DIS/ABLING MOBILITIES:
URBAN-RURAL EXPERIENCES OF IMPAIRMENT & WELL-BEING

BY

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DISSERTATION

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ABSTRACT

This dissertation is comprised of three papers that, as a unit, study the geographic patterns and processes that influence the well-being and mobility of people with disabilities in the U.S. The *first paper* investigates the relationship between welfare reform and the geographies of disability across the U.S. Using GIS and statistical methods to analyze aggregated county-level data, I examine enrollment trends in the Supplemental Security Income (SSI) program in 2000 and 2010, two points in time in the post-1996 welfare reform period. I produce empirical evidence to support the medicalization of welfare, in which access to welfare-related benefits is increasingly contingent on a medical diagnosis of disability. I also uncover SSI hot spots in parts of the southeast, Appalachia, and northern California, and these hot spots are largely rural. The findings suggest that political and economic conditions specific to these rural localities are driving spatial concentrations of disability, poverty, and un(der)employment.

The *second* and *third papers* investigate the individual experiences of residents in the San Francisco Bay Area who have vision loss as they navigate the urban built environment. In the *second paper*, I utilize a qualitative space-time framework to analyze interview transcripts, seeking to understand how the combined effects of space and time impact the everyday mobilities of individuals who are visually impaired (VI). I find that people who are VI negotiate significant space-time constraints that are conditional on their access to transportation, assistive technology, and mobile devices. The temporal dimension of mobility is especially notable, as the timing of transit schedules, work hours, and social events shapes when and where people can travel and what activities they can participate in.

In the *third paper*, I evaluate the applicability of well-established activity space measures for representing the mobilities of people who are visually impaired. First, I employ GIS to map and visualize the activity spaces of participants based on three measures: standard deviational ellipse, network buffer, and potential path area. Then, I use statistical methods to compare the area sizes of these three types of activity spaces. Finally, I compare the activity space results to a qualitative analysis of individuals' travel behaviors and their perceptions about the accessibility of their environments. A comparison of results from both quantitative and qualitative methods reveals that popular activity space measures have significant shortcomings for summarizing the daily travels of individuals who are VI. Widely-used activity space models assume that individual accessibility depends only on distance and time from locations and travel routes, overlooking other factors that cause many urban and suburban environments to be inaccessible to individuals with vision loss.

This dissertation contributes to the existing disability literature by foregrounding the influence of geographic context in mobility and access, applying and evaluating spatial analytic techniques for understanding the geographies of disability, and studying the structural and individual dynamics affecting welfare enrollment, personal well-being, and mobility. The findings suggest a need for developing policies specific to people with disabilities that: (1) improve their employment outcomes to reduce their need for welfare assistance and (2) expand their transportation options to increase their daily mobilities and access to resources. Future research directions include in-depth case studies to better understand how the medicalization of welfare is experienced in rural localities, activity space modeling that combines quantitative and qualitative methods, and mapping (in)accessible spaces to better address the spatial obstacles faced by people with disabilities.

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CHAPTER 1

INTRODUCTION

Despite the passage of the 1990 Americans with Disabilities Act (ADA) in the U.S. that prohibits discrimination against people with disabilities, most individuals continue to encounter tremendous difficulty navigating everyday spaces and gaining access to well-paid employment. To date, there is little evidence to demonstrate that the ADA has improved the economic well-being of people with disabilities. Recent statistics suggest that inequalities in employment and household income between adults with work-limiting disabilities and those without any disabilities have steadily increased from 1990 to 2013 (Fessler, 2015). Compared to people with no disabilities, individuals who experience disablement are more likely to face unemployment and poverty and enroll in government assistance programs (Houtenville et al., 2014). As a result, people with disabilities are at a higher risk of experiencing social isolation and poor physical and psychological health, further complicating their career development and employment opportunities (Strauser, 2014).

This dissertation is a three-part investigation into the geographic patterns and processes that influence the well-being and mobility of people with disabilities in the U.S. It draws from and contributes to the growing subfield of disability geography as well as the larger fields of rehabilitation and disability studies. Social science and health researchers have long examined a diversity of biological, social, and environmental influences on the welfare of people with disabilities, and geographers' entrée into disability studies is relatively new (Park et al., 1998). Until recently, geographic context has been overlooked in disability research or characterized as a static, passive setting where social processes take place (Dyck, 2010; Park et al., 1998). In

contrast, this research foregrounds place and space in the relationships between disability, well-being, and mobility. Geographic context refers to the spatial patterns and processes of people's lives, particularly how individuals occupy and use space. Space is critical to the lived experience of disability as space actively creates and strengthens social processes that continue to marginalize individuals with disabilities (Gleeson, 1999). Geographers have long argued that space is produced by the interactions between people, institutions, and structures. Moreover, the production of space is a socially contested process that has historically marginalized people with disabilities, who continue to be excluded from the planning practices and discourses that shape their physical surroundings (Gleeson, 1999; Imrie, 2013).

1.1 Disability, Geography, & Geographic Information Science

In geography, two focal and distinct approaches have been undertaken to analyze the experience of disability. One is a behavioral approach that examines how individuals with sensory disabilities learn and store spatial information to map their travels cognitively, and how that process translates to their physical navigation of the built environment (Golledge, 1993; Kitchin et al., 1997; Marston et al., 1997). In this research area, behavioral geographers are interested in the development of accessible technological applications for improving the mobility of people with disabilities (Golledge et al., 1998; Marston et al., 2007). As an example, an early geographic study on visual impairment found the most critical mobility issue to be a lack of information about the spatial layouts of destinations and travel routes (Marston et al., 1997). One proposed solution to these limitations is to improve access to technological aids that provide more tactile and auditory information to individuals about their surrounding environments (Golledge, 1993; Marston et al., 1997).

Drawing from social theory, other geographers utilize a socio-political approach to understanding the experience of disability. Social geographers recognize the social construction of disability and how becoming disabled is a process rooted in ableist politics and discourses (Chouinard et al., 2010; Crooks et al., 2008; Park et al., 1998; Pow, 2000). Ableism is prejudice and discrimination against people with disabilities. In geography, one stream of research analyzes the socio-political construction of disability in relation to the built environment (Chouinard et al., 2010). As an example, Imrie (2013) highlights the role of inaccessible built environments in the UK in impeding the mobility of pedestrians who are visually impaired. He interrogates the shared space design, which eliminates traditional street features that people with canes use to navigate the built environment, such as pavements and curbs. Consequently, this new urban development further spatially and socially marginalizes individuals who are visually impaired. Improving people's mobility and their access to public spaces continue to be critical issues for empowering people with disabilities and expanding their societal participation (Park et al., 1998). There is still a need for research that identifies and addresses barriers in the built and social environments for people with disabilities.

Compared to disability research in behavioral and social geography, there is relatively little contemporary scholarship at the intersection of geographic information science (GIS) and disability. GIS has been used to develop wayfinding technology, examine spatial patterns of unemployment and rehabilitation service access, and create databases of resources for people with disabilities. Early work by behavioral geographers included the integration of geographic information systems with global positioning systems (GPS) in portable devices to provide real-time wayfinding assistance to travelers who are visually impaired (Golledge, 1993; Golledge et al., 1998). In more recent endeavors, other scholars utilized GIS to analyze spatial variations and

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concentrations of area economic factors to understand unemployment trends of people with disabilities (Botticello et al., 2012; Metzel & Giordano, 2007) as well as differential access to rehabilitation services (Passalent et al., 2013). In emergency management and disaster response, GIS is used to build a database of resources specific to the needs of people with disabilities (Enders & Brandt, 2007). However, the list of published studies that use GIS in understanding geographic patterns and processes of disability is very sparse, especially considering the number of people who face disability-related challenges. In the U.S., approximately 19% of people have a disability (Census Bureau, 2012), creating a great deal of potential for productive, high impact research at the juncture of disability and GIS. GIS can provide valuable insights into people's habitation and negotiation of space and into the political and economic processes at various scales that shape their experiences and well-being. Critical issues that would benefit from GIS include people's enrollment in disability assistance for survival and their everyday (im)mobilities in urban environments.

In addition to using GIS to understand everyday experiences and geographic contexts for people with disabilities, few researchers have examined the validity and accuracy of widely-used GIS-based models for capturing the mobility experiences of people with disabilities. Activity spaces are extensively used to model people's potential mobility and accessibility, or the spatial extent of where they can travel (Kamruzzaman et al., 2011; Li & Tong, 2016; Patterson & Farber, 2015), but few studies examine how living with a disability affects individuals' activity spaces. A couple of notable examples include Casas (2007) and Townley et al. (2009). Casas (2007) used accessibility measures to reveal that people with disabilities have lower mobilities and access to opportunities compared to individuals with no disabilities. Townley et al. (2009) found larger activity spaces to be positively associated with better life assessments among people

with serious mental illness. More work is needed on the activity spaces of people with disabilities, and qualitative methods can be combined with GIS for model selection and validation (Kamruzzaman et al., 2012; Patterson & Farber, 2015).

1.2 Chapter Overviews

The three dissertation papers contribute to the existing disability literature by foregrounding the influence of geographic context, applying spatial analytic techniques, and investigating both structural and individual factors in the relationships between disability, well-being, and mobility. In *Chapter 2* – which examines the relationship between welfare reform and the geographies of disability – I utilize GIS to reveal uneven geographic trends and I implicate the welfare state regime in the development of asymmetrical spatial outcomes across different localities. I draw on the political economy of health and produce new empirical evidence to support the ongoing trend on the medicalization of welfare, in which access to welfare is increasingly conditional on a medical diagnosis of disability. In *Chapter 3* – which uses a qualitative space-time framework for analyzing the effects of space and time on the mobilities of individuals who are visually impaired – I draw from approaches from both behavioral and social geographers. I consider both the individual behaviors used to navigate the urban built environment as well as the social milieu that structures mobility and access. The findings deepen our current understandings on the relationship between disability and mobility. *Chapter 4* – which assesses the applicability of well-established activity space measures to the travel experiences of people who are visually impaired – is a mixed quantitative and qualitative methods project. It contributes to the existing literature in two ways. In evaluating the activity spaces of individuals who are visually impaired, I draw attention to the unique travel experiences

and accessibility issues of a socially marginalized and often overlooked group. A second contribution is to demonstrate that the triangulation of results from both quantitative and qualitative methods generates different and complementary inferences about people's travel experiences and the accessibility of their environments. For Chapters 3 and 4, study participants' eye sights span the range of vision loss, from moderate to severe visual impairment.

Altogether, the three chapters examine the well-being and mobility of people with disabilities at two distinct geographic scales in the U.S.: at the national scale using aggregated county-level data and at the metropolitan scale using individual data. The metropolitan case study is the San Francisco Bay Area, a region that has historical symbolic and material significance for the disability community. Multiple methods are utilized: survey questionnaires, statistical techniques, GIS, semi-structured interviews, mobile interviews, and qualitative analysis. The three papers examine in more quantitative and qualitative detail the extent to which place, space, distance, and time impact the well-being and mobility of people with disabilities.

1.2.1 Chapter 2: Geographies of medicalized welfare: Spatial analysis of Supplemental Security Income in the U.S., 2000-2010

This chapter, published in *Social Science and Medicine* (Wong, 2016), examines county-level Supplemental Security Income (SSI) enrollment trends and spatial clusters across the U.S. in 2000 and 2010. The content of this dissertation chapter is slightly modified from the published version to reflect comments from my doctoral committee members. In this chapter, I provide a snapshot of how welfare reform has shaped the geographies of disability, unemployment, and poverty. In the post-1996 welfare reform period in the U.S., disability assistance has become a significant source of government aid for low-income residents as other forms of public support

have faced considerable reductions and restrictions (Berkowitz & DeWitt, 2013; Hansen et al., 2014; Joffe-Walt, 2012; O'Brien, 2015). SSI is a disability assistance program that provides income stipends to eligible U.S. residents. To qualify for SSI, working-age individuals with disabilities must have (1) little income and resources and (2) procure medical documentation that confirms that they are unable to work due to a disability.

One consequence of rising SSI enrollment, as other government assistance programs face cutbacks, is the *medicalization of welfare*, whereby receipt of welfare benefits is increasingly contingent on a medical diagnosis of disability (Hansen et al., 2014; O'Brien, 2015). While the medicalization of welfare is well-established (Hansen et al., 2014; O'Brien, 2015), there are no studies on the variability in geographic and demographic experiences. Welfare policies and practices have uneven outcomes across different regions within the same country (Cope & Gilbert, 2001); thus, it is critical to uncover the geographic variation in SSI enrollment as a first step towards understanding how the medicalization of welfare differentially impacts communities across diverse places. While contributing to recent research on the medicalization of welfare, this chapter also builds on older studies that explored SSI spatial patterns (McCoy et al., 1994; McVicar, 2006; Perrin et al., 1998) and assessed covariates of SSI participation (Black et al., 2002; McGarry, 1996). This paper offers new empirical findings to support and complicate the medicalization of welfare by examining spatial variation in and statistical correlates of county-level SSI enrollment of the working-age population at two points in time in the post-1996 welfare reform period: 2000 and 2010.

I use county-level demographic and socioeconomic data from the American Community Survey and the Bureau of Labor Statistics and SSI data from the Social Security Administration to analyze statistical and spatial patterns of SSI participation. There are two main findings from

the analyses. First, with multiple linear regression models, I found that SSI participation is significantly correlated with county-scale rates of disability, poverty, race, family type, and level of education in both 2000 and 2010. I also found that percent change in SSI enrollment from 2000 to 2010 has a significant inverse correlation with percent change in employment over the same time period. The statistical results reveal strong ties between SSI enrollment and various measures of population vulnerability, disability, and economic decline – findings that generally confirm those in previous studies. Second, with GIS mapping and the application of univariate LISA (Local Indicators of Spatial Association), I found both overall growth in SSI participation across the U.S. and significant hot and cold spots in SSI participation in both 2000 and 2010. Distinctive spatial clusters of higher than average SSI participation are located in the southeast and Appalachian regions of the U.S. and in northern California. Spatial clusters of lower than average SSI participation are in the Midwest and Mountain States. These findings demonstrate that spatial concentrations of disability and poverty persist in largely rural areas. Additionally, the hot and cold spots in distinctive geographic regions suggest a heterogeneity of experiences in the medicalization of welfare, complicating the existing narrative that there is a ubiquitous development in the rising medicalization of welfare (Hansen et al., 2014; O'Brien, 2015). The paper ends with a discussion on the likely social and economic implications of long-term SSI clustering on localities and residents. It also suggests future directions for research and policy to improve the lives of poor, underemployed people with disabilities.

1.2.2 Chapter 3: Traveling with blindness: A qualitative space-time approach to understanding visual impairment and urban mobility

This chapter uses a space-time approach to produce new insights into the everyday mobilities of individuals who are visually impaired in the San Francisco Bay Area. I draw from Hägerstrand's space-time framework to analyze qualitative data collected from sit-down and mobile interviews. Apart from McQuoid et al. (2015), who analyzed the logistical challenges of balancing work and health-related activities for people with chronic kidney disease, there has been little contemporary research that employs Hägerstrand's three space-time constraints to qualitatively examine the mobilities of people with disabilities. By utilizing this approach, this paper generates conceptual and practical insights for improving the lives of people who are visually impaired (VI). In particular, it sheds light on the barriers impeding people's mobility and their access to workplaces and public transportation, as well as other places and resources essential to their economic, social, and physical well-being.

This paper bridges the behavioral and social approaches to disability geography by using a qualitative space-time framework to analyze the effects of space and time on the everyday travels of people who are VI. While I directly draw from and expand on the earlier work of behavioral geographers, my approach also considers the social contexts that enable or disable individual mobility. These include people's negotiations with rehabilitation agencies to access assistive technologies and with sighted strangers as they navigate the built environment. This paper also builds on previous studies by examining an urban case study. It investigates the experiences of individuals residing in a major metropolitan region with a dense transit network. In contrast, prior research by behavioral geographers assessed the spatial cognition of people who are VI in small cities or small spaces such as building corridors (Kitchin et al., 1997; Marston et al., 1997).

I analyze data collected from 13 sit-down, semi-structured interviews and eight mobile interviews. Interview transcripts and notes were coded, with initial codes grouped into main themes. The main findings are that the space-time constraints of people who are VI are closely linked to their access to transportation options and assistive and mobile technologies. Additionally, individual space-time constraints are subject to dynamic and relational changes in personal circumstances, social attitudes, built environments, and assistive technologies. In employing a qualitative space-time approach, this paper expands on conventional quantitative approaches that draw from Hägerstrand's framework. In doing so, this chapter deepens our understandings on the relationship between health and mobility, and provides practical intervention opportunities for improving the quality of life of people who are VI. Future directions are discussed for enabling the mobilities of individuals who are visually impaired.

1.2.3 Chapter 4: Activity spaces & visual impairment: A case study in the San Francisco Bay Area

This chapter (1) evaluates the activity spaces of 31 individuals who are visually impaired (VI) in the San Francisco Bay Area and (2) compares the activity space results to qualitative information about individuals' travel behaviors and their perceptions about the accessibility of their environments. Activity space methods are often used to measure the physical spaces that individuals travel through and have access to over the course of their daily activities. This paper contributes to the existing activity space literature by highlighting the activity spaces of individuals with vision loss and using mixed quantitative and qualitative methods to determine how well existing activity space models describe spatial access to opportunities for people who are VI. Apart from a couple of notable studies (Casas, 2007; Townley et al., 2009), activity space

measures have rarely been used to examine the mobility of people with disabilities, who often encounter difficulties accessing transportation and navigating the built environment. As a result, there is inadequate spatial information about the places that are inaccessible to people with disabilities. To date, no studies have used activity spaces to analyze the mobilities of individuals who are VI. Additionally, researchers have yet to compare results from activity space measures to people's perceived accessibility as a means of model validation (Patterson & Farber, 2015; Kamruzzaman et al., 2012).

Recent computational advancements coupled with the development of accessible software tools have driven the application of activity space measures in transport geography, demography, and health research (Matthews & Yang, 2013; Patterson & Farber, 2015). While by definition activity space refers to an individual's *actual accessibility* – the spaces they access on a daily basis – activity spaces are often used to summarize an individual's *potential accessibility* – the spaces they are able to reach given the fixed time-space constraints of daily activities (Patterson & Farber, 2015). As use of activity spaces for representing potential accessibility increases, it is critically important to evaluate the validity and accuracy of well-established activity space measures: Do these measures accurately depict the spaces people have access to on a daily basis? For this paper, three widely-used activity space measures are assessed: the standard deviational ellipse, network buffer, and potential path area (Patterson & Farber, 2015; Perchoux et al., 2013; Sherman et al., 2005).

This mixed quantitative and qualitative methods project maps individuals' activity spaces from travel diaries based on the three activity space measures and analyzes participants' travel behaviors and perceptions from interviews. The main outcome is that there are significant shortcomings in existing activity space measures for representing the experiences of people who

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are VI. This is supported by a couple of results. First, the area sizes of individuals' activity spaces vary greatly with each activity space measure, leading to different conclusions about the areas that are accessible and inaccessible to individuals. Second, the qualitative results reveal that individuals perceive an asymmetrical landscape of accessibility across the environments that they travel through. These asymmetries emerge from individuals' perceptions and experiences of everyday landscapes, their reliance on fixed transit routes and schedules, and their use of navigation technologies that direct them unevenly through space. These asymmetries conflict with assumptions in activity space measures, which consider accessibility to be based solely on distance and time from activity locations and travel routes while neglecting other critical factors. These findings indicate a need for differential weighting of activity locations and travel routes and for incorporation of local barriers (or facilitators) to travel. In general, this paper provides empirical support for activity space research that incorporates both quantitative and qualitative methods to better understand how places become accessible and how people experience mobility and transport disadvantages.

1.2.4 Chapter 5: Conclusion

This chapter provides a synopsis of the major research findings and implications from the dissertation papers, which altogether demonstrate the critical role that geography plays in analyzing and understanding disability issues. I summarize my research contributions to the existing literature on the political economy of health, space-time constraints, mobility and access, and GIS. Then I discuss my dissertation's limitations and policy implications. I conclude with recommendations for future research in disability geography.

