglements a clear theme thus far has been narrow margins for error. For students who are entirely dependent on school busses the margin for error

between attendance and non- attendance is slim. This is a challenge in and of itself, but even more so when combined with schedule constraints across multiple schools and programs.

Set against the backdrop of the other findings in this section, the residents' experiences accessing educational opportunities seem all the more complex. Public housing provides a stable platform for mobilizing one's educational journey, but the gentrification processes generate uncertainty in the educational landscape through school closings and loss community connections diminish potential sources of support. The key, public systems that are intended to support educational decisions are highly variable and so the whole landscape of choices are not clear while public transit systems further constrain the possible landscape. These findings lay the groundwork for the next major section in this chapter that unpacks the major findings from residents' engagement with key smart city assets.

Key Findings from Research Question Two: Residents' Experiences Accessing ICT-Based Technologies and Smart Mobility Options

In this section, I discuss the findings to my second research question about how public housing residents characterized their experience with ICT-based technologies and smart mobility resources. Overall, my findings suggest (a) residents' use of ICT-based technologies is limited by outdated hardware; (b) residents experience highly variable access to wifi and data plans; (c) residents have mixed impressions and experiences of whom smart mobility options are meant to serve; (d) residents experience digital, economic and physical barriers to accessing smart mobility options; (e) residents are deterred by the social dimensions of rideshares; and (f) residents access to ICT-based technologies and smart mobility is mediated by deals in the private sector. To begin, I discuss residents' experiences with ICT-based hardware.

Residents' Use of ICT-Based Technologies is Limited by Outdated Hardware

For the purpose of this study, I focus on the baseline ICT-based technologies residents referenced during their interviews including smart phones, tablets, personal computers, wifi and cellular data. I focus on these technologies because they represent the baseline interface for most smart systems (e.g. rideshares, telehealth, virtual schooling). For many residents, accessing ICT-based resources has been life changing and has impacted how they are thinking about the next chapters of their lives.

Amy, for example, recounted a recent conversation with a close friend where she was struck by how different her childhood had been having not grown up with technology. “I’ve always been very closed off to the world. As a child I did not have a computer at home and that was not that long ago,” she reflected. As she and her children transitioned out of her marriage and into public housing she secured access to computers and internet for the first time. “Just having access has been a journey for me,” she said:

Like Amy, stable housing created the conditions for Monica to develop her digital literacy. After years of chronic homelessness, Monica said:

I was worried about being naive about technology, because I didn't have a computer. I didn't have access to a computer, you know...HACA introduced me to the computer lab apprentice program and when I started doing that it did like open my eyes to see that I had more opportunities.

For Amy and Monica, regular computer access and training helped them quickly transition to using digital technology as a tool for thinking about and planning for their future. Regardless of their individual proficiencies, residents’ ability to use technology to advance their educational

and life goals dependent upon having technology embedded support and relevant hardware – hardware with operating systems that can interface with other current-generation technologies.

I did not find any examples through the course of this study of residents who were currently unable to access a cellular phone or computer. Many of the residents obtained their technology at no cost through an assortment of public entities. For example, all three of the high school students in the study received their laptops from the school district. “AISD gave everyone Chromebooks, so that's really awesome,” reported Alexandria who attends the Liberal Arts and Sciences Academy. “So, it’s not really a big deal getting work done at home,” she said. Three of the other young adult participants in the study described similar experiences while they were in high school, but mentioned that they each had gaps in access once they had to return their devices back to the school.

Violet was one of those students who no longer had access to her own computer after she left high school and entered and entered a period of chronic homelessness. She then experienced another gap in access after leaving an abusive relationship, which eventually lead her to Overton. Violet smiled broadly when describing her home computer, saying “I had won one of the raffles that they do for a desktop. It changed our world.” For Violet, having a computer in a safe home has meant that she has been able to access educational resources for her child and build a network of support through social media, which she reports is helping her to nurture her own mental health. Additionally, while she is not currently in school due to a lack of affordable, quality childcare, she indicated that she uses her computer to research educational options for herself and to explore future career paths.

Emily already has a college degree and is clear that she wants to pursue a career providing English language tutoring. Like Violet, she experienced periods of chronic

homelessness with no access, but after arriving at Overton received both her laptop and cell phone by completing one of HACA's digital literacy classes. As she has pursued her career, however, she has encountered technical barriers that have mitigated her ability to translate technology access into opportunity. Describing her current situation, she said, "The laptop and phone that I have, I got both of them as incentives from the digital literacy classes. They were pretty useful, and functional at the time I got them, but then quickly they got outdated." She continued:

just the other day I was struggling with the phone company....I have a government subsidized phone plan and then the phone I got is from the class. So the phone that I got doesn't have this piece of technology that most phones have and my phone company told me that I may not get reliable data connection because of my phone not being technologically, developed.

The mismatch between her hardware and data connections extends to her laptop as well. She reflected:

I'm thinking, okay, what resources would maybe get me unstuck, and get me some forward momentum? I mean, far as I can tell it's the laptop equipment. I found some programs where you have really affordable wifi or internet service, but [I need] a laptop that has enough processing power to keep up with things and things like editing lesson plans, and doing video chat for online conversational tutoring, and other instruction.

Emily's experience highlights that technical proficiency and access to hardware alone are insufficient to generate opportunities in the context of a broader technological ecosystem that is constantly refreshing and advancing. The following section further complicates this scenario as residents discuss their varied experiences trying to access wifi and data plans.

Residents Experience Highly Variable Access to Wifi and Data Plans

A clear theme that emerged throughout this discussion on technological literacy and access has been the importance of HACA's role in providing baseline training and tools. This pattern extends into the realm of ICT infrastructure as well as the housing authority has entered into an innovative partnership with Google Fiber that will provide free high-speed wifi to all Overton residents. This partnership is one component of the broader revitalization effort at Overton and Amy feels like it is a foundational support. "I don't know," she said, "it just feels like another, it's a necessity in the sense, you know, to be able to have online access." Emily echoed these sentiments and stressed how important access is to her in the context of the current workforce and modern life:

A lot of things are dependent on your, I guess online footprint. That's how you're interacting in a lot of ways, whether it's *LinkedIn* or looking for jobs or staying connected socially or, gosh, just, I'm going to say most of is kind of just either functional or social stuff like paying bills or looking for information, doing research. So a lot that's riding on an internet connection and not everybody can afford, unlimited data and phone plans.

A number of residents' experiences affirmed the importance of being able to regularly access the internet as they went to great lengths to find free wifi access. Like most of the residents we interviewed, Destiny has had on-and-off access to wifi due to affordability. When she was just out of high school she lived with her grandmother in another housing project several blocks to the east of Overton. Her grandmother didn't have wifi access, but the property management office did, so Destiny would lean out of her bedroom window to access their wifi on her tablet. Today, Selena, who does not have access to home wifi, has tried to use the same

strategy to complete her homework by sitting in the office at Overton, but frequently cannot, because the bus home from her school in west Austin drops her off after the office is closed.

When home or property-based wifi is not an option, some residents turn to either local businesses for access or do their internet-based work by access wifi through a cellular hot spot. Destiny, for example, reported that she would walk down the street to Juan In A Million – a legendary Mexican food restaurant in East Austin – to access their wifi. Gloria’s children preferred to sit in McDonalds or Wendy’s. Ruben simply arrives early to his job at a nearby convenience store to get his schoolwork done.

In each case, these young adults and their parents articulated that they choose to access wifi in public spaces, because the alternative is to access the web through a hot spot on their cellular plan setting off a financial domino effect. We will see in the findings related to research question three that these wifi and data plan tradeoffs have specific implications for accessing educational opportunities. First, however, I turn to discuss what residents have experienced using their ICT-based technologies to access smart mobility options.

Residents Harbor Mixed Impressions of Who Smart Mobility Options are Meant to Serve

I next examine how participants describe their experiences with Austin’s growing shared-use ecosystem beginning with residents’ perceptions of shared mobility options. Participants perceptions of smart mobility assets included: enthusiasm for how smart mobility contributes to their lives, mixed perceptions of microtransit safety, and the view that they are meant to serve a particular demographic. I begin with Destiny, who’s experiences with shared mobility have changed her impression of herself and what’s possible. “I feel more independent,” she said, “like there should never be anything to stop me from doing anything that I want to do or going anywhere.” A self-described “gypsy,” Destiny is young, technologically savvy and uses Uber or

Lyft rideshare service regularly to get to school and work when she encounters an issue with her own vehicle and previously used the bike-share services to get to the library for computer and internet access.

Other residents were more measured in their enthusiasm and perception of how shared mobility options might be integrated into their lives. Monica, for example, was once extremely reticent to try one of the fleet of scooters that are available on most street corners surrounding the Overton property. “I’d heard so many stories about the scooters that the scooters are dangerous,” she remembered. She decided that she could not have an opinion about the scooters until she tried them, and so, attended a HACA-sponsored event at the Lyft headquarters, one of the largest scooter vendors in the Austin area. Monica reported that she liked them, “they were fun” and “they were safe”, but still did not see them as a viable daily transportation option.

Several other residents shared similar sentiments about the scooters – that they seemed entertaining, but they “aren’t for me.” During his interview, Julio gestured towards the window of Daniel’s office at Overton towards a street corner where scooters are often available. “You are talking about things for young people,” he said. “Is this what I have to use to go from here to where I work in south Austin? By this? No.” Barbara echoed Julio’s sentiment that the scooters are reserved for the young. Imagining the possibilities, she thought, “it would be something fun to do when I give a picnic, then we could hand one to the kids, you know, and they could ride around the park and stuff like that.” Even Destiny who is young and more bullish on shared options was cool on the idea of the scooters. She confided:

I’m not getting on the scooters. I feel like I’m a bit too wide and I don’t want to get on the scooter. I just don’t want to break any bones... There’s no safety, you know, at least a bike, it’s got breaks.

Bicycles were generally well-regarded when referenced during the course of this study, however, residents' tones were often nostalgic, and the few examples mentioned were in the past tense. Emily, for example, was the most enthusiastic about Austin's fleet of bike-shares and remembered her earliest days in Overton after having finally settled in Austin. She said:

I was really excited when I figured out how the bikes worked and I pretty much told everyone who would listen, cause I wanted more bikes. I wanted people to be into it and make use of it and you know, be able to run to the store. I just thought it would be really great for traffic and pollution.

In Emily's remembrance of her early days riding bike-shares in Austin we see reflections of idealized smart city synergies between ridership and environmental. Destiny's perception furthers this ideal and frames ride shares as not only viable, but personally empowering. For others, however, smart mobility options are mismatched to their individual circumstances. The new modes of transit do not fit their body or their life. In the next section we see that smart mobility adoption is further mitigated by other key barriers to access.

Residents Encounter Technological, Economic and Physical Barriers to Accessing Smart Mobility Options

Participants described both technological and financial barriers to accessing smart mobility options. For some residents ridesharing is a desirable option because it is more affordable than taxis, but accessing the ICT-based applications presents a barrier. Sally, for example, regularly visits family members who live approximately five miles to the south of Overton. She knows that taking a rideshare will cost her approximately \$7 versus the \$14 she typically spends on a cab every week. In the context of her tight economic margins, these savings are welcome. Despite the clear financial advantages to making a change, Sally explains why she has yet to adopt rideshares into her weekly regimen:

I don't know how to order those or whatever. My niece ordered it for me from Riverside to my house on her phone and that, no, I don't know how to do all that... I wouldn't know how to use it cause I only have this flip phone.

Monica spoke at length about this issue and indicated that many of her neighbors at Overton aren't able to engage in shared mobility, because they have government subsidized flip phones, or, "Obama phones." She asked:

Well, what if a person doesn't have a phone? How are they gonna use it? Because you have to have an app. I don't believe everybody around, you know, low income people, have phones or if they do, they have a flip phone and they can't download the app.

