4-2019

Understanding the Construction of Accessibility and Mobility: Non-Car Transportation in St. Louis, Missouri

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25 April 2019

Honors Thesis
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Abstract

This research examines disadvantaged populations' accessibility and mobility in the non-car transportation system in St. Louis. By employing mixed methods, this research investigates accessibility and mobility through three distinct scholarly lenses: physical infrastructure and proximity, individual experiences, and political processes. The thesis synthesizes the analyses from these three approaches in order to provide holistic policy recommendations for creating more equitable transportation systems in St. Louis and beyond. Empirical findings show that neighborhoods with lower median incomes and lower percentages of white population in St. Louis are less accessible for biking and walking, with highly variable public transit accessibility. Bike system connectivity presents a barrier to mobility for people across the city, and dockless bike share, once thought to be a panacea for bike equity in the city, failed after less than a year in operation. Walking mobility remains an acute challenge in disadvantaged neighborhoods, as sidewalk infrastructure crumbles and safety issues persist. Public transit accessibility and mobility are multi-layered and highly dependent on individuals' patterns of life and desired destinations; for some people, the system works efficiently, while for others, trips can be inconvenient or unpleasant. Overall, the insights from interrogating non-car accessibility and mobility in St. Louis generate two major recommendations for creating more equitable non-car transportation systems: 1) "commoning mobility," which refers to cultivating mobility policies around collective ownership and responsibility, rather than scarcity of money, street space, or time, and 2) advocating across temporal and geographic scales to bring about this "commoning" in large and small ways.

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Acknowledgements

I owe a giant thank you to my advisor, Professor Catherine Chang, as well as my co-advisor, Professor Laura Smith, who I was lucky to have as an on-campus presence to guide me and answer questions while Catherine was away on research trips for her sabbatical. Catherine supported me and challenged me from the conception of this thesis project through every stage of editing and refining my arguments, and her input made this thesis a far, far better document than it would have been otherwise. I would also like to thank Professor Dan Trudeau for serving as the third member of my thesis committee and providing me with encouragement and thoughtful feedback, particularly on the biking-focused chapter.

The support of my friends and family was integral to creating this thesis. In particular, my dear friends Eleanor Beaird, Ellie Hohulin, Julia Bayer, and Livvie Avrick, and my parents, Cindy and Jim Shumway, all found ways to make me feel human again in the times when I felt most mired in the gritty details of writing, and for that, I am eternally grateful.

Finally, I would like to thank all of the St. Louisans who allowed me to take a peek into their lives through interviews and surveys so that I could learn more about non-car mobility and accessibility in the city.

Chapter 1: Introduction

Cities- as large, heterogeneous, and densely populated as they are- buzz with activity at all hours of the day. What are people doing? They could be heading to work, school, restaurants, theaters, grocery stores, banks, post offices, sports arenas, recreation centers, or just going on a stroll. How are they getting there? People are traveling by car, bus, train, bike, or their own two feet. Getting from place to place is a vital function within the city. Further, city-dwellers' trips are imbued with meaning, based on their experiences as well as the sociopolitical structures that discursively construct the places and spaces in which they move.

Cars have been the dominant mode by which people move in the United States since the mid-twentieth century, and the private automobile's influence on the built landscape and people's lives has been veritably hegemonic. With the car and Fordist American car culture has come a revolution in urban land use and social life, ushering in the destruction of older, often minority neighborhoods for urban renewal and interstate highways along with the rise of mass consumerism (Lutz, 2014). This is not to mention the severe environmental degradation and public health threats posed by automobiles' emissions and the built environment of concrete-and-asphalt slabs that cars promote (Brunekreef et al, 1997; Nieuwenhuijsen & Khreis, 2016). These enviro-health burdens, too, have been borne disproportionately by disadvantaged groups in cities, including low-income, racial minority, elderly, and youth populations.

Behind the dominance of the car in popular media and urban infrastructure funding for highways, the established urban mass transportation and non-motorized transportation systems remain, in various states of repair or disrepair depending on one's location. Today, biking, walking, and public transit at once serve as viable modes of transportation for those who cannot afford cars or are unable to drive and serve as more environmentally sustainable, and perhaps even more socially sustainable,[1] alternatives to private automobiles. Yet, these alternate modes of transportation have not been given the same ubiquitous levels of support and funding by the federal, state, and local governments in the United States (EWG, 2015; Cortright, 2017). It is with this reality in mind that this research focuses on accessibility and mobility within non-car transportation systems, particularly for disadvantaged populations who are most adversely affected by the ills of car culture and least likely to have access to the benefits of private automobiles.

Literature Review

First, it is helpful to distinguish between "mobility" and "accessibility," as they each have specific definitions and corresponding connotations in the literature on

[1] This thesis' definition of social sustainability starts with the the UN's 1987 "Our Common Future" document, better known as the Brundtland Report (World Commission on Environment and Development, 1987). The Brundtland Report established the three pillars of sustainable development: ecological sustainability, economic sustainability, and social sustainability (World Commission on Environment and Development, 1987). Social sustainability includes satisfaction of basic needs and quality of life, equal opportunities (for education, employment, etc), and social coherence (Griessler & Littig, 2005). Social sustainability is particularly applicable to this research because non-car transportation is well-regarded as low-carbon and ecologically sustainable, but biking, walking, and various modes of public transportation have mixed records in terms of their social sustainability. The operative question is whether each mode of non-car transportation actually promotes a better quality of life for all (e.g., the health benefits of active transportation), helps people gain greater access to education and employment, and allows people to become more integrated into their communities.

geography and urban planning. Susan Hanson and Genevieve Giuliano (2017) describe the interplay between the two terms by saying (emphasis is theirs):

> *Accessibility* refers to the ease of reaching potential destinations, also called 'opportunities' or 'activity sites'; it depends on the number of opportunities available within a certain distance or travel time, and on *mobility*, which refers to the ability to move between different activity sites. (pp. 4)

This paper defines accessibility in the same way that Hanson and Giuliano (2017) do; accessibility simply asks how easily a person can reach the places they want to go, and, with its discussion of "number of opportunities," lends itself well to being quantified. Mobility, however, is somewhat more complex. The definition that Hanson and Giuliano (2017) give is just the starting point, as the idea of mobility as the ability to move between different activity sites has been complicated and elaborated upon by a host of scholars who make up a "new mobilities paradigm" in the social sciences (e.g., Cresswell, 2011; Sheller & Urry, 2006; Adey et al, 2012; Nikolaeva et al, 2019; Reid-Musson, 2018). Among other insights, the mobilities literature highlights the fact that city-dwellers' movements are imbued with meaning, based on their experiences as well as the sociopolitical structures that discursively construct the places and spaces in which they move. Whether concerned with context-dependent processes or ones that are more explicitly affective[2] and cut across geographic boundaries, mobilities scholars elucidate the idea that the term "mobility" should and does carry more conceptual weight

[2] The word "affective" refers to those things "relating to, arising from, or influencing feelings or emotions" (Merriam-Webster, 2019a).

than the logistical definition that Hanson & Giuliano (2017) give. Moving from place to place is both a deeply meaningful and necessary part of people's lives that is mediated by policies, societal norms, and physical constraints, and "mobility" is a term that helps us as researchers recognize the complexity of movement.[3]

A relevant example of how scholars build from this multifaceted understanding of the term "mobility" is the idea of "commoning mobility," as defined by Anna Nikolaeva et al (2019). "Commoning mobility" calls for a reimagining of mobility policies- and particularly mobility policies for low-carbon transportation options- such that they cultivate a sense of collective ownership and responsibility, rather than appealing to fears about the scarcity of money, street space, or time. Nikolaeva et al (2019) thus envision mobility in a way that engages with the right of individual citizen to move and the ways in which mobility helps negotiate collective social needs.

Accessibility and mobility are separate concepts, but they feed into one another; in today's connected world, accessibility increasingly relies upon mobility (Hanson & Giuliano, 2017). Even though accessibility describes the ease of reaching locations and the number of activity sites within a certain travel time, that ease of access necessarily

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[3] Mobility, in this interpretation, can help us expand our conceptions of movement to encompass phenomena like the "shadow citizenship" that Emily Reid-Musson (2018) writes about in her research on migrant bicyclists in rural Canada. She describes "shadow citizenship" as the "overlapping regulatory and geographical exclusions from mobility rights that create risk and stigma for migrants," and further explains how biking education/awareness programs targeted toward migrant communities serve to "regulate" migrants' behavior and "inadvertently normalize the risky and racist conditions under which migrants circulate by bicycle" (Reid-Musson, 2018, pp. 308). Other authors, like Peter Adey et al (2012) bring the multiplicitous idea of mobility to life through a focus more broadly on what it means to move, rather than specific place-based structures that construct mobility. Adey et al (2012) are particularly concerned with the *passenger,* which they claim can be, among other things, "constituted and supported by other 'passengers' that take the form of encumbering luggage, documents and 'data doubles' that shadow the fleshy body" (Adey et al, 2012, pp. 171).

depends on our ability to move from one activity site to another, which has more intricacies than first meets the eye. With these concepts in mind, I can apply the conception of meaning-laden, multiple mobilities to the context of St. Louis' walking, biking, and public transit, and effectively delineate the ways in which non-car transportation serves (and does not serve) disadvantaged populations.