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CHAPTER 2

GEOGRAPHIES OF MEDICALIZED WELFARE:

SPATIAL ANALYSIS OF SUPPLEMENTAL SECURITY INCOME IN THE U.S.,

2000-2010[1,2]

Abstract

In the post-1996 welfare reform period in the U.S., disability assistance has become a significant

source of government aid for low-income residents as other forms of public support have faced

considerable reductions and restrictions. In order to qualify for Supplemental Security Income

(SSI) – a means-tested assistance program that provides income stipends to qualified residents –

working-age individuals with disabilities must have little income and resources, and procure

medical documentation that confirms that they are unable to work due to a disability. The result

of rising SSI enrollment in the face of cutbacks to other government programs is the increasing

medicalization of welfare, whereby receipt of welfare benefits is contingent on a medical

diagnosis of disability. Using county-level data from the American Community Survey, the

Social Security Administration, and the Bureau of Labor Statistics, this paper examines the

changing spatial patterns of SSI participation of the working-age population in 2000 and 2010

across the U.S. in addition to the interconnections between disability, welfare, and poverty.

Results from spatial analyses illustrate geographic variation in SSI prevalence, with distinctive

spatial clusters of higher than average SSI participation in the southeast and Appalachian regions

of the U.S. and in northern California. Multiple linear regression model results reveal that SSI

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[1] Most of this chapter was previously published in 2016 in *Social Science & Medicine*. I am the sole author. Elsevier, the copyright owner, allows authors to include their articles in their dissertation. Compared to the published paper, this chapter has minor modifications to reflect feedback from my doctoral committee members.
[2] Wong, S. (2016). Geographies of medicalized welfare: Spatial analysis of Supplemental Security Income in the U.S., 2000 – 2010. *Social Science & Medicine*, 160, 9-19.

participation is significantly correlated with disability, poverty, race, family type, and level of

education in both 2000 and 2010; and that change in SSI enrollment is significantly correlated

with change in employment from 2000 to 2010. The findings suggest that spatial concentrations

of disability, poverty, and underemployment persist in largely rural areas. The discussion

explores the potential social and economic implications of long-term SSI clustering on localities

and residents, and points to future research directions.[3]

2.1 Introduction

When President Clinton signed the Personal Responsibility and Work Opportunity Act

(PRWORA) into law in 1996, cash support to poor families was dramatically restricted in an

effort to increase labor market participation among welfare recipients. Under PRWORA,

Temporary Assistance for Needy Families (TANF) replaced Aid to Families with Dependent

Children (AFDC) and stipulated a five-year ceiling on benefits within a recipient's lifetime

(Hansen et al., 2014). As TANF went into effect and low-income families concurrently reached

their benefit cap and experienced limited success in securing employment, Supplemental

Security Income (SSI) became an increasingly critical source of financial support because it has

no lifetime ceiling and offers greater cash payments than TANF (Hansen et al., 2014; Wamhoff

& Wiseman, 2005/2006). While TANF does not have a disability requirement, SSI eligibility is

based on both income and disability. Working-age individuals must meet two requirements in

order to qualify for SSI. First, they must not earn a monthly income above a low threshold and

they must have few assets. Second, they are required to obtain medical documentation that

confirms that they are unable to work due to a disability (Berkowitz & DeWitt, 2013).

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[3] This paper should not be misconstrued as an endeavor to analyze and explain poverty, a socially constructed condition of material deprivation. Rather, this paper is a study of SSI, a government program that provides income support for some low-income individuals who meet specific institutional definitions of poverty.

While illness-testing has been used in the U.S. as an eligibility requisite for the receipt of many social welfare benefits for decades (Berkowitz & DeWitt, 2013; Stone, 1979), medicalized welfare (specifically SSI) in the post-1996 welfare reform period has developed in a distinctive capacity within distributive politics: SSI has become an increasingly important economic safety net for low-income adults and families in the face of cutbacks to other means-tested welfare programs (Berkowitz & DeWitt, 2013; Hansen et al., 2014; O'Brien, 2015). In recent years, the largest and fastest growing group of SSI recipients are individuals with psychiatric disabilities and chronic pain. A growing proportion of beneficiaries are poor individuals facing economic adversity, who apply for SSI on the basis of a mental health diagnosis as a critical survival strategy (Hansen et al., 2014; Joffe-Walt, 2012; O'Brien, 2015). In this paper, the term *medicalization of welfare* is used to describe the increased necessity to procure a medical diagnosis of disability in order to receive welfare benefits in the post-1996 welfare reform era (Hansen et al., 2014; O'Brien, 2015). *Medicalized welfare* is used to refer to SSI in the U.S. and disability-tested government assistance elsewhere.

While the growing medicalization of welfare in the U.S. is well-established (Hansen et al., 2014; O'Brien, 2015), variability in geographic and demographic experiences with medicalized welfare is not well-studied. Welfare policies and practices have uneven outcomes across different regions within the same country (Cope & Gilbert, 2001); thus, it is critical to uncover the geographic variation in SSI enrollment as a first step towards understanding how the medicalization of welfare impacts communities across different places. A few studies have explored SSI spatial patterns (McCoy et al., 1994; McVicar, 2006; Perrin et al., 1998) and assessed covariates of SSI participation (Black et al., 2002; McGarry, 1996), but they are largely dated and examine geographic trends at the scale of the state. This paper offers new empirical

findings to the existing literature by examining spatial variation in and statistical correlates of county-level SSI enrollment of the working-age population at two points in time in the post-1996 welfare reform period: 2000 and 2010. Three main questions guide this paper:

1. What are the spatial patterns of SSI and public assistance receipt at the scale of the county, and how do they change over time?

2. Where is county-level SSI enrollment much higher and lower than the national average, and does regional variation differ over time?

3. At the county level, what demographic and socioeconomic covariates correlate with SSI participation, and how do they shift over time?

2.2 Background & Significance

2.2.1 Disability trends

Approximately 15% or one billion of the world's population experiences disability (Kostanjsek et al., 2013). In the U.S., nearly 10.3% or 19 million of the population ages 18-64 have a disability (Houtenville et al., 2014). According to a 2008-2010 U.S. survey, cognitive disability is more common among individuals younger than 40 while physical disability is more prevalent among those who are 40 years and older. Labor market participation varies by type of disability: individuals with ambulatory and cognitive disabilities both have similar rates of employment at 25%, while those who are visually impaired have an employment rate of 38% and individuals with hearing impairment have an employment rate of 50% (Houtenville et al., 2014).

Compared to people with no disabilities, individuals who experience disablement are more likely to face unemployment and poverty (Houtenville et al., 2014). In many developing countries, working-age people with disabilities have significantly lower employment rates and

higher poverty status compared to those with no disabilities (Mitra et al., 2011). Most developing

countries provide social insurance to individuals in the event of a disability, but it is usually

restricted to workers employed in the formal sector (Mitra, 2005). Trends are similar in

developed countries. In Canada, individuals with a disability participate less in the labor market

and are at a greater risk of having persistently low income (Galarneau & Radulescu, 2009). Both

public and private programs that provide income support to Canadian residents with disabilities

have expanded over time (Campolieti & Lavis, 2000). In the United Kingdom, half of adults with

disabilities are employed while 80% of those who are not disabled are employed (Hall & Wilton,

2011). Moreover, large numbers of working-age individuals with disabilities in the United

Kingdom receive incapacity benefits (Lindsay & Houston, 2011). In the U.S., working-age

people with disabilities are half as likely to be employed and twice as likely to be poor compared

to those with no disabilities (Houtenville et al., 2014). The majority of individuals with

disabilities in the U.S. receive income from government programs, including SSI (Houtenville et

al., 2014; Stapleton et al., 2006).

In 2001, the World Health Organization (WHO) introduced a new health classification

system called the International Classification of Functioning, Disability, and Health (ICF) in

order to better model the experience of disability (Cerniauskaite et al., 2011). The ICF reflects

broader philosophical changes in the societal conception of disease and disability; it is a

classification of health rather than of disease, and it defines disability as relational to personal

and environmental factors rather than as a purely medical condition. Both individual and societal

conditions are recognized as major influences in the process of disablement (Cerniauskaite et al.,

2011).

In the U.S., individuals with disabilities who are negotiating the low-wage labor market are particularly vulnerable, not just because of their health condition but also due to deregulated labor markets that devalue their labor (Hansen et al., 2014; Joffe-Walt, 2012). Such individuals face two dilemmas. One is to work and earn poverty-level wages. Some may receive in-kind supports, but this is unusual. The alternative option is to drastically cut their work hours or not work at all, enroll in public assistance, receive in-kind benefits, and collect poverty-level stipends (Stapleton et al., 2006). Both choices lead to poverty, but the latter choice is more favorable because government assistance provides a more stable source of income and benefits than employment in the contingent, low-wage labor market. It is under such political-economic circumstances – in addition to diminished options in the social safety net – that the medicalization of welfare has developed (Hansen et al., 2014; Joffe-Walt, 2012).

2.2.2 Geography of welfare

Welfare reform measures in many Western countries have led, in varying degrees, to spending cuts, stricter eligibility criteria, more stringent stipulations on benefit receipt, lesser benefits, and lower levels of social and economic security (Hamnett, 2014; McAllister et al., 2015; Peck, 2001; Ploug, 1999). In the U.S., United Kingdom, Canada, Australia, New Zealand, and Denmark there is a general trend toward workfare, where welfare recipients are required to work in order to receive benefits. These more work-oriented welfare developments are intended to maximize paid employment and minimize welfare dependency (Hamnett, 2014; McAllister et al., 2015; Peck, 2001). The retrenchment of the welfare state affects regions unevenly, with localities of high welfare dependency shouldering most of the impact from budget cuts. In the U.S. and United Kingdom, the areas that are hit hardest are usually deindustrialized regions with

inadequate job opportunities and limited socio-political abilities to cope with welfare reform (Hamnett, 2014; Miewald, 2001).

Medicalized welfare programs in liberal welfare states have increasingly incorporated workfare policies, but they have had limited success in improving labor market participation because they focus on an individual's responsibility to work and neglect to address the structural barriers to employment for people with disabilities (Harris et al., 2012). In the United Kingdom, welfare recipients with disabilities are partitioned into a hierarchy of three groups by their work capacity, which is based on medical assessments. Individuals who have the ability to work must participate in work-focused interviews and employment services in order to receive their full benefits. Otherwise, they face a reduction in benefits. In Australia, beneficiaries with a disability undergo a similar medical assessment to determine their work capacity. The higher their work capacity, the lower their benefits. In the U.S., all disability recipients are eligible to participate in a voluntary workfare program, but it has failed to meaningfully increase participants' employment and employability (Harris et al., 2012). It is under workfare regimes in certain liberal welfare states that the medicalization of welfare continues to develop, as evident in the large numbers of incapacity benefits recipients in the United Kingdom who represent 'unemployment hidden as sickness' (Lindsay & Houston, 2011) and SSI claimants in the U.S. who are enrolled in SSI on the basis of mental disability because it is the best means to avoid destitution (Hansen et al., 2014; Joffe-Walt, 2012).

In the post-1996 welfare reform period in the U.S., the rapid expansion of the SSI program is partly explained by restrictions and reductions in other major welfare programs such as TANF (Hansen et al., 2014; Wamhoff & Wiseman, 2005/2006). Adverse labor market conditions also drive demand for SSI, by leading to job loss or decreased work opportunities for

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people with disabilities and compelling them to apply for disability assistance programs like SSI (Rupp, 2012). Cash benefits and access to Medicaid health coverage are strong incentives to apply for and remain on SSI (Rupp et al., 2008). Higher punitive measures in means-tested assistance programs like TANF, limited work opportunities in deregulated labor markets, and the economic security of SSI benefits altogether contribute to growing SSI enrollment and the medicalization of welfare (Hansen et al., 2014; Rupp, 2012; Wamhoff & Wiseman, 2005/2006).

SSI and Social Security Disability Insurance (SSDI) are two vitally important disability assistance programs in the U.S. (Berkowitz & DeWitt, 2013; Stone, 1979). While both utilize the same disability determination procedures, SSDI only disburses benefits to individuals who have worked long enough and contributed sufficient Social Security taxes within a recent time period. SSI is based on financial need rather than on Social Security contributions (Berkowitz & DeWitt, 2013; Houtenville et al., 2014). In order to investigate trends in the medicalization of welfare in the U.S., this paper focuses on the welfare-oriented SSI program over the work-related SSDI program.

While it is recognized that welfare policies and practices have uneven outcomes across different regions within the same country (Cope & Gilbert, 2001; Hamnett, 2009), little is known about the spatial trends of SSI prevalence and the relationship between SSI and socioeconomic factors like class, gender, and race. The existing literature mainly relies on descriptive mapping of trends at the national or state scale, and many studies use dated information from the pre-welfare reform era (Black et al., 2002; McCoy et al., 1994; McVicar, 2006; Perrin et al., 1998). These studies found that SSI recipients were geographically concentrated in the southeastern U.S. (McCoy et al., 1994), and that unemployment characterizes the experience of most SSI participants (Black et al., 2002; McVicar, 2006). For 1989 and 1992, poverty rates accounted for

most of the state-level variance in SSI enrollment for children (Perrin et al., 1998). This paper contributes to the existing literature by utilizing more sophisticated spatial analytic techniques to better identify geographic patterns, presenting results in the post-1996 welfare reform period, and by evaluating trends at the county level to reveal uneven variation within states. This is a first step towards unpacking the uneven experiences in the medicalization of welfare across different geographic regions and demographic groups in the U.S.

2.3 Data & Methods

2.3.1 Data

To follow changes in SSI participation of the working-age population in the post-1996 welfare reform period, SSI, public assistance (specifically TANF and General Assistance), and demographic data for 2000 and 2010 were used in the analysis. Publicly available county-level data on SSI participation of individuals ages 18-64 years and total yearly payments were obtained from the Social Security Administration (Social Security Administration, 2014) for all U.S. counties. Data on the demographic and socioeconomic characteristics of county populations were drawn from the 2000 U.S. Census, the 2008-2012 five-year (2010 estimate) American Community Survey (ACS), and the Bureau of Labor Statistics' 2000 and 2010 Quarterly Census of Employment and Wages. The ACS is conducted every year by the U.S. Census Bureau (U.S. Census Bureau, 2015). Variables selected for inclusion in the analyses are percent households on public assistance income (TANF or General Assistance), percent disability (of individuals 18-64 years of age), percent poverty (of individuals 18-64 years of age), percent unemployed (of individuals 18-64 years of age), percent female-headed households with children (of total households), percent non-Hispanic white (of individuals 18-64 years of age), percent less than

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high school education (of individuals 18-64 years of age), and total employment. General Assistance (GA) is state-level aid to individuals and families who are ineligible for major assistance programs – including TANF – but whose benefits from other programs are not enough to meet basic needs. The Census Bureau datasets do not distinguish TANF from GA income receipt.

The 2000 Census and the 2008-2012 ACS have different questions regarding disability (Brault, 2009). Recognizing that the definition of disability was changing and informed by ICF's conceptual framework of disability, the Census modified the type and wording of survey questions on disability beginning with the 2008 ACS. The 2000 Census contains questions regarding six disability concepts: sensory disability (vision or hearing), physical disability, cognitive difficulty, self-care difficulty, independent living difficulty, and employment difficulty. The 2008-2012 ACS includes questions that cover six types of disability: hearing difficulty, vision difficulty, cognitive difficulty, ambulatory difficulty, self-care difficulty, and independent living difficulty. One major difference is that the 2008-2012 ACS does not measure employment difficulty (for the actual wording of the questions, see Brault, 2009). For both surveys, the responses are self-reported without the aid of instruments. If a respondent, or a proxy respondent, answers yes to having any one of these difficulties, then the person is considered to have a disability (Brault, 2009).

Researchers disagree over which set of survey questions more accurately estimates disability prevalence. According to the Census Bureau, the disability questions in the 2008-2012 ACS have better response rates and reliability compared to questions in the 2000 Census. The newer questions also result in lower estimates of disability prevalence, reflecting both measurement differences and real changes in disability status (Brault, 2009). Burkhauser et al.

(2014) contend, however, that the newer questions underestimate the actual prevalence of disability as well as the population receiving SSI or SSDI by excluding questions related to employment difficulty. Recognizing these measurement issues, this paper will take care not to overstate results involving disability prevalence.

The variables female-headed households and non-Hispanic white were included because welfare participation in the U.S. has longstanding racial and gender dimensions (Smith, 2007). The majority of TANF families are single parent households and most single parents are mothers. Additionally, African Americans and Latinos are overrepresented in the TANF program (Smith, 2007). If families on TANF are shifting to SSI, then it is expected that family type and the racial composition of county populations will become more strongly associated with county-level SSI participation over time.

Three variables were calculated from the original data collected. One is average monthly SSI stipend for counties, which was computed by dividing the total yearly payment by the total number of SSI recipients and then dividing by 12 months in a year. A second variable is SSI location quotient for the working-age population. Location quotient is a technique that allows for the comparison of local area characteristics to national level ones (Robinson, 1998). For this paper, SSI location quotients for the working-age population were calculated by dividing percent SSI of the total 18-64 year old population in the county by percent SSI of the total 18-64 year old population nationally. If the location quotient is less than one, then the county has proportionately fewer working-age SSI recipients than at the national level; conversely, a location quotient greater than one indicates that a county has proportionately higher working-age SSI beneficiaries compared to the national average. A third variable is percent change in total

employment from 2000 to 2010, which was calculated by subtracting total employment in 2000 from 2010, and then dividing by total employment in 2000.

2.3.2 Methods

The county-level analyses proceeded in three distinct stages. First, 2000 to 2010 change in county-level working-age SSI participation (percent of population ages 18-64 years) and public assistance receipt (percent households of total households) were mapped to compare geographic trends. Second, spatial analysis was carried out to detect areas where county-level SSI participation was much higher and lower than the national average. Third, statistical analyses were performed to discover county-level factors that correlated to county-level SSI location quotients and 2000-2010 change in county-level SSI enrollment.

To identify county-level spatial clusters of SSI location quotients in 2000 and 2010, univariate LISA (Local Indicators of Spatial Association) was utilized. Univariate LISA is a common spatial analytic technique for identifying statistically significant local clusters (Anselin, 1995). Queen contiguity was employed to measure spatial relationships among the counties. This technique reveals statistically significant hot and cold spots of SSI location quotients. Alaska and Hawaii were excluded from univariate LISA because of their isolated locations relative to the contiguous U.S. Counties with no data for any of the variables were eliminated from all analyses. Sixty-four counties had no data in 2000 and 145 counties had no data in 2010. A total of 3077 counties in 2000 and 2999 counties in 2010 were included in all analyses except for univariate LISA. Univariate LISA involved 3054 counties in 2000 and 2974 counties in 2010 due to the exclusion of counties in Alaska and Hawaii.

For 2000 and 2010, multiple regression models were estimated with county-level SSI location quotients as the response variable and county-level households receiving public assistance (%), poverty (%), disability (%), female-headed households (%), non-Hispanic white (%), less than high school (%), unemployment (%), and average monthly SSI stipend as explanatory variables. A linear regression model was also estimated with 2000-2010 percent change in county-level SSI enrollment as the response variable and 2000-2010 percent change in total employment as the explanatory variable.

2.4 Results

From 2000 to 2010, most counties experienced an increase in the proportion of working-age residents receiving SSI (Figure 1). At the same time, most counties experienced a decline in percent households receiving income from TANF or GA (Figure 2). The majority of counties experienced a simultaneous increase in SSI receipt and decrease in TANF and GA enrollment over time, which corresponds with earlier studies' position that welfare reforms have restricted nationwide participation in TANF and other government programs while concurrently driving up enrollment in SSI (Hansen et al., 2014; Wamhoff & Wiseman, 2005/2006).