Barriers to accessing shared mobility applications extend beyond the functionality of hardware. For example, when asked about her experience catching an Uber or Lyft, Selena noted that the issues are straightforward, especially for young adults. She explained, "for teenagers my age, like to get an Uber, you obviously have to pay for it and you obviously have to get a card for it. And we can't work right now." Monica reiterated that this issue impacts low income adults generally and especially if they are unbanked and solely use cash and money orders for their transactions.

Even when residents have banking accounts, the appropriate vintage of cell phone and the desire to move about the city more efficiently, narrow financial margins discourage adoption. For Julio, the potential benefit of shared-mobility options doesn't outweigh his other financial priorities. "I have to save money because tomorrow is here," he said, "tomorrow you need money for this school or then you have money for when you retired or something like that. So you have to save money. So I don't want to spend my money, my salary on Uber."

Thus, we see that rideshare application access is complicated by entangled relationships between technological hardware, technical proficiency, hardware, banking and affordability which all have to be aligned before one can secure a ride share, scooter or e-bike. However, access is further complicated if one is not able to physically access the resources.

The majority of participants in this study are currently dealing with physical ailments, raising young children with little support, or both. In conversations about microtransit options it became clear that “the young” are also able-bodied and childless. Losing access to the pedal assisted bikes was a big blow for Emily. She can only walk short distances at a time due to a variety of mobility impairments and has struggled with a combination of other conditions that leave her feeling ill and depleted after only short stints of movement. Pedal assisted bikes were a revelation. “I would say it's about half the effort of a regular bike and you can make the same distance... they're so amazing for a city like Austin and for someone like me,” she said.

Other residents struggled to see the utility of either bikeshares or scooters. “They seem to forgotten the elderly,” Sally observed, “you can't bring groceries on a bike or scooter.” When I asked if either the bikes or scooters might be relevant options when she didn't have to carry groceries or other items, she said:

Well, I haven't rented a bike in so many years. I just feel I'm going to tumble over and just fall right in my face and you know, then I'll end up in the hospital. All broken up is bad enough and then to break my leg or something. Oh no, I can't afford that. Sorry.

That's just me.

Other residents are currently able-bodied, but always have precious cargo in tow – their young children. Violet, for example, had fond memories of cycling in her childhood. When I asked if she would consider using the bikeshares now she gave me a look as if I was a bit dim,

“they don’t have child attachments,” she said. Monica politely mirrored Violet’s this-is-a-no-brainer tone when I asked her a similar question about parents with young children. She explained:

I mean the only one that I would see that would benefit a family of two would be Uber or Lyft. Cause you can't put a kid on a scooter... only to one person can be on a scooter by law, uh, a bicycle. How are you going to transport a kid on a bicycle if it's only one seat?

We see in these examples that there are specific design features that can render smart mobility options either “game-changing” or null and void if you are not a member of “the young” demographic. For Emily, pedal assisted bikes quite literally altered her view of what she could accomplish personally as well as her view of and access to the city. By contrast, not one option in the current microtransit fleet is designed for parents with young children, and so, the potential benefit remains inert for a significant demographic at Overton. These design challenges are solvable in a controlled environment where the only variables under consideration are the users and the technology. However, this study has shown how no variables exist in a vacuum and that solving a problem in one space (e.g. pedal assisted bikes) doesn’t address related challenges in another space (e.g. variable access to smart phones or street safety). In the next section, I highlight how, even when these foundational elements of hardware, banking, affordability and physical accessibility are in place, the sharing experience has complicated social dimensions that can be either a benefit or deterrent for some residents.

Residents are Deterred by the Social Dimension of Rideshares

In continuing to address the smart mobility-specific dimensions of research question number two, I found that ridesharing appears to have social dimensions that are distinct from public transit or taxi services. As with most of the other themes in this study, residents had a

range of experiences. Destiny, the “gypsy”, was again the outlier in this space as she is actually drawn to rideshares in part because they offer diverse social experiences. She explained:

I like Lyft. The people are usually always friendly. If they're foreign they probably won't speak, like they won't talk a lot, you know they'll say hello. But usually I meet pretty cool people from all over the place.

It was clear from the look in Destiny’s eyes and her body language in the interview that using diverse modes of transit and engaging with strangers was energizing for her as she transitions into her career and adulthood. However, for several of the other residents the experience was off-putting.

For two of the younger residents, the experience with a stranger was too intimate. Maribel, for example, when asked why she didn’t like her one experience in an Uber said, “It's not that I'm scared of shit it's just weird.” Ruben was equally uncomfortable after his one experience trying to take a Lyft home from a medical appointment across town. He recalled, “I was like, I don't really like it. Yeah, it was just quiet, or it was, I don't know, just weird. I don't really like talking.”

It may be the case that Maribel and Ruben’s experiences could be attributed to being teenagers in equal measure to being in new or uncomfortable social situations. However, two of the older residents’ experiences suggest that there are deeper issues of social trust that go beyond mere interpersonal interactions. Remember from a previous section that Sally only has a flip phone, and so, has very specific technical barriers to accessing a rideshare. During her interview she asked, “can we just call the company directly? I don't know if it's a company or a person.” Her uncertainty suggested an additional factor coloring hers and others’ experiences with rideshares – trust in the person and trust in the company.

Shirley's experience with rideshares puts a finer point on this issue. She takes Ubers on a regular basis, because she frequently joins her best friend (also an Overton resident) to earn extra money cleaning offices on the night shift. Her friend always calls the Uber, "because it's on her card." Shirley reports that she doesn't trust Uber with her money, because "they give her problems every time a foreigner come." Shirley's story illustrates that ridesharing introduces trust dynamics that are novel and problematic for some residents – dynamics involving trust in institutional transactions between banks and unseen companies. I conclude the findings from research question two by examining residents experiences navigating the private sector entities who sell access to ICT-based technologies and smart mobility options.

Residents' Variable Access to ICT-Based Technologies and Smart Mobility Options is Mediated by Deals in the Private Sector

The findings indicate that residents' variable access to ICT-based technologies and smart mobility options is due in part to pricing fluctuations in the private sector. Private sector companies surfaced in numerous interviews wherein residents described their experiences juggling private sector deals. This juggling process is intertwined with a central theme throughout the findings thus far– the domino effect of narrow financial margins.

In general, residents reported that they have more recently had success navigating vendors to find affordable internet access. For residents who have recently received free access to Google Fiber, early results are positive as residents like Amy are already voicing their gratitude. "It just feels like another, it's a necessity," she said, "you know, to be able to have regular online access, internet access." For Amy, not having to manage varying pricing with a vendor has been a relief. She reflected, "sometimes it could be burden, you know, having to keep up with how much internet costs, especially after your promotion trial period. Then the price goes up."

Violet's journey to secure affordable internet spanned several years and involved jumping across numerous companies before landing on an option that is stable within the constraints of her budget. She explained:

I had to make a call to the different companies. Spectrum and AT&T were the only ones who serve our property. I went with AT&T. They came and installed that thingy, and I was able to afford it. I was paying \$50... I was paying \$50 for so long, and then just by word of mouth, I heard that they had a \$10 program for low income like me. I was able to make that switch, and now that I'm in school. It's pretty stable again.

Finding stable, reliable and affordable internet is a new development for Sally and her children as well. By chance, she shared that, "I saw a commercial on TV about it that if you're low income you'd get it for \$10. So, I did call, and they came out and...it was neat that she was able to do her homework."

Opportunities for residents to secure free or inexpensive internet have been counterbalanced by highly variable efforts to access functional cell phones and affordable data plans and smart mobility rides. In a number of cases, these efforts were defined by a persistent hunt for promotions. Shirley, for example, had faithfully gone to Cricket because they regularly have entry-level deals. However, "the phone blew up," she reported. "So I immediately went back to Cricket," she said, "and I told them, 'I'm not dealing with you all no more. You all shit blows up.'"

She has yet to replace it, because the financial margins in her current budget are too tight. During her interview she described what her hypothetical next steps would be if she were to have enough money to buy a new phone. She said:

If I had, whatever funds, I could go and buy a new phone, go to MetroPCS, and buy a new phone with a new plan. And it would be really cheap because they're doing a promotion, right? And then, I would try to maintain that plan as long as I could, and then when I couldn't, I would have to change that over to a government subsidized plan. You know, I would have to find an alternative way to get a phone that was more current than my phone now.

This scenario jives with Ruben's experience as he has bounced around to various cellular plans over the course of the last couple of years in order to find one that is sustainable for his budget. Describing his process, he said, "first it was Sprint, but I kind of spent too much money on that. So that's why I left that. And then I went with my mom and she had Boost...and then now I'm on my own at Metro."

Ruben's data plan will arise again momentarily as it has been regularly implicated in his efforts to complete assignments for his coursework at ACC. For now, however it is important to emphasize the erratic access and variability that some residents are experiencing maintaining regular access to ICT-based technologies and that – with the exception of the new arrangement with Google Fiber – their access is entirely mediated by the private sector. Importantly, for the purpose of this study, residents' access to smart mobility is subject to the same financial peaks and valleys.

Emily was especially tuned-in to these dynamics during the course of her interview and, as one of the few rideshare and e-bike enthusiasts I encountered in this study, described her process for promotion-hunting in the smart mobility space. For her rideshares she said, "Uber and Lyft have their competitions and there's lots of promos. So, I try to take advantage of Uber and Lyft whenever there was a promo code where I could afford it, because Car2Go is pretty

pricey.” For shorter trips around the neighborhood, she indicated that in the early days off the pedal assisted e-bike deployment, the original company that owned the fleet of bikes offered a very cheap “boost plan” that she could fit into her budget. During the last year, it is her understanding that the company was acquired by Uber. “It seems like Uber took that plan away,” she said:

I feel like they got all the little subsidy bonuses from having this electrical off-the-grid bike program, instead of having gasoline cars on the road. That's what the whole point of the boost plan was. You were getting subsidies for these other people that were connected with their electric bills and all that. I was like, why is that going away? Why is that being taken away from the people who really need it the most?

At the time of our interview with Emily she reported that she rarely, if ever, accesses the city's bikeshare fleet any longer. Seen in a vacuum, one might assert that these are just issues all consumers face and that a person will pay the price if it's a priority. Yet, seen against the backdrop of the factors influencing residents' geography of educational opportunity in research question one, we know that there is little room for variance with money, distance or time. Residents place a premium on stability. For some, it is a precondition for personal growth. Thus, partnerships such as HACA's with Google Fiber are more meaningful than they might be for the general public.

The findings from research question two, illustrated that residents' experiences with and access to ICT-based technologies and shared-mobility options are rife with complex interrelationships. While most residents have access to ICT-based technologies, their ability to translate technological access into opportunity is complicated by technology vintage and variable access to wifi and data plans. These technical issues limit smart mobility adoption, especially in

combination with tight financial constraints and discomfort with social situations. Many of these factors surface during the process of juggling private sector vendors, whose wares and prices determine the extent and efficacy of residents' access.

While complicated, we also see that residents draw on clear resources as they find their own path to improved technological connections and mobility. Again, stable housing and HACA-lead trainings and services surfaced as valued foundational supports. We saw regular examples of friends and family supporting residents' access to technological resources. In one instance, we saw Destiny, a third generation housing resident, fluidly integrating technology and shared-mobility into her repertoire as she proceeds towards graduation from ACC and, hopefully, the self-sufficient life aspires toward. In the next section, I discuss the findings related to research question three, which examines the relationship between residents' geography of educational opportunity, ICT-based technology and smart mobility options.