This thesis synthesizes the approaches of three sets of literature- one that focuses on physical access/spatial proximity to non-car transportation, another that focuses on individual experiences, and a third that highlights structural political processes- in order to inform urban planning/policy in a more holistic fashion and integrate disparate understandings of non-car transportation accessibility and mobility. Such a holistic approach adds richness and nuance to the policy decisions planners make about non-car transportation. Take a decision making process around pedestrian infrastructure in St. Louis, for example. Analysis of physical access and spatial proximity to walking infrastructure in the city shows that there is no correlation between a neighborhood's racial makeup and its Walk Score, nor a neighborhood's median household income and its Walk Score. This alone might lead planners to believe that there are no disparities in walking accessibility and mobility in the city. However, the accounts of individual experiences of walking in the city paint a completely different picture. In interviews and surveys, residents say that walking mobility varies because of poor-quality sidewalks in many areas, automobile-centric infrastructure that cuts off pedestrian access to businesses (even when there are sidewalks technically nearby), and concerns about crime that leave

people afraid to use the physical infrastructure that is present in their neighborhoods to its fullest extent. Without examining political processes, planners are just left to grapple with this apparent disconnect between infrastructure proximity and residents' lived experiences.

An analysis of political processes around walking accessibility and mobility, then, can fill in contextual gaps about why and how this came to be, and, importantly, help identify policies that might be most appropriate to create walking mobility equity. If the problem isn't pure provision of sidewalks in historically disadvantaged neighborhoods, then what is it? In St. Louis, political processes have facilitated a systemic lack of funding for city services like sidewalk upkeep enforcement because of a shrinking tax base and vacancy epidemic in the city, a dearth of willingness from planners and government officials to use the political capital necessary to take responsibility for significant improvements to pedestrian accessibility and safety, and the proliferation of private streets and streets blocked off by concrete balls and planters that make any "outsiders" to a neighborhood feel excluded from walking there. These findings suggest that taking steps to open the street grid, making pedestrian infrastructure more prominent at crosswalks, incentivizing businesses to make their property entrances pedestrian-friendly, and dedicating new funding for sidewalk upkeep could be particularly effective for improving walking accessibility and mobility for disadvantaged populations in St. Louis. These policy recommendations would have been impossible to devise without the synthesizing the baseline information about infrastructure via the

quantitative analysis of Walk Scores, the narrative accounts of personal experiences walking in the city that established the ground-truth of walking mobility, and the examination of long-standing political processes; these recommendations underscore the idea that integrating scholarly approaches is not only helpful in understanding accessibility and mobility from an academic perspective, but it is applicable for the everyday workings of urban planners, as well.

This review of the literature summarizes the contributions of each set of scholars in turn- those who focus on infrastructure and proximity, those who focus on individual experiences, and those who focus on political processes- in order to more deeply understand how their perspectives help us answer questions of accessibility and mobility in non-car transportation systems. Then, it underscores the ways in which these perspectives on their own are neither sufficient for understanding everyday mobilities, nor for making sound non-car transportation policy; therefore, this thesis takes an integrated approach.

Physical Infrastructure and Proximity

First, many scholarly discussions of non-car transportation focus primarily on efficiency, proximity, and networks in order to engineer solutions for better accessibility to public transit and walking/biking amenities (Cervero, 2001; Foda & Osman, 2010; Syed & Khan, 2001; Ziari, Keymanesh, & Khabiri, 2007; Mavoa et al, 2012). Discussions of spatial proximity, which center around quantitative analysis, offer the chance to understand the physical constraints that lay the groundwork for individuals'

daily mobility and the accessibility of non-car transportation systems. Mohamed Foda and Ahmed Osman's (2010) research using geographic information systems[4] to better understand transit accessibility is prototypical of a proximity, efficiency-focused view on transit accessibility. Foda and Osman (2010) develop indices that use pedestrian road networks around bus stops to measure the "actual" access coverage of a stop (i.e., how many people live within walking distance of that stop), rather than the more common tool of a circular buffer analysis that measures all places within a given rectilinear distance of the bus stop but doesn't take into account whether that distance can actually be walked by pedestrians-*cum*-transit riders. This analysis adds nuance to the research concerning where bus stops should ideally be located and provides a closer approximation of the situation on the ground for people who ride the bus, yet is still easily quantifiable in a way that can speak directly to the optimization-focused road engineers and planners who may come across it.

Individual Experiences

Another group of scholars interrogates people's personal mindsets and motivations to take certain modes of transportation, but these authors, who are often environmental psychologists, seldom concern themselves with the details of planning transportation systems (Carrus, Passafaro, & Bonnes, 2008; Brown et al, 2016). The environmental psychology lens, with its focus on individual experiences, can help explain

[4] The term "geographic information systems" refers to "computer assisted systems for the capture, storage, retrieval, analysis and display of spatial data" (Clarke, 1986). Common geographic information systems platforms used for analysis include QGIS and Esri's ArcGIS.

the lived meaning behind statistics about spatial proximity. For example, Barbara Brown et al (2016) studied the attitudes and perceptions of people who rode a new light rail in Salt Lake City, Utah- some who rode regularly, and others who rode more rarely. The researchers considered the relationship of variables including place attachment, pro-city attitudes, and perceptions of path incivilities (i.e., vacant lots, graffiti, visible gang activity, etc) to use of public transit among study participants. They found that place attachment, which they defined as, "positive affective, cognitive, and behavioral bonding with places and people associated with a setting," was a salient predictor of continuing or new transit ridership, especially when a resident held pro-city attitudes; control variables for various aspects of the built environment in a given neighborhood were not as important, particularly for new riders (Brown et al, 2016). These sorts of insights are key to grasping what accessible daily mobility looks like for urban-dwellers. Recognizing that individual attitudes are a powerful part of mobility experiences, whether those attitudes are about the level of place attachment to one's own neighborhood, ideas about the city writ large, neighborhood safety, or other affective mediating factors, is a critical addition to engineering studies that focus on traffic flows and infrastructural concerns. To attract users and build a socially sustainable city that provides all of its citizens with the freedom to move from place to place, urban planning must cater to citizens' sometimes less-tangible mobility needs, too.

Political Processes

A third group of scholars has contributed to the body of knowledge about structural political factors (especially path-dependency from decades of disinvestment in communities of color) that have created the inequality we observe in St. Louis and heavily influence which populations most need to bike, walk, or use public transportation for mobility today (Gordon, 2010; Tighe & Ganning 2015; both of these pieces of research specifically concern St. Louis). Conversations that explore political processes and structural factors fill in the contextual gaps left when purely focusing on mobility as a product of physical proximity and experiences on a person-by-person level. To illustrate, Colin Gordon (2010) in his book *Mapping Decline: St. Louis and the Fate of the American City,* provides an account of the institutional ways in which black people have been forced to live in certain places and robbed of the ability to build wealth, including redlining, racial covenants, blockbusting, racial steering by real estate agents, and "slum clearance" urban renewal policies that destroyed low-income minority neighborhoods. These discussions highlight how physical infrastructure is bound to and affected by past and present urban planning policies and has a continual, back-and-forth relationship with individuals' mobility experiences through planners' public outreach or lack thereof. Many of the authors who take this structural political perspective turn their attention primarily to historical policies and processes that have created present situations, or are laser-focused on the current-day metropolitan public input process (to the point that they virtually disregard other scales at which decisions about non-car

transportation systems are made), so, while essential to an inquiry into accessibility and mobility in non-car transportation systems, the work of these scholars cannot stand alone.

Synthesizing the Scholarship

In an attempt to examine issues of accessibility and mobility in a way that incorporates the contributions of the academic conversations around physical proximity/infrastructure, individual experiences, and political processes, I follow the lead of scholars who have found ways to explicitly factor in individuals' perceptions into a discussion of non-car mobility (Spears, Houston & Bournet, 2013; Börjesson, 2012), as well as those who have interrogated access to non-car transportation in concert with structural political factors and related social exclusion (Kenyon, Lyons, & Rafferty, 2002; Lucas 2012; Preston & Rajé, 2007; Cass, Shove, & Urry, 2005). These authors' approaches to mobility are applicable to the case of St. Louis because even though some of the study areas are geographically distant, they nonetheless converge around themes that are at the core of this inquiry. They do this by seeking to understand how to facilitate the mobility of cities' most excluded or disadvantaged inhabitants. These authors pave the conceptual ground upon which this research walks by crossing disciplinary boundaries in the attempt to better comprehend how mobility and accessibility function; this thesis aims to purposefully extend the work of these authors by making plain (rather than leaving implicit) the connections and points of synthesis that come from the roadway engineers, environmental psychologists, and political historians who have all approached the idea of accessibility and mobility in non-car transportation systems.

Non-Car Transportation Systems in St. Louis, Missouri

This thesis focuses on looking at accessibility and mobility within non-car transportation systems in one city, St. Louis, Missouri, because St. Louis functions as an "ordinary city," as defined by Jennifer Robinson (2002). That is, it is not known for being especially connected to the global economy, nor is it internationally recognized for its high culture. St. Louis is one of several mid-sized, post-industrial cities in the United States, particularly in the Rust Belt,[5] that has suffered from central city population decline and high levels of racial and economic inequality in the past fifty years. Nonetheless, like all cities, it has a "diverse range of links with places around the world" (Robinson, 2002, pp. 545). Viewing the world through the lens of an ordinary city, Robinson says, can help us as scholars see a broader set of activities and livelihoods in the urban sphere than we would if we were siloed into examining the machinations of big-money capitalism in New York or London, for example (Robinson, 2002). Focusing on St. Louis as a case study can help us explore accessibility and mobility through a diverse range of meanings, nuances, and subjectivities in the everyday life of an ordinary city, which will also contribute to a better understanding of contemporary non-car, alternative modes of transportation.