Figure 1. 2000-2010 change in % SSI recipients 18-64 years of age, by county (n=3077)
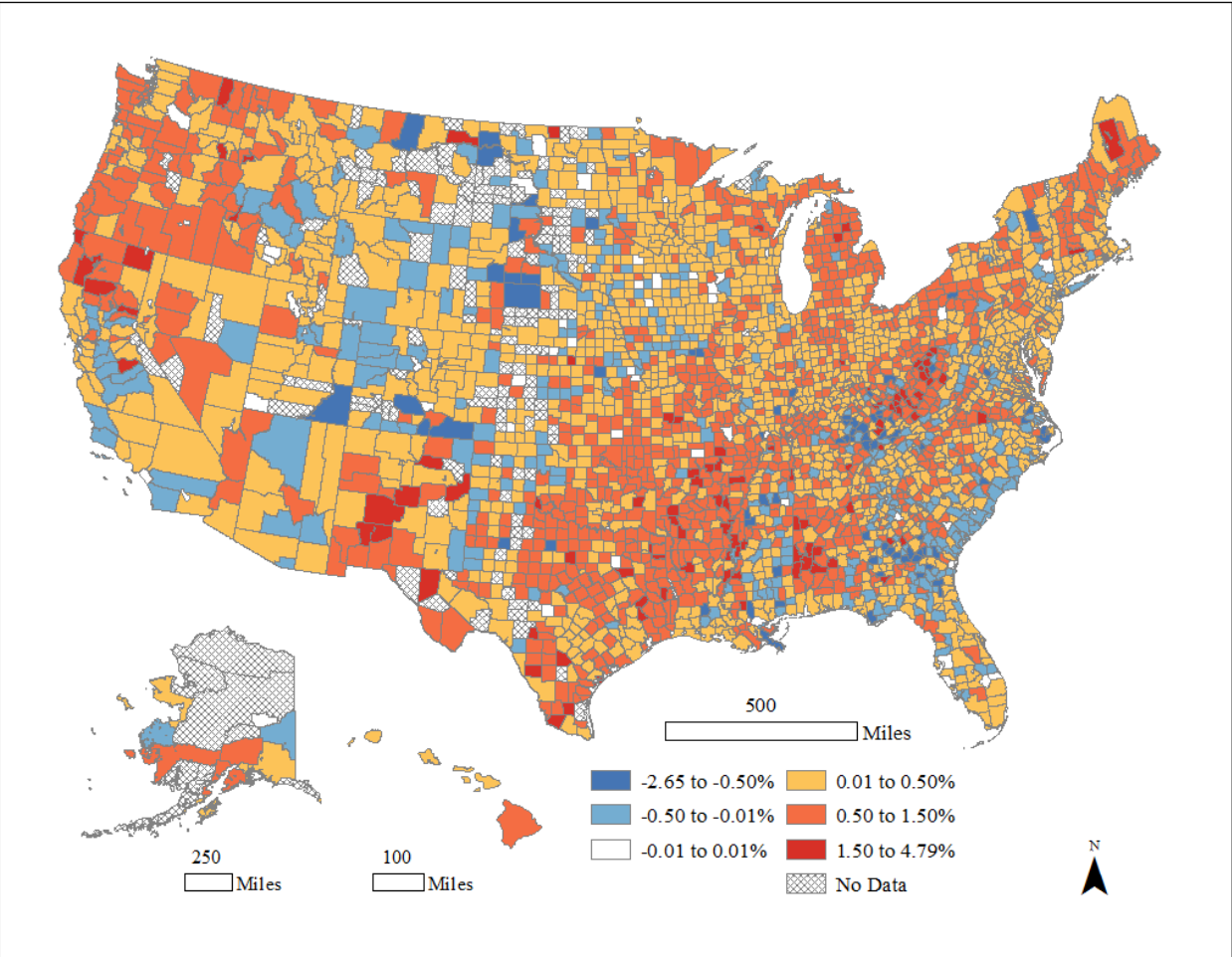
Figure 2. 2000-2010 change in % households receiving public assistance income (TANF & GA), by county (n=2999)
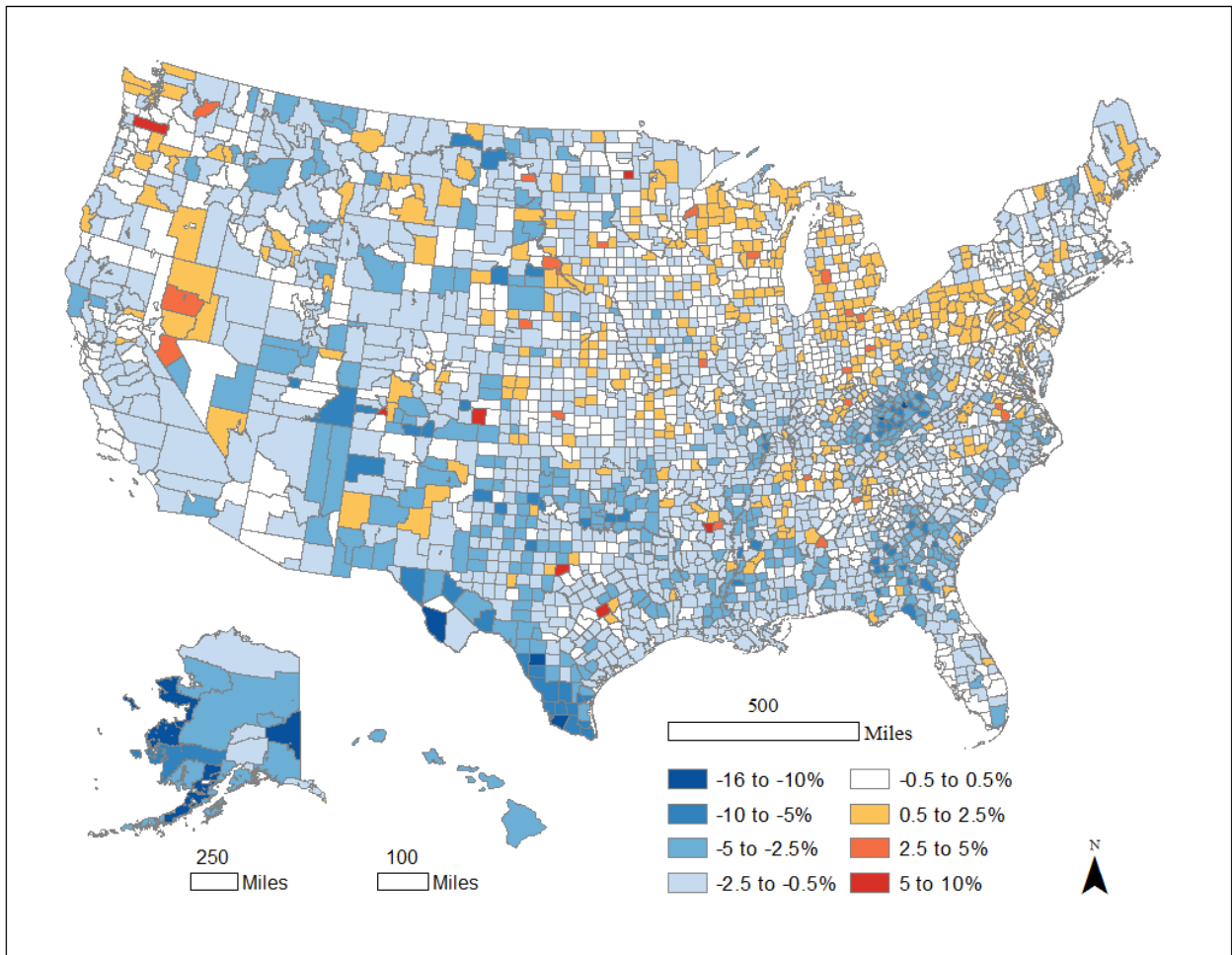
Figures 3a and 3b illustrate county-level SSI location quotients for 2000 and 2010, respectively. In 2000, approximately 47% of counties had a location quotient over one, indicating that they had a higher proportion of working-age SSI recipients than the national average. About 12% of counties had a location quotient over two. Of these counties, most were located in the Appalachian and southeastern regions of the U.S. Twenty counties had a location quotient greater than five, with 17 located in Kentucky. The spatial patterns in 2000 were similar to those in 2010. In 2010, 53% of counties had a location quotient over one and approximately

14% had a location quotient over two. Seventeen counties had a location quotient greater than five, with 13 located in Kentucky.

Figure 3. SSI location quotients of population 18-64 years of age, by county

a. 2000 (n=3077)
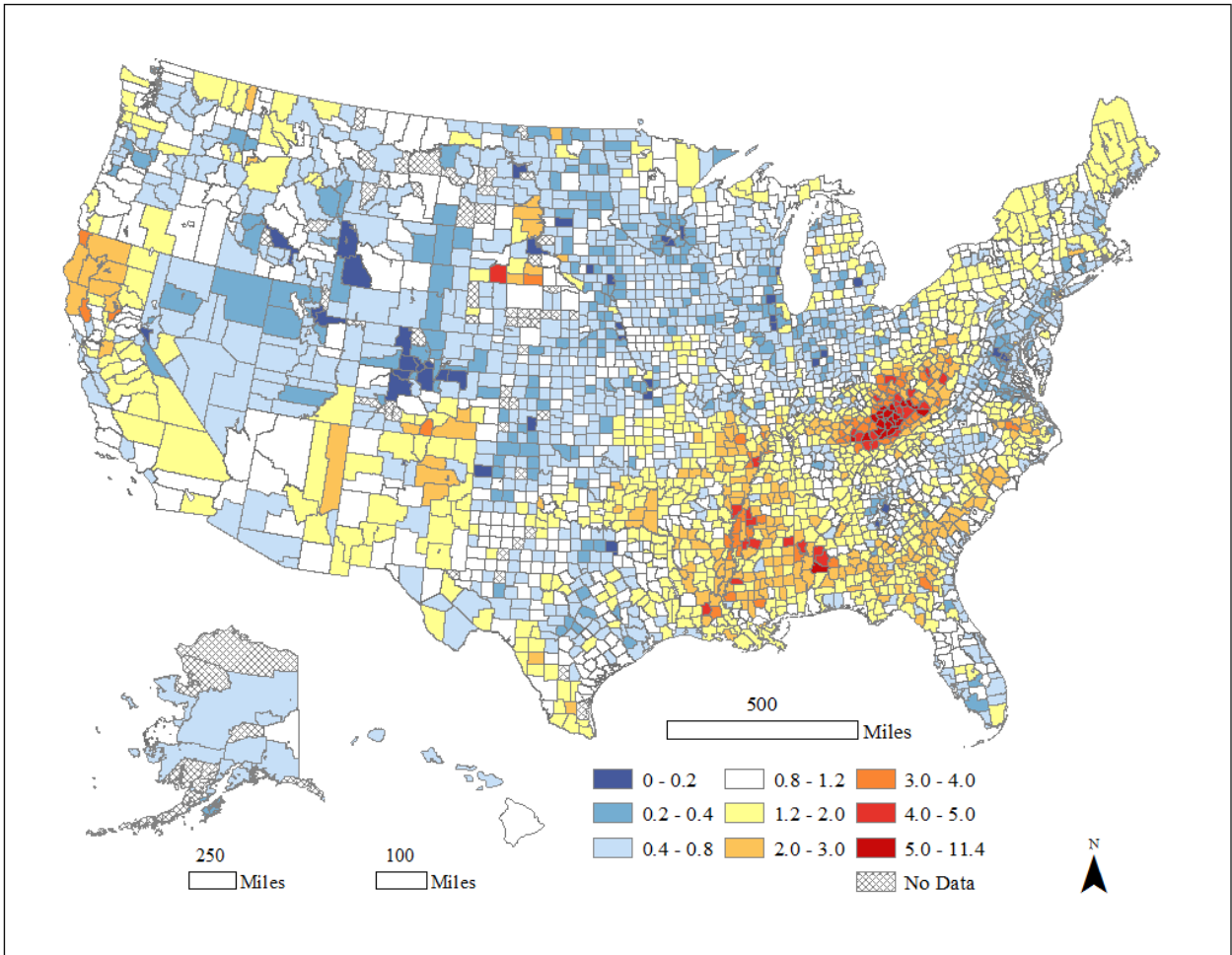
Figure 3 (cont.)

b. 2010 (n=2999)
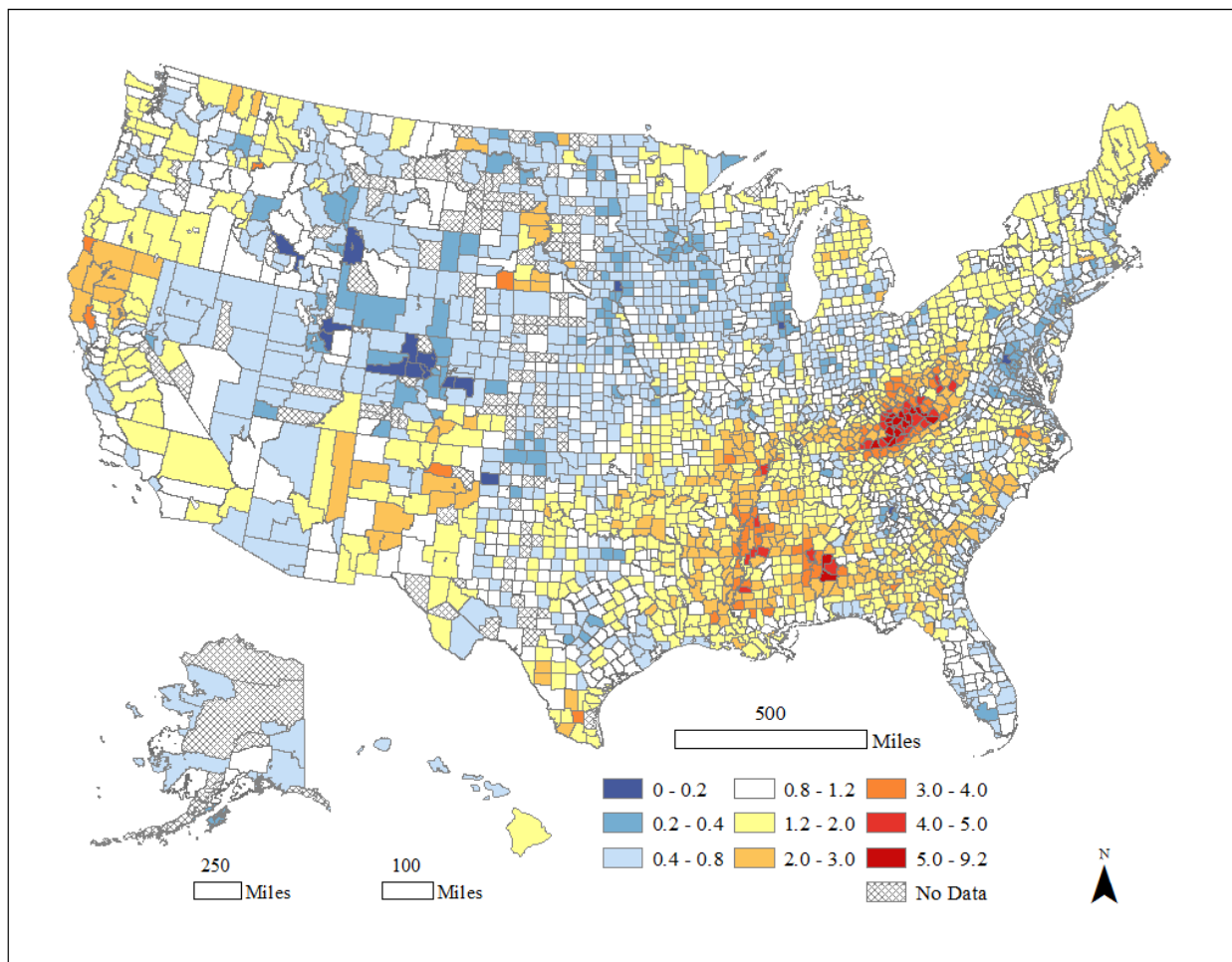
These spatial trends reflect patterns related to population health; the Appalachian region and areas in southeast U.S. are sites of poor health and high mortality (Bush et al., 2014; He et al., 2015; Schoenberg et al., 2015; Siegel et al., 2015). The geographic patterns also reflect TANF cutbacks related to welfare reform. West Virginia was one of many states that was successful in dramatically reducing TANF caseloads soon after the passage of PRWORA in 1996. However, compared to states outside of the Appalachian region, West Virginia's decline in TANF participation from 1997 to 2000 was less a result of recipients finding employment and

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much more an outcome of policy compliance, including beneficiaries reaching lifetime limits.

This suggests that former TANF recipients in West Virginia were experiencing ever-increasing

difficulty finding employment (Myadze, 2006). These contextual conditions may explain the

relatively high county-level SSI location quotients in these same regions.

Many of the counties with extremely elevated levels of SSI location quotients were

located in one state – Kentucky. Compared to the rest of the country, Kentucky has historically

low scores on numerous health indicators. Explanations for the state's alarming figures of ill

health include poverty, low educational attainment, lower than average physician-to-population

ratio, and high uninsurance rates (Costich, 2012). Additionally, workfare initiatives have focused

on a narrow scope of work activities, neglecting the region's ongoing deindustrialization and

limited economic sectors, the scarcity of educational opportunities and living wage jobs, and the

general inability of many localities in Kentucky to respond to welfare reform (Miewald, 2001).

Given these circumstances, high levels of geographic clustering of SSI location quotients within

specific states like Kentucky suggest that state-level issues and policies contribute to high

concentrations of disability assistance. These findings closely align with trends in the United

Kingdom, where receipt of disability benefits is strongly concentrated in old ex-industrial areas

(Hamnett, 2014).

Most counties with low SSI location quotients in 2000 and 2010 were located in the

Midwest and in the Mountain States, confirming geographic trends of low disability beneficiary

prevalence in an earlier study (McCoy et al., 1994). These patterns reflect both the high

availability of employment opportunities and better health and mortality patterns compared to

other regions of the U.S. (Mokdad et al., 2001; Siegel et al., 2015). Other counties with low SSI

location quotients were in the northeast. Additionally, many counties in the Mountain States and

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Midwest had no data in 2010. These same counties had extremely low SSI prevalence in 2000. No data indicates that county-level SSI participation was so low that recipients could be identifiable, so SSI enrollment numbers were not released.

Figures 4a and 4b show the LISA results of the county-level location quotients for 2000 and 2010, respectively. The LISA maps confirm the trends illustrated in Figures 3a and 3b, but they also highlight statistically significant hot and cold spots. In 2000, approximately 12% of counties were high-high, indicating that they had a significantly high value ($p<0.05$) and that their neighboring counties had similarly high values. Most counties were located in the southeast, and in the states of Kentucky, West Virginia, Virginia, Tennessee, and California. About 24% of counties were low-low, indicating that they had a significantly low value and their neighboring counties had similarly low values. These clusters were widely distributed across the Great Plains, Midwest, northeast, and Texas. Small numbers of low-high and high-low clusters were identified. Similar geographic patterns emerged in 2010. In 2010, approximately 12% of counties were high-high and they were located in most of the same regions as in 2000. About 22% of counties were low-low, and although the clusters were located in similar regions as in 2000, they were smaller. The maps demonstrate uneven spatial patterns of SSI location quotients across the U.S. and within states, reflecting differing local health patterns as well as differential social, economic, and political processes.