**Key Findings from Research Question Three:
Relationships Between Residents' Access to Educational Opportunities and Their
Utilization or Avoidance of ICT-Base Technologies and Smart Mobility Options**

In the remainder of this chapter I discuss findings related to my third and final research question, which is what relationships can be drawn between the factors influencing public housing resident's access to educational opportunities and their utilization or avoidance of ICT-based technologies and smart mobility resources? The findings suggest that (a) the saturation of smart mobility options in East Austin is negatively impacting community safety and cohesion in residents local geography of educational opportunity, (b) smart mobility assets are not viable options for most residents to access educational opportunities, and (c) variable access to ICT-based technologies impacts access and achievement in contemporary educational settings. I begin by discussing the relationship between smart mobility and community cohesion and safety.

Smart Mobility Saturation is Negatively Impacting Community Safety and Cohesion in Residents' Geography of Educational Opportunity

One of the ways that smart city assets and the geography of educational opportunity relates is through the negative impact of smart city assets on community cohesion and safety. In this section I focus on residents' experiences in the streets around their homes. "We're getting really closed-in," Violet observed. "There's so many people. So many cars on the road." Ideally, Violet would like for her child to attend a school in the neighborhood so that they can walk together. In addition to not being sure that the neighborhood elementary school will be open by the time her child is school-aged, she is concerned about the act of getting to school and crossing streets.

Recall from the first research question in this chapter the premium that many residents placed on having safe and stable housing as a precondition for pursuing educational opportunity. Throughout numerous interviews residents described their interactions with smart mobility options and felt that they are contributing to a culture in the streets that is increasingly unsafe – especially for women.

Sally sees a distinct difference in rideshare standards versus traditional taxi drivers. "They had laws for taxis...they had rules to abide by. These Lyft drivers and Uber drivers. They just parked, pulled over wherever. Half the time they don't put on their signals, they don't put on their hazards," she said. For Evelyn, this sense of lawlessness is coupled with the feeling that rideshare drivers don't care about the people moving around them. Remember that Evelyn lost her youngest child in a pedestrian-traffic fatality, so she is especially in tune with human beings' movement in relation to cars. She watches rideshare drivers in their cars and noted:

You're busy looking at your phone because you're trying to figure out where your location is to pick up these people. So, okay, we're not supposed to text and drive, but

we're sitting on the phone, trying to find that address. So that's what's it's like, come on now, you know, you're not thinking about these people.

She continued:

I mean the other day, it was yesterday, matter of fact, I was coming off of... Chicon and it was three little girls crossing the street. And I'm thinking, God, do people stop and let these kids cross the street? Do you not have children? Do you not have grandchildren?... it's like you're not thinking about your safety and these other people's safety.

Both Sally and Evelyn suggest that apparent disregard for custom or law and unsafe practices are symptoms of the larger issue that drivers don't care about the people around them like they once did before. This suggests that the lost community connections that some residents have experienced as local businesses like the tortilla factory have shuttered, may also extend to mobility options as Eastside cab details have been replaced with rideshares who are, perhaps less known, trusted and invested in the local community. Importantly, this perceived disregard for safety and community surfaced in discussions about microtransit options as well.

Residents generally voiced distain for electric scooters and, as I mentioned when discussing the second research question in this study, were more positive about the potential of bikeshares. What became clear through residents' stories is that their perceptions of each option were informed by the unsafe user behaviors around them and a general sense of lawlessness or lack of shared norms.

Amy, for example, actually served a stint as a charger for one of the scooter companies, which required her to drive around the neighborhood making sure scooters were arranged neatly on the street and fully-powered. She observed, "they're supposed to follow the guidelines...[but] people aren't following those." Emily echoed this sentiment when discussing her desire for more

pedal-assisted e-bikes with baskets, but noted the city needs to, “figure out a way to get cars and bikes to agree to some code on how to share the road.” For Evelyn, responsibility falls with the city as well as the current microtransit riders. “The people on bikes are either they're not educating themselves or they just don't care and they're just crossing in front of you,” she said, “you know, they're not stopping at stop signs. They're not walking their bikes across like they used to. Back in the day we had to walk or bike across the crossing, you know?” Again, there is a nostalgia for the norms that once governed the neighborhood.

In the absence of shared community understandings around behaviors and safety precautions, numerous residents are simply avoiding microtransit. Maribel stated it plainly, “I'm not stupid enough to be going in the street getting ran over.” Indeed, two residents' experiences reinforce Maribel's concern. As I've mentioned, Destiny and Emily were each early adopters of smart mobility options. In the past, Destiny use to use bikeshares frequently to go to the library and run errands around the neighborhood. One day, a few blocks away from Overton she pulled up to a four-way intersection and prepared to cross. “I made sure I made eye contact [with the car to my left]”, she said:

So like if I see you, you see me, that means you have to stop. And he didn't. I braked a little bit to make sure that we seen each other and then I let go, because I thought he was going to stop and he didn't, he just hit me.

Destiny laughed about the experience during the interview and told us about what she described as a hilarious phone call with her sister who could not believe Destiny had been hit by a car.

While she wasn't injured in the incident, she has never ridden a bikeshare again.

Emily continues to hold out hope for bikeshares despite the fact that she had a similar situation that could have understandably deterred her for good. Describing the scene, she said:

I was on an Uber jump bike one time and some lady was so mad about something, and she decided that it was me on the bike that was the problem and she tried to run me over twice within three blocks, right up here off by the side of the property.

These scenes in and of themselves are troubling and one might argue that they are just natural growing pains that cities should expect as new modes of transit are being introduced into existing systems. However, in the context of Overton we spoke to resident after resident who found relief in housing because it is safe and stable and that was the point of departure for educational opportunity. Now, they are experiencing unsafe and erratic behaviors outside of their front doors.

The impact of unsafe and under-normed behaviors on smart mobility adoption is clear, but for the purpose of this study I center the implications for educational access. Amy, for example is theoretically open to the idea of her oldest child riding a bikeshare to school. However, she notes, “there's always that concern of safety getting to school. I mean the area we are in, we're familiar with this area.” Pointing to the streets outside of Paul’s office, Luz had a similar orientation, but for reasons beyond street safety. “My son use to use the bikes to get the school for a while,” she said, “but with my daughter I am more concerned about the bikes, because she's a girl. It's more dangerous.”

Luz’s perspective on bikeshares highlights that safety concerns extended beyond street culture and into other domains that I highlighted in the first major section of this chapter. For example, Maribel and Alexandria – both high-school aged young women – are forbidden from taking rideshares due to a perceived threat of gender violence. Maribel shared that, “my parents don't let me do anything that involves calling cars...[they don't] want me to be alone.” She joked that her mother “watches too many telenovelas.” Alexandria made a similar quip about her father, Julio, noting she can’t take Ubers, because “he's Hispanic and he's over-protective,

but that's all Hispanic parents.” She went on to explain the choice to avoid rideshares was a personal preference as well. “I don't like to Uber alone,” she said, “it's just like there are all these horror stories of girls who are just kidnapped, and I don't feel safe doing that.”

Soledad articulated similar concerns from a parent's perspective. “With Uber and Lyft there are trust issues,” she explained, “because there is so much information in the news that they don't check the backgrounds of the drivers and I have heard about sexual assault on young women.” Out of context these comments might be chalked up to parental paranoia or urban myth. However, when set against the backdrop of earlier stories wherein numerous women and single mothers arrived in public housing in the wake of abusive domestic situations, safety from gender-based violence is a legitimate concern that hasn't been quelled by the city's rideshare fingerprinting policy, which according to one resident's experiences are not yet ensuring that all drivers are fit for service.

Shirley, who you will remember takes Ubers regularly with her friend to clean office buildings, has had a number of experiences on late night rideshares that suggest that caution for one's safety is warranted, and that race may also be a factor in addition to gender. She relayed a tale about a recent experience that began as she and her friend were waiting for their rideshare outside of Overton Heights during a thunderstorm trying to get to work:

This man, he reeked of alcohol really strong. And he was a Uber driver. And I was like, "Oh I'm not getting in that car. That man smell like he on alcohol. I'm not getting in no wreck." And she said, "I can't cancel it because if I cancel it, they're going to charge me four dollars." I say, "Well, he going to cancel anyway, because he's looking at us like I don't like niggers.” And then, I swear that man canceled that trip and told us to “shut his fucking door”. Talking about "The trip is canceled and shut my fucking door." And she

say, "What?" He say, "Shut my mother fucking door." And I'm like, "Oh my God, call them right now and tell them he's drunk and cussing us out. And we don't have no ride to your job."...Two other guys canceled trips because they didn't like black people. And I'm like, "Oh my God. What kind of trip of this?"

Shirley's vignette caps off a collection of experiences showing a complicated and often contentious relationship between new smart mobility assets and a variety of factors shaping residents' geography of educational opportunity. Specifically, some residents couple the emergence of smart mobility with the loss of community care and connection that they have experienced through Eastside gentrification. Concurrently, the lack of care and norms has generated a street culture that is perceived as erratic and unsafe – two qualities that run directly askew of values residents hold dearly in housing. Also, we see that for some residents, rideshares have created an opening for potential gender violence that should be avoided as well as racialized interactions that seem to be regularly tolerated. In the next section, I turn from considerations of the broader geography of educational opportunity to explore what residents revealed about their experiences using smart mobility options to access educational opportunities.

Residents' Experiences with Smart Mobility Show Little Relation to Educational Opportunity

I have explored a number of intersections between smart city assets and factors shaping residents' broader geography of educational opportunity. In these final two sections, I conclude with an examination of moments in residents' stories when they explicitly discussed the relationship between smart mobility, ICT-based technologies and their own or their children's

education. I begin by exploring the relationship between smart mobility options and educational opportunities.

In the evidence from research question one, public transit and school bussing emerged as the primary methods in which most participants were accessing their geography of educational opportunity. In particular I described how city and school district bus routes defined several residents' access to the city and to educational opportunities – transit is destiny, if you will. Based on my reading of the City of Austin's Smart Mobility Plan, this deterministic relationship between transit and opportunity is *the* primary objective and shared mobility services are posited as the “game changers.”

Notwithstanding the wide availability of these game changing mobility options in the Overton neighborhood, there were very few references directly linking shared mobility to educational opportunity in any of the interviews. Two residents referenced taking rideshares or scooters to their schools. They are each in their early twenties, able bodied, single with no children and are attending ACC. They, more than any of the other participants in the study, fit the bill of “the young” that Julio referenced in an earlier section.

By now it may come as no surprise that Destiny has been an early adopter. She reported that over the last year she has taken Uber and Lyft rideshares frequently to get to her IT courses at the ACC campus approximately five miles to the north. She indicated that she has done so when her car has been in the shop, or when she is running late and can't afford to spend extra time looking for parking. Like Destiny, Ruben's vehicle is his primary mode of transport, but it too is frequently broken down. There have been a number of times over the past year when his car is broken down or he is running late that he has utilized scooters to get to his classes at the

ACC campus approximately two miles to the east. “Just it's more faster,” he said, “I don't have to wait for traffic or anything. I just go by on the sidewalk.”

Beyond “the young”, no parents in the study reported that shared mobility services were viable options to get their children to school. Julio, for example, gives his daughter, Alexandria, a ride to her high school every day. He does so despite the fact that he works at a department store in far south Austin and their pick up/drop off schedule is frequently complicated. Julio explained that they have persisted this way because the school bussing schedule is even more challenging and would get his daughter home much later. When asked if he would ever consider any shared mobility options, he replied, “Uber is better than taxi. Of course. It's cheaper. It's very good service, but it's not for this routine.”

Luz and Amy were of similar mind that shared options might be relevant for some, but not for this routine. Amy noted that there are obvious reasons why young people can't utilize microtransit to access school options beyond the banking issues I described earlier. She observed, “You have to have a license just to operate it. Kids can't necessarily ride those to school. And from a legal standpoint, there's liability there.”