Transportation has long been a source of pride for people living and working in the City of St. Louis. The early growth of the city was defined by its central location for

[5] The term "Rust Belt" refers to an area of the United States in the Northeast and Midwest that is characterized by "diminishing population, aging factories, and decreasing [manufacturing] production" (Houghton Mifflin Harcourt, 2010).

trade on the Mississippi River, its railroads, and its status as the "Gateway" to the markets of the American West. Though it was once an industrial-era city chock-full of 485 miles of streetcar lines, St. Louis quickly became a mecca for automobile transportation as the 20th century progressed, particularly after the Second World War, when people around the country left the bustling crowds of the city center for single-family homes in the suburbs (O'Neil, 2010). In St. Louis, this shift toward car-centrism was hastened by influential planner Harland Bartholomew, a civil engineer by training who pushed for urban renewal and more logistically efficient transportation infrastructure, including grade-separated highways, widened streets, and parking lots (Cook, 1989; City of St. Louis, 2018b). While Bartholomew's initial approach was multimodal,[6] his plans ended up facilitating the rapid construction of car infrastructure, including the construction of five interstate highway routes that cross through the city of St. Louis: Interstates 70, 55, 64, 44, and 270 (City of St. Louis, 2018b; St. Louis Regional Freightway, 2018).

In the mid-1960s, the last few remaining streetcar lines made their final trips through the city, and the administrative roots of today's regional transportation planning organizations began to take shape (O'Neil, 2010). In 1963, the Bi-State Development Corporation acquired the transit facilities in several counties across the metro area from 15 private firms in order to unify the public transit system in St. Louis (Metro St. Louis,

[6] In the context of this thesis, the term "multimodal" refers to considering multiple modes of transportation- and particularly the connections between different modes of transportation- in the urban planning and research process.

2018). Bi-State subsequently, in 1965, helped form the East-West Gateway Council of Governments (EWG), which became the region's federally-mandated Metropolitan Planning Organization (MPO) (EWG, 2018a; Federal Transit Administration, 2016).[7] Since then, the transit system in St. Louis has functioned as a region-wide unit; notable improvements include the addition of wheelchair lifts to buses in the 1970s, the construction of the first light rail line in the area in 1993, and several subsequent light rail extensions to the east and west (Metro St. Louis, 2018).

Those improvements aside, even the EWG concedes that non-car transportation has not been a major focus for St. Louis planners since the demise of the streetcar. The move toward more extensive public transit in the metro area has been slow, and the region has only begun planning in earnest for nonmotorized transportation options in the past 15-20 years. For example, the EWG established its Bicycle and Pedestrian Advisory Committee in 1995, and the first bicycle plan for the City of St. Louis wasn't written until 2000 (EWG, 2018b; City of St. Louis, 2018a). One of the primary agencies that plans and advocates for biking/walking/trail infrastructure, Great Rivers Greenway, was created in 2000 as well (Great Rivers Greenway, 2018). EWG planners summarized the situation in the most recent long range transportation plan, *Connected 2045*:

> As more people began to move away from the city's center, roadway engineers began prioritizing the needs of automobiles in roadway design; this focus continued for the next

[7] A Metropolitan Planning Organization, commonly referred to by its initialism, "MPO," is the policy board of an organization created and designated to carry out the metropolitan transportation planning process. MPOs are required to represent localities in all urbanized areas with populations over 50,000, as determined by the U.S. Census (Federal Transit Administration, 2016).

> half century...by prioritizing the needs of automobiles for over 50 years, the region now has limited travel options for those without a car. (EWG, 2015, pp. 3)

Today, planners and citizens of St. Louis find themselves, for better or for worse, dealing with the legacy of decades of car-centric development. However, this long-term focus on serving people with private automobiles does not mean that everyone has access to a car.

As of 2016, 21.4% of households in the City of St. Louis do not have a car (US Census Bureau, 2016), and this statistic is just one measure of the acute need for non-car mobility options in the city. St. Louis' population is also rapidly aging, causing a growing need for alternative modes of transportation to help seniors- and especially disabled seniors- live independently (EWG, 2015, pp. 6-7). Industry leaders in regional freight and logistics even cited "a lack of alternative transportation options such as transit and bicycle facilities as one of the main reasons low-skill jobs, such as those in freight warehouses, are difficult to fill" in a panel on transportation's connections with the economy (EWG, 2015, pp. 5).

While metro area transportation plans explicitly recognize the deep-seated need for transit, pedestrian, and bike infrastructure, these plans also often speak to the tension of using limited budgets to expand non-car options when there are hundreds of miles of aging roads and bridges (upon which most commuters still rely) to maintain. The EWG is one of the most pro-transit governmental bodies in the region, but it also fills up most of its priority project list in the long-range transportation plan with car-centric road and bridge projects that are necessary just to keep the highways at a safe level of maintenance

(EWG, 2015, pp. 2). This funding tension is compounded by two other major factors influencing how non-car transportation policy is made in St. Louis: 1) clashes between city and county in a region with an abundance of individual municipal governments and 2) the history of segregation and disinvestment in the city's black communities.

With regard to the governance clashes, St. Louis city set its final territorial boundaries in 1876 (City of St. Louis, 2018b). That year, the city declared home rule, divorced itself from St. Louis County, and opted not to affiliate with any county at all, sowing the seeds for city-county tensions years later (City of St. Louis, 2018b). In 1950, St. Louis hit its peak population size, and it did not have any more room to grow within its fixed boundaries, nor could it annex outlying areas. Therefore, the city population shrank as people moved out to the new housing stock in the suburbs, and the number of incorporated suburbs ballooned; just between St. Louis city and St. Louis County, there are 114 governments that provide municipal-level services today (Juvers, 2018). This municipal fragmentation[8] makes for fraught political fights over the future of the regional transportation network, which have particular consequences for St. Louis city residents. Residents of the city proper have the greatest need for non-car options to complete their daily tasks, as the city alone is home to more than a third of zero-car households in the 15-county metropolitan area but less than a fifth of its total households, and city residents are hence disproportionately affected by regional unity (or lack thereof) in non-car

[8] The term "municipal fragmentation" refers to the proliferation of local municipal governments in a given metropolitan area; it is contrasted with a "concentrated" municipal government system, which has very few, or just one, local municipal government (Goodman, 2015).

transportation funding and planning decisions (US Census Bureau, 2016; EWG, 2015, pp. 6).

The latter factor fueling tensions about non-car transportation planning in St. Louis is racial segregation and disinvestment in black communities. This is intertwined with fragmented governance. Many of St. Louis' suburbs were populated and incorporated because of white flight from the city, as nearly 60% of white city residents left between 1950 and 1970 (Gordon, 2010). Black folks were kept in certain areas by restrictive deed covenants, neighborhood associations that strived for racial homogeneity, and racial steering by real estate agents, among other things. The Federal Housing Administration's discriminatory practice of "redlining" made it difficult to obtain loans for mortgages in "risky" neighborhoods (places inhabited by people of color) and discouraged outside investment in those areas (Gordon, 2010). This stopped black people in the city of St. Louis from building wealth in homes and hobbled the ability of black neighborhoods to attract businesses or residents to pay taxes for public services, namely public schools (Capps & Rabinowitz, 2018; Gordon, 2010). The lack of ability to build wealth has contributed to the greater economic precarity and higher rates of poverty for black people living in St. Louis that we see today (Phillips, 2015). National statistics show that the majority of zero-car householders live in center cities and earn lower incomes because car ownership can be a significant financial burden that economically precarious citizens simply cannot take on (Tomer & Puentes, 2011; Lutz, 2014). These economic patterns and the history of racial exclusion in St. Louis help us understand why

today, most of the zero-car households in the metro area are lower-income black households concentrated in the city proper of St. Louis, and further, why outlying municipalities and counties have been sporadic in their support of non-car transportation projects (EWG, 2015, pp. 6; Tomer & Puentes, 2011).

Research Framework, Questions and Methodology

The stark dichotomy between a legacy of car-centric development and a wide-ranging need for alternative modes of transportation makes St. Louis an important place to research the mobility and accessibility of non-car infrastructure like transit routes, bike lanes, and sidewalks. In particular, understanding how the non-car transportation system could better serve those who need it most could allow future planners and policymakers to avoid exacerbating the existing inequalities in St. Louis' transportation system. People who need to use public transportation, biking, and walking to get from one place to another- whether it is because they cannot drive or because they do not have the funds to purchase a car- are most directly affected by access to non-car transportation, and it is for that reason that this project focuses on their accessibility and mobility instead of just the public at large.

In this thesis, I aim to understand the differentiated mobility and accessibility in the non-car transportation system in St. Louis from three angles: spatial proximity to infrastructure, individual experiences, and political/bureaucratic processes. My main research question is: *How does non-car transportation provide accessibility and mobility to disadvantaged populations in St. Louis?*

Three major sub-questions guide this thesis in order to help me answer the broader research question:

Sub-question 1: How does the physical infrastructure of the St. Louis' non-car transportation system serve the mobility and accessibility needs of disadvantaged populations?

Sub-question 2: How do individuals experience mobility and accessibility to non-car transportation in St. Louis? In what ways is this similar to or different from their physical proximity to infrastructure?

Sub-question 3: How do the political processes— past and present— of the St. Louis metropolitan area affect how non-car transportation can provide daily mobility and accessibility to those who need it most, and how do political processes interact with physical access and individuals' experiences?