Figure 4. Local Indicators of Spatial Association (LISA) results of SSI location quotients of population 18-64 years of age, by county

a. 2000 (n=3054)
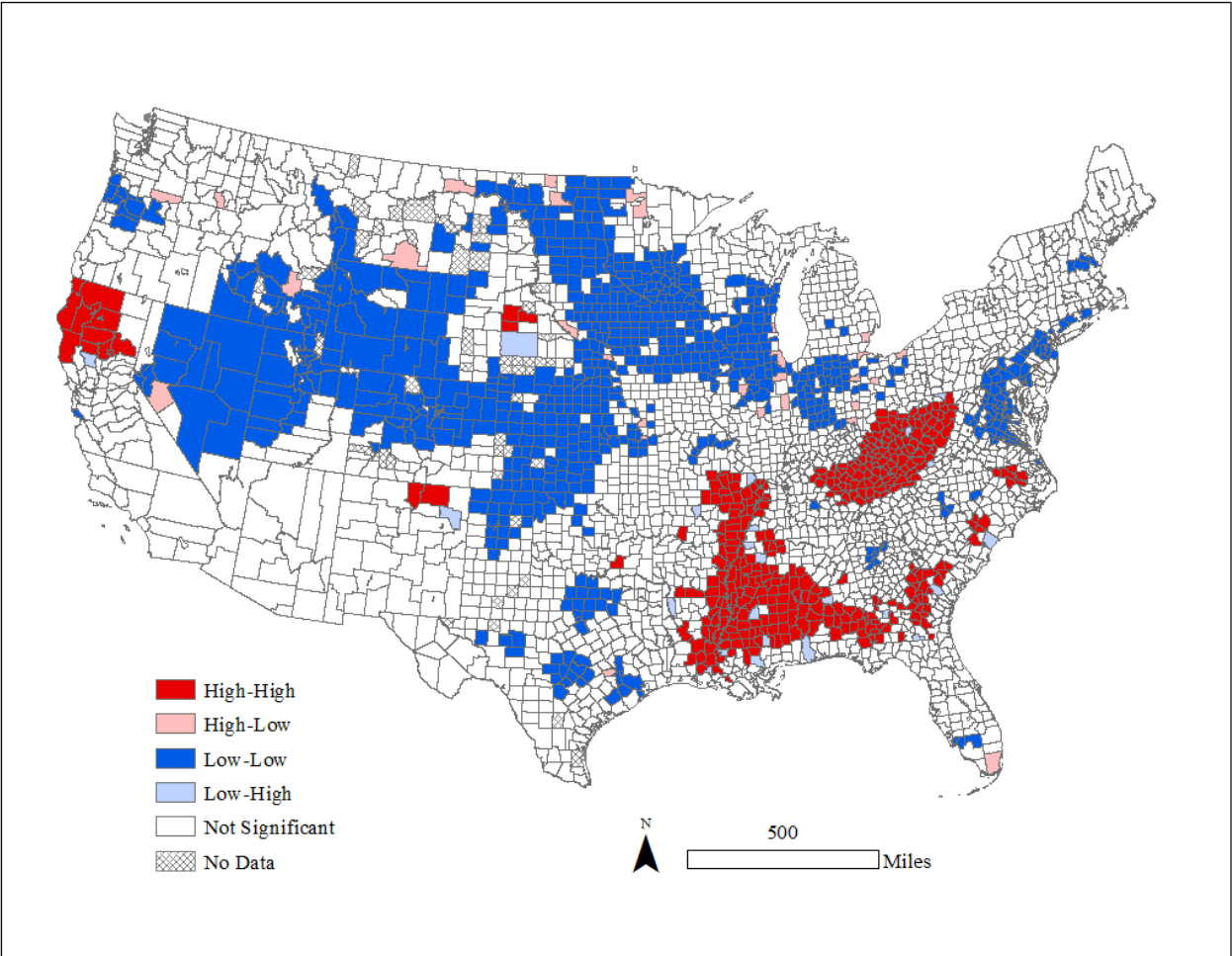
Figure 4 (cont.)

b. 2010 (n=2974)
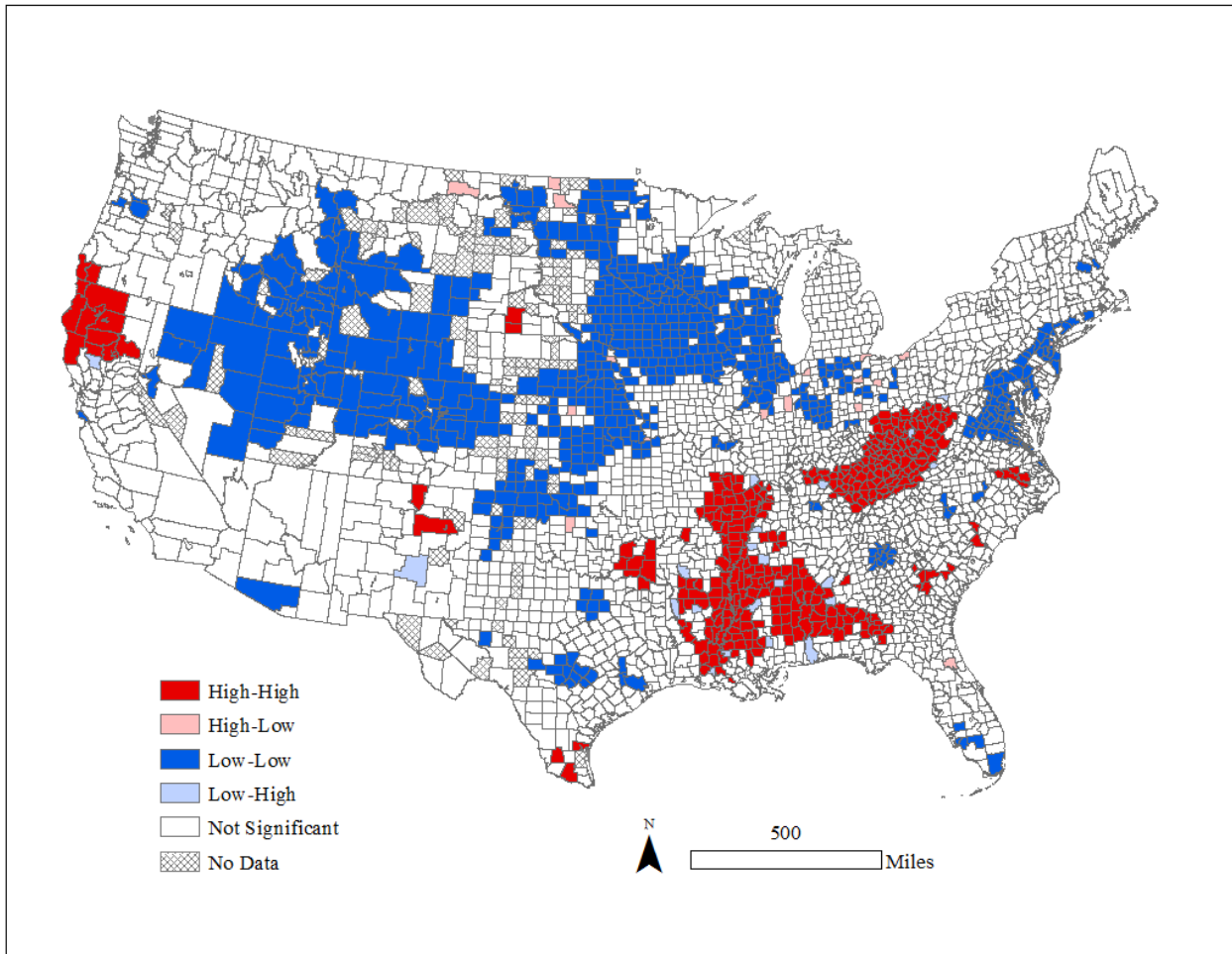
In addition to the Appalachian and southeast regions, hot spots of county-level SSI location quotients were found in northern California in the counties located closest to Oregon. This area is much less studied. It is comprised of largely rural counties where major economic sectors include timber, agriculture, and fishing industries (Brady, 2013; Polson, 2013). Limited, labor-intensive job opportunities may partly explain the higher disability benefit prevalence in this region.

Most cold spots of SSI location quotients were located in the Mountain States, the Midwest, and northeast regions. This may be partially explained by buoyant labor markets. After 1996, many TANF beneficiaries in Colorado, Idaho, Wyoming, and Wisconsin left the program due to employment, suggesting that the labor markets in these regions provide adequate jobs for former TANF recipients (Myadze, 2006), thus alleviating SSI demand. Trends in some places can also be explained by better health outcomes (Mokdad et al., 2001; Siegel et al., 2015). Another possible explanation is that many counties located in the cold spots have higher levels of educational attainment relative to the rest of the country, and studies suggest that greater educational attainment is associated with higher earnings (Bosworth et al., 2000) and better health (Zajacova et al., 2012).

Table 1 summarizes the county-level variables of interest for both years. The mean SSI location quotient increased from 2000 to 2010. Having a location quotient higher than 100% became a more common experience across counties over time, indicating that more counties had higher working-age SSI participation than the national average. From 2000 to 2010, the mean values increased for percent SSI, average monthly SSI stipend, percent poverty, percent unemployed, and percent female-headed households, indicating complementary and mutually-reinforcing trends.

Other county-level variables decreased in mean value over time. From 2000 to 2010, the mean percent of households receiving TANF or GA declined. For percent white, the average fell, reflecting changes in the racial makeup across counties (Pew Research Center, 2011). The average percent with less than high school education also declined over time. For individuals living with a disability, the mean decreased from 19.7% in 2000 to 13.4% in 2010, reflecting changes in disability measurements and real changes in disability status (Brault, 2009).

Table 1. Descriptive Characteristics of U.S. Counties, 2000 and 2010

	Mean	SD	Range
SSI Program			
Recipients age 18-64 years, %			
2000 (n=3077)	2.5	1.9	0.1-24.6
2010 (n=2999)	3.0	2.0	0-21.9
Location quotient age 18-64 years, %			
2000	116.8	88.0	4.2-1144.9
2010	124.4	84.7	0-921.4
Average monthly SSI stipend, $			
2000	349.1	50.5	170.7-705.9
2010	494.8	52.1	0-826.8
Demographic			
Households on TANF or GA, %			
2000	3.5	2.1	0.4-36.9
2010	2.5	1.6	0-23.5
Living below poverty age 18-64 years, %			
2000	12.7	6.0	2.0-53.8
2010	15.3	6.1	1.9-46.0
Living with a disability age 18-64 years, %			
2000	19.7	5.1	6.6-45.0
2010	13.4	4.8	3.1-34.4
Female-headed households, %			
2000	9.0	3.3	2.0-28.2
2010	9.8	3.6	0-29.0
White age 18-64 years, %			
2000	81.6	18.6	2.1-99.4
2010	78.1	19.7	1.5-100.0
Less than high school age 18-64 years, %			
2000	19.1	8.1	3.6-59.3
2010	14.0	6.5	2.1-46.6
Unemployed age 18-64 years, %			
2000	4.1	1.7	0.2-32.0
2010	6.3	2.3	0-19.0
Total employment, thousands			
2000	41.3	147.9	0.2-4110.9
2010	41.8	143.0	0-3856.8

Table 2 contains the outputs from multiple linear regression models for 2000 and 2010. The results demonstrate that county demographic and socioeconomic factors are consistently and strongly associated with SSI location quotients. Percent poverty and percent disability were strongly and positively correlated with SSI location quotients in both years. Over time, poverty and disability had the strongest relationships of all the covariates. The results align with an earlier study on state-level variations in SSI participation for children, in which poverty rates accounted for most of the variance in enrollment (Perrin et al. 1998). For 2000 and 2010, percent households on TANF or GA and percent white had positive associations. However, the coefficient magnitude for both variables decreased considerably over time, suggesting a downward trend. Average monthly SSI stipend, percent female-headed households, and percent less than high school education were also positively and strongly associated with SSI location quotients for both years. All covariates accounted for nearly three-fourths of the variation of county-level SSI location quotients in 2000 and more than two-thirds of the variation in 2010. Percent unemployed was not included in the final model due to multicollinearity with other variables. Analyzed alone, percent unemployed had strong, positive correlations with SSI location quotients in both years.

Table 2. Covariates Associated with Location Quotients of SSI Recipients 18-64 Years of Age, 2000 and 2010

	2000 (n=3077)			2010 (n=2999)		
	Coefficient	β	95% CI	Coefficient	β	95% CI
Households on TANF or GA, %	4.022***	0.096	3.021, 5.024	1.353*	0.026	0.198, 2.509
Average monthly SSI stipend, $	0.133***	0.076	0.100, 0.166	0.111***	0.069	0.076, 0.147
Living below poverty, %	5.259***	0.355	4.848, 5.669	4.093***	0.294	3.676, 4.511
Living with a disability, %	6.272***	0.365	5.790, 6.753	8.887***	0.502	8.393, 9.381
Female-headed households, %	8.799***	0.332	8.042, 9.555	3.580***	0.151	2.870, 4.291
White, %	2.090***	0.441	1.948, 2.232	0.533***	0.124	0.398, 0.667
Less than high school, %	2.106***	0.195	1.776, 2.436	1.332***	0.102	0.937, 1.726
Adjusted R^2		0.746			0.670	

* = P<.05, ** = P<.01, *** = P<.001

Table 3 summarizes the relationship between the 2000-2010 change in percent SSI enrollment as the response variable and the 2000-2010 percent change in total employment as the explanatory variable. Although the R^2 is quite low, the model shows a statistically significant inverse association between change in SSI enrollment and change in total employment from 2000 to 2010. This result supports the link between employment decline and increase in SSI enrollment. In other words, SSI participation increased in places where job opportunities were diminishing, an indication of SSI's growing importance as a source of financial support in areas of economic decline.

Table 3. Correlation Between 2000-2010 Change in Percent SSI Enrollment
& Percent Total Employment (n=2989)

	Coefficient	β	95% CI
Change in total employment, %	-.006***	-0.201	-.007, -.005
Adjusted R^2		0.04	

*** = P<.001

A major limitation of the results is that all variables are aggregated to the level of the county, and inferences cannot be made about individual-level mechanisms and correlations (Schwartz, 1994). Still, a number of possible explanations for the results are postulated because the development of rising SSI receipt is complex and it is likely that a wide assortment of individual-level and neighborhood-level factors are causing SSI demand. Future studies should investigate individual-level models as well as multilevel models in order to better capture the complexity of SSI trends.

2.5 Discussion

This paper reveals asymmetrical trends in medicalized welfare for the working-age population across different geographic regions and demographic groups, with the intention of illuminating the uneven processes of and experiences in the medicalization of welfare in the U.S. The results demonstrate that patterns in county-level SSI receipt for the population ages 18-64 years are uneven over space and time, during a period of rapid SSI expansion (Social Security Administration Office of External Relations, 2013) partly linked to a decline in other major welfare programs (Peck, 2001; Wamhoff & Wiseman, 2005/2006). An examination of SSI

receipt among working-age adults uncovers patterns of disability and financial insecurity, as well as a general inability to participate sufficiently in the labor market (Hansen et al., 2014; Joffe-Walt, 2012). Significant hot and cold spots of SSI location quotients in distinctive geographic regions suggest that there is a dichotomy and heterogeneity of experiences in the medicalization of welfare, complicating the existing narrative that there is a ubiquitous development in the rising medicalization of welfare (Hansen et al., 2014; O'Brien, 2015).

Future research should consider investigating the hot and cold spots of SSI location quotients as case studies for deepening current understandings on the medicalization of welfare. For both 2000 and 2010, most statistically significant clusters of counties with high location quotients were located in the Appalachian and southeast regions of the U.S., identified in earlier research as the "Disability Belt" where high, chronic rates of disability, poverty, and underemployment co-exist (McCoy et al., 1994). The spatial clustering of higher than average county-level SSI prevalence reflects long-standing, ecological patterns of socioeconomic disadvantage, high morbidity and mortality rates, and accelerated declines in TANF participation (Bush et al., 2014; He et al., 2015; Myadze, 2006; Schoenberg et al., 2015; Siegel et al., 2015). The Appalachian and southeast regions are largely rural and are also sites where many employment opportunities involve hazardous, physically demanding work, including coal mining and petrochemical industries (Glavovic, 2014; Hendryx & Luo, 2015; Kurth et al., 2014). Once workers acquire a serious physical impairment, they are no longer employable in a place where most jobs require manual labor. Moreover, many workers in these industries have limited educational attainment and are only able to work in blue-collar jobs, making them ineligible for occupations that do not involve manual labor. In this scenario, the only alternative is to go on disability benefits (Joffe-Walt, 2012). These factors may collectively explain the high

concentrations of hot spots in the region. Another site with hot spot clusters is located in northern California, a location that is little studied and therefore a promising site for future studies on rural health, welfare, and demographics.

In 2000 and 2010, distinct cold spots of SSI location quotients were located in the Mountain States, the Midwest, and northeast regions. Explanations may include higher levels of educational attainment compared to the rest of the country, better health outcomes (Mokdad et al., 2001; Siegel et al., 2015), and relatively robust labor markets that provided jobs to those exiting TANF (Myadze, 2006). A closer examination of these sites may identify specific community conditions and administrative policies that discourage SSI participation, and thereby provide guidance to those counties experiencing disproportionately high levels of SSI receipt. An in-depth investigation would also complicate and expand on theories related to the medicalization of welfare, particularly how local contexts resist and mediate individual and community-level need for medicalized welfare.

This study has a number of limitations. It uses cross-sectional data, so the trends discussed are observed during specific points in time with different populations. Longitudinal surveys should be administered to allow for analyses of changes over time with the same study population. This paper uses variables aggregated to the county-level, which hinders inferences about individual-level relationships and detection of spatial variation within counties. Future research should locate and utilize individual-level data at finer geographic scales in order to identify individual-level mechanisms and more local spatial patterns of SSI receipt. The changing definition of disability, both by society and the Census Bureau, introduces uncertainty in the measurement of disability prevalence over time. However, if a major measurement issue is that the population receiving SSI is underestimated in more recent surveys (Burkhauser et al.,

2014), then the results in this paper may understate the county-level associations between SSI location quotients and disability prevalence in 2010. Another limitation is the use of SSI location quotients to represent the indigent, working-age population with disabilities, which may make cross-national comparisons difficult. Development of a multidimensional index to represent the most vulnerable group of individuals with disabilities may provide a better measurement for comparison in international analyses. Despite these limitations, this study highlights meaningful ecological patterns and promising case studies for future research.

Growing SSI enrollment during a period of welfare retrenchment suggests that the post-1996 welfare reforms have not had the intended effect of reducing the need for government aid among the working-age population in the U.S. Current policies need to be reevaluated and new ones deliberated. Scandinavian countries have been more successful in maintaining high employment rates for individuals who are chronically ill or disabled, and this achievement is linked to these countries' active labor market and employment protection policies (Burström et al., 2000; McAllister et al., 2015). U.S. policymakers should investigate the adoption of such policies for increasing labor market participation among people with disabilities and decreasing need for medicalized welfare. Additional Scandinavian policies that support the employment of working mothers and democratize access to education should also be considered for promoting greater equality between groups (Esping-Andersen, 2014), given that county-level SSI location quotients are strongly associated with family type and level of education. Moreover, Honig (2013) suggests that the political orientation of state governors plays a more significant role than economic factors on SSI participation, so one possible future research direction is to investigate political factors alongside economic ones.

As the SSI program expands in the post-1996 welfare reform era, an increasing proportion of SSI claims are based on mental health diagnoses (Hansen et al., 2014; Joffe-Walt, 2012). Faced with limited public assistance options, many of the poor bear the stigma of mental illness in exchange for a disability check. In this case, SSI is a stable source of income that enables poor, underemployed individuals to realize important social roles like providing for their families, roles that they would otherwise be unable to fulfill if their only option was to negotiate the unstable, contingent, low-wage labor market (Hansen et al., 2014; Joffe-Walt, 2012). While enrolling in SSI provides some degree of economic security, it is a strategy of necessity that enmeshes individuals into a cycle of poverty and underemployment, one that does not offer a clear path toward upward mobility (Stapleton et al., 2006). More comprehensive investigations of SSI spatial clusters will better uncover local causes and processes related to disability, poverty, employment, and welfare, and better reveal relevant issues and appropriate solutions for improving localities and the livelihoods of its residents.

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CHAPTER 3

TRAVELING WITH BLINDNESS:

A QUALITATIVE SPACE-TIME APPROACH TO UNDERSTANDING VISUAL

IMPAIRMENT AND URBAN MOBILITY

Abstract

This paper uses a space-time approach to produce new insights into the everyday mobilities of

individuals who are visually impaired in the San Francisco Bay Area. While existing research on

visual impairment and mobility emphasizes individual physical limitations resulting from vision

loss or inaccessible public spaces, this article highlights both the behavioral and social processes

that influence individual mobility. I draw from Hägerstrand's space-time framework to analyze

qualitative data collected from sit-down and mobile interviews. The results show that the space-

time constraints of people who are visually impaired are closely linked to their access to

transportation options and assistive and mobile technologies. In employing a qualitative space-

time approach, this paper expands on conventional quantitative approaches that draw from

Hägerstrand's framework to deepen our understandings on the relationship between health and

mobility, and to provide clearer intervention opportunities for improving the quality of life for

people with disabilities. Future directions are discussed for enabling the mobilities of individuals

who are visually impaired.

3.1 Introduction

Many individuals with disabilities face difficulties with independent travel and access to

public spaces, which considerably shape their social inclusion, employment prospects, and

quality of life (Lubin & Deka, 2012; McClimens et al., 2014; Townley et al., 2009). Their social and physical exclusion in turn reinforces their experiences of disablement. Therefore, it is critical to examine and address the issues that impede the mobility of people with disabilities. Since individuals with different disabilities have diverse mobility concerns, this paper focuses on the distinct experiences of people who are visually impaired (VI). While we know that individuals who are VI face travel barriers due to locational and spatial issues such as limited transportation options and inaccessible built environments (Crudden et al., 2005; Imrie, 2013; McDonnall, 2011; O'Day, 1999), much less is known about the effects of time in conjunction with space.

A qualitative space-time approach offers an innovative conceptual framework for understanding both the temporal and geographic dimensions of mobility for people who are VI. A qualitative approach also provides scope for analyzing the dynamic and relational processes that facilitate or hinder travel. Hägerstrand's (1970) space-time constraint framework – which includes capability, coupling, and authority constraints – is drawn upon to examine the everyday mobilities of individuals experiencing blindness. Understanding the embodied experiences of travel for people who are VI is vital for identifying intervention opportunities that improve individual mobility and overall well-being.