For Luz, she is intrigued by the scooters and mentioned, “I'd like to use them one day for fun with my kids.” Recall that Luz' daughter, Selena was not able to attend her first choice of schools due to a lack of bussing and is now facing attendance issues because of misalignment between bus times and school master schedules. When I asked if she would ever let her daughter take the scooters to solve her transportation issues, her tone changed and she said, “No, not to get to school.” For Luz, the threat of gender violence is real and not the product of “too many telenovelas.” After the interview, my co-researcher, Mary, pointed out that Luz' reticence is also likely due to the recent wave of raids by ICE, which has generated fear amongst the

undocumented immigrant community and increased the value of predictable, public school bussing.

Based on these few references and the issues that surfaced regarding shared mobility in research question two, I am left to wonder “game changer” for whom? For Destiny and Ruben, it seems that shared mobility provides a safety net when their primary mode of transit fails, which appears to have resulted in more regular attendance. For other Overton residents: residents with physical disabilities, residents with young children, residents with outdated technology, residents with variable data plans, elderly residents and teenagers – the *majority* of residents – there are a variety of entangled issues that, together, limit shared mobility’s potential to expand educational access and opportunity. Virtual educational opportunities are not enmeshed with the same assortment of issues influencing smart mobility use. I conclude this chapter with an examination of the themes that emerged when residents discussed the relationship between ICT-based technologies and their educational opportunities.

Variable Access to ICT-Based Technologies Impacts Educational Access and Opportunity

Participants in this study described a geography of educational opportunity that straddles virtual and physical space. At this intersection of these spaces, ICT-based technology plays a pivotal role in mediating access in achievement. On-line educational interfaces varied in their purpose and complexity in this study. At one extreme, all of the content and project work for Destiny’s associate’s degree occurs on-line. Describing her school life, she said:

I’m an IT major, so everything’s online. I use Cengage, I’m taking Web Design Tools, all my resources are online. Like I don’t have a paper textbook. My textbook is online and my schoolwork is online.

Ruben's homework and assessments are largely managed on-line even though he is enrolled in a hands-on, automotive certification program. The tasks are basic content overviews and quizzes. "There's this videos we have to watch, or slides I have to read," he said, "and then after reading all of them I have to take an exam."

Residents' virtual learning tasks in the public schools were equally simplistic and generally focused on administrative tasks or basic skills rather than delivery of core content. Amy's children, for example, are each in elementary school and she reported that:

I believe they use as much technology as they can at school. They have different programs that they do on the computer to help with reading. They have different sites that they go to for reading and math and I believe it's easier for them to keep track of the kids' progress that way instead of grading papers all the time...we've, um, used those resources at home too, they would give us the username and passwords so they can read at home.

At the high school level, Maribel's engagement with virtual resources was reflective of what Selena and Alexandria described. "Checking grades...[I] go to Blend, which is where all the things are. Normally when you're absent you can just go there and see what you've missed, but I'm never absent," she said. Ideally, Selena would like to be able to access more credit-bearing high school courses on-line. Specifically, she said, "I would take health class and economics and get that over with...because, like, we need .5 credits for [those classes] so we can graduate and if I do it right now, like, I wouldn't worry about it." In follow-up conversations she clarified that taking some of the basic courses on-line would allow her to take more college credit-bearing courses through her school's articulation agreement with ACC. When I asked why she hadn't pursued the on-line coursework, her answer was simple, "I don't have internet at home."

Selena was not alone in facing ICT-specific barriers to educational options. At the time of his interview Ruben was facing a variety of entangled barriers. He mentioned that he is currently falling far behind in one of his course because he can't complete his assignments. He explained, "I haven't done that because I don't have internet. So I'm kind of held back, kind of late turning in homework and stuff." In the absence of having home internet he tried to download his textbook (which was only offered in an on-line format) and assignments on his phone, but "it takes too much data to download, and I can't really download it. And it's a big book, I'm already late and I have to do four, no, six chapters." When this plan backfired, he pivoted and said, "I got the password at work, so I'm just go early and study at work." Quickly, however, he discovered that when he went to work, "most time I'm working and I can't really do school work, or study. And then other times it's I don't have internet so I can't really do anything."

Intractable ICT-specific barriers have recently surfaced for Destiny as well. In her case, free computer access at the local libraries was insufficient to the tasks she needed to complete. Destiny described the drama that unfolded when her personal laptop crashed in the middle of the school semester:

When my laptop broke I was really stressed, because I had assignment to do that Sunday...I was trying to go to the [public] library to download like a text editor, but the library won't let you download stuff on their computers...I needed, it's called FileZilla. So basically when I do an assignment, I have to go to the text editor, create a webpage, and then I have to upload it to ACC's, well my professors server...I wasn't able to do it because all week, my computer, I was trying to get it to work. So I would just sit at the library and try to get it to work and then go back to doing something on the computer.

But when it came to actually like having to upload my assignments, I couldn't do it...[and] you have to upload it into the server, or it doesn't count.

Destiny reported that she was able to coordinate with her professor and they made the appropriate accommodations to get her assignments submitted for credit. Not all residents have had such positive interactions with their instructors as they have tried to navigate virtual learning environments. Their experiences demonstrate that access to functional ICT-based technologies are critical ingredients for modern day learning opportunities that ultimately fall flat if the content isn't assessable.

For example, remember from earlier in this chapter that over the last several years Luz has taken numerous computer classes, but has yet to progress because the content and instruction didn't include accommodations for non-Native English speakers. She shared her frustration, because "you can't even check out of the grocery store without using a computer." More importantly, Luz feels like she is not able to support her daughter with her on-line school work, keep track of her grades, or provide parental oversight of the content her daughter is viewing. "It's important to me," she said after indicating she would still attend classes – accommodations or not.

The lack of quality accommodations surfaced for Evelyn and Barbara as well as each had negative experiences with on-line classes and now each have decided that their geographies of educational opportunity will no longer include virtual options. In the first part of this chapter we saw how important learning accommodations are for Overton residents who are still healing from past trauma and mental health challenges. Barbara recently dropped out of an on-line course because she felt that the teacher assumed she should know more than she did and didn't adjust her pacing or provide any additional supports to catch her up. Barbara is no quitter having

earned her associate's degree in her sixties. However, the next chapters of her lifelong learning will be limited to what's offered face-to-face. After a similar experience, Evelyn recently felt like she needed to drop out of a virtual course as well. Another resilient and determined non-traditional student, she is now pursuing coursework in an attempt to reenter the labor market after over a decade of crippling depression.

As she pursues her educational goals in order to support her grandson, she said she will be avoiding on-line content, because the experience is too impersonal and that, just as she described the changing face of the Eastside neighborhoods she grew up in, it lacks a sense of community. "At some point you're taking away that interaction with an actual person," she said, "what's going to happen later on? How are we going to know how to communicate with a person?"

Conclusion

This chapter has detailed the findings from what is, to my knowledge, the only study to have critically examined the relationship between foundational smart city assets – ICT-based technologies and smart mobility options – and the geography of educational opportunity amongst low income individuals and families living in public housing in the urban core of a smart city. In doing so I examined the following research questions: How and in what ways do public housing residents characterize their experience in accessing educational opportunities in the urban core of a smart city? How do public housing residents describe their experience with ICT-based technologies and smart mobility resources? And what relationships can be drawn between the factors influencing public housing resident's access to educational opportunities and their utilization or avoidance of ICT-based technologies and smart mobility resources?

In my examination of research question one I found that stable housing plays a foundational role in supporting all aspects of residents' access to educational opportunities, but that the sanctity of that space is being compromised by gentrifying forces in the surrounding neighborhood. In addition, I found that despite the changes in the neighborhood, residents' educational opportunities were still mediated by an ensemble of systems and supports that are frequently mismatched to residents' needs.

In question two, the theme of systemic mismatches persisted as ICT-based technologies were accessible, but not functional, wifi and data plan access was highly variable. In addition, smart mobility options were inaccessible along multiple dimensions and rife with social discomfort. These findings were further complicated by the whole smart ecosystem which is mediated by varying price points in the private sector.

Lastly, I turned to research question three to examine the intersections the two previous lines of inquiry and found that smart mobility is negatively impacting community cohesion and culture around Overton, smart mobility options are mismatched to residents' paths to educational opportunity, and technological variability is complicating educational access and opportunity for many residents.

In the fifth and final chapter of this dissertation I discuss how the four overarching findings from this chapter speak back to and extend upon existing research and theory, explore implications for education administration and educational research, and suggest directions for methodological advancement and future, place-specific research amongst low income communities in smart cities.

CHAPTER V: DISCUSSION AND IMPLICATIONS

This dissertation study was conducted for the purpose of understanding the relationship between foundational smart city assets in Austin, Texas and the geography of educational opportunity amongst public housing residents living at Overton Courts. Specifically, I sought to answer three research questions: (1) How and in what ways do public housing residents characterize their experiences accessing educational opportunities in the urban core of a smart city? (2) How do public housing residents describe their experience with ICT-based technologies and smart mobility resources? (3) What relationships can be drawn between the factors influencing public housing resident's access to educational opportunities and their utilization or avoidance of ICT-based technologies and smart mobility resources?

Unlike previous studies in the smart cities corpus that have primarily included energetic scholarly debates about the theoretical implications for equity, inclusion and education in smart cities, this study grounded the debate by including public housing residents and HACA staff in the conceptualization and implementation of the study. By privileging the lived experience and voices of low income individuals as the centerpiece of the analysis this study has provided unique insights into the specific linkages between smart city assets and educational opportunity as they have manifested in a particular context. Based on the Overton residents' stories

Through the residents' lived experiences, I derived four overarching findings. Two of the findings align to my investigation of research question one, which focused on residents' experiences accessing educational opportunities in a smart city. Given my wide lens on the whole geography of educational opportunity and opportunities within geography (Green, 2015; Tate, 2008), I found that public housing played a central role in many residents' stories about accessing educational opportunities. Housing provided not only shelter, but also the necessary

safety and stability some residents needed to sustain their educational pursuits. However, beyond the safety, stability and community support at Overton Heights gentrification processes have diminished community connections and generated uncertainty in the educational landscape as numerous Eastside schools are now slated for closure due to low enrollment.

In my second finding from research question one, I found that despite the influx of wealth and resources into East Austin neighborhoods, residents' direct engagement with educational opportunities are still limited by public systems and supports that are mismatched to their educational needs and aspirations. Changes in demographics, cultural assets and community culture has had a more pronounced impact on residents' geography of educational opportunity than I had anticipated.

Within this gentrifying neighborhood environment, I discovered that residents' experiences with educational systems and access to the broader geography of educational opportunity in Austin are still dependent on traditional public resources and infrastructure. Based on the literature I reviewed in chapter two, key smart city assets like ICT-based technologies and smart mobility options theoretically should present more effective and efficient means for accessing educational opportunities. However, based on my findings in research question two, residents' access to smart city assets was highly variable and frequently mismatched to the residents' needs and circumstance.

The variability and mismatch of smart city assets surfaced in my examination of research question three as well. The influx of under-normed smart mobility options diminished residents' access to the broader geography of educational opportunity around their homes while the variability of ICT-based technology access complicated their access to educational opportunities. The residents' stories illustrate that these negative externalities are not due to the smart city

assets themselves, but rather to how they integrate with gentrifying processes, private sector services and existing public systems that manifest differentially in certain contexts.