By answering these sub-questions, this thesis develops a greater understanding of the interconnections between the built environment, individual experiences, and political processes in assembling mobility and accessibility in non-car transportation systems in St. Louis and sheds light on these processes in cities outside St. Louis as well. Based on the research findings, I make informed policy recommendations aimed at improving accessibility and mobility for disadvantaged populations in St. Louis.

I employed a mixed method design in answering these research questions; specific methods included participant observation, semi-structured interviews, a written survey, data analysis, literature research, policy research, and discourse analysis on media coverage. The following sections explore how I used these methods to answer each research question in turn. As a young white woman who is able-bodied and has not lived as a racially or economically disadvantaged resident of St. Louis, it is important to

establish my relatively privileged positionality in this investigation at the outset; through the aforementioned research methods, I engage in constant dialogue with myself, St. Louis residents (both disadvantaged and advantaged alike), the datasets I choose to analyze, policymakers, newswriters, and other scholars in order to tease out thoughtful insights about accessibility and mobility for disadvantaged populations in the St. Louis non-car transportation system.

Sub-question 1: I explored the quantitative spatial relationship between access to mobility and the allocation of non-car infrastructure in St. Louis. By using spatial analytic tools, I examined the correlation or lack of correlation between demographics at the neighborhood scale and the level of physical access people in those neighborhoods have to biking, walking, and public transportation. I then conducted Anselin Local Moran's I cluster analysis to understand how these statistical patterns play out spatially. Because people who identify as white and people who identify as black make up the vast majority of St. Louis residents (no other groups, including Hispanic people of any race, make up more than 4% of the population; US Census Bureau, 2016), I completed correlation analyses that tested the percentage white population in a neighborhood versus Bike Scores, Transit Scores, and Walk Scores. Sub-question 1 explicitly and purposefully aligns with a quantitative lens and is an attempt to factor in the work that positivist, efficiency-focused transportation geographers and engineers have done concerning non-car transportation system accessibility. Because physical access is the kind of "access" that many people imagine when they think about research on access (e.g., How

far does a person live from a bike lane or public transit line? Does their neighborhood have sidewalks?), these statistics also serve as a baseline. They both help convey how the aspirations of planners play out in physical space and provide a reference for how individuals' experiences with non-car transportation accessibility and mobility may be similar to or different from what maps and graphs of demographics and infrastructure suggest.

Sub-question 2: I first conducted seven semi-structured interviews with community members about their experiences with non-car mobility in the St. Louis metropolitan area. I recruited participants on neighborhood Facebook groups, via emails to community organizations, and at community meetings. I also found participants through the social networks of initial interviewees. In the interviews, I asked participants to talk candidly with me about their experiences commuting, going to the grocery store, and other day-to-day tasks that require transportation, and I asked them to share their perceptions of St. Louis' public transit, sidewalk, and bike route infrastructure in more general terms.

In addition to the interviews, I distributed surveys to community members in-person at community meetings and public transit stops, as well as online on community Facebook pages and via neighborhood association email lists; I collected 88 survey responses (*see Appendix 2 for survey questions; see Appendix 3 for demographic information on survey respondents*). The survey included questions that were very similar to those that I asked during the semi-structured interviews, but the surveys allowed me to

receive responses from a more diverse set of people, many of whom were more dependent on non-car transportation and may not have had 45 minutes to devote to a sit-down interview. These interviews and surveys conveyed the multifaceted emotions and impressions of everyday St. Louisans that are not usually found in the quantitative data on physical access to non-car transportation or in government planning documents.

I also conducted a participant observation. I rode the buses and light rails, utilized sidewalks, rode on bike lanes/trails, and took detailed notes about what I saw and heard, along with capturing images of the general environment when appropriate. The participant observation was particularly valuable because it gave me the chance to gain insight into the patterns of life for people who take transit, bike, and walk for mobility. I was able to observe seemingly mundane things- like bus driver-rider greetings, bus passengers helping riders in wheelchairs get hooked on to their seat, or folks shuffling across long crosswalks with their hands full of groceries- that people may not see fit to mention in an interview or on a survey, but that nonetheless help me better understand how they experience non-car mobility on a daily basis.

This participant observation would be dubbed “mobile methods” by scholars of the mobilities turn, from whom I draw inspiration. Mobile methods, in the view of those scholars, are broadly defined as, “methods that enable researchers to ‘be’ or ‘see’ with mobile research subjects” (Merriman, 2014). The participant observation of a transportation system is necessarily mobile, and especially insomuch as buses, trains, sidewalks, and bike lanes are “public,” they have allowed me to both “be” and “see” *with*

research subjects. My work therefore meshes very well with the conception of mobile methods. That said, Peter Merriman (2014) makes a pointed critique of people who rely too heavily on mobile methods and regard them as a more authentic or authoritative way to understand mobility; he says that innovative mobile methods are best suited to complement a variety of traditional methods, not to supplant them entirely. Because I employ interviews, surveys, and various sorts of document research along with mobile methods, I hope to avoid some of the pitfalls that Merriman mentions while capitalizing on the merits of having the lived, embodied experiences that mobile methods provide.

Sub-question 3: I conducted five semi-structured interviews with officials and advocates who are involved in the transportation planning process in order to help discern how decision makers choose to provide non-car infrastructure in certain areas and not in others, how they run their outreach campaigns to communities with non-car transportation needs, and how they take equity into account while planning a transportation system. In particular, I conducted interviews with key actors from the aforementioned EWG, regional transit authority Metro St. Louis, walking and biking advocacy and planning nonprofit Trailnet, and regional parks and trails district Great Rivers Greenway. These interviews helped me better understand the thought processes and regulatory maneuvering that underlie the St. Louis planning bureaucracy.

To supplement the interviews, I also conducted archival research in order to decipher how the political processes and discriminatory policies of the past affect the current landscape of non-car transportation accessibility and mobility in St. Louis. For

example, I performed discourse analysis on the policy documents and promotional materials written by planning entities and advocacy groups in the area in an attempt to understand how they convey their responsibilities to serve historically disadvantaged communities. By discourse analysis, I mean a deep reading of the texts, and as Lawrence Berg (2009) suggests, I identified the knowledges and assumptions that serve as a foundation for the documents' claims, identified inconsistencies and contradictions, and coded themes I found along the way (pp. 219).

Taken together, the methods I employed in answering three sub-questions purposefully align with the bodies of literature that I seek to integrate in this project, and the policy recommendations emerge from analyzing them together. The data analysis for sub-question 1 mirrors the quantitative approach of efficiency-focused transportation geographers and engineers, while the interviews, surveys, and participant observations for sub-question 2 represent environmental psychologists' attempts to understand individuals non-car transportation experiences, and the interviews with planners and historical policy analysis for sub-question 3 link to historians and political scientists' attention to structural factors, past and present, that have created St. Louis' inequalities.

Structure of the Thesis

I have organized my thesis topically, such that I can address my research questions through case studies on particular modes of transportation. In this introductory chapter, I set the stage for the bulk of my thesis by introducing my conceptual framework. This includes a review of the literature on non-car accessibility, mobility, and

inequality in St. Louis in order to better understand how my thesis fits into the larger scholarly conversations around these topics. The following three chapters will then explore three non-car transportation modes- walking, biking, and public transit- in St. Louis. In each of these chapters, I interrogate the effects of physical infrastructure, individual experiences, and political processes on accessibility and mobility for disadvantaged populations in the given mode of transport, and I offer policy recommendations based on my findings. After considering these case studies, I move on to make the culminating remarks of the thesis. In these remarks, I explore themes and system improvements that cut across specific modes of transportation. I also delineate how one might apply the insights I learned from St. Louis to the concepts of accessibility and mobility for disadvantaged populations in non-car transportation systems elsewhere.

Chapter 2: Bicycling in St. Louis

Biking is one of the most efficient, least carbon-intensive forms of transportation (Gilderbloom et al, 2015). It at once serves as a viable mode of mobility for those who cannot afford cars or are unable to drive and as an active form of transportation that can confer health benefits (Saelens, Sallis, & Frank, 2003).

Biking holds possibilities for being an equitable form of transport that provides accessibility and mobility to disadvantaged populations, but sometimes biking has been a more exclusionary than equitable form of transport.[9] One set of scholars is skeptical about the idea of biking as a tool for social sustainability. For instance, Melody Hoffmann, in her book *Bike Lanes Are White Lanes: Bicycle Advocacy and Urban Planning*, lays out the compelling argument that mainstream bike advocacy and planning, as they currently stand, privilege the voices of the white middle class and marginalize most other bike rider voices (Hoffmann, 2016). In this vein, Hoffman contends that biking serves as a "rolling signifier" that changes over time and as it moves through different socioeconomic and cultural spaces (Hoffman, 2016). While affluent white communities might regard the bicycle as a signifier of sustainability and progressive values, working-class non-white communities might see it as a sign of pure necessity or poverty, providing one explanation as to why these communities haven't connected with the mainstream, white biking organizations and narratives (Hoffman, 2016). What's

[9] With that said, biking is unable, under most circumstances, to serve as an accessible mode of transportation for people with physical disabilities that limit their bodily mobility. This is an inherent flaw of biking as well as other modes of active transportation, like walking.

more, scholars have found that the promotion and construction of bicycle infrastructure can become a part of a larger wave of gentrification that overtakes traditionally working-class neighborhoods (Stehlin, 2014). In San Francisco, John Stehlin (2014) observes that bicycle advocates have long made the case for building more bike infrastructure by highlighting biking's ability to provide an area with economic development. This has led to a situation where today, as he puts it, "the bicycle represents the creativity and economic dynamism of urban newcomers and their high-value labor power, putting livability on the municipal economic growth agenda" (Stehlin, 2014, pp. 122). With this association with economic growth, then, building bike infrastructure can raise property values in an area and price out existing, lower-income residents rather than helping them achieve freedom of movement or adding to the area's social sustainability.