This paper begins with a brief review of relevant research on visual impairment and mobility, highlighting key theoretical and empirical scholarship both outside and within geography. This is followed by an overview of Hägerstrand's (1970) conceptualization of space-time constraints, and a summary of conventional space-time methods in transportation and health research. The most common methods are quantitative, and I make a case for utilizing a qualitative space-time approach to examine the daily mobilities of individuals who are VI. Finally, based on a qualitative analysis of individuals' experiences in the San Francisco Bay

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Area, findings on the space-time constraints of people who are VI are presented and future

suggestions are provided for advancing disability research and for addressing mobility barriers.

3.2 Background & Significance

3.2.1 Visual impairment & mobility

Drawing from the medical model of disability, much of the health research on visual

impairment and mobility focuses on how individuals face reduced mobility due to physical and

cognitive limitations related to vision loss. The more severe a visual impairment, the more likely

a person is to experience a decline in mobility (Aartolahti, et al., 2013; Salive, et al., 1994).

There are varying levels of visual impairment, from moderate and severe visual impairment to

total blindness (WHO, 2014). Most individuals who are VI have some sight. Common

experiences include loss of central or peripheral vision, blurred vision, light sensitivity, and night

blindness (American Optometric Association, 2016). Individuals who are VI may walk slower

due to lower levels of balance and fears of falling, resulting in restricted activities outside the

home, decreased independence (Ramulu et al., 2012), and lower perceived quality of life (Yeung

et al., 2014).

In geography, two distinct approaches have been used to understand the mobility of

individuals who are VI. One line of research examines the social experience of visual

impairment in public spaces and critiques the medical model of disability for imposing a narrow,

individualistic lens on the experiences of disability (Imrie, 2013; Pow, 2000; Worth, 2013). Imrie

(2013) highlights the role of inaccessible built environments in the UK in impeding the mobility

of pedestrians who are VI. He interrogates the shared space design, which eliminates traditional

street features that people who are VI use to navigate the built environment, such as pavements

and curbs. Consequently, this new urban development further spatially and socially marginalizes individuals who are VI. In contrast to disabling environments, other geographers emphasize individual agency. As 'creative spatial dissidents' in Singapore (Pow, 2000) and 'competent spatial actors' in England (Worth, 2013), people who are VI employ multiple mobility strategies to navigate public spaces and in doing so challenge negative social attitudes towards blindness. Strategies for facilitating travel and being visible in public spaces include performing visual impairment by using a cane and traveling with a guide dog (Pow, 2000; Worth, 2013).

A second stream of geographic research utilizes a behavioral approach to examine how individuals who are VI learn and store spatial information to map their travels cognitively, and how that process translates to their physical navigation of the built environment (Golledge, 1993; Kitchin et al., 1997; Marston et al., 1997). Prior to the efforts of behavioral geographers in the 1990s, there was very little research and considerable uncertainty about the effects of vision loss on individuals' travel and activity patterns (Kitchin et al., 1997). In an early study, Marston et al. (1997) found several circumstances that influence the travel behavior of residents who are VI in Santa Barbara, California. Key factors include the proximity of residential location to important amenities and travel and wait times for transit and car use. Based on their survey findings, Marston and his colleagues contend that the most critical mobility issue is a lack of information about the spatial layouts of destinations and travel routes. One proposed solution is to improve access to technological aids that provide tactile and auditory information to individuals about their surrounding environments (Golledge, 1993; Marston et al., 1997).

Today, mobile, location-based technologies are reshaping the everyday mobilities of individuals who are VI and their interactions with the built environment. Many navigation applications are accessible and some are customized for users with partial or no sight (National

Federation of the Blind, n.d.). Mobile navigation applications join well-established assistive technologies such as white canes to facilitate daily travel, access to transportation, and the linking of activities in space and time. While previous studies recognize traditional white canes as critical tools for aiding mobility (Pow, 2000; Worth, 2013), the use of modern mobile technology is scarcely researched. Mobile technologies are now ubiquitous, and it is important to understand how an increasing reliance on mobile devices for navigating the built environment impacts the everyday travels of individuals who are VI.

In using a qualitative space-time framework to analyze the effects of space and time on everyday travels, this paper contributes to shortcomings in both literatures. While social geographers examine the experience of visual impairment in relation to place and space (Imrie, 2013; Pow, 2000; Worth, 2013), they have paid less attention to the temporal dimension of vision loss and mobility. Time imposes logistical constraints on when people can travel and how long they can participate in daily activities, and it is critical to understand how individuals who are VI manage time as they traverse urban landscapes and confront environmental challenges. Whereas behavioral geographers do consider the effects of time and space on travel (Golledge, 1993; Kitchin et al., 1997; Marston et al., 1997), they largely overlook the social milieu that structures the environments that disable or enable individual mobility. A qualitative space-time approach provides scope to consider the temporal aspect of physical movement, the social relationships that shape individual mobility, and the evolving technologies that provide accessible, real-time spatial information to people who are VI. This paper also builds on past work by investigating individual space-time constraints in a major metropolitan region with a dense transit network. Previous research took place only in small cities or small spaces like building corridors (Kitchin et al., 1997; Marston et al., 1997).

3.2.2 Hägerstrand's space-time framework

The behavioral approach to visual impairment and mobility draws from a space-time framework, which regards individual behaviors and activities as being restricted by space and time (Hägerstrand, 1970; Kwan, 1998; Miller, 1991). Within a space-time framework, individual mobilities and activity patterns are affected by three distinct yet interconnected types of constraints: capability constraints, coupling constraints, and authority constraints (Hägerstrand, 1970). Capability constraints restrict what individuals can do because of their social and demographic characteristics, resources, skills, and information. Coupling constraints determine when and where people and things must convene to accomplish activities that are important in everyday life. Authority constraints control access to places and events through institutional and power relationships. The three constraints interact in both direct and indirect ways to impose space-time restrictions on a person's mobility (Hägerstrand, 1970; McQuoid et al., 2015).

Researchers across diverse disciplines such as transport planning, demography, and health have drawn from Hägerstrand's space-time framework to quantitatively analyze people's spatial behaviors (Patterson & Farber, 2015). Quantitative space-time methods, specifically activity space measures, are increasingly popular in health research (Patterson & Farber, 2015). People with disabilities are much more likely to experience transport disadvantage than the general population (Golledge, 1993; Casas, 2007), but the space-time constraints of people with disabilities are rarely studied. When they are, quantitative methods are typically used. For example, Casas (2007) utilizes accessibility measures to find that people with disabilities have lower mobility and access to opportunities compared to their nondisabled counterparts. Townley et al. (2009) use activity spaces to represent the mobility and place experiences of individuals

with serious mental illness and find larger activity spaces to be correlated with more positive life assessments.

Apart from McQuoid et al. (2015), who analyze the logistical challenges of balancing work and health-related activities for people with chronic kidney disease, there is little contemporary research that employs Hägerstrand's three space-time constraints to qualitatively examine the mobilities of people with disabilities. By utilizing a qualitative approach, McQuoid et al. (2015) generate new understandings on multidimensional conceptualizations of time and space, dynamic interactions in daily space-time conflicts, and practical interventions for workplaces and health services to improve the lives of people with chronic kidney disease. This paper produces similarly unique insights into the experiences of visual impairment and mobility. In particular, I seek to better understand and identify the barriers impeding individuals' mobility and their access to workplaces and public transportation, as well as other places and resources essential to their economic, social, and physical well-being such as supermarkets, friends' homes, and health providers' offices. I examine these concerns in the San Francisco Bay Area where residents navigate a dense transit network with varying degrees of accessibility.

3.3 Methods

Participants were recruited from three key organizations in the San Francisco Bay Area that provide rehabilitation services to residents who are VI. I corresponded with staff members via email and asked them to forward study information to clients whose visual impairments include legal blindness, functional blindness, and total blindness. Legal blindness is a visual acuity of 20/200 or less after correcting with glasses or contact lenses, and/or a visual field of 20

degrees or less in the better eye. Functional blindness is having light perception, but no form perception (i.e. object recognition). Total blindness is having no light nor form perception.

Thirty-one individuals completed a survey with questions that assessed their disability, well-being, and mobility. A sample of the survey respondents were then invited for follow-up interviews. This paper only focuses on the data collected from interviews.

Of the survey respondents, thirteen were selected for an in-person, semi-structured interview. The sample represents different experiences related to type of visual impairment (legally blind, functionally blind, totally blind), employment status (employed, unemployed, student), age (22 to 64 years), and gender (female, male). Participants chose the interview location, which included workplaces, coffee shops, and public libraries. The interview length ranged from half an hour to an hour and a half. The interview included questions about participants' visual impairment, daily activities, transportation options, mobility, and accessibility.

Of the thirteen interviewees, eight were invited to participate in a mobile interview where I joined them on their scheduled travel route. Mobile interviews offer opportunities for participants to convey multifaceted perceptions and feelings about their experiences; and for researchers to observe first-hand place-specific practices and understandings (Carpiano, 2009; Finlay & Bowman, 2017). During the mobile interview, I asked participants about their travel experiences, strategies, and constraints. Informants articulated in more detail the mobility issues they encountered. They were also inspired to identify challenges that they did not recall during their sit-down interviews.

The interviews were recorded and coded with assistance from qualitative data analysis software. Audio recordings of sit-down interviews were transcribed, and notes from mobile

interviews were documented. Drawing from Hägerstrand's (1970) space-time framework, a deductive approach was used for coding. The content was reviewed multiple times and initial codes were grouped into main themes.

Data collection took place November 2015 to October 2016. Ethical approval for this research was obtained by the University of Illinois' Institutional Review Board. At the completion of both interviews, participants were compensated for their time with a $20 gift card. The names used are pseudonyms.

3.4 Results

3.4.1 Everyday mobility & space-time constraints

There are marked similarities in the space-time constraints that influence participants' everyday mobilities and the kinds of places and resources they have access to. To accomplish daily activities that require travel, individuals who are VI pinpoint space-time constraints centered around access to three resources: transportation, assistive technology, and mobile technology. Transportation includes public and private forms of transport, assistive technology is technology that improves individuals' functional capabilities, and mobile technology is GPS-based digital technology that performs tasks in real-time. Each theme reveals a varying mix of capability, coupling, and authority constraints. The following sections provide notable examples of each constraint related to participants' access to transportation, assistive technology, and mobile devices. These examples reveal that both behavioral and social processes interact to shape space-time constraints on individual mobility. They highlight the role of power relationships in mediating individual mobility as well as the importance of time in shaping people's travels.

3.4.2 Evaluating accessible transportation options

Capability constraints strongly influence the types of transportation that participants access. For people whose vision loss precludes them from driving, access to public transit is especially vital for enabling mobility and independent living. Emma, a college student in her twenties who works part-time, aptly states: "I'd like to drive, but I can't drive… There's tons of public transportation. It just takes me longer to get there." Like Emma, most other participants walk and utilize public transportation to accomplish their daily activities. The most common travel modes are Bay Area Rapid Transit or BART (regional rail service for the San Francisco Bay Area) and public bus.

Coupling constraints are critically important as individuals knit together different public transit routes to reach a destination. Several individuals identify transfers between different bus and BART lines as major restrictions on travel plans and opportunities given the set of tasks they need to accomplish over the course of a day. Amy, who is in her fifties and nearly totally blind, routinely schedules time in her workday to exercise, purchase groceries, and prepare healthy meals. Maintaining a work-life balance is important to Amy, and her short commute to work enables her to realize both her personal and professional goals. Amy and other participants actively seek simple travel commutes to establish stable and manageable daily routines, which are crucial for maintaining health and well-being (McQuoid et al., 2017). Amy explains transfer time as the foremost reason for why she is not considering an ideal job located further away from her home:

"[The position] was a great fit for me…but it was in [City Name]. Now I'm not

commuting that far. So, I usually try to limit it to one transfer… Because it's the

transfer time that really takes the time, and it's the waiting time for the bus or the

BART to get there… So, it makes for really long days of not just the work day but

getting all of my other things in, and so having an easy commute and a short

commute is really important."

Others also prefer one or no transfers when traveling from one location to another. As

Joe, an employed man in his thirties, explains: "…when you get too many transfers, there's a lot

more failure points along your way. So, if one of your transfers screws up, then all of your others

will get screwed up too." Transfers impose significant coupling constraints, requiring people to

spend more of their time waiting, traveling, and adjusting their original travel plans to

unexpected changes. For many, the number of transfers and the amount of time needed to

transfer directly influence the quantity and quality of their daily activities.

While public transportation is important for increasing personal mobility, its fixed route

and timetable impose authority constraints over which regions riders have access to and at what

times. These constraints lead some participants to use paratransit, a door-to-door service for

people with disabilities. Robin, a college student in her twenties and legally blind, explains why

she uses paratransit frequently despite her confidence with navigating public transportation:

"I like [paratransit] when I can't get to places with public transportation.

Sometimes it can be unreliable because it can be late and they have other people

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to pick up so it takes forever. I'll use it when I can't get to places with the bus or

BART."

As a young woman, Robin also uses paratransit for traveling late at night to avoid uncomfortable encounters with strangers that she previously experienced when using public transit. For Robin and other informants, gender intersects with disability to influence how and when they travel. Others use paratransit to reach an unfamiliar location for the first time. Many use paratransit when they are carrying a lot of stuff, such as groceries or a suitcase. However, while paratransit provides an affordable, accessible option for people who are VI, it is consistently unreliable and tardy. Riders must have flexibility in their schedules and anticipate spending a greater share of their day using paratransit. They also have to plan ahead of their scheduled ride, as local paratransit services require riders to make reservations over the phone with advanced notice ranging from 24 to 72 hours.

Some individuals supplement or completely substitute public transit with a car, by having relatives or friends drive them. Their social support network facilitates their mobility. However, dependence on drivers can also impose constraints that limit access to social and recreational opportunities. Mia, an employed woman in her forties, is able to continue working after her vision loss because her parents are able to drive her to and from her job site. Nevertheless, because she relies on a driver and lives in a suburban neighborhood with infrequent and limited bus options, Mia identifies limits to her social life:

"At night, you don't have the additional resources and at night my dad does not

drive, and I don't want to inconvenience other people, so most of the time I'm not

going out for night events. Just limits myself that way. But it would be nice to drive somewhere and have dinner far away, especially it would be nice to commute down to San Jose or go somewhere in Santa Cruz, you know further away, you know expanding my horizons."

In Mia's case, her driver comes with capability and authority constraints due to his inability to drive at night, which in turn influences when she can be mobile and for what purposes. This consequently restricts the kinds of social activities that Mia can partake in.

In general, people who are VI evaluate and negotiate variable space-time constraints that come with different transportation options. While participants pinpoint serious capability, coupling, and authority factors that impact how they navigate the urban built environment, they also actively seek to increase their agency over their mobility by accessing multiple modes of transport. The temporal dimension of travel is particularly important as public transit users weigh the cost of transfer time and as paratransit riders budget for waiting time. Although some individuals have drivers which reduce the constraint of time, the driver is typically someone in their informal social support network who also has space-time constraints. For people who are VI, the use of a car to improve their mobility is subject to interdependent and relational space-time constraints.

3.4.3 Utilizing assistive technologies

Assistive technologies are crucial to bolstering individuals' travel capabilities, but authority constraints around access to rehabilitation services impact people's ability to obtain assistive equipment and training. White canes are especially important for enabling the

mobilities of individuals who are VI. Many use a white cane as an extension of their arm to detect potential hazards in front of them as they walk. Informants typically acquired their white cane as a client at the Department of Rehabilitation (DOR), a state department that administers vocational rehabilitation services. To become a client, individuals must identify an employment goal that they need DOR assistance with. As a result, their access to a white cane is contingent on working towards an employment objective. At the same time, access to the DOR is not straightforward. A few informants describe being unaware of the DOR at the onset of their impairment. They spent months and years struggling with how to live with vision loss before learning about the existence of rehabilitation services. They explain that being aware of the DOR earlier would have led to an easier adjustment to blindness.

Participants concur that traveling with a cane greatly improves their mobility. Not only does a cane help people detect obstacles in their walking path, it also makes their impairment visible and legible to bystanders, who at times offer assistance. Jamie explains that a cane makes traveling less stressful:

"[The cane] makes it a little, a little bit easier to get through. Like getting off of the train… there are people that kind of, there's always one [who] won't let you get through… some of them are just like not gonna move, but then, some of them are a little bit more kinder and they'll allow you to get through easier… Some people will allow you to have a seat…"

In making their impairment visible to others, individuals find sighted travelers to be helpful in enabling their mobility by getting out of their walking path, providing directions, and

offering seats closest to the doors of buses and trains. Their capacity to navigate the built environment is not just improved by the use of a cane, but also by the mindful actions of sighted bystanders. However, while informants agree that white canes are useful mobility tools, individuals with some vision are less likely to use them. Emma, a college student in her twenties who works part-time, shares that she does not use a cane despite tripping frequently while walking. Others describe a desire not to make their visual impairment visible and appear disabled, engaging with strategies to 'pass' as sighted (Worth, 2013). Visibility can be a double-edged sword. While it may lead to more help from strangers, it also marks people as disabled and exposes them to ableism, or discrimination against people with disabilities.

To access and use assistive technologies that facilitate their travels, individuals who are VI navigate relations of power with government employees and sighted strangers. To access assistive technologies at little to no financial expense, individuals must enroll in rehabilitation services and consent to work towards specific employment-related goals. With their rehabilitation counselors, individuals negotiate their employment objectives and assistive technology requests, but rehabilitation counselors can occasionally exercise their authoritative power to ignore their consumers' wishes and minimize their options. People who are VI also routinely contend with sighted strangers during their travels, and other travelers can either be helpful or obstructive to their mobility.

3.4.4 Navigating with mobile devices

Mobile technologies are vital to improving individuals' travel capabilities by hosting applications that provide geolocation information in real time. Prior to the availability of mobile technology, individuals relied heavily on bus drivers, train conductors, and other travelers for

locational information while traveling. For people who are VI, mobile devices and navigational applications have shifted the power over access to real-time information from everyone else back to the individual. While traveling, many individuals who are VI use mobile applications to obtain updated GPS information and public transit arrival times.

However, mobile applications are not always accurate. Amy describes her use of a mobile application for a recent trip to an unfamiliar location and how she was unable to rely on it completely to get to her destination:

"I turned on my GPS… and I asked Siri to give me directions from my current location to [an address]. And that went well but it told me to walk to the route. And it's like, well, I don't know where the route is. And so I canceled that. I then asked it for current location to [the address] again and that's when it said to continue on [Street Name]. And it's like okay, good, I know I'm on [Street Name]… I was walking and I was walking and I thought this is really far… I also knew it was a totally different route from what I'd been told… I was definitely late so I went a couple more blocks and finally my GPS said that I had arrived at my destination, it was on the right. Well, of course I couldn't find the entrance. So then I called… and so they came out and found me."

While Amy's mobile application ultimately helps her reach her destination, it requires some experimentation to provide directions that she can actually follow since it assumes that she is a sighted user who can see the map on the screen. The navigational application also does not provide the quickest route because it is unaware of a more direct walking path that is not a part

of the sidewalk network. Furthermore, the application does not have any spatial information about the building that Amy needs to enter, specifically the entrance location. As a result, Amy cannot rely solely on her mobile device to navigate to the room she needs to be in.

Participants also use GPS applications to track their locations while on public transit, but the applications are not always accurate. During a travel interview with Meg, a college student in her thirties and legally blind, she nearly got off the wrong bus stop because her GPS application gave her the wrong information about where she was. The bus driver intervened to make sure she was getting off at the right bus stop.

Mobile applications are also helpful for situations where the capability, coupling, and authority constraints associated with using public transportation are too high. When people get lost traveling or miss their ride, they use mobile applications to request a ride-hailing service such as Uber or Lyft. However, only individuals who have the financial resources to pay for the service can use this option. Paul, who has more financial means relative to other participants, explains that he uses Uber when public transit takes too much time or when he gets lost traveling to a destination:

"It can be easier just to get off the bus, go okay, pull out the phone and hit the Uber app. I mean, yeah there's a cost associated with it, you're paying more… I feel like I'm in a situation where it's almost just easier for me to Uber… I have enough means to do that, not necessarily on a daily basis, but if I needed to go to an interview, I had to be there, then I could get into an Uber. Or take a cab. The fact that Uber is all electronic, it's much more convenient for somebody who just doesn't want to deal with any kind of paper."

Joe expresses similar sentiments, stating that Uber or Lyft is a great last resort option: "…if something goes wrong with BART, for whatever reason, I kind of have Uber and Lyft as a last resort. It's the most costly of the options I use. It's definitely the most flexible and most powerful option."