Though the Overton community represents a single context in a single smart city, this work underscores the importance of engaging and involving those who are most impacted by a phenomenon in the critical examination of said phenomenon. Grounding this study in the community advisors' trusting relationships created a space for residents' dreams and lived experiences to take center stage and moved the analysis beyond technocratic assumptions to more personal and visceral depictions of how smart and educational systems relate in situ. Getting to school and accessing virtual resources is not as simple as it may seem. While Overton residents' experiences were in no way homogenous, the patterns that emerged across their stories commune with the previous literature and clearly suggest that more educational research is warranted in the smart cities space. In the following sections I discuss the main findings from each research question within the context of the literature I reviewed, discuss implications and conclude with recommendations for future educational research. I begin with a discussion of the two key findings from research question one.

**Revisiting Research Question One, Finding One:
Public Housing Provides Stability Amidst Destabilizing Community Changes**

Of all of the opportunities in geography (Green, 2015) that were named throughout the interviews in this study, public housing and services provided within public housing were referenced most frequently. I would emphasize that other than asking how long residents have lived at Overton, none of the other questions in the interviews directly referenced housing. For many of the residents' – especially single mothers – stories about their own or their children's educational journeys began with funding a safe and stable place to live. Being able to conduct their lives without the threat of homelessness or fear of domestic abuse created the conditions for

them to begin planning for and pursuing educational opportunities or job training. The residents' journeys were further aided by a variety of HACA-administered self-sufficiency programs including Paul's support and advisement services through the Jobs Plus.

These findings illuminate the previous literature focused on the connection between public housing and educational opportunity by intimately showing how stable, quality housing connects to residents' mobility, academic performance and educational opportunities (Braconi, 2001; Crowley, 2003; Mueller & Tighe, 2007; Quercia & Bates, 2002). This study extends these findings by demonstrating how public housing properties and housing authority services are especially well-suited to enhance educational opportunities *in the context of smart cities*. We witnessed that in addition to support and advisement, the HACA services and strategic partnerships (e.g. Google) are already oriented towards a technologically-mediated future of work. While the residents' stories also revealed a complex assortment of barriers related to these services (e.g. technology vintage, technology classes in English-only) the potential for impact seems inescapable. Given the increasingly entangled sociotechnical relationships in smart cities (Chopra, Paja, & Giorgiani, 2011; Um, Lee, & Choi, 2015), the residents stories reveal that public housing provide supports across social, cyber and physical realms. However, it is also evident that the potential for diverse and systemic supports within the housing community does not disrupt the political economies and spatial inequalities in sociotechnical realms beyond housing property walls. This was evident in residents' discussions about the neighborhoods around Overton.

Gentrification is a Disruptive Factor in Residents Geography of Educational Opportunity

Recall one of the dominant rationalizations for creating smart city contexts: projections that the world's urban population will grow to 6.5 billion by 2050 and to 8 billion by 2100

(United Nations World Population Prospects, 2015). As I've stated previously, Austin's population growth over the last two decades affirms these urbanization trends – trends that have been due to the city's success attracting people with the engineering, creative or design skills whom are the “currency of the age” in the global economy (Coccoli, et.al., 2017; Ojo, et.al., 2016). Numerous Overton residents described this process from their perspective as longtime families and community businesses have been steadily priced out of the neighborhood and replaced with condos and chic cafes that cater to the new Eastside residents.

The Overton residents' experiences suggest that the benefits they have derived from securing stable housing and accessing HACA-administered programs are dulled in some ways by the loss of community and relationships in the surrounding neighborhoods. Neighborhood school closings – a result of Eastside demographic change – have introduced an added layer of uncertainty and frustration specific to those residents raising young children. The residents' experiences speak to a phenomenon I had not considered in my initial review, which is Fullilove's (2004) concept of “root shock.” Root shock refers to the emotional or traumatic reactions individuals experience due to the transformation or destruction of one's ecosystem (Fullilove, 2004). While Fullilove's seminal work focused on public housing residents who had been displaced by urban renewal, at Overton it seems that root shock can also manifest when communities experience gentrification without displacement.

Indeed, residents' pining for the old families, their small houses and neighborhood tortilla shops echo Shaw and Hagemans' (2015) work with public housing residents living in a rapidly gentrifying neighborhood in Melbourne, Australia. Their sample reported feeling a loss of place without actually having been physically displaced. For the purpose of this study, it is important

to highlight how loss of place, community connections and local schools negatively impacts residents' geography of educational opportunity.

Also, with the large concentration of single mothers in the Overton study, it is critical to emphasized that loss of place has implications beyond one's individual emotional state. Scholars focused on gentrification without displacement and the social determinants of health have shown that loss of place can also be associated with the loss of community elders and transgenerational caregiving networks. The impact of this "dislocation of care" has been shown to present later in life in the form of racial differences in school readiness amongst pre-school aged children (McCallister, Thomas, Wilson and Green, 2009). Overton parents' stories affirm the coupled need for affordable, quality childcare networks as well as trusted guidance about educational supports and options.

This brings us back to the smart city – a city where ICT-based technologies are leveraged to meet the needs of its diverse and growing populous. In Austin, it is difficult to disentangle the implementation of smart city resources and Eastside gentrification – they have grown up together in the same neighborhoods and, based on my study and others, seem to serve the same demographic (Caragliu and Del Bo, 2016). Overton residents have witnessed this evolution from ground zero, yet many do not feel personally connected to or supported by the new community, nor, as I will discuss in a moment, do they generally feel that smart assets are a fit for their circumstance.

The residents' experiences captured in this study stand in sharp contrast to the Smart City Council's (DeKeles, 2015) depiction of Josie moving seamlessly from home and throughout her community. This gap between the smart ideal and the reality of smart implementation amongst low income communities affirms the scholarship suggesting that smart city resources cater to

prototypical “smart” demographics (Kitchin, 2015; Nam & Pardo, 2011a; Wiig, 2015). As such, it bolsters Hollands’ (2008) observation that it is difficult to tell the difference between true smart cities and “entrepreneurial cities” wherein ICT-based resources and smart mobility simply fuel new waves of capitalist accumulation (Harvey, 2003). My study extends this scholarship by providing insights into how these dynamics manifest in situ from the perspective of low income individuals. I turn now to discuss the second key finding from research question one related to residents’ direct experiences with educational systems.

Revisiting Research Question One, Finding Two: Educational Access and Opportunity Still Limited by Public Systems and Supports

The geography of educational opportunity is evolving for Overton residents. However, their engagements with educational opportunities continue to be shaped by a familiar ensemble of publicly-administered systems and supports that are still solidly anchored in and impacted by longstanding spatial inequalities (e.g. geographic distance to “good” schools). In this section I reiterate core findings from residents’ stories through the filter of the broader gentrification patterns I discussed in the previous section.

The appropriate point of departure for this discussion is the first substantive question we asked in each of the interviews at Overton: What are your dreams for your children’s and/or your own education? While the residents’ responses were not germane to the research questions in this study it warrants mention here that most resident’s goals were collective in nature and focused on either breaking generational patterns of poverty or learning specific skills that would benefit the local community (e.g. childcare provider or immigration lawyer). Seen through the lens of the findings in the previous section these aspirations and advocacy take on a different meaning as the “community” in question is increasingly insular to the housing community and disconnected from new Eastside demographics.

This surfaced in Monica’s report from the field describing the mood amongst Overton and longtime community residents who are preparing to adjust to forthcoming school closures. “Parents are just frustrated, because, you know, they’re so used to the community,” she said, “and they sent their kid [to that school] and now their grandkids are going there. So it’s like a generational thing.” Again, the emphasis is on the community and the generational implications of changing educational options – a loss of place while staying in place.

Given this changing context, what are the implications for educational opportunity at Overton? Nine of the twelve schools that are slated for closure are located in historically Black and Latinx communities in East Austin (Lowe, 2019). This is consistent with recent research showing that school closure processes disproportionately affect poor communities and communities of color (Tieken & Auldridge-Reveles, 2019). The Overton residents’ stories extend this narrative and illustrate that “disproportionate affects” are place-specific and complex in that they are braided with inequalities across multiple sectors (e.g. public transportation, location of high-quality programming).

Reconsider the residents’ journeys from deciding on school options, to attending specific schools or classes, to achieving in extracurriculars or advanced programs. School closures and school choice policies¹⁷ have cumulatively reconfigured Austin’s educational market in such a manner that elevates the importance of quality guidance on enrollment. When asked how they go about choosing a school options, for some the answers were uncertain: “maybe I will go ask at the school” (Amy), or, “I’ve heard those charters are good” (Evelyn). In combination with Monica’s observation that school closures are “like a generational thing”, these comments reinforce the consequence of demographic shifts in the immediate neighborhoods around

¹⁷ In AISD, school choice and application processes are concentrated at the secondary level, but parents are able to access different elementary schools through an annual transfer process.

Overton may be a loss of access to institutional knowledge and sources for advisement.

Ironically, when elders were available to advise on school options, there were no choices about which school to attend and now that residents are faced with school choices there are a paucity of longtime families on the Eastside left to advice.

It is disingenuous, however, to imply that Overton residents have access to an expansive menu of options. Residents' stories clearly suggest that this is not the case. The elementary school-aged children discussed in the study either attended a school where they were receiving special education services or the school in nearest proximity. With rare exception (Alexandria, Destiny and Ruben), residents who were enrolled in high school or a postsecondary program or simply wanted to access resources in the city, were limited in their options by available school busses or public transit. Their experiences illustrate how complex spatial inequalities manifests at the intersection of multiple systems in place-specific ways that limit access to the geography of opportunity (Anyon, 2005; Harvey, 1973; Sampson, 2015; Sharkey, 2013; Soja, 2008).

For example, we learned that in an effort to improve the efficiency of public transit and better serve its ridership, Austin Metro reduced the number of bus stops and increased the frequency of bus pick-ups. Recall that the consequences for Overton residents were multidimensional. The added distance to the bus stops limited accessibility for both parents with young children and residents with physical disabilities – all who want and needed to access educational opportunities through transit. Accessibility was further compromised by the fact that the city's growing homeless population had been pushed out from underneath central overpasses into the Eastside where they have become more densely concentrated around the reduced number of bus stops. This migration has compelled some residents to avoid public transit altogether unless they are accompanied by a friend or neighbor. Meanwhile, once on the bus, residents

discovered that while the busses were picking up at a higher frequency the reduced number of stops has meant that common trips covering small distances now take considerably longer. Thus, what was once – according to residents – a fairly straightforward task of accessing a city bus is now unnecessarily complex due to considerations for physical health, physical safety and available time.

Similarly, complicated dynamics surfaced in the public school space, but with more direct impact of educational opportunities. For high school residents (Maribel and Salina), their dependency on school bussing limited their options to three schools: a neighborhood school, a magnet and a campus in West Austin. Their default neighborhood school has been chronically underserved and considered “low performing” since the earliest days of No Child Left behind even after numerous unsuccessful reform efforts.

Regardless of their school choice, bussing availability further constrained their program or course choices including enrollment in off-site academy options and forced trade-offs between dual-enrollment and extracurriculars. These choice sets were further minimized by school master schedules that were not coordinated across schools and geographies. For Salina, this mismatch resulted in threats to her attendance and achievement. Lags in attendance and achievement will limit her ability to stay in advanced programing and to maintain their transfer out of their neighborhood school. Thus, we see how “choices” are filtered through a complex convergence of place specific systems. What’s striking in the residents’ stories is how frequently interrelated systems have served to limit options. This seems odd given that systemic changes like school closures and choice processes and alterations to public transit routes were each championed by city leaders as advances in efficiency and access. The residents’ stories force an important question that resonates throughout critical geographic, educational, and smart cities scholarship

(e.g. Harvey, 1973; Hollands, 2008; Soja, 2008; Lipman, 2011): More efficient and accessible for whom?

Whom are the choices for?