Other scholars, though, are hopeful about bike equity, highlighting that despite the largely racially white public image of biking, people with low incomes actually have the highest rates of biking and walking for commuting, and cyclists are concentrated in immigrant communities and communities of color (Cahen, 2016). Further, there is evidence to suggest that implementing genuine community engagement and participatory planning practices with bicycle infrastructure projects can allow the infrastructure to serve historically disadvantaged groups effectively (Lubitow, Zinschlag, & Rochester, 2016; Lusk et al, 2017). For example, in Amy Lubitow et al's examination of a bike lane project in a predominantly Puerto Rican area of Chicago, the existing community was at first skeptical of the push for bikeways in their neighborhood because of worries about

white “hipsters” and “affluent yuppies” moving in and “taking over” as a result of the new infrastructure (Lubitow et al, 2016). However, once a community-led bicycle training center and repair shop began to engage residents more meaningfully in the process of establishing the new infrastructure, emphasizing the connections between biking and the cultural identity of the neighborhood and maintaining relationships with longstanding organizations in the neighborhood, residents reported that they were able to take ownership of and embrace the “burgeoning bike culture” in their community (Lubitow et al, 2016). This situation is much closer to the ideal of bicycling infrastructure that can enhance urban social sustainability. This chapter teases out where the St. Louis bike system lies in this universe of bike systems with differentiated social sustainability; does it tend to be one that whitewashes biking to the detriment of disadvantaged groups or does the bike infrastructure more often reflect the diverse communities it serves and create opportunities for accessible mobility? In order to address these questions and determine the extent to which bicycling helps work toward such an urban social sustainability that serves disadvantaged, car-less populations, the following sections develop a greater understanding of the interconnections between three major facets of mobility and accessibility in bicycling systems and their implications. It first addresses proximity to physical infrastructure and the timeline of bike infrastructure in St. Louis, then analyzes the individual experiences of citizen bicyclists, and finally takes a look at political processes. The chapter ends by providing policy recommendations based on these findings.

Physical Infrastructure and Proximity

The bike infrastructure in St. Louis has been built up mostly in the last twenty years. The EWG established its Bicycle and Pedestrian Advisory Committee in 1995, and the City of St. Louis wrote its first bicycle plan in 2000 (EWG, 2018b; City of St. Louis, 2018a). Also in 2000, a popular referendum established Great Rivers Greenway, a regional parks and trails district that has overseen the construction of greenways (i.e., off-street biking and walking trails) in St. Louis city, St. Louis County, and St. Charles County ever since (Great Rivers Greenway, 2018). Trailnet, a nonprofit that was an early player in the St. Louis cycling scene and instrumental in advocating for the establishment of Great Rivers Greenway, has taken on the role of planning and lobbying for better on-street biking infrastructure like bike lanes, protected bike lanes, shared use lanes, and bike boulevards (Trailnet, 2018). These organizations have helped create the physical components of the St. Louis regional biking system that citizens see today (*see Figure 1, left*; image source EWG, 2018a). The system in the city proper of St. Louis mostly consists of Shared Road Facilities

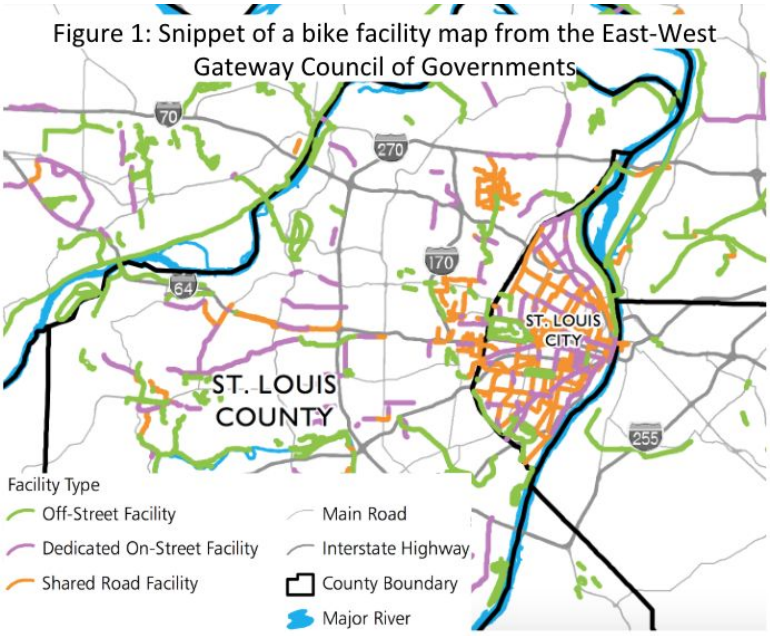


Figure 1: Snippet of a bike facility map from the East-West Gateway Council of Governments

(orange) where signs that read “Share the Road with Bicycles” are posted. The other major type of bike infrastructure on St. Louis streets is Dedicated On-Street Facilities (purple), like bike lanes and a few protected bike lanes that provide a buffer from automobile traffic with either a few feet of painted lines or parking spaces. Off-Street Facilities (green) are more often found in parks and suburban locations; besides the Mississippi Greenway, which runs for 15 miles along the industrial west bank of the Mississippi River to downtown St. Louis, very few off-street bike routes run arterially in the city.

A more ephemeral form of bike infrastructure that appeared on St. Louis’ streets was the popular and much-talked-about dockless bikeshare program. Two companies, ofo and Lime, dropped over 1000 bikes throughout the city in April 2018 (Schlinkmann, 2018a). Without predetermined stations, budding cyclists picked up and left these bikes wherever their trips took them and were able to pay for their rides on a mobile app. Those I interviewed, planners and citizens alike, hailed dockless bikeshare as a low-cost (both for the city government and for riders) non-car mobility solution, tailored for the flexible, modern sharing economy. In early August 2018, Lime began reducing the number of bikes in St. Louis in favor of a burgeoning electric scooter fleet (Wicentowski, 2019). By September 2018, ofo had pulled their bikes from the streets of St. Louis as a part of a larger reduction of their services worldwide (Barr, 2018). Lime announced in January 2019 that it would be phasing out bikeshare bikes in St. Louis entirely, leaving a

once-promising bike share program in St. Louis vacated by all of its vendors in less than a year's time (Wicentowski, 2019).

With these physical features of the St. Louis bike system in mind, this section aims to figure out how the bicycling system in St. Louis provides physical mobility and accessibility to disadvantaged populations and understand one measurable component of the extent to which biking fulfills its promise as a tool for social sustainability. To do this, the section first explains the concept of a Bike Score as a way of quantifying an area's bike accessibility. Then, it spatially analyzes Bike Scores by the income and racial makeup of St. Louis neighborhoods, and, finally, it considers how the presence and subsequent absence of the dockless bike share program has impacted bike mobility.

Bike Score is a tool developed by scholars working with the Walk Score company, which started as an effort to quantify the "walkability" of a property for the use of real estate professionals, home buyers and renters, and urban planners alike ("About Walk Score," 2018). Bike Score extends the original idea of a walkable neighborhood to another non-car mode of transportation. Bike Scores are based on an area's proximity to bike lanes (weighted by the bike infrastructure's degree of separation with the road, with shared lanes being the least valuable), the hilliness of an area, destinations and road connectivity, and bicycle mode share, which is included in order to account for the safer mobility facilitated by a "critical mass" of cyclists on the street ("Bike Score Methodology," 2018).[10] Bike Score is not a 100% complete measure of physical

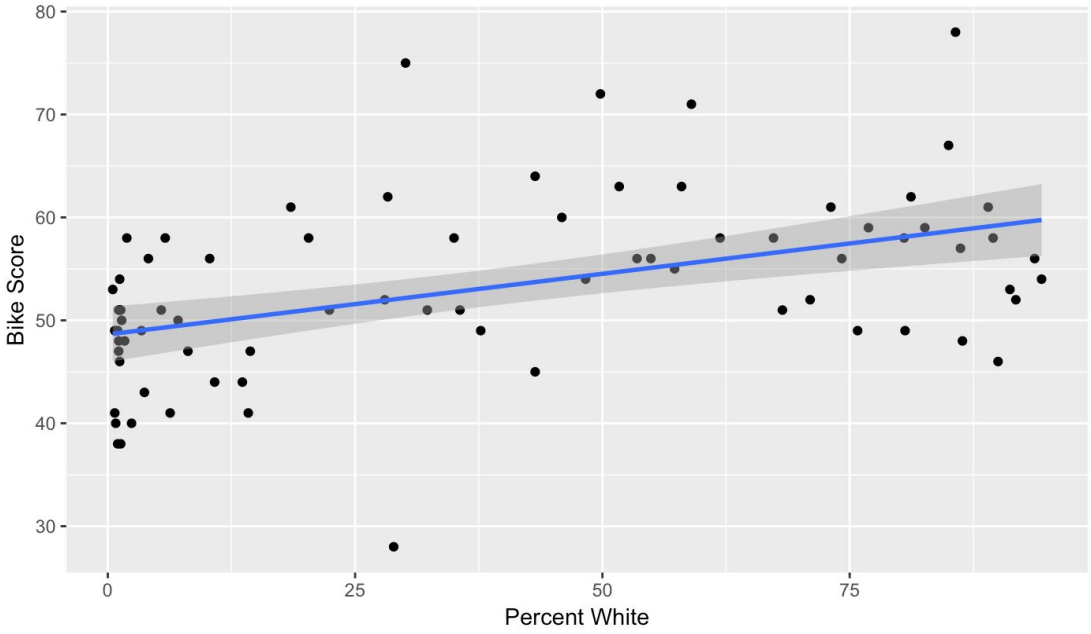
[10] Read more about the Bike Score Methodology at: https://www.walkscore.com/bike-score-methodology.shtml

accessibility to bike infrastructure because it has no way to account for the quality of the bike infrastructure near a given area, nor whether that street has heavy car traffic (which Boettge, Hall, & Crawford, 2017 found was a key factor for bikers in St. Louis). That said, because it considers multiple facets that make up the physical environment for biking, Bike Score serves as a helpful proxy for an area's proximity to bike infrastructure, and it speaks to bike accessibility and mobility by considering available routes, destinations, and how certain aspects of bike infrastructure (such as mode share and separation from traffic) may impact safety and comfort while riding.