While mobile navigation applications provide more accessible spatial information to users about their immediate surroundings as they travel, people who are VI continue to need sighted individuals for information when mobile applications fail. Their mobility is still mediated through relations of power with sighted strangers. Mobile applications for ride-hailing services also expand individuals' travel options to include car transport. For circumstances in which individuals are unable to reach their destination in time through their primary modes of transit, Uber and Lyft rides are valued contingency plans.

3.5 Discussion

In using a qualitative space-time approach to investigate the everyday mobilities of people who are VI, I build on established conceptualizations of space-time constraints. While previous studies use more positivistic and quantitative definitions of space-time constraints (Patterson & Farber, 2015), I find constraints to be more dynamic and relational. Space-time constraints are moving targets that are not fixed in time and place, nor by one's health condition. They evolve with changes in personal circumstances, social attitudes, built environments, and assistive technologies. While individuals who are VI identify many constraints in transportation and technology that impede their mobility, they also utilize varied strategies to address these restrictions and increase their agency and access to critical material resources. We know from

non-representational theory that disabled subjective becomings develop from the embodied

practices of individuals in relation to other bodies, spaces, and objects (Hall & Wilton, 2016).

People's mobilities are produced through their relational dependencies on transportation systems

and the ways in which they engage with other people and their environments. A qualitative

space-time approach offers a framework that makes possible the inclusion of the dynamic and

relational processes that shape differential access to places and spaces.

Relatedly, I regard authority constraints more broadly than previous definitions in the

literature (Marston et al., 1997) – as power that can take on various guises and be concentrated or

networked (Allen, 2008). As an example, authority constraints in the form of power relationships

restricted individuals' access to white canes and expensive mobile technologies. People who are

VI have to enroll in the DOR and satisfy institutional requirements like actively seeking

employment in order to access mobility-facilitating technologies. At the same time, knowledge

about available resources at the DOR is uneven. Several informants only discovered the DOR

indirectly and belatedly through social networks rather than through their primary care eye

doctor or through outreach activities. Lack of information constrains access to assistive

technologies, limiting everyday mobility and access. Without the DOR and other organizations

that provide rehabilitation services, many would not have the resources necessary to travel and

live independently.

In Marston et al.'s (1997) investigation of individuals who are VI in a small California

city, one key finding is that people greatly need access to information to enable their mobility.

Since the time of their study, numerous technological developments have improved access to

travel-related information for individuals with limited or no sight. In this study, I find access to

mobile technologies crucial to facilitating people's travels and their navigation of a dense urban

transit network. This kind of technology has only been available in the last several years. With a mobile device, people now have access to real-time information through various applications, including ones that are specifically tailored to users with vision loss. Information from mobile applications can be read to users or enlarged on their screens. These applications provide information about public transit schedules, instructions for route navigation, and GPS tracking. Participants recognize that their mobile phones are extremely useful for trip planning and travel navigation, particularly when they get lost or when they have to unexpectedly change their original plans.

Through an analysis of qualitative space-time constraints, this paper also bridges the behavioral and social approaches to investigating the complex relations between vision loss and mobility. Historically, geographic research on visual impairment and mobility has tended to advance one approach or the other. This article demonstrates that both are important to understanding the day-to-day travel experiences of people who are VI. While this paper reveals that advancements in mobile technologies are tremendously helpful for facilitating travel, as proposed by early behavioral geographers (Golledge, 1993; Marston et al., 1997), it also finds that individual mobility and access are constrained by social and relational processes that center on interactions with family members and friends, other sighted individuals, and governmental agencies that provide assistance and support. Additionally, this article demonstrates that time is an important dimension of travel, building on work by social geographers who largely focus on the spatial aspects of mobility (Imrie, 2013; Pow, 2000; Worth, 2013). For individuals who are VI, time often imposes considerable limitations on when and how people travel, and how long they can participate in various activities. For instance, paratransit users budget for waiting time in their daily schedules since their rides are often delayed, and public transit commuters weigh

the costs of transfer time against the benefits of activities. Concerns about time also result in carefully established daily travel routines that reduce the stresses that emerge when people who are VI navigate unfamiliar spaces at unfamiliar times.

Research limitations include generalizability. The results are based on the experiences of a small number of individuals at a specific time and place, and may not be generalizable to the circumstances of people in other urban and rural localities. The findings may not be particularly transferable to individuals living in less developed countries, where people who are VI have difficulty accessing even basic assistive technologies. Only 5-15% of people in low- and middle-income countries who need low-tech, assistive technologies have access to them (WHO, 2017). Additionally, participants were recruited from organizations that provide rehabilitation services, and this paper may be neglecting the experiences of individuals who do not need services as well as those who need services but do not have access to them.

3.6 Conclusion

This paper reveals the various mobility issues that individuals who are VI confront as they navigate the urban built environment. They negotiate critical space-time constraints that are tightly contingent on their access to transportation, assistive technology, and mobile devices. These space-time constraints impact where they can go, what activities they can participate in, and what resources they have access to. The temporal dimension of mobility is particularly important for people who are VI. The timing of transit schedules, work hours, and social gatherings influences when, where, and how they travel. Moreover, while many actively utilize varied travel strategies to increase their mobility and access to places, the strategies often require a significant fraction of their daily time.

The results inform avenues for intervention that would improve the mobility and quality of life for many people who are VI, as well as for individuals with other types of disability. For example, many would benefit from improvements to existing door-to-door transportation services. Participants in this study generally had two kinds of options. One was paratransit, which while affordable was consistently unreliable and late. The alternative was Uber or Lyft, which provided dependable, but relatively expensive services. Initiatives to improve the quality of paratransit services and lower the financial constraints of using ride-hailing services would increase the transportation options and mobility of people with disabilities. Another point of intervention is to increase access to autonomous vehicles when they become available. Most informants identify the inability to drive as a severe mobility constraint, and access to an autonomous vehicle would eliminate that limitation. Moreover, improvements to walking directions in GPS applications on mobile devices, including increasing locational accuracy and identifying entry points in a building, would enhance the travel experiences of people who are VI.

More research is needed to understand the complex and evolving interconnections between health and (im)mobility for people with disabilities. To generate more comprehensive insights on health-related mobility challenges, future studies should investigate the relational effects of health on mobility as well as (im)mobility on health. The mediating role of omnipresent mobile technologies should be especially studied, as mobile technology increasingly permeates daily travel logistics, access to resources, and overall well-being.

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CHAPTER 4

ACTIVITY SPACES & VISUAL IMPAIRMENT:

A CASE STUDY IN THE SAN FRANCISCO BAY AREA

Abstract

Activity space measures are often utilized to quantify the physical spaces that individuals travel through and have access to over the course of their daily activities. To date, these measures have rarely been used to investigate the mobility of people with disabilities, who often experience difficulties accessing transportation and navigating the built environment. Additionally, researchers have yet to compare results from activity space measures to people's perceived accessibility as a means of method validation. This paper contributes to the existing literature by (1) evaluating the activity spaces of individuals who are visually impaired (VI) in the San Francisco Bay Area and (2) comparing the activity space results to qualitative information about individuals' travel behaviors and their perceptions about the accessibility of their environments. This mixed quantitative and qualitative methods project models individuals' activity spaces from travel diaries and analyzes participants' travel behaviors and perceptions from interviews. Three activity space measures are considered: standard deviational ellipse, network buffer, and potential path area. The results demonstrate significant shortcomings in activity space measures for representing the experiences of people who are visually impaired and identify how existing methods can be improved for future research on environmental accessibility.

4.1 Introduction

People with disabilities continue to face a number of transportation challenges that impede their mobility and access to places (Graham et al., 2014; Lubin & Deka, 2012). For many, transportation options are inaccessible, expensive, or unavailable. Limited access to transportation makes commuting to work and competing in the labor market more difficult (Gillies, 2012; McDonnall, 2011; O'Day, 1999). It also makes travel to health care facilities a challenge, leading to lower health care utilization and to a greater risk of unmet health care needs (Iezzoni et al., 2006; McDoom et al., 2012; van Rooy et al., 2012). This kind of transport disadvantage can significantly curtail individuals' access to places, resources, and opportunities, and diminish their quality of life. This paper focuses on the mobility experiences of individuals who are visually impaired (VI), a particularly vulnerable subgroup of people with disabilities who encounter distinct travel challenges.

In transportation geography, many scholars seek to understand the impact of transport disadvantage on vulnerable populations (Hernandez & Titheridge, 2016; Maia et al., 2016), often through the development and application of different measures of accessibility (Casas et al., 2009; Pyrialakou et al., 2016; van Wee, 2016). Activity spaces are increasingly used to quantify and summarize individuals' potential accessibility, or the spatial extent of where they can travel given constraints related to daily activities, time, and transportation mode (Kamruzzaman et al., 2011; Li & Tong, 2016; Patterson & Farber, 2015). However, the vast majority of activity space research focuses on able-bodied populations. With some notable exceptions (Casas, 2007; Townley et al., 2009), the activity spaces of people with disabilities continue to be understudied despite recognition that they are much more likely to experience transport disadvantage than the general population. Furthermore, the activity spaces of people who are VI have not been studied.

There are consequently few research efforts to quantify areas that are inaccessible to people with disabilities and to understand the kinds of transport disadvantage that they face.

This paper has two interrelated objectives. First, it evaluates the accuracy and appropriateness of three activity space measures when applied to the travels of individuals who are VI. The activity space measures are standard deviational ellipse (SDE), network buffer (NB), and potential path area (PPA). Then the activity space results are compared to individuals' perceptions of travel opportunities and barriers and the accessibility of their environments. The main contribution of this paper is to assess the applicability of well-established activity space measures for the mobilities of individuals who are VI. This research also seeks to address a literature gap identified by Patterson and Farber (2015) – that few scholars have made explicit comparisons of different activity space measures and compared the quantitative outcomes with perceived accessibility. In comparing quantitative and qualitative results, this article draws attention to the distinct accessibility issues of a marginalized and often overlooked group – people who are VI.

In the sections that follow, I begin with a brief overview of visual impairment and the travel challenges faced by people who are VI. This is followed by a review of accessibility methods and activity space measures used in research on transport disadvantage. Next, the activity space measures and qualitative analysis of interviews are discussed. Finally, the results are summarized and future recommendations are provided for improving existing methods.

4.2 Background & Significance

4.2.1 Visual impairment & transportation challenges

Visual impairment refers to a spectrum of sight loss ranging from moderate and severe vision loss to total blindness with no light perception (WHO, 2014). Many people who are VI have partial sight and may experience loss of peripheral or central vision, light sensitivity, blurry vision, and night blindness (American Optometric Association, 2016). Approximately 7.3 million people (2.5%) in the U.S. (National Federation of the Blind, 2016) and 285 million people in the world (less than 4%) have a visual disability (WHO, 2014). The travel experiences of people who are VI depend partly on the type of vision loss they have (Casey et al., 2013).

Recent improvements to the built environment and increased access to assistive technologies have greatly facilitated the mobility of individuals who are VI (Casey et al., 2013). However, despite these advancements, having a visual impairment still amplifies travel constraints and challenges. Transportation choices are often inaccessible, unaffordable, or unavailable (Crudden et al., 2005; Gold & Simson, 2005; McDonnall, 2011; O'Day, 1999). With rare exceptions, people who are VI are unable to drive and therefore rely on public transit, walking, or on someone else to drive them (Gallagher et al., 2011). Some experience travel challenges due to a lack of spatial information about their routes and destinations (Casey et al., 2013; Golledge, 1993; Marston et al., 1997). Another issue is difficulty navigating busy traffic intersections, construction areas, and crowded public events (Kaminsky et al., 2014).

Apart from a couple of studies (Casas, 2007; Townley et al., 2009), there is little research on the activity spaces of people with disabilities as they relate to issues of transport disadvantage and mobility. Utilizing accessibility methods to measure people's mobility and access to opportunities, Casas (2007) finds that people with disabilities experience greater transport disadvantage than individuals with no disabilities. Using activity spaces to represent the mobility of individuals with serious mental illness, Townley et al. (2009) find larger activity spaces to be

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positively associated with more optimistic life assessments. In these studies, findings from activity spaces reveal how living with a disability can influence individual mobility and access to resources and amenities.

No studies have used activity spaces to analyze the mobilities of individuals who are VI, who have unique travel experiences and views about the accessibility of their environments. Bridging the work of behavioral, time, and transport geography (Casas et al., 2009; Charleux, 2015a; Golledge, 1993; Hägerstrand, 1970; Kwan, 1998; Marston et al., 1997; Miller, 1991; Patterson & Farber, 2015) and that of disability geography (Gleeson, 1999; Imrie, 2013; Macpherson, 2008; Pow, 2000; Worth, 2013), this paper evaluates three types of activity space measures using the daily travel diaries of 31 individuals who are visually impaired. The modeled activity spaces are compared with individuals' perceptions to identify the method that best represents their everyday experiences. This paper's key contribution is assessing the applicability of activity space measures for characterizing the idiosyncratic mobility and accessibility experiences of people who are VI.

4.2.2 Accessibility & activity space measures

In recent decades, transportation researchers have developed and utilized accessibility measures that can be categorized as either place-based or people-based (Charleux, 2015a; Kwan, 1998; Miller, 2007; Neutens et al., 2010). Place-based methods generally assess the geographic proximity of opportunities from a reference location, such as an individual's home or workplace. A wide variety of place-based measures exist. These include indices based on: (1) calculating the number or ratio of opportunities that can be reached from a reference location within a given time, distance, or geographic area (Black et al., 1982; Handy & Niemeier, 1997; Hanson &

Schwab, 1987), (2) determining supply to demand ratios within floating catchments (Wang, 2012), or (3) using gravity-based measures in which the attractiveness of opportunities decreases with increased distance, time, or transport costs (Hansen, 1959; Guy, 1983; Linneker & Spence, 1992). While place-based measures are useful for evaluating and comparing the accessibility of different places, they have been critiqued for ignoring individual space-time constraints that affect people's ability to access locations when and where needed (Kwan, 1998; Miller, 2007; Neutens et al., 2010). A significant limitation is that all individuals are attributed the same level of access to opportunities (Kwan, 1998), when in reality different groups experience variations in access. Given that place-based measures use reference locations as proxies for individuals (Kwan, 1998; Miller, 2007), individuals' unique traits and behaviors are not considered and the issue of differential access is disregarded.

To address the limitations of placed-based accessibility measures, scholars have increasingly turned to people-based methods that explicitly consider individuals' travel behaviors. Computational advancements coupled with the development of accessible software tools have driven the application of people-based methods, particularly those focusing on activity spaces (Patterson & Farber, 2015). Introduced by behavioral geographers, activity spaces (AS) are defined as the physical spaces within which people travel in the course of their daily activities (Golledge & Stimson, 1997). In theory, AS refers to an individual's actual mobility – the spaces they access daily. However, in practice, AS is typically used to summarize an individual's potential mobility – the spaces they are able to reach given the fixed time-space constraints of everyday life (Patterson & Farber, 2015). Activity spaces are utilized in transport geography and demography, and health researchers are increasingly using the methods to model health service access and environmental health effects (Kamruzzaman et al., 2011; Li & Tong,

2016; Matthews & Yang, 2013; Patterson & Farber, 2015; Townley et al., 2009; Zenk et al., 2011). However, the activity spaces of socially vulnerable populations such as people with disabilities have been overlooked by transport scholars, along with their perceived accessibility to opportunities and places (Patterson & Farber, 2015; van Wee, 2016).

Diverse activity space measures have been developed and applied in understanding travel behavior. Some widely-used methods such as the network buffer and standard deviational ellipse are easy to compute in a GIS, whereas other methods are more computationally intensive (Patterson & Farber, 2015; Perchoux et al., 2013; Sherman et al., 2005). In many applications, researchers choose an AS method based on access and computational considerations, while giving less weight to the appropriateness of the method for the population and study area of interest.

Patterson and Farber (2015) identify a shortage of research that explicitly compares AS measures. Previous studies compare place-based accessibility measures with people-based ones (Casas et al., 2009; Kwan, 1998; Neutens et al., 2010), providing evidence that people-based methods more accurately represent individuals' accessibility to locations and opportunities. Others compare different AS measures (Kamruzzaman et al., 2012; Rai et al., 2007; Sherman et al., 2005; Zenk et al., 2011). The findings are mixed, with the best choice largely dependent on the research question. Sherman et al. (2005) regard the network buffer to be the most suitable for representing healthcare accessibility since it considers the physical networks that facilitate travel. Kamruzzaman et al. (2012) call for using qualitative data to determine which AS measure is most appropriate. Similarly, Patterson and Farber (2015) recommend that future studies include individuals' perceptions for method selection and validation. This paper contributes to these

research gaps by evaluating three different AS applications via triangulation of quantitative outcomes with qualitative results.

4.3 Methods

4.3.1 Study design

This study compares three different activity space measures to assess their effectiveness in representing the environmental accessibility and transport disadvantage of individuals who are VI. Using individuals' qualitative perceptions and behaviors, I discuss the strengths and weaknesses of these widely used AS-based accessibility measures and their overall validity in estimating the space-time accessibility of people who are VI. The analysis draws on a case study of 31 visually impaired individuals who reside in the San Francisco Bay Area, which was chosen because the region has historical symbolic and material significance for the visually impaired community. Berkeley and San Francisco, both prominent cities in the region, have been critical sites for the disability rights and independent living movements (Grim, 2015; Regents of the University of California, 2004). Today, there are ongoing discussions about designating Berkeley as a disabled city and a blind city (Disability Visibility Project, n.d.; Lee, 2015). Similarly, San Francisco has long engaged in planning and policy-making to support people with disabilities (City & County of San Francisco, n.d.). With major rehabilitation and independent living resources located in San Francisco and the East Bay, the San Francisco Bay Area is an attractive region to live in for people who are VI. Additionally, as a large metropolitan region connected by an extensive web of commuter rail and bus lines, the region comprises of diverse places that afford varying levels of access and mobility for people who are VI.

Data collection involved four phases: (1) a screening survey, (2) a comprehensive survey, (3) a sit-down interview, and (4) a mobile interview. Three organizations in the San Francisco Bay Area that provide rehabilitation services to residents who are VI were contacted by email to forward information about the research project to clients. During the first phase, individuals who expressed interest in participating completed a screening survey that included several demographic questions. Participants were screened primarily by their impairment, place of residence, and age; individuals selected for research inclusion had a visual impairment, resided in the San Francisco Bay Area, and were working-age adults. Individuals who met the screening criteria were invited to complete a longer survey that took approximately one hour to complete. The survey included questions related to travel behaviors, activities impacted by vision loss, overall health, technology use, and a travel diary of a typical weekday. Both surveys followed best practices for surveying individuals who are VI (see Murray, 2007).

The final two phases involved follow-up interviews. A subset of the survey respondents was invited to participate in a semi-structured interview at a place of their choosing. The interview participants represented a variety of backgrounds. Interviews lasted between half an hour to an hour and a half, and took place in coffee shops, workplaces, and public libraries. Then, a sample of interview participants representing diverse travel experiences and daily activities was invited to participate in a mobile interview. Mobile interviews involve traveling with participants as they move through a travel route. Researchers can observe participants' practices and behaviors while acquiring information about their lived experiences and sense of place (Carpiano, 2009; Finlay & Bowman, 2017). During the mobile interview, I asked participants about their travel experiences, strategies, preferences, and constraints. The mobile interview provided opportunities for participants to expand on transportation issues they

mentioned during their sit-down interview and survey, and to suggest improvements to the built environment that would improve their mobility.

Data were collected from November 2015 to October 2016. Ethical approval was obtained from the University of Illinois' Institutional Review Board, and informed consent was acquired at each phase. Participants received a $20 gift card upon completion of the survey and interviews. Thirty-one individuals completed the survey, 13 participated in sit-down interviews, and eight participated in mobile interviews.

4.3.2 Activity space measures

For each of the 31 survey respondents, three commonly-used activity space measures were estimated: standard deviational ellipse (SDE), network buffer (NB), and potential path area (PPA). SDE and NB are commonly used by researchers as representations of potential accessibility or proxies for actual mobility (Patterson & Farber, 2015; Sherman et al., 2005; Zenk et al., 2011). A SDE is an elliptical polygon that encapsulates locations at one, two, or three standard deviations from the mean center of the locations. For this paper, SDEs were created at one and two standard deviations, capturing approximately 68% and 95% of activity locations, respectively. A major limitation of the SDE method is that it requires a minimum of four activity locations for computation. Because sixteen participants had only three activity locations, they were excluded from the SDE method, leaving only 15 participants whose AS could be modeled by SDE. Figure 5 illustrates SDEs at one and two standard deviations using hypothetical activity locations. Hypothetical locations were used for all figures to protect participants' confidentiality.