Monica and Evelyn's discussion about school choices was more nuanced than I have explicitly called out thus far. Their question was not simply, "where are *we* going to send our kids to school?" The question was also, "where are *they* going to send their kids to school?" The looks on Monica and Evelyn's faces were priceless – the sheer absurdity of being a young professional or family and moving into a neighborhood that is about to lose a significant percentage of its schools to closure. However, what gets lost in the absurdity is that it is precisely because of school choice processes that the new White, college-educated households with children were willing to gentrify the poor communities and communities of color – there is a way out (Pearman and Swain, 2017). Seen through this lens, the interests undergirding school changes and closures come into clearer light.

School closures have been absorbed into AISD's broader umbrella of "school changes" - a districtwide effort to "reimagine, reinvest and reinvent" educational opportunities in all regions of the city (<https://www.austinisd.org/schoolchanges>). With an evolving menu of school program options, school renovations and choice process the effort signals to future families that they can customize their children's education without being tethered by geography (Pearman and Swain, 2017). While these efforts are guided by equity objectives (<https://www.austinisd.org/schoolchanges/guiding-principles>) they persist in tension with the evidence from educational research showing that school closures do not alleviate, but rather exacerbate sociogeographic inequality in access to education. (Lee and Lubienski, 2017). This speaks to numerous findings that educational diversity and equity imperatives sit in an

uncomfortable balance with efforts to appease, recruit and retain gentrifying families in public schools and that the latter ritually overshadows the former (Cucchiara, 2015; Diem, Holme, Edwards, Haynes and Epstein, 2019; Lipman, 2011).

The Overton residents' stories put a finer, more intimate point on the matter. They demonstrated that educational opportunities shrink when they are filtered through multiple integrated systems (e.g. public transportation services and homeless policy) that are geared to appease a different demographic. The ascendancy of smart cities and the infusion of ICT-based technologies into daily life and city governance has resulted in an additional system that Overton residents must access in order to navigate virtually all other systems. In the next section I discuss key findings from the second research question focused on residents' experiences accessing a utilizing ICT-based technologies and smart mobility options.

Revisiting Key Findings from Research Question Two: Access to Smart City Assets is Variable and Often Mismatched to Residents' Circumstance

In the discussion of findings thus far I emphasized the residents' experiences accessing the geography of educational opportunity in and around Overton. I described their strong connections to their homes and the housing community, which for some residents is counterbalanced by sense of loss or "root shock" as the Eastside has gentrified over the last decade. While the topic of gentrification only surfaced explicitly in a handful of interviews, stories about "efficient bus lines", homeless relocations and school changes each suggest a broader pattern of civic pandering to a demographic other than the housing community.

This study holds a light to these machinations and concretely shows – in the residents' own words – how new city-based initiatives (e.g. school changes) and political economies (e.g. affluent in-migration to the Eastside) intersect with existing spatial inequalities (e.g. public transportation) to complicate residents' access to educational opportunities. I now turn more

explicitly towards the foundational aspects of Austin's smart city movement and meditate on residents' experiences with ICT-based technologies and virtual learning and in what ways they relate to the patterns I've described thus far.

In the previous sections I highlighted a number of interdependent relationships that residents try to keep in balance to manage their lives and their education. Transportation routes, physical distance and school schedules had a rigid, yet misaligned interdependence that had consequences for school choice, attendance and achievement. In each case, one factor could be subtly out of sync, but the residents could persist. The interdependencies within technology are different in this regard in that some factors simply do not function without the other (e.g. cell phones, data plans and digital literacy). If we adopt an ideal for residents to be able to fully benefit from advances in a smart city then ICT-specific interdependencies warrant our focus.

As I described at length in chapter two, the entire smart cities movement is dependent upon the comprehensive expansion and uptake of ICT-based technologies. Smart cities recast urban environments as sociotechnical systems that fluidly integrate the social, cyber and physical realms (Chopra, Paja, & Giorgiani, 2011; Um, Lee, & Choi, 2015). The residents' stories about integrating technology into their learning and their lives affirms previous scholarship suggesting that the migration towards sociotechnical contexts has implications for personhood and learning, which is a core concern of this study (Sol, et.al., 2013; Brynjolfsson and McAfee, 2012; Williamson, 2017).

The "persons" in question can be loosely organized in two camps as smart cities discourse and planning documents typically refer to (a) social inclusion of historically marginalized populations while sending tech-specific signals to lure (b) future residents with the engineering, creative or design skills whom are the "currency of the age" in the global economy

(Coccoli, et.al., 2017; Ojo, et.al., 2016). Like the school changes process in Austin (and as we will see with shared mobility in a moment) there is an inherent tension in smart sociotechnical systems that try to serve both privileged and disadvantaged populations with the same solution. The residents' stories offer insight into the complexity of these tensions and how they have manifested at Overton as residents have tried to access ICT-based technologies to support their learning and journey to self-sufficiency.

In chapter four, I described that for most of the residents their access to ICT-based technologies has been highly variable. Frequently residents did not have access to either a cell phone or computer until after they secured stable housing. Again, HACA was instrumental in making certain those who wanted to access technology and develop their proficiency could do so. What emerged, however, is that the cyber realm advantages newer technology vintages. Simply having access to ICT-based hardware is insufficient. "Obama phones" (basic flip phones) and inherited PCs do not translate to full participation.

The residents who managed to secure capable hardware encountered more variability and technological interdependencies as they tried to translate their access to action. Residents who attended one of a number of digital literacy trainings in the area generally described their experiences in positive terms. However, their stories also suggest that persistence and progress was complicated by inconsistent offerings across various locations with a rotating cast of teachers. Additionally, some residents left both HACA-based and ACC-based technology classes feeling frustrated, because instruction was not differentiated for those who needed learning accommodations or non-native English speakers. Like housing in some ways, residents needed for the classes to be available, consistent and attentive to their specific needs.

For residents (typically younger residents) who were more technically savvy, consistent access to technology and data surfaced as an on-going challenge. Many of the residents were well-versed in the technology realm and spoke casually about smart phones, operating systems and software applications. They clearly understood the interdependencies between hardware (cell phones and computers) and data access (wifi and cellular data), but regularly struggled to maintain synergy between the components. The implication for high school students and ACC students warrants additional attention here. Once students experienced a gap in wifi access they could temporarily redirect to cellular data. Doing so would drive up their data plan expenses instigating a financial domino-effect. Therefore, they would quickly turn to wifi assets in their immediate geography in what I began to think off as a “wifi goose chase.” Destiny, Emily and Ruben discussed similar experiences with hardware as a laptop malfunction (or irrelevant tech) would redirect activity to their smart phones and eventually to a community-based lab where they encountered gaps in software availability. Misalignment of technological interdependencies seemed to shut down access more quickly than many other factors in this study.

There were a number of causes of technological misalignment that the residents described, but one that emerged across most stories was variability of quality and cost in the private sector. Numerous residents’ stories suggested that promotion-jumping from one deal to another was a distinct skill set and one that requires constant mental bandwidth. According to Amy, free Google Fiber is already relieving pressure and providing consistency for residents in the new Overton property, but that only addresses one relationship in the technological interdependencies. It seems clear that if residents are going to secure and sustain consistent, functional technology access moving forward they will have to do so by finding balance in cost

and service across multiple companies in a manner that is coherent with the complexity of their income and their lives.

What emerges then is a picture of human beings being integrated into interdependent technological relationships with both the technologies themselves and technology vendors. This dynamic gives weight to assertions that we are evolving into sociotechnical systems (Chopra, Paja, & Giorgiani, 2011; Um, Lee, & Choi, 2015) and that within these systems smart technology vendors are strategically positioned as “obligatory passage points” for traditional cities and people who aspire to become smarter (Söderström, et.al., 2014). The residents’ stories clarify the contours of this evolution from the perspective of low income city residents. In doing so their experiences highlight how sociotechnical inequalities are entangled with spatial inequalities in ways that have concrete implications for educational equality. I conclude this chapter with a discussion about what I believe this means for future directions in educational research, but first unpack a final discussion about ICT-based technologies and shared mobility options relate to residents’ geography of educational opportunity.

**Revisiting Key Findings from Research Question Three:
Variable Access to ICT-Based Tech and Mismatch Between Smart Mobility and Residents’
Context Complicates Educational Access and Opportunities**

In the previous section I discussed an assortment of interdependencies that must be balanced for one to consistently interface with ICT-based technologies. I asserted that imbalances within these technological interdependencies generates sociotechnical inequalities that in combination with spatial inequalities has implications for educational equity and access. In this section I extend this discussion to highlight how ICT-based technologies and shared mobility options – the “gamechangers” in Austin’s smart city portfolio – interface with and complicate residents’ sociotechnical geography of educational opportunity.

Recall what we learned from the residents' experiences. From a technical perspective, the interdependent relationship between smart phones, data plans and technological literacy prevented several residents from being able to access rideshare mobile applications that are required for every private vendor's shared mobility platform. Some residents who had access to the ICT-enabled basics did not have a banking account, did not have available income to sustain regular ridership, or were not willing to link their bank account to the mobile applications due to a lack of trust in the technology and a lack of trust in the company behind the technology. Trust issues transcended technology for other residents who do not use rideshares, because they are uncomfortable riding alone with strangers or they have had specific experiences that made them feel concerned for their safety.

Safety concerns extended beyond interpersonal interactions. Multiple residents shared that (a) due to their own physical conditions they didn't feel comfortable trying microtransit options, (b) they would not sanction their children's use of shared mobility for fear of gender violence, (c) they could not safely transport young children on microtransit, and (d) that the influx of rideshares and microtransit into the Eastside has created a chaotic and unsafe environment for riders and pedestrians alike. When describing the current street environment some residents noted that, from their perspective, shared mobility riders aren't abiding by established safety protocols. Others suggested that the safety issues are a product of a lack of community respect and represent yet another departure from the way things used to be.

What emerges from the residents' stories is a clear sense that shared mobility is entrenched in the full spectrum of sociotechnical systems: social, cyber and physical realms are each implicated in ridership. Critically, within the social and physical realms the implications transcend single riders and extend to changes in community culture. Amongst the two residents

in this study, these changes did not present barriers or raise their ire. They were each in their early twenties, enrolled at ACC, employed, childless, able-bodied, technologically proficient and banked. Indeed, their personal characteristics were more similar to the young White woman running at 6 o'clock in the morning than they were to the other fifteen residents in this study.

The residents' stories affirm and extend upon a number of empirical and theoretical discussions in the smart cities literature. Recent scholarship suggests that while smart mobility options are *potentially* transformative for low income communities, cities lack the necessary planning, policymaking and governance structures to ensure that smart mobility options actually benefit low income communities of color (Creger, Espino & Sanchez, 2018). This study suggests that these city structures must also be attentive to how smart mobility resources manifest differentially within specific communities. Additionally, residents stories suggest that smart mobility options must also be designed for human beings outside of young, employed, technologically savvy and able bodied demographic. Tawanna Dillahunt's research (2018a; 2018b) focused on community-based design research, human computer interactions and ICT-enabled resource deployment in low income communities is trendsetting in this regard. The residents' experiences suggest, however, that there is value in situating work like Dillahunt's within the context of broader sociotechnical systems in order to have a fuller picture of access, impact and unwanted/unexpected externalities. Without such grounding, presumably non-ideological, inclusive, socially just and citizen-centric technologies may actually accentuate sociotechnical inequalities across multiple realms (Griffiths, 2016; Colding & Barthel, 2017).