To understand whether disadvantaged populations in St. Louis are well-served by the bicycling system, then, one can first consider how Bike Scores are distributed across neighborhoods that have varying percentages of their populations who identify as white (*see Figure 2, below*). St. Louis is known nationally for its racial segregation and historic disinvestment in its predominantly black North Side, so this seems like an intuitive place to begin. I ran a Kendall's tau correlation test, which is appropriate for this case because the dataset on percentage white by neighborhood does not follow a normal distribution. It is instead bimodal, as St. Louis' segregation means that there is a high frequency of neighborhoods with a low percentage of people who identify as white and a high frequency of neighborhoods with a high percentage of people who identify as white, with few in the middle. This bimodality violates the assumption of a normal distribution that is required for parametric tests to be robust, so Kendall's tau, a nonparametric test that checks for correlation between two variables by the relative ranks of the data points (as

opposed to the absolute values) and is more resistant to outliers, functions effectively in this case. The results of a Kendall's tau test for correlation showed that a significant (at the <.0001 level) positive relationship exists between Bike Score and percentage white

Figure 2: Bike Score by Percentage White Population in St. Louis Neighborhoods



population in a given neighborhood. This means that neighborhoods with a higher percentage white population tend to have higher Bike Scores, and it suggests a disparity between historically advantaged, majority-white neighborhoods and disadvantaged, majority-black neighborhoods in terms of physical accessibility to bike infrastructure.

In *Figure 2,* this correlation bears out visually, particularly with regard to a lower-Bike Score cluster of neighborhoods with a racial makeup below 25% white, and a higher-Bike Score cluster of neighborhoods that are around 75% white. These clusters are notable because while a linear depiction of the correlation between whiteness of a neighborhood and Bike Score can seem to suggest that the relationship is smooth and

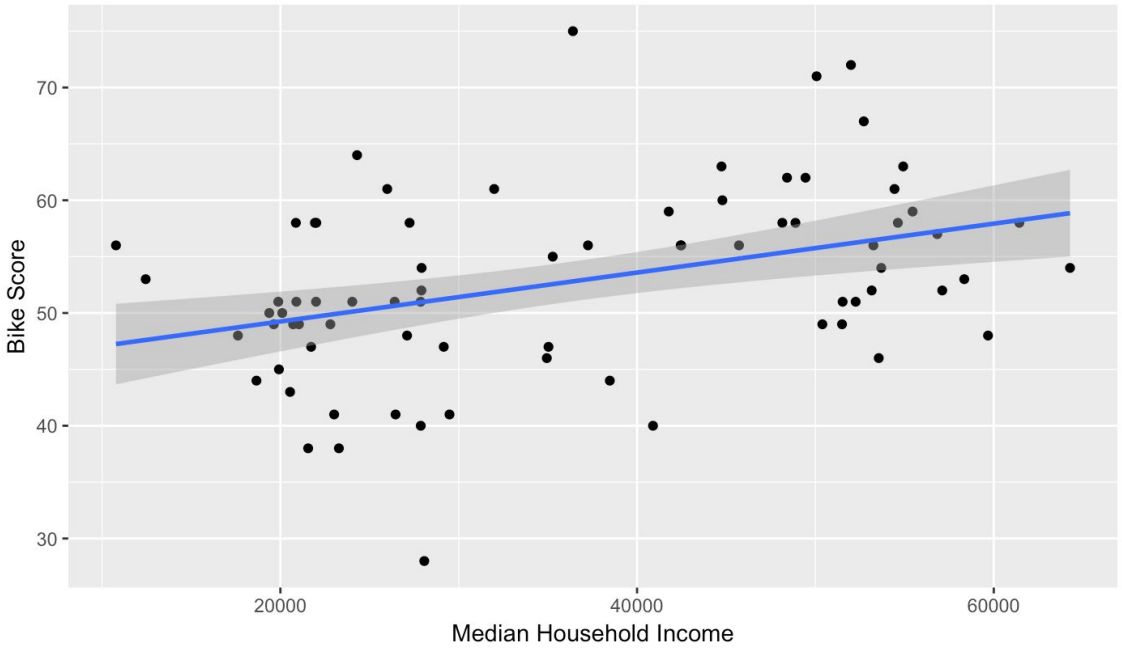
constant, that's simply not the case. Separating neighborhoods with more than 50% white population and less than 50% white population into different groups weakens or completely erases the significance of the correlation. This shows that it's not necessarily the entire range of neighborhoods that matters for the overall relationship. Rather, looking at the differences between those distinct clusters of highly segregated neighborhoods at either end of the distribution is most helpful for understanding the association between racial makeup and Bike Score.

Next, examining Bike Scores in relation to the median household income in a neighborhood helps capture the physical accessibility of bike infrastructure for those who may be most in need of it economically, especially in as much as low-income people are least able to afford a car or pay the maintenance fees for a broken car (Lutz, 2014). The Kendall's tau test of correlation was a better fit for this situation, too, because median household income by neighborhood doesn't follow a normal distribution, so a nonparametric test was necessary.

The result of Kendall's tau test for correlation showed a significant positive correlation (at the <.001 level) between a neighborhood's median household income and its Bike Score. *Figure 3* (*see below*) graphically depicts the scatterplot of the two variables. Again, two relatively distinct clusters- a low-income and low-Bike Score cluster and a high-income and high-Bike Score cluster- emerge as the defining features of the relationship. Notably, the Wydown-Skinker neighborhood, an outlier that has a median household income nearly $40,000 higher than any other neighborhood in the City

of St. Louis (along with the highest Bike Score), was removed from the dataset before the final analysis of the relationship, as it alone inflated the correlation between Bike Score and median household income in absolute terms and increased the correlation's significance. Nonetheless, this relationship shows that, similar to predominantly-black

Figure 3: Bike Score by Median Household Income in St. Louis Neighborhoods



neighborhoods, lower-income neighborhoods are provided a lower level of physical accessibility and mobility to bike infrastructure in St. Louis, as measured by their Bike Scores.

For all its merits, the Bike Score methodology does not take into account infrastructure related to bike parking and bike sharing, which renders St. Louis's introduction of dockless bike share invisible in these statistics, and makes it difficult to quantify how the unfulfilled promise of dockless bike share might have impacted

mobility. After all, planners reported in interviews for this research that the bike share ridership in St. Louis ranked in Lime's top 5 cities globally for its first four months before the introduction of scooters, so we can be certain that the bikes were making an impact of some sort on the mobility landscape. However, the vast majority of dockless bike share companies are private and do not share their aggregated bike parking/ride locations with the public, so they can be difficult to track.[11] Lime St. Louis is no exception; when I inquired about acquiring trip data at an aggregated scale for the purposes of this research, Lime informed me that "these metrics represent proprietary information." This was the first, but certainly not the last, clue that private companies running a bikeshare program that was ostensibly meant to serve the public might have its pitfalls.

Dockless bike share is also quite new; it was first implemented in China in 2015, and it has greatly expanded into North America in 2017 and 2018. Given its short history in the US, research on dockless bike share and its potential implications for equity in US cities is limited (McKenzie, 2018; Shi et al, 2018). Still, some scholars have expressed optimism that dockless bike share may be able to avoid the downsides of the traditional bike share systems with docking stations (Sturdivant-Sani, 2018). Docked bike share systems replicate the spatial inequalities of other bike infrastructure (like the racial and

[11] Washington, D.C. is one of the only cities (if not the only city) that requires bike share companies to provide a publicly available API showing the current locations of any bicycle available for rent in order to operate within its jurisdiction. Unfortunately, its data is difficult to apply to St. Louis's situation because D.C. has a popular and well-established docked bike share system that operates alongside the newer dockless system (McKenzie, 2018).

economic disparities this paper examined in St. Louis), serving disadvantaged populations less-well than advantaged ones by locating docking stations in places that have higher median incomes and higher percentage white populations (Ursaki & Aultman-Hall, 2016; Hosford & Winters, 2018). While docked bike share systems have a "service area" in the same way that a transit system would, the "service area" of dockless bikes is virtually as large or small as people's trips make it. This allows the accessibility of dockless bikes to shift more easily with individuals' transportation mode preferences than might be the case when there are fixed points at which people have to pick up and drop off bikes (Sturdivant-Sani, 2018).