Figure 5. Standard deviational ellipse (SDE)
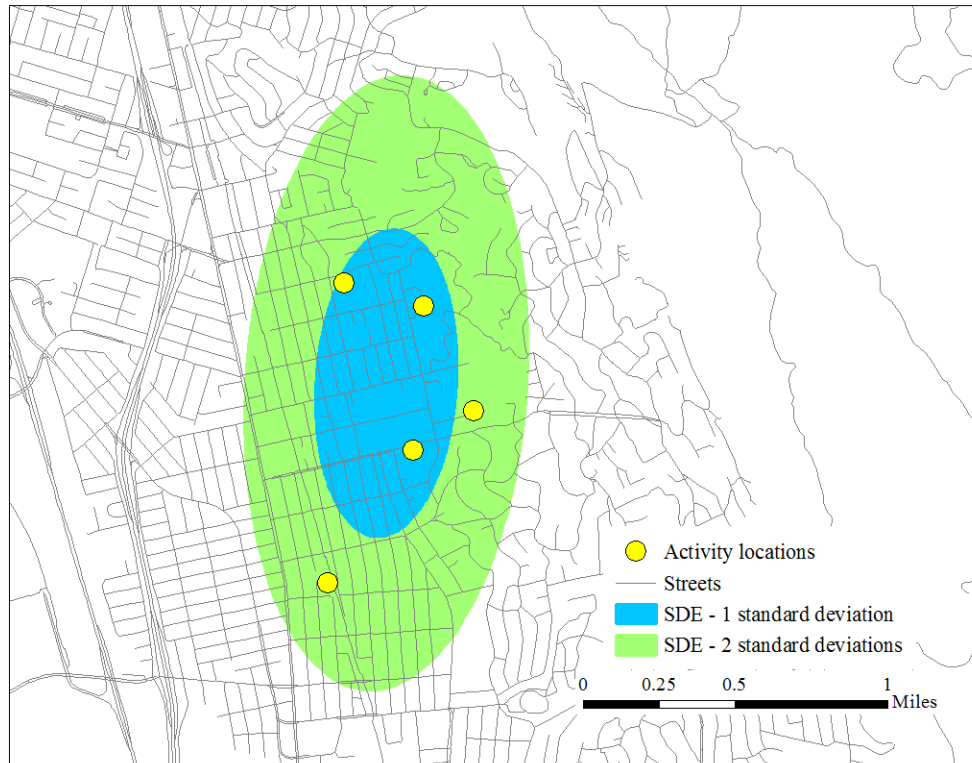
The network buffer method of defining activity spaces focuses on areas that are within close proximity to an individual's typical travel route. A network buffer activity space is constructed by creating a Euclidean spatial buffer around a travel route. For each respondent, the shortest path between sequential activity locations was first created based on the shortest distance via a street network. Then a quarter mile buffer (approximately 402 meters) was created around each individual's travel path to represent locations that are easily accessible from the daily travel route (Figure 6). This distance was chosen because it captured the immediate environs around the route, and it was a reasonable distance for traveling, even if on foot (Gordon et al., 2011).

Figure 6. Network buffer (NB)
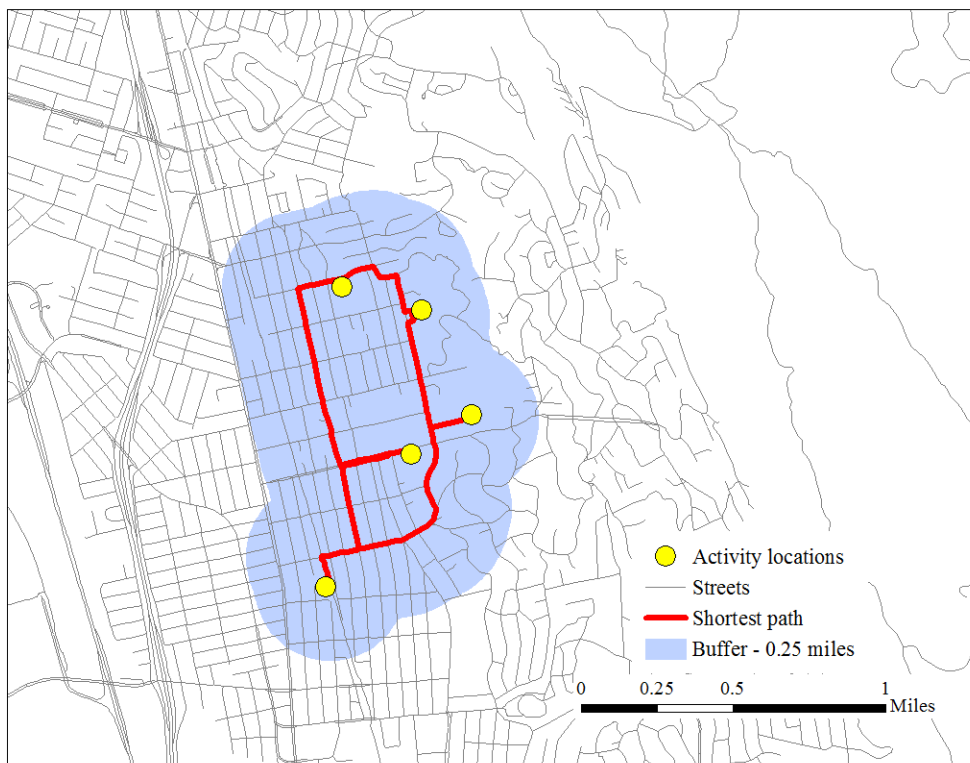
The third measure, potential path area, is also utilized to represent individuals' mobility

and potential accessibility, but it is less commonly employed in research, in part because PPAs

require more complicated inputs and involve more computation time (Charleux 2015a; Patterson

& Farber, 2015). Unlike the other two methods, the PPA incorporates the available time between

activity locations (Table 4). It represents the area that can be accessed via the street network

within an available time interval. This paper used the PPA toolbox created by Charleux (2015b).

The specific tool utilized was the Daily PPA, a term coined by Kwan (1999) to refer to the sum

of all PPAs over the course of a day. There were three inputs: individuals' activity locations, a

street network, and a grid for the raster output. The activity locations included time attributes,

and the PPA tool considered the fixed time spent at activity locations and calculated the time

available between activities for traveling. The raster output quantifies the amount of time that an

individual can spend at each cell given a time budget and a sequence of activity locations (Figure

7). To calculate the area size, the raster output comprising cells with values greater than zero was

converted to vector. Note that the PPA activity spaces correspond to the "reachable" space

within a person's space-time activity constraints. The activity spaces are large in size because

they reflect assumptions about the amount of time people might spend at each location within the

reachable space.

Figure 7. Potential path area (PPA)
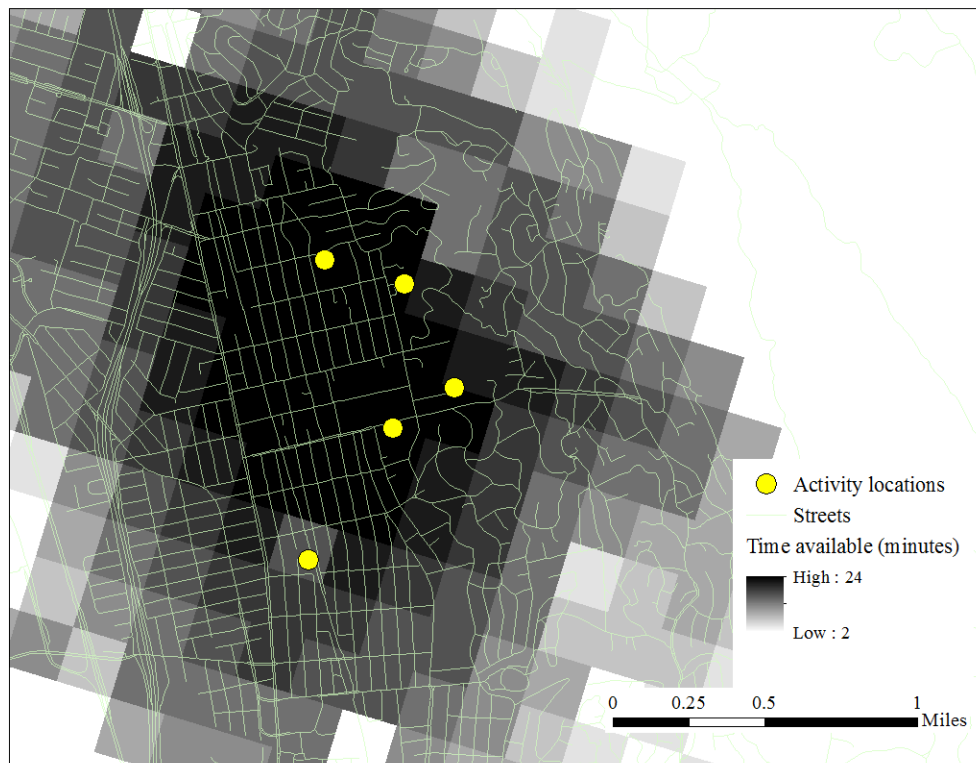
Table 4 summarizes the main attributes for each activity space measure. The SDE

calculates the spatial direction of the activity locations, but it does not consider the timing or

sequence of activities, nor travel along street networks. The NB reflects individual movement

from one activity to another via the street network and assumes that people can access places

within close proximity to their travel route. In contrast, the PPA is the most computationally

intensive and conceptually rich measure. It incorporates network distances and the space-time

locations and sequences of activities. However, the PPA entails significant assumptions about

individual travel mobility. In the time available between activity locations, it assumes that people

can utilize multiple alternative routes to travel from one location to another and that people can

potentially access many more places in between activities than they may be aware of or feel

comfortable traveling to.

Table 4. Summary attributes of activity space measures

	Standard Deviational Ellipse (SDE)	Network Buffer (NB)	Potential Path Area (PPA)
Inputs	Activity locations	Activity locations, network dataset	Activity locations, network dataset, grid for raster output
Output	Ellipse that best fits direction of activity locations	Buffer of specified distance around travel route	Raster of area accessible between two places within specified time budget
Transport-based	No	Yes	Yes
Time-based	No	No	Yes
Use restrictions	Minimum number of activity locations (four)	N/A	N/A
Computation time	Seconds	Seconds	Hours

4.3.3 Qualitative analysis

To compare activity space results to qualitative information about individuals' travel

behaviors and perceptions, interview data were prepared for qualitative analysis. Audio

recordings from sit-down interviews were transcribed, as were notes from both sit-down and

mobile interviews. Using a deductive approach, transcripts were coded with assistance from

qualitative data analysis software. The content was reviewed multiple times for codes related to travel behaviors and the perceived accessibility of environments. The codes were then grouped into major themes.

4.4 Results

4.4.1 Summary of activities, transit modes, and activity space sizes

Quantitative summaries of activity spaces including number of locations, transport mode, and area size indicate that study participants have varied travel experiences and activity spaces. Informants have between three to 12 activities on a typical weekday, and the mean is four activities. Thus, the activity spaces are relatively restricted in terms of number of locations. Most participants walk and use public transit. A minority utilize a different primary mode of transit: car, paratransit, or ride-hailing service (Lyft, Uber, taxi).

AS size differs by level of visual impairment, employment status, and gender (Table 5). Wilcoxon rank-sum and Kruskal–Wallis tests were used to test the equality of distribution of AS sizes between groups, but differences between groups were non-significant, likely due to the small sample size. On average, the activity spaces of individuals who are functionally blind (can see light) or totally blind (no light perception) are bigger than those of people who are legally blind (have some vision). In other words, people with less vision have larger activity spaces. While this is a counterintuitive finding, it is partly explained by employment status and age of onset of visual impairment. Most of the individuals who are functionally or totally blind are employed and were born with blindness, so they learned how to travel with blindness from an early age. The mean activity space size for students and employed individuals are the largest while unemployed participants have the smallest. This confirms the benefits of employment for

expanding the daily mobility of individuals who are VI. Men have, on average, larger activity spaces than women. Although these results are limited by small sample size, they generally support findings observed in previous research (Casas, 2007; Kwan, 2000; Preston & McLafferty, 2016).

Table 5. Area size (miles^2) summary statistics for NB and PPA (N = 31)

		NB		PPA	
	N	Mean	SD	Mean	SD
Visual impairment type					
Legally blind	25	5.44	4.57	413.58	415.97
Functionally/Totally blind	6	8.53	6.26	553.8	487.1
Employment status					
Employed	11	6.7	5.61	513.62	436.31
Student	6	6.42	4.09	569.27	444.68
Unemployed	14	5.36	5.06	328.35	412.06
Gender					
Female	18	5.58	4.35	438.61	440.25
Male	13	6.68	5.87	443.64	422.2

4.4.2 Area sizes of activity space measures

The area sizes of individuals' activity spaces vary greatly with each activity space measure, leading to different conclusions about the areas that are accessible and inaccessible to individuals. Table 6 provides the summary statistics for each activity space measure. The NB has the smallest average area size while the PPA has the largest. The coefficient of variation is higher for SDE than it is for NB and PPA, indicating that the SDE results have greater dispersion relative to the mean. The magnitude of difference is tremendous between the PPA area sizes and those of the other activity space measures. The considerable variability in average area size is critical because it shows that each activity space measure produces results that demarcate very different spaces as being accessible.

Table 6. Area size (miles^2) summary statistics for all activity space measures

	N = 15				N = 31			
	Mean	Median	SD	CV	Mean	Median	SD	CV
SDE 1	7.18	1.24	12.52	1.74				
SDE 2	28.71	4.96	50.07	1.74				
NB	5.69	3.74	4.27	0.75	6.04	4.91	4.98	0.82
PPA	486.74	322.8	412.42	0.85	440.72	223.7	425.6	0.97

SDE 1 = Standard Deviational Ellipse at 1 standard deviation
SDE 2 = Standard Deviational Ellipse at 2 standard deviations
SD = Standard Deviation
CV = Coefficient of Variation

A correlation matrix (Table 7) demonstrates that results from different activity space measures are not necessarily proportional nor congruent and would lead to different inferences about the accessibility of environments for people who are VI. While the correlation coefficients are positive between the SDE, NB, and PPA, the magnitudes are only moderate, ranging from 0.57 to 0.79. Each activity space measure generates dissimilar results about the mobility of people who are VI and the places that they can potentially access.

Table 7. Correlation matrix of area size results from all activity space measures

N = 15, *N = 31

	SDE	NB	PPA
SDE	1.00		
NB	0.79	1.00	
PPA	0.57	0.74*	1.00

Note: Both SDE correlations are identical.

4.4.3 Qualitative perceptions regarding mobility and access

Activity spaces are intended to represent the spaces and places people experience and have easy access to in the course of their daily routines. As this section demonstrates, qualitative methods can be used to critically evaluate measured activity spaces in relation to people's perceptions and experiences of access. Based on interviews with participants who are VI, two main themes are identified related to informants' views about the accessibility of their environments and the strategies they utilize to facilitate their travels. First, individuals identify different types of areas that are accessible and inaccessible, explaining that some locations are more accessible than others because of familiarity and walkability rather than simply because of geographic location and distance. Second, how people travel and access places are contingent on the availability of transit options and use of mobile technologies.

4.4.4 Distinguishing (in)accessible environments

The three activity space measures consider all activity locations and travel routes connecting activity sites (in the case of the NB and PPA) to be equally accessible; however, the interviews raise questions about this assumption for individuals who are VI. Study participants typically view their residential neighborhood as the most accessible area, followed by the immediate surroundings of other activity locations and public transit stops. Thus, their experiences illustrate an asymmetrical landscape of accessibility.

Individuals perceive their home environment to be the most accessible for two reasons. One is that they are most familiar with their residential neighborhoods, since they regularly walk to and from their home. Secondly, many individuals settled into their place of residence specifically because it is an area that is accessible to essential resources. Many choose to live in

accessible places and travel to accessible locations, with accessibility defined as places that are convenient to public transit. As one informant explains:

> "When I chose this area, I chose it specifically because I can't drive. I have to
> be around where everything's accessible to me… Grocery store's close to you,
> Social Security building's close to you… places to eat if you don't have
> money, churches are close to you, transportation's close to you, shopping
> center's close to you."

Participants also view the areas around other activity locations (e.g. workplace, school) to be accessible, but these areas are usually perceived as less accessible and familiar than their home location. As an example, one participant takes walks around her office building during lunch breaks, but she does not walk very far for fear of getting lost. She explains: "I would walk around this block… I don't want to go out too far and have to find my way, you know, to find my way back."

4.4.5 Traveling everyday routes

Unlike the environments around activity locations, areas along travel routes are not typically viewed as accessible, which is contrary to assumptions embedded in the NB and PPA. The perception that areas around travel routes are inaccessible is commonly voiced by participants, reflecting the kinds of transit options that are available to them. Although most participants regularly use public transit which restricts travel to fixed transit routes, even individuals who have access to a car do not necessarily have access to opportunities along travel

routes because they are often subject to their driver's time constraints. When using public transportation, individuals tend to follow easy, efficient travel routes – routes that they feel unable to deviate from due to the logistical challenges of navigating alternate paths. One individual who lives in a suburban neighborhood with infrequent bus service outside of work hours explains: "If I miss that bus, then the next one after that's not for another hour… I have to be there at that specific time to get that [commuter rail]." For their everyday travels, many have only one scheduled route with little to no scope for incorporating spontaneous activities and alternative transit possibilities.

Some informants use paratransit, which is a door-to-door transportation service for people with disabilities. Since paratransit can take riders to any location within its service area, it is often used as a supplement to fixed transit routes. Many participants use paratransit when public transportation options are unavailable, infrequent, or inconveniently located. However, paratransit is often a shared ride with multiple pick-ups and drop-offs, so while riders traverse a large geographic area because they travel to multiple places before they reached their destination, they do not have access to any of the opportunities along the route. One individual describes his paratransit experiences: "You [are] driving around the whole city by the time you get home."

Many participants regularly use navigational applications on their mobile phones to determine the best paths to reach their destinations. Individuals' close adherence to navigational instructions provides additional evidence that the immediate environments around travel routes and activity locations are not necessarily accessible. The navigational applications provide audio instructions to individuals as they travel to their destination. Users follow the audio instructions closely and are unlikely to stray from the planned route. As a result, areas that are a short walking distance from the route are not accessed and may not be considered accessible. With

their point-to-point emphasis, navigational applications do not foster exploration of nearby areas. If an individual's vision loss is severe, then even incidental opportunities along the route may go unnoticed.

4.4.6 Comparing activity space outputs to people's perceptions and experiences

The qualitative results reveal a better understanding of the factors that facilitate people's capacity to travel and the processes that make certain places accessible. They clearly demonstrate that individuals who are VI view different places as being differentially accessible based on familiarity with areas near home and other key sites, reliance on public transit and paratransit, and use of mobile applications that direct them along fixed routes. In contrast, well-established AS models assume that accessibility depends solely on distance and time from daily activity locations and travel routes, neglecting many factors that impact accessibility and mobility for people who are VI. The qualitative results uncover the considerable limitations that activity space measures have in representing individual mobility, environmental accessibility, and transport disadvantage for individuals who are VI. For example, the SDE is a geometric feature that describes the locations and orientations of activity locations. It does not consider individuals' travel routes and is likely to include areas that people may not actually travel to or have access to. The PPA assumes that there are multiple pathways to reach a destination within a given time budget, thereby deducing that a large area is reachable and accessible. However, in practice, the people in this sample are primarily interested in the easiest, most efficient route to get to a destination and are unconcerned about alternative routes.

Of the three activity space measures, the NB best fits the experiences of people who are VI because it does not assume that people can freely travel in all directions and along all routes

relative to their activity locations. However, even the NB involves a significant assumption – that areas in close proximity to travel routes are accessible. The qualitative results suggest that this is not the case for people who are VI, who need more forethought and planning to deviate from a well-known route. Additionally, their travel routes may be dictated by directions from GPS devices or the fixed schedules of public transit, so the spaces that are accessible are very constrained.