Lastly, when examined through the lens of residents' stories about their geographies of educational opportunity, it is difficult to distance the ascension of smart city resources from longstanding spatial inequalities, educational inequalities and emergent spatial injustices that are

manifesting alongside Eastside gentrification processes. From school closures to bus lines to homeless relocations to mobile apps to scooters, the misalignment with residents' needs suggest the initiatives are tailored to the needs of upper-class urbanites (Wacquant, 2008). I am not, in fact, suggesting that this is wholly a bad thing. Rather, like all urban solutions that are employing the discursive strategies of the global neoliberal project (e.g. school choice) it is important that researchers intentionally dig under the skin of coupled claims of social equity and competitive progress (Bourdieu and Wacquant, 2001; Slater, 2006; Tickell and Peck, 2003). Place-based, collaborative efforts such as this study suggest that low income residents are uniquely qualified to ground research and describe the complex interrelationships at play within a particular sociotechnical context and to provide a sober understanding whom is and whom isn't accessing opportunities a smart city. With this in mind, I conclude this dissertation study by proposing a number future directions for educational research in smart cities.

Implications for Educational Policy, Practice and Research in Smart Cities

In the spirit of critical praxis (Freire, 1970), it has been my intent to start a needed conversation amongst the educational community and local stakeholders (including residents) by providing an exploratory and critical scan of the relationship between smart city expansion and educational opportunities. From the outset, I have conceived of this study as a first step in a more robust research agenda into this emergent and complex space. With this in mind, I am delighted to have arrived at the end of this journey having unearthed a variety of rich directions for future research as well as a number of what feel like urgent implications for policy and practice.

First, this study has demonstrated that collaborative, qualitative case studies can be leveraged in order to better understand how complex systems dynamics and educational inequalities manifest across social, cyber and physical realms within a particular community. In

this instance, I focused on a single site and didn't aspire to produce findings that were generalizable to populations beyond the residents at Overton Courts. However, this study justifies a more comprehensive study along the same line of inquiry that should involve multiple housing sites and integrate additional methods (e.g. spatial analytics, social network analysis, survey data) in order to improve the triangulation of findings and increase external validity.

Additionally, I also see the need to expand this line of inquiry beyond the public housing community who have stable housing in the urban core in close proximity to smart city assets. In rapidly gentrifying cities like Austin, housing choice voucher recipients and other low income individuals and families are vulnerable to the whims of the local real estate and are often priced out to the city's fringes or into adjoining suburbs (Way et al., 2018; Orfield, 2011). While living beyond the edges of an articulated and organized smart cities strategy, these communities still have access to ICT-based tech and shared mobility. For educational administrators who are attentive to issues of regional inequality (Pastor, Benner & Matsuoka, 2015) it feels critical to understand how smart systems impact educational opportunity over dispersed geographies and across geopolitical boundaries.

This study also points to several new directions for future research. For example, the residents' stories suggest a complex and emerging nexus between inner city gentrification, school closures and the deterioration of community advisors. This space seems rich for further inquiry, but especially with an eye towards how social media are factoring into these phenomenon. Also, as cities urbanize and school configurations and programming continue to evolve, more research is needed into how public transportation systems and school bussing operations function at the intersection social, cyber and physical realms. Within this space, spatiotemporal analyses feel especially ripe with possibility.

In the meantime, there are a number of implications for civic and educational policy and practice that feel especially urgent. It seems clear in this study that smart infrastructure operates on a logic that if the market is saturated with many options then all people will be served. The residents' experiences clearly reveal that this privately managed ecosystem is rife with variability and access is highly unpredictable for low income people. We also see that the public sector has provided specific supports on the ICT-based technology supply side (e.g. Chromebooks through AISD or Google Fiber through HACA), but they haven't fully accounted for the interdependencies between current generation hardware, wifi and data plans that are required in order to fully participate in smart city life and sociotechnical educational environments. It seems within our grasp to develop ecosystemic policy frameworks that account for these interdependencies, which could guide public-private partnerships with more place-specific precision.

Lastly, in the universe of place-specific interventions it seems that public housing is an underutilized resource in regard to expanding educational opportunity and attainment in the context of technologically-mediated smart cities. As we witnessed at Overton, public housing and housing authorities can dovetail a unique ensemble wraparound services, educational supports and technology assets that are potentially transformative. One can imagine that these potentials might be more fully-realized if intentionally coupled with supports from public school districts that are grounded in the realities of and lead by those who stand most to benefit from more purposeful and aligned systems. Many thanks to the community advisors and residents at Overton for showing how this might be accomplished.

Closure

The final analyses and member checking for this dissertation study occurred in the midst of the COVID-19 pandemic. At a global scale, there feels to be a shared sentiment that we are all dreaming about the places that we want to go but can't. As the virus has spread, so has the realization that social, cyber and physical realms are inextricably entangled. So too has the recognition that these social, cyber and digital realms are highly uneven as school districts have rushed to ensure that all students have access to virtual content and learning opportunities and, predictably, digital inequalities are spatially specific. While I am hopeful that the educational community emerges from this historical moment more informed about a path forward towards sociotechnical equality, I am also clear that our "smartest" ideas can change dramatically once placed into the stream of longstanding patterns of social and spatial inequality. My hope is that this dissertation has in some way shed light on this dynamic and served as a reminder that human experiences and stories can help to provide a roadmap for a different way forward.

APPENDIX

Appendix 1

Community Advisor Recruitment Email

Greetings Ambassadors,

I hope these words find you well. I am writing to extend a special opportunity to each of you to do some early work on the Smart City Ambassadors Program before we formally launch with the whole team. I believe that most of you know Trent Sharp from previous ambassador work. Trent is a PhD candidate in the Department of Education at the University of Texas and he is interested in understanding whether people have greater access to educational using "smart technology" and "smart mobility."

He would like to recruit three to four "co-investigators" to help advise on this research. This is a voluntary role. If you are interested, here is what you will be asked to do:

1. Join Trent for a 30 minute conference call on July 2nd (next Tuesday) at 2 PM to discuss the project and set times for project meetings that work with your schedules
2. Attend 6-8 project meetings over the next 2 months where you will work with Trent to plan 6 - 10 focus groups and follow-up interviews, advise on the analysis of the data, and identifying "themes" you are seeing. You will also provide advice and recommendations related to overcoming barriers to accessing education.

He would like this work to be mutually beneficial to the Smart City Ambassadors, HACA Residents and the City as a whole. Therefore, it's ideal if you have an interest and passion related to education, or if you are in school and pursuing a new line of work and this would help you learn how to study or learn more effectively.

As a result of your contributions to the research, you will be cited as contributors on the final dissertation document, you will co-author a short article for publication in a research journal, and you may be asked to share your recommendations with policy makers, planners and practitioners.

You are expected to volunteer about five to seven hours per week for six weeks starting July 1 and ending August 15. You will be provided with training related to education and the "smart city."

Trent is aware that many of you have volunteer commitments, so the first call at 2PM on July 2nd is intended to find times and days of the week that this project can work in your lives.

If you are interested in participating, please call (512-789-0634) or email (trentsharp@gmail.com) Trent directly no later than 5 PM this Friday, June 28th. Thanks in advance for your interest!

APPENDIX B

Reyna's Personal Bio

To whom it may concern:

My name is [Reyna] and I am 68 years age and live at [Overton Heights] in East Austin. I have been President of the Resident Council at Chalmer's for 6 years. Two years ago I took an Oath as Resident Commissioner for the Housing Authority of the City of Austin. I represent the residents of the 18 properties for HACA . I have gotten to know the residents here at [Overton Heights]. in the 8 years I've lived here thru working as a liaison for a program called 'Jobs Plus' that was started here at [Overton] going on 4 years in June. During that time I came to know many of the residents here at [Overton Heights].

Working with Austin Pathways at HACA , I became a Senior Ambassador for Digital Inclusion, where I came to meet Trent Sharp. It has been a thrill and a learning experience for me. One that I have thoroughly enjoyed these last few months. I believe my experience working with the community at Overton has contributed to Mr. Sharp's research.

[Reyna]-Resident Commissioner

APPENDIX C

Destiny's Personal Bio

My name is [Destiny] and I helped assist Trent on his research held at one of the Housing properties. What makes me unique to this research study is my ability to connect on both the sides of the fence; I am studying Computer Science at ACC and I also live at [Overton Heights]. I grew up at a housing property not too far from [Overton] called [Sanchez Place]. In my mother's household we didn't have internet access or cable television. My mom had a budget mobile phone that used monthly minutes for texting/calling that I used rarely. Growing up in [Sanchez] I felt cut off from the world. We couldn't watch the news or even check to see what time it was after our microwave broke. When I got to high school, I was given an iPad. I was able to connect to the wifi at the community center and make phone calls and look up resources with my iPad. In High school I was considered homeless, so I was catching the city bus from south Austin to the school bus on Loyola Ln. to get to school. I was able to do this by using the house phone. I would call Capitol Metro in the morning to see what city busses would be able to get me to the school bus in time.

I think this research study is so important to me because I am living proof of how digital and virtual resources can improve lives in low income environments. I know that not all people can say this, but micro mobility has advanced the choices of transportation that I can use. My connection to the digital world has made me self-sufficient and capable of accomplishing my goals. I have lost jobs because of reliable transportation but now If something happens to my car, I can have a lyft ride pick me up in 5minutes. This research is also Important because of my work with Austin Pathways. Austin Pathways is a non-profit agency that works with HACA residents with digital literacy and digital inclusion. With the information that I've obtained I'm able to understand the minds of other people who aren't as fortunate as me. People who cannot afford technology or don't understand it have different views on digital and virtual resources. It's my job to help uplift my community and to help Austin become a Smart City that doesn't t exclude people based on their income.

APPENDIX D

Paul's Personal Bio

My name is [Paul] and I currently work as a Jobs Plus Career Coach through the Housing Authority of the City of Austin. There, I connect people to educational and employment related resources, work with community partners to build strong relationships and effective programming, and help bridge the gap in social, educational, and economic inequalities.

From small intern positions filing paperwork to my current role at HACA, I have worked on the East side of Austin for 7 of the 8 years that I have lived in the city. I have grown to call the East Side my home away from home and have seen many changes since first being dropped off at The University of Texas at Austin in 2012. At UT, I pursued the field of social work as I greatly enjoy working with others, especially individuals who come from underprivileged or disadvantaged backgrounds. During my upbringing, I had many individuals help me along the way. Without them, I can easily see myself wandering in a different direction towards a path I would not be so proud of. I wish to give back in the same ways I have been given to.

After graduating in 2016 with my Bachelor's Degree in Social Work, rather than going back home to a very limited job market, I decided to be a part of the growing population, change my number to start with (512), and officially call Austin my home. I began my professional work as a social worker through Goodwill Central Texas, where I served as an employment specialist for people throughout the Greater Austin area living in public and Section 8 housing.

Shortly after, I began working for HACA while pursuing my Master's Degree at Texas State University, where I graduated in 2018. Pursuing graduate education was never on my agenda, but after being a part of the job market for a year, I soon realized I needed to further my education to be better equipped to serve my community. I greatly enjoy the work that I do at HACA, as each day is different and I am surrounded by the [Overton Heights] community, a tight-knit community that has embraced change and is always willing to lend a hand. At the moment and similar to the city of Austin as a whole, [Overton Heights] is undergoing physical changes. As the on-site community development specialist, it is my intention to help residents undergo the transformation while also giving space for their concerns, needs, and stories.

APPENDIX E

Semi-Structured Interview Guide

Interviewee Name(s):		
Interviewers:		
Place:	Date:	Time:

INTRODUCTION

- Thanks again for taking the time to meet with me.
- Before we get started I'd like to go over what is called a consent document, which covers all of the information about the research study and asks for your permission to use the information you share with me in the interview.
- The interview should only take an hour.
- This interview is anonymous and confidential
- Also, please feel free to not answer any questions you would prefer not to answer.
- I will be taking notes on these sheets of paper, but I would also like to ask your permission to record the interview so that I can make sure that I get all of the details. Is that alright?
- Thanks so much. Before we get started, do you have any other questions about the study or the interview?