In St. Louis, the permitting process for the bike share companies stipulates that the companies must keep 20% of their bikes available in "Social Equity and Inclusion Target Neighborhoods," which have high concentrations of low-income households, people of color, households with no access to a vehicle, and non-English speakers, and are also within reasonable biking distance of MetroLink and the urban core of the city ("St. Louis Bike Share," 2019). This means that the bikeshare companies' employees (the same people who pick up broken bikes to be repaired, for example) are responsible for relocating bikes to meet the requirement, which is assessed on a daily average. This bike share requirement is a notable way the city has committed to working toward making biking a tool for social sustainability by physically increasing biking accessibility for disadvantaged populations, and it, luckily, remains a key component of the permitting requirement for scooters as well. A major issue with scooters, though, is that even if they

are available in a neighborhood, people may not have a safe place to ride them because sidewalks are off-limits (which is not the case with bikes in most areas outside of downtown St. Louis), and bike infrastructure simply isn't designed for scooter use at this point (Schlinkmann, 2018d). Medical statistics legitimize the concern about this lack of infrastructure. Hospitals have reported up to 11 scooter-related injuries in emergency rooms per week in St. Louis, and some Washington University doctors were so concerned in November 2018 that they wrote a letter to St. Louis Mayor Lyda Krewson asking her to assemble a task force to craft better scooter safety policies (Wicentowski, 2019). The safety concerns have not yet been resolved.

Because renting bike share bikes costs money, the city has been sensitive to the idea of monetary accessibility to the bike infrastructure along with spatial proximity. Therefore, the St. Louis bike share permit also requires companies to offer a non-credit card and non-smart phone option for renting the bikes and scooters so that people who do not have smartphones or access to credit/traditional banking will still be able to ride these mobility options ("St. Louis Bike Share," 2019). However, taking a ride on the Lime scooters is three times more expensive than riding one of Lime's pedal bikes ("Lime Micro-Mobility FAQs," 2019). In addition, Lime offered a 95% discounted rate of 100 rides for $5 on its pedal bikes for those who are enrolled in a low-income state or federal government assistance program- this comes out to 5 cents per 30 minutes- as well as a 50% discount for anyone with a ".edu" email address ("LimeAccess," 2019). The discount rate for low-income people, by contrast, is only 50% for the already more

expensive scooters, which cost 50 cents just to unlock and another 7 cents per *minute* of use, and Lime does not provide a scooter discount for people associated with educational institutions ("LimeAccess," 2019).

Though there are clear disparities in the current physical accessibility of St. Louis's bike system, particularly for people who live in low-income and/or majority-non-white neighborhoods, programs like the dockless bike share in St. Louis provided cause for hope for disadvantaged populations' physical mobility and accessibility in the city's biking system, as this program had been purposefully designed to represent their interests. However, the switch toward more expensive electric scooters that don't have any existing dedicated infrastructure instead of bikes highlights the fact that it is risky to rely on the private market to provide accessible mobility options to those who need them most.

Individual Experiences

Bike Scores, the presence or absence of bike share bikes, and monetary concerns represent one facet of the accessibility and mobility of disadvantaged populations within the St. Louis biking system; these sorts of inquiries about physical proximity and tangible forms of accessibility are relatively easy to quantify. The individual experiences that constitute those aggregate figures about neighborhoods and the compelling stories at the heart of bike mobility are harder to convert into a graph or table. Even understanding what an indexed number like the Bike Score means as an absolute value can be difficult. Sure, a 78 Bike Score for a neighborhood means it's easier to get around by cycling than

if the neighborhood scored a 54; that's intuitive enough, but what does it *feel like* to cycle in either of these neighborhoods? Numbers can't explain that. Nor can numbers explain how the lived experiences of disadvantaged populations might differ from their wealthier peers, even if those lower income or marginalized people live in neighborhoods that aren't quite as disadvantaged. Those people's experiences and stories matter too. That's why this research consulted residents to describe the on-the-ground reality of biking in St. Louis (*see Appendix 3 for demographic information on survey respondents)*. Survey respondents expressed broadly positive perceptions of the dockless bike share program (particularly the Lime Bikes), and this pattern extended across income and racial groups in interviews and surveys, which raises concerns given that this mobility option is now defunct. Two major themes emerged in research participants' experiences with the bike system that this section explores in further detail: 1) safety concerns regarding poorly-kept infrastructure and hostile automobile drivers and 2) dissatisfaction with the bike system's lack of cross-city connectivity.

First, both people who bike regularly and those who rarely find themselves on a bike expressed deep concern about the safety of biking in St. Louis. People went so far as to say that they were afraid to use some of the existing bike lanes because of poor placement of lanes, potholes, and hostile drivers on busy roads. One avid cyclist (white, working class) described the situation on a busy North-South route, Grand Avenue, this way:

> Now, there's, you know, different levels of bike lanes, right? There's...bike lanes like you might see on Grand where it's just, you know, a stripe of paint that takes you over a grate where you can actually break bones- and I know people who have broke bones- because, you know, a bike lane just takes you into a grate...so your wheel falls in...Those are not, that's not really good infrastructure, that's just 'well, we've got to get 20 miles of bike lanes in, so let's just, you know, put 20 miles of paint.' (Personal communication, July 14, 2018)

As this quote illustrates, to many St. Louisans, it seems that bike infrastructure has just been plopped anywhere it was convenient for planners and engineers to put it, instead of being placed thoughtfully for the purpose of promoting biking as a mobility option. In my experience of participant observation, I saw many people- even those who seemed comfortable on a bike- riding in the sidewalk on streets that were technically a part of the Bike St. Louis system, either as sharrows or as unprotected bike lanes. There is also the related issue that because (at least in many residents' perceptions) streets aren't very well-maintained in St. Louis, the on-street bike infrastructure is equally as cracked and potholed as the roads themselves. Several people cited road quality as a reason they found few legitimate biking opportunities in St. Louis. Interacting with cars was another major concern. Some survey respondents were blunt, calling automobile drivers "hostile." Others commented that "sharing the road with drivers is dangerous," and yet others said that "drivers do not know how to interact with bikes," suggesting a role for further driver education. This experience of high-volume automobile streets as inadequate or dangerous bikeways has been corroborated by larger-scale studies like one

by Bram Boettge, Damon Hall, and Thomas Crawford (2017), who found that cyclist stress in St. Louis correlates with speed limit, roadway classification, and number of lanes.

A theme among residents that has perhaps more direct consequences for the equity of St. Louis's biking system (and not just the user mobility experiences of the system overall) is a lack of connectivity. Though people told me over and over again that there were many opportunities to bike in St. Louis, they also told me that those opportunities were primarily recreational, happening at parks and at suburban, scenic off-road trails. While some people cited bike lanes as providing a good opportunity to bike in the city, others said that the city was completely devoid of bike lanes. Even one man (Native American, working class) who lives in a neighborhood that has the second-highest Bike Score in the city, Forest Park Southeast (also known as The Grove), reported that there were no bike lanes in his neighborhood and that "it is tough to bike if you do not live near a major park." This was the first clue of an incomplete, or at least inconspicuous, bike system. One respondent who identified as a bike commuter articulated the sentiment of numerous residents when they said, "If I think about my immediate neighborhood, it is easy to get around without a car, but anything further afoot is more difficult. St. Louis in general is a disconnected city. Bike route[s] start and stop in weird areas…" "Weird" areas were identified by this cyclist and others as simply abrupt or unexpected gaps in bike infrastructure that hindered residents' ability to bike in an efficient and safe manner. Though the system of bike facilities (recall *Figure 1)* looks, on

the surface to be connected, this isn't the lived experience of people who bike for mobility. For instance, there is very little practical difference between a road with no bike infrastructure and one that is marked with "Share the Road with Bicycles" signs, especially when the streets in question have high-volume traffic flows. Hence, the bike system seems to start and stop abruptly. North-South bike routes in the city seem to be particularly problematic; either they're nonexistent or include treacherous intersections on bridges over interstates and railroad tracks.

This state of affairs, given that the city of St. Louis is notably racially segregated between its North and South sides, raises serious concerns that the current bike system in St. Louis cannot effectively serve as a mobility tool- a tool for social sustainability- to connect disadvantaged communities on either side of the divide to economic opportunity.

Political Processes

The final major lens through which this chapter explores the mobility and accessibility provided for disadvantaged groups by the St. Louis bike system is political processes. This look at the structural factors that underlie St. Louis' bike system fills in the contextual gaps left when purely focusing on mobility as a product of physical proximity and experiences on a person-by-person level; it highlights how physical infrastructure is bound to and affected by past and present urban planning policies and has a continual, back-and-forth relationship with individuals' mobility experiences through the planners' public outreach. Interviews with planners and analyses of policy documents show that while equity is *a* priority for city and regional planners in St. Louis,

it is typically not *the* priority; deep-seated regional tensions about funding and pressure to adhere to organizational constraints are the two biggest barriers to equity-driven bike policy from a bureaucratic perspective.

In terms of funding, Metro area transportation plans often speak to the tension of using limited budgets to expand non-car options when there are hundreds of miles of aging roads and bridges (upon which most commuters still rely) to maintain. The EWG, for example, fills up most of its priority project list in the long-range transportation plan with car-centric road and bridge projects that are necessary just to keep the highways at a safe level of maintenance (EWG, 2015, pp. 2). This funding tension is compounded by two major factors: 1) extreme municipal fragmentation and accompanying city-county clashes and 2) the history of segregation and disinvestment in the city's black communities.