While this study focuses on the experiences of individuals who are VI, some of their travel behaviors, perceptions, and motivations may be relevant to the general population. For instance, people in the general population may consider places that they are more familiar with to be more accessible and they may choose home locations with positive accessibility characteristics. To better represent individuals' activity spaces, areas around activity locations should be given more weight relative to all other areas. This paper also demonstrates the utility of using qualitative methods to select the best activity space measure. In the existing literature, the few researchers who compare results from different activity space or accessibility measures do so quantitatively, and identify the most appropriate measure based on their own intuitions rather than on the grounded experiences and perspectives of their study population (Patterson & Farber, 2015).

4.5 Discussion & Conclusion

For this sample of individuals who are VI, comparing different activity space measures demonstrates that each method yields different results in terms of not only area size but also the spaces that are delineated as accessible and inaccessible. An analysis of the results reveals that correlations are not very strong nor congruent between area sizes generated from the SDE, NB,

and PPA applications. Researchers often employ only one method to quantify area sizes, which are used as proxies for individual mobility, areal accessibility, and the number of opportunities that people potentially have access to (Sherman et al., 2005; Townley et al., 2009; Zenk et al., 2011). Theoretically, the larger the area size, the greater an individual's mobility and access to places and opportunities. However, different measures produce diverse results, leading to varying research conclusions and policy implications. Therefore, a careful comparison of different activity space measures is necessary before drawing any inferences.

Quantitative comparisons also reveal sharp differences in activity spaces among participants who are VI irrespective of the AS measure used. Although many informants' activity spaces are constrained in geographic extent and by number of activity locations, others are more expansive as people travel long distances via public transit to reach workplaces, health care providers, and other important daily activity sites. Differences in AS size are largest by type of visual impairment, revealing vision quality to be a significant mobility factor. Variations in AS size by gender and employment status are also apparent and mirror trends observed in the non-visually-impaired population (Kwan, 2000; Preston & McLafferty, 2016). However, a central feature of participants' activity spaces is their routinized and fixed geographical configurations. Many participants express concerns about deviating from well-established routes, reflecting the tightly structured nature of everyday mobility for people who are VI.

This paper demonstrates that adding a qualitative analysis of people's travel experiences and behaviors is critical for method validation and improvement, contributing to a research gap identified by transport scholars (Patterson & Farber, 2015; Kamruzzaman et al., 2012). The qualitative results reveal how individuals travel across and experience space, and how areas become accessible to people, whereas a strictly quantitative approach would overlook these

processes. A comparison of quantitative outcomes with qualitative ones reveals that the network buffer best fits the experiences of participants in this study. However, these results also demonstrate that each of the three activity space measures is flawed to some extent for representing the mobilities of people who are VI. In particular, the existing methods overestimate the areas that are accessible to people who are VI, especially the SDE and PPA. Future research should study other groups and evaluate whether it is appropriate to weigh areas around particular activity locations more and other areas less.

Another contribution to transport geography is the inclusion of experiences of people who are VI. In general, the mobility and accessibility issues of people with disabilities have been overlooked in the research literature in transportation geography. Many individuals with disabilities continue to face considerable transportation and mobility challenges in part because little attention is paid to their concerns, further marginalizing a socially vulnerable group. While in recent years people who are VI are increasingly mobile due to improvements in built environments and mobile technologies, they continue to experience unique transportation challenges that impede their mobility and their access to critical resources and opportunities. This paper highlights these issues as a first step towards policy change.

A key limitation of this research is that the results cannot be used to generalize to a larger population. The findings are based on a cross-sectional case study of a small sample of urban and suburban residents, and may not be transferable to the circumstances of people in rural localities or in less developed countries. Despite limitations in generalizability, the experiences of individuals in this sample suggest how existing activity space methods can be improved to more accurately represent the spaces to which people have access. For individuals who are VI, these results indicate a need for differential weighting of activity locations and travel routes such that

the areas along routes are assigned less weight or treated as inaccessible. Additionally, more weight should be given to activity locations and public transit stops, with the most weight assigned to residential neighborhoods as they are typically perceived to be the most accessible areas.

Other limitations involve sampling and the use of a street network for the AS measures. Participants were recruited from organizations that provide rehabilitation services, and this paper may be missing dissimilar perspectives from individuals who do not need services and those who need services but do not have access to them. A street network was used for the network buffer and PPA, and travel times based on the street network assume that people drive from one location to another. In contrast, most participants in this study walked or used public transit when traveling.

Future research opportunities include the development of a multimodal network dataset and a GIS database on inaccessible features of the built environment. A multimodal network dataset would include multiple modes of travel such as walking and public transit in addition to driving. This would facilitate better models and representations of individual mobility. Secondly, a GIS database would consolidate information about fine-scale, inaccessible aspects of the built environment that impede mobility and access to places. This database could be incorporated into activity space models to more realistically distinguish accessible areas from inaccessible ones.

This paper highlights the benefits of a mixed quantitative and qualitative research design to better understand how places become accessible and how people come to experience mobility and transport disadvantages. While the findings are specific to urban residents who are VI, similar methods can be used for studying the general population or other groups of people with disabilities. Triangulating results from multiple measures generates distinct and complementary

perspectives that facilitate the selection of the best activity space measure and the discovery of new information to improve existing methods. A mixed method approach integrates patterns with processes and better identifies how individual mobility and environmental accessibility can be improved for individuals who experience transport disadvantage.

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CHAPTER 5

CONCLUSION

Drawing from and contributing to disability geography, this dissertation investigates the spatial patterns and processes that impact the well-being and mobility of people with disabilities in the U.S. Disability issues are examined at two different geographic scales: at the national scale in the first paper and at the metropolitan scale in the second and third papers. As a unit, the three chapters highlight the significant role of geographic context and consider both the structural and individual influences on access to governmental assistance programs, personal well-being, and mobility. In the following sections, I synthesize my dissertation's contributions to the scholarship on the political economy of health, space-time constraints, mobility and access, and GIS. I then discuss my dissertation's limitations and policy implications. I end with recommendations for future disability geography research.

Chapter 2 examines the uneven geography of the Supplemental Security Income (SSI) program in the U.S. that provides crucial financial assistance for people with disabilities. The paper reveals asymmetrical spatial trends underlying the medicalization of welfare in the U.S., with growing dependence on disability-oriented SSI as a means of income support in response to deep cuts in traditional welfare programs. I find that while enrollment in major welfare programs has declined due to welfare reform, SSI participation grew in most U.S. counties. SSI expansion is particularly concentrated in the southeast, Appalachia, and northern California, most of which are areas of high poverty, deindustrialization, and poor health outcomes.

In addition to offering empirical findings on the geography of the medicalization of welfare, this work contributes more broadly to literature on the political economy of health

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(Bambra, 2011; Hansen et al., 2014; Pryma, 2017). The political economy of health points to political and economic institutions as the main arbiters of health inequalities as these institutions structure differential access to labor markets and wage inequalities, and produce increasingly degrading work conditions that place workers at a higher risk of morbidity and mortality (Bambra, 2011; Hansen et al., 2014). However, poverty is largely characterized in popular discourse as an individual failure. The poor are 'deserving' of welfare assistance only in rare circumstances outside of their control (Pryma, 2017; Schweik, 2010). I implicate the welfare state regime in the production and reproduction of workforce and health hierarchies, which have led to uneven spatial outcomes on poverty, disability, and SSI.

Welfare reform is intended to regulate the flows of low wage labor by maximizing employment and minimizing welfare dependency (Hamnett, 2014; McAllister et al., 2015; Peck, 2001). However, as many welfare recipients are pushed out of traditional welfare programs and find that they are unable to secure employment, they turn to SSI, which requires applicants to have a disability to access welfare-related benefits (Hansen et al., 2014; Wamhoff & Wiseman, 2005/2006). Rapid SSI expansion is therefore partly a result of higher punitive measures that weed out the 'undeserving' poor in major welfare programs. The poor increasingly need to be disabled to be refashioned as 'deserving' welfare subjects. Welfare reform is recognized as a site of social struggle (Peck, 2001), typically along divisions of class, race, and gender. My research reveals disability to be an increasingly important facet of welfare politics as social entitlements are rolled back.

Chapter 3 contributes to space-time research by analyzing the dynamic and relational processes that shape the space-time constraints of individuals who are visually impaired (VI). In transport planning, demography, and health research, quantitative space-time methods are

typically used, resulting in more positivistic conceptualizations of and findings on space-time constraints (Patterson & Farber, 2015). In utilizing a qualitative approach, I find that people who are VI adhere to strongly routinized daily activity patterns that reflect coupling, capability, and authority constraints. Everyday mobility is affected by access to transportation and assistive technologies, transit schedules and routes, and by increasing reliance on navigational applications that, while immensely valuable, can lead people astray with inaccurate information. To increase their agency and access to important resources, individuals who are VI navigate relations of power with drivers from their social support networks, rehabilitation counselors who regulate access to mobility technologies, and sighted strangers who help or hinder their daily commutes.

Furthermore, analyzing both the temporal and spatial dimensions of mobility generates new insights into the everyday travels of people who are VI. While space matters in terms of locational proximity to transportation and ease of walking paths, reflecting prior research on the sociospatial mobility challenges of individuals who are VI (Crudden et al., 2005; Imrie, 2013; McDonnall, 2011; O'Day, 1999), time is also an important consideration. Time influences when people can travel and how long they can spend traveling to different places. I find that people who are VI actively manage their time to facilitate their capacity to traverse the urban built environment and negotiate environmental challenges. Compared to spatial concerns, issues of time and temporality have only rarely been considered in qualitative research on mobility and disability. On chronic illness, McQuoid et al. (2015) found that time impacts how people who have chronic kidney disease juggle work and illness management and Wilton (1996) uncovered how the experience of disease evolves over time for men with HIV/AIDS and affects their everyday geographies. Relatedly, my research reveals that public transit transfer time and

paratransit waiting time constrain the daily activities of individuals who are VI, indicating that dimensions of both temporality and spatiality are critical to the everyday lives of people with disabilities.

Chapter 4 demonstrates that well-established activity space measures have significant shortcomings in representing the everyday experiences of people who are VI, providing new understandings into how mobility and accessibility should be evaluated in activity space research. Activity spaces are regularly used to quantify individuals' potential mobility and accessibility (Kamruzzaman et al., 2011; Li & Tong, 2016; Patterson & Farber, 2015). For this sample of adults with vision loss, I show that three commonly-used activity space measures generate very divergent estimates of the spaces to which people have access. Comparing these estimated activity spaces to qualitative information reveals that none of the estimated spaces accurately capture peoples' perceptions of mobility and access.

In much of the literature on activity spaces, the concepts of mobility and accessibility are treated as nearly synonymous – as the spaces that people are able to reach given the fixed time-space constraints of daily activities. By including qualitative methods, I consider how mobility and access are experienced in situ and how the concepts may be multidimensional in practice. For people who are VI, I find that mobility involves both physical movement and "the experienced and embodied practice of movement" (Creswell, 2010, p. 19), and access to be both physical proximity and "the ability to derive benefits from things" (Ribot & Peluso, 2003, p. 153). Individuals who are VI are more mobile when they travel along known, practiced routes in familiar spaces and they have access to places not merely through geographic proximity to buildings but also when they have the spatial information to locate building entrances and reach their final destination within buildings. Here, mobility is a critical means to accessibility. In

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incorporating qualitative results that consider embodied dimensions of mobility and access, I identify how existing activity space measures can be improved to better represent the everyday lives of individuals who are VI.

Chapters 2 and *4* demonstrate the use of GIS for examining disability at national and local scales. In *Chapter 2*, I use GIS and the application of univariate LISA to map spatial patterns and detect hot and cold spots of SSI participation. The asymmetrical geographic trends in SSI demonstrate that the medicalization of welfare is not a ubiquitous development; rather, there is a heterogeneity of experiences in the medicalization of welfare across different regions in the U.S. In *Chapter 4*, I investigate the validity and accuracy of widely-used GIS-based models for representing the mobility experiences of people who are VI. I find that the GIS-based activity space models have considerable limitations in capturing the mobilities of individuals who are VI, and in doing so, I raise questions about the models' applicability for people with other disabilities as well as for individuals in the general population. For future research, I identify a need for differential weighting of activity spaces via qualitative analyses of individuals' perceptions that better reflect how people travel and access places.

5.1 Limitations

Chapter 2 has a number of limitations related to the changing definitions of disability and the use of aggregated data from the Census Bureau, the Bureau of Labor Statistics, and the Social Security Administration. Over time, definitions of disability evolved within society and institutions like the Census Bureau and the Social Security Administration, resulting in some uncertainty in analyses of disability trends across space and time. Data are aggregated at the level of the county; thus, inferences cannot be made about individual-level correlations and

mechanisms. Within counties, we do not know if people who are pushed out of major welfare programs are the same individuals who are enrolling in SSI. The data are also cross-sectional and variables can only be analyzed for correlations, not cause-and-effect relationships. The geographic areas and population sizes of some counties are fairly large. Analyzing the spatial variation within counties would be useful for identifying more local trends, but the county is the smallest geography available for public data on disability assistance.

Chapters 3 and *4* have limitations associated with generalizability and sampling. I collected data from a small sample of urban and suburban residents residing in one metropolitan area at a specific time. The results cannot be generalized to a larger population or to other metropolitan areas. Moreover, the results are unlikely to reflect the situations of people living in rural places, less developed countries, or other geographic settings that are unlike the San Francisco Bay Area. Limitations associated with the sampling process are also relevant. I recruited participants from organizations that provide rehabilitation and independent living services. In doing so, I may be neglecting the experiences of individuals who do not need services as well as those who need services but do not have access to them. There may also be self-selection bias. The individuals who agreed to participate in this project may be more active and mobile than the general population with visual impairment. My study participants have access to organizations that provide employment and mobility resources to people who are VI, which in turn facilitate their mobility. This may not be the case for all individuals who are VI in the U.S., particularly those who have no access to rehabilitation and independent living resources.

In *Chapter 4*, an additional limitation is the use of a street network for the network buffer and potential path area methods. Travel times based on the street network assume that people

drive from one location to another. In reality, most participants in this research did not access a car for their daily travels. Instead, they walked and used public transit, which involve longer travel times than driving.

5.2 Policy Implications

The everyday challenges faced by people surveyed in this project emphasize that more needs to be done to improve the well-being of people with disabilities in the U.S. Most individuals with disabilities continue to live in poverty and experience poor health outcomes, in part due to unemployment or underemployment that stems from limited mobility and access. Scandinavian countries have more success with sustaining high employment rates for individuals who are chronically ill or have a disability, and their achievement is associated with national policies on active labor markets and employment protections (Burström et al., 2000; McAllister et al., 2015). For people with disabilities in the U.S. and elsewhere, particularly individuals negotiating the low wage labor market, similar labor policies would facilitate their employment and reduce their need to enroll in public assistance.

For improving the welfare of people with disabilities, it is also important to expand people's mobilities and access to resources. Many would benefit from initiatives to improve existing door-to-door transportation services, specifically paratransit and ride hailing services such as Uber or Lyft. Paratransit services need to be more reliable and punctual while ride hailing services need to be more affordable. These improvements would increase people's transportation options and magnify their mobilities. Another recommendation is to provide financial support to family members and friends who supply informal, unpaid labor when they help drive individuals to places and assist in other daily activities. Increasing access to

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autonomous vehicles when they are available would also expand people's geographic reach outside the inflexible routes of public transit and the fixed service areas of paratransit. For individuals who are VI, improvements in the locational accuracy of mobile navigational applications would enhance their travel experiences.

For a few of these recommendations, there are comparable efforts already in place, but their availability is geographically uneven. For instance, residents of the city of San Francisco can use their paratransit card for taxi rides, thus accessing a faster yet affordable transportation service. However, this is not offered in most other regions in the San Francisco Bay Area. Another issue is that many people are unaware of all the resources that exist. One resource available to people with disabilities is a personal assistant financed by their state's human services department. Family members and friends can apply to be a personal assistant and receive compensation from the state for their otherwise unpaid labor. Introducing accessible transportation policies to more places and increasing outreach activities that provide individuals with information about the resources available would improve the mobilities of people with disabilities.

For creating accessible cities, urban planning initiatives must consider perspectives from people with mobility impairments to design cityscapes that facilitate their travels. For wheelchair users, additional curb ramps would enable their mobility. For cane users, additional curbs and brightly colored tactile surfaces angled towards crosswalks would make more urban spaces accessible. For pedestrians who are VI, audible traffic signals at busy crosswalks would help them determine when it is safe to cross the street. These improvements to the urban built environment would make public spaces more accessible to people with disabilities.

5.3 Future Directions

To expand our current understandings on the medicalization of welfare, more research is needed on the local political-economic circumstances in the southeast, Appalachia, and northern California, where SSI enrollment is disproportionately high. Questions remain about how deepening austerity at local and regional levels impact individuals' experiences with poverty, disability, and welfare assistance. For instance, are people actually leaving major welfare programs to enroll in SSI and for what reasons? In the process of proving yet again that they are 'deserving' welfare subjects, how do individuals legitimize their disability claims while facing gendered and racialized welfare stigmas? An in-depth investigation into localities where SSI enrollment is particularly high will uncover the political-economic conditions driving SSI participation. This will in turn help identify appropriate policies for reducing the vulnerabilities of people with disabilities with little income and resources.

Future research should investigate disability in rural areas and in less developed, non-Western nations. In my dissertation, I find SSI hot spots in rural regions, suggesting that political and economic conditions in some rural areas are causing high levels of disability and poverty. Generally, we know that rural residents have lower access to health care (Coughlin et al., 2008; Onega et al., 2008) and poorer accessibility to community resources (Pearce et al., 2006). In rural areas, regular access to a car is necessary for many residents to get around (Gray et al., 2008). Given these aspects of rural places, rural residents with disabilities are likely to be disadvantaged if they cannot drive. Likewise, the little research on disability in less developed, non-Western contexts indicates that residents with disabilities are navigating tremendously disabling environments (Livingston, 2006; Mitra, 2005; Mitra; 2011). Research in rural, non-Western

contexts is imperative for understanding and addressing the sociopolitical conditions that render people with disabilities to be especially vulnerable.

To better map individual mobilities, future work on activity space modeling should incorporate mixed quantitative and qualitative methods. The inclusion of qualitative data about people's travel experiences and behaviors is critical for method validation and for identifying improvements to existing activity space measures. Qualitative data reveal how individuals become mobile and how places become accessible, complementing quantitative results that do not measure these processes. Additionally, the development of a multimodal network dataset would improve the accuracy of activity space models. A multimodal network dataset would include multiple modes of travel such as walking, cycling, and public transit in addition to driving.

More work is needed in mapping accessibility that considers the experiences of people with different disabilities, who make up nearly 19% of the population in the U.S. (Census Bureau, 2012) and 15% of the global population (World Bank, 2017). People with disabilities navigate challenging accessibility problems related to inaccessible built environments and transportation (Graham et al., 2014; Imrie, 2013; Lubin & Deka, 2012), but there are few research efforts to map (in)accessible spaces to better understand and target the kinds of spatial disadvantages that people with disabilities face. Mapping (in)accessibility for and with people with disabilities is vital for improving mobility and access to resources and opportunities, thus enabling individual agency, visibility in public spaces, and societal participation.

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APPENDIX A

IRB LETTER

UNIVERSITY OF ILLINOIS
AT URBANA-CHAMPAIGN

Office of the Vice Chancellor for Research

Office for the Protection of Research Subjects
528 East Green Street
Suite 203
Champaign, IL 61820

09/30/2015

Sara McLafferty
Geography & GIS
225 Computing Applications Building
605 E. Springfield Ave.
M/C 150

RE: *Urban-Rural Experiences of Visual Impairment: Mobility Employment and Well-Being*
        IRB Protocol Number: 16216

EXPIRATION DATE: 09/29/2018

Dear Dr. McLafferty:

Thank you for submitting the completed IRB application form for your project entitled *Urban-Rural Experiences of Visual Impairment: Mobility Employment and Well-Being*. Your project was assigned Institutional Review Board (IRB) Protocol Number 16216 and reviewed. It has been determined that the research activities described in this application meet the criteria for exemption at 45CFR46.101(b)(2).

This determination of exemption only applies to the research study as submitted. Please note that additional modifications to your project need to be submitted to the IRB for review and exemption determination or approval before the modifications are initiated.

We appreciate your conscientious adherence to the requirements of human subjects research. If you have any questions about the IRB process, or if you need assistance at any time, please feel free to contact me at the OPRS office, or visit our website at http://oprs.research.illinois.edu.

Sincerely,

Rose St. Clair, BA
Assistant Human Subjects Research Specialist, Office for the Protection of Research Subjects

c: Sandy Wong

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