INTERVIEW QUESTIONS

Question One: Introduction

Before we dive into to the main questions in the interview, we would love to know a little bit more about you.

- What is your name?
- Where are you from?
- How long have you lived in Austin?
- How long have you lived at Overton?

Question Two: Dreams and Aspirations

As you know, we are interested in learning more about Overton Heights residents' experience accessing educational opportunities in Austin. Before we get into that, I would love to understand your dreams for your/your children's education.

- What are your dreams for your/your children's education?
- Are there specific things you would like to learn about? Skills you would like to have?
- Are there specific degrees you would like to earn?
- Are there specific schools you would like/you would like your children to attend?

Question Three: Geography of Education Card Sort Story

Now I would like to shift gears and hear a bit more about your/your child(ren)'s experience accessing educational opportunities while you have lived at Overton. Specifically, I would like to know more about (a) the things that are supporting your/your child(ren)'s educational opportunities and (b) the barriers that may be getting in the way either now or in the past. In order to do so, I would like to use these cards in order to get us thinking about the things that sometimes impact our access to education (*lay out the cards*).

- Are there any other things you can think of that have impacted your/your child(ren)'s educational opportunities?
- I'd like to start with the strengths: When you think of your/your child(ren)'s educational journey, what things have supported you and helped you accomplish your goals?
- Now I would like to change gears a bit, and think about barriers to educational opportunity.

Question Four: ICT-Tech and Smart Mobility

One of the things the City of Austin is trying to accomplish is to become what's called a "Smart City". What this basically means is that Austin is trying to use new technology in order to improve people's quality of life, including educational opportunities. When we think about accessing educational opportunities like going to a good school, it really use to be dependent on whether or not you could get to the school by foot, car or bus (*Show first slide*).

Today, as Austin has begun to provide new Smart City resources, there are a bunch of new ways you access all kinds of educational opportunities in and out of school buildings (*Show second slide and walk through ICT-based and Smart Mobility options*).

- First, lease tell us about your experience accessing (a) cellular phone and computers; (b) using cell phones and computers to access educational resources like virtual education, AISD parent portal, etc.
 - What types of things supported your access to the technology resources? (*pull out cards again*)
 - What types of things got in the way of your access to the technology resources? (*sort the supports and barriers into two piles*)
 - What types of things would you like to be able to do with technological resources?
 - What types of support do you think you would need?
- Now I would like to know about your experience using what the city calls "smart mobility options" (*walk through the smart mobility visual*).
 - Are there any of these that you use regularly? If so, can you share how you use it? Why do you feel like it's a good option for you?
 - How, if at all, have you used it to access educational opportunities? Other enriching opportunities around the city?

- Are there any of these that you will not use? Can you help us understand why? Is there a specific experience you can share with us?
- Are there any of these options that you would like to use, but can't for some reason? What are the barriers that are getting in the way? (use cards, to match other factors to mobility options, if applicable)

Question Five: Is there anything else you feel like it would be important for us to know about your experience accessing educational opportunities? Are there questions we should have asked, but didn't?

Closure

I want to thank you again for your time and for sharing so many details about your experience.

- Reiterate confidentiality
- Make sure they have contact information
- Share timeline for analyzing the data and writing up the findings
- Share that HACA will provide an executive summary of the report once it is complete and that there will be more opportunities to come.

APPENDIX F

Informed Consent Document



UT Austin IRB Approved
Protocol Number: 2019-02-0008
Approved: April 12, 2019

Title of the Project: Examining the Impact of Smart City Innovations on Public Housing Residents' Educational Opportunities

Principal Investigator: Trent Sharp, Doctoral Candidate, University of Texas at Austin

Faculty Advisor: Dr. Terrance Green, Assistant Professor, University of Texas at Austin

Consent to Participate in Research

Invitation to be Part of a Research Study

You are invited to be part of a research study. This consent form will help you choose whether or not to participate in the study. Feel free to ask if anything is not clear in this consent form.

Important Information about this Research Study

Things you should know:

- The interview will take about one hour.
- You will receive a \$10 gift card for participating.
- The purpose of the study is to understand the impact of smart transportation and digital technologies on public housing residents' education.
- If you choose to participate, you will be asked to answer questions about you and/or your children's experience accessing educational opportunities in Austin.
- Taking part in this research study is voluntary. You do not have to participate, and you can stop at any time.

More detailed information may be described later in this form.

Please take time to read this entire form and ask questions before deciding whether to take part in this research study.

What is the study about and why are we doing it?

The City of Austin is working hard to become what is called a "Smart City", which means that it is using technology to improve people's lives. These new technological innovations should make it easier to get a high quality education. However, the problem is that no research has shown whether or not these "smart" innovations are actually

improving educational opportunities for low income people. The purpose of the study is to understand how, if at all, smart technologies and transportation are impacting HACA residents' access to educational opportunities.

What will happen if you take part in this study?

If you agree to take part in this study, you will be asked to do one of two things:

1. Participate in a one-hour interview, OR
2. Participate in a one-hour focus group with 3 to 5 of your neighbors

How long will you be in this study and how many people will be in the study?

This study will involve in between 15 and 25 HACA residents and each of the interviews and focus groups will last about one hour.

What risks and discomforts might you experience from being in this study?

There is one risk you might experience from being in this study. All information collected in this study will be held strictly confidential by the researcher. However, if you participate in a focus group, I cannot guarantee that the other HACA residents will keep your comments confidential.

The researcher will let you know about any significant new findings (such as additional risks or discomforts) that might make you change your mind about participating in this study.

How could you benefit from this study?

You might benefit from being in this study because the findings will be presented to the City Of Austin and they may use your feedback to provide you better access to transportation options and digital technology.

What will happen to the samples and/or data we collect from you?

As part of this study we will only collect the name of the HACA property where you live and your responses to interview or focus questions.

How will we protect your information?

For Ambassadors:

We will protect your information by using a pseudonym (a fake name) making sure that any other information that can directly identify you is stored separately from the data collected as part of the project.

For Focus Group Participants:

We will protect your information by not collecting any other information that can directly identify you.

For Both:

The data we collect from you during interviews and focus groups may be given to the Housing Authority of the City of Austin. The data or samples that we will collect about you will not be shared with any other researchers.

We plan to publish the results of this study. To protect your privacy, we will not include any information that could directly identify you.

What will happen to the information we collect about you after the study is over?

We will not keep your research data to use for future research or other purposes. Your name and other information that can directly identify you will be deleted from the research data collected as part of the project.

How will we compensate you for being part of the study?

You will not receive any type of payment for your participation.

Your Participation in this Study is Voluntary

It is totally up to you to decide to be in this research study. Participating in this study is voluntary. Your decision to participate will not affect your relationship with The University of Texas at Austin or the Housing Authority of the City of Austin. You will not lose any benefits or rights you already had if you decide not to participate. Even if you decide to be part of the study now, you may change your mind and stop at any time. You do not have to answer any questions you do not want to answer.

If you decide to withdraw before this study is completed, the researcher will delete all of the data that has been collected from you.

Contact Information for the Study Team

If you have any questions about this research, you may contact:
Trent Sharp

Phone: (512) 789-0634
Email: trentsharp@gmail.com

Contact Information for Questions about Your Rights as a Research Participant
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If you have questions about your rights as a research participant, or wish to obtain information, ask questions, or discuss any concerns about this study with someone other than the researcher(s), please contact the following:

The University of Texas at Austin Institutional Review Board
Phone: 512-232-1543
Email: irb@austin.utexas.edu

Please reference study number 2019-02-0008.

Your Consent

By signing this document, you are agreeing to be in this study. We will give you a copy of this document for your records. We will keep a copy with the study records. If you have any questions about the study after you sign this document, you can contact the study team using the information provided above.

I understand what the study is about and my questions so far have been answered. I agree to take part in this study.

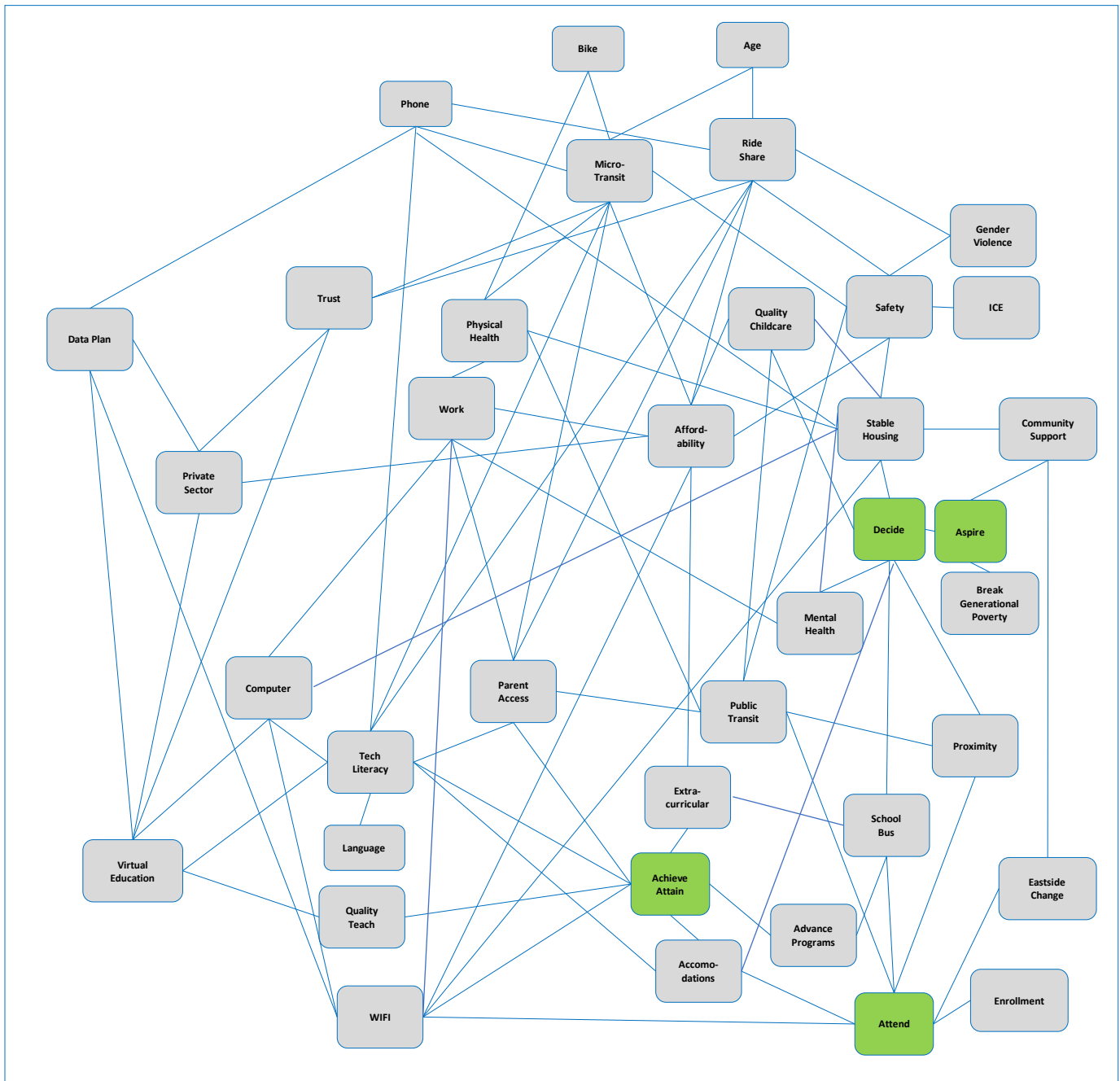
Printed Subject Name

Signature

Date

Appendix G

Summary Thematic Map



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