St. Louis city started down the path of municipal fragmentation when it set its final, fixed territorial boundaries in 1876 (City of St. Louis, 2018b). That year, the city declared home rule, divorced itself from St. Louis County, and opted not to affiliate with any county at all (City of St. Louis, 2018b). In 1950, St. Louis hit its peak population size, and it did not have any more room to grow within its fixed boundaries, nor could it annex outlying areas. Therefore, the city population shrank as people moved out to the new housing stock in the suburbs, and individual suburbs abounded; just between St. Louis city and county, there are 114 governments that provide municipal-level services (Juvers, 2018). This fragmentation makes for fraught political fights over the future of the

regional transportation network. Planners from EWG and Great Rivers Greenway interviewed for this project said that suburban municipalities are often far more resistant to any bike plan that may imperil ease of parking or narrow the automobile lanes in the road. This tension has particular consequences for St. Louis city residents, who have the greatest need for non-car options to complete their daily tasks and are deeply affected by the regional unity (or lack thereof) in bike funding and planning.

The latter factor fueling tensions about non-car transportation planning in St. Louis- racial segregation and disinvestment in black communities- is intertwined with this fragmented governance. Many of St. Louis' suburbs were populated and incorporated because of white flight from the city, as nearly 60% of white city residents left between 1950 and 1970 (Gordon, 2010). Black folks were kept in certain areas by restrictive deed covenants that barred homes from being sold to black buyers, neighborhood associations that strived for racial homogeneity, and racial steering by real estate agents (Gordon, 2010). In addition, the Federal Housing Administration's discriminatory practice of "redlining" or making it difficult to obtain loans for mortgages in "risky" neighborhoods (places inhabited by people of color), stopped black people in the city from building wealth (Capps & Rabinowitz, 2018; Gordon, 2010). This history helps us understand why today, most of the zero-car households in the metro area are lower-income black households concentrated in the city proper of St. Louis, and, further, why outlying municipalities and counties have been sporadic in their support of non-car transportation

projects, leading to fraught disagreements about meting out limited funding (EWG, 2015, pp. 6).

The effects of fragmentation and segregation on limited funding do not entirely explain why an inequitable pattern persists in St. Louis' bike system today, though. Another piece of the puzzle is that each major agency or nonprofit group involved in the bike planning process has its own guiding mission and purpose that often takes priority over a wholehearted commitment to equity. Individual planners across agencies are often invested in the process of creating a more equitable bike system, but the extent to which their organizational constraints allow them to fully carry out this commitment to equity vary.

A Bike/Pedestrian Planner from the EWG interviewed for this project, for example, was easily able to identify spatial discrepancies in bike infrastructure, but she emphasized, time and time again, the role of the EWG as a facilitator and connector between disparate organizations across the metropolitan region, not an organization that necessarily advocates for certain courses of action for municipalities. There are scores of municipalities in the ultra-fragmented and suburbanized St. Louis metropolitan region, and they play host to thousands of jobs for people who live in the center city, making bike accessibility in outlying areas just as much of an economic priority for car-less St. Louisans as bike lanes in the city proper. The EWG planner emphasized the role of her organization as the region's MPO and a gateway to federal funding for projects across the region, and she suggested that federal funding guidelines are the only channel through

which she and her agency can pressure municipalities into considering non-car infrastructure in their plans. By way of explanation, she said:

> It's the federal policy [to consider non-car options], but there's not, um, I guess we don't have a lot of clawback on what we can really force them to do. Like I said, they have to come to us with the projects, so we can't just you know, rewrite their project for them. If it doesn't get funded and they ask us why, we can be like, well, you need to do this and this and this and maybe, maybe they'll come back with bike lanes… (Personal communication, July 25, 2018)

While the EWG Bike/Ped planner saw herself as having very little individual agency in planning the regional bike system, the experience for an Economic Development planner at Bi-State Development was very different, but organizational constraints still impacted her. Fresh out of her undergraduate education at 23 years of age, one interviewee, Liza Farr, was able to spearhead the introduction of the dockless bike share program to St. Louis by forming a regional bike share work group and nearly single-handedly writing the permit to allow bike share companies to operate in the city proper. While she and the work group focused on equity (and were able to make strides in the right direction by requiring that 20% of bikes be deployed in high-need neighborhoods, as mentioned in the *Physical Proximity and Infrastructure* section), she maintained in interviews that bike share, along with being an equitable mobility option, was also a way to make St. Louis "stand out" among similar mid-sized US cities. Promoting economic development in the region was, at the end of the day, her organization's priority, and bike share would help them do that. The St. Louis bike and scooter share's website even lists that the vehicles

serve as a "modern amenity for **attracting residents and employers**, as well as for visitors, **boosting the local tourism economy"** ("St. Louis Bike Share," 2019, emphasis original). Both Ms. Farr's comments and the marketing narrative from the website play into the association of bike share with capital accumulation in a way that is consistent with Stehlin's (2014) analysis of advocate discourses in San Francisco that laid the foundation for biking to be a driver of neighborhood gentrification. This suggests that even before bikes were taken off of the streets, the organizational adherence to Bi-State Development's mission hampered the ability of bike share to serve disadvantaged communities.

Along with the legitimate concern about gentrification that has come out of framing biking in terms of economic development, so has a naivety about the ability of private companies to serve the public good. When I spoke with Ms. Farr, she expressed support for the entrance of electric scooters into the St. Louis market, though neither she nor any other planner I spoke with anticipated that all bikes would be pulled from the streets in favor of scooters by the year's end. She went as far as to herald the "multiplication of [mobility] options" that she believed that Lime would introduce to St. Louis. This has not come to fruition, as Lime has now switched out its entire pedal bike fleet for the more lucrative scooters, limiting the breadth of mobility options in St. Louis.

Trailnet, for its part, is the only nonprofit in St. Louis that primarily advocates for on-street bike infrastructure, and it is the major organization in the region that has successfully built equity into its mission and everyday processes. According to the

Trailnet planner who participated in an interview for this project, Trailnet actually pays people from disadvantaged communities- who the organization calls "community champions"- to do outreach to their neighbors, and this is just one key piece of its approach to participatory planning (i.e., a planning paradigm wherein the needs and desires of citizen stakeholders are at the center of decision making rather than relying only on "expert" opinions). Trailnet also, during the formation process for its most recent plan, "Connecting St. Louis," collected survey input on broad priorities from a regional community, and then it drilled down into a planning needs assessment targeted at residents of the chosen study areas (Trailnet, 2019). During the planning needs assessment, the organization, with the help of its paid community champions, particularly focused on soliciting feedback from communities who are "historically underrepresented in public decision-making or with greater and more specific mobility needs" (Trailnet, 2019). Trailnet further held open houses, tabled at events, interviewed stakeholders, and attended community meetings to better understand how its in-progress plan would affect city-dwellers (Trailnet, 2019). Even since a draft of "Connecting St. Louis" was finalized, Trailnet has purposefully focused on public participation in all phases of the implementation of its plan, taking pains to ensure that none of its outreach is duplicative of any other outreach to a neighborhood. Rather, it aims to "deepen" existing partnerships with community organizations during the design and construction process.

Trailnet's participatory practices are consistent with the highly engaged and community-sensitive bike planning that scholars like Lubitow et al (2016) found is most

effective for promoting the social sustainability of historically disadvantaged communities because citizens feel as if they have a say in shaping the plans, and therefore can derive more benefit from the resulting bike infrastructure (Lubitow et al, 2016; Lusk et al, 2017). As a dual advocacy and planning organization that isn't technically affiliated with any one governmental body, Trailnet avoids some of the barriers to equity-driven planning that come with a taxpayer-funded institutional mandate and municipal fragmentation. It sidesteps (for the positive, in this case) some of the bureaucracy and specific regulations that governmental bodies must adhere to while planning (like the EWG's federal requirements), and it is more flexibly able to change its mission statement and focus as time goes by, because it's not enshrined in law (unlike Bi-State Development's economic development agenda, for example). Because of this, it can be an incubator for equitable practices. Unfortunately, Trailnet's participatory framework has not yet permeated into other planning organizations in the St. Louis region because this freedom to foster innovative ideas around equity as a nonprofit has also meant that Trailnet has struggled to find consistent funding sources to carry out its plans and must lobby lawmakers for the inclusion of its priorities in broader city and regional budgets.

Policy Recommendations

In all, an analysis of physical proximity, individual experiences, and political processes shows that structural inequity persists in the St. Louis bike system. Neighborhoods with higher percentages of non-white population and lower incomes tend to have lower physical accessibility to biking, and citizens report that the infrastructure

that does exist is often inconspicuous, disjointed, poorly-maintained, and puts cyclists dangerously in the midst of unfriendly drivers. Municipal fragmentation, segregation, and strict adherence to institutional mandates have limited the extent to which planning bodies embody equitable practices, thereby entrenching the inequities in the system. In other words, biking has not yet fulfilled its potential as a tool for urban social sustainability, as it is most accessible for richer, white inhabitants of the city, and the infrastructure doesn't adequately connect people in historically disinvested areas to education, jobs, and the like.

Even so, St. Louis' bike policy was trending in an equitable direction with the introduction of dockless bike share and a push from some planners to build more bike infrastructure, particularly in high-need areas. However, the failure of dockless bike share in St. Louis has called that progress into question. Several policy priorities will help heal from the failures and build off the positives of recent programs. Publicly reckoning with the physical disparities in St. Louis's bike system would start a broader public conversation about increasing accessibility of bike infrastructure, where now the inequities have lain in the shadows, acknowledged by bike planners among themselves, but seldom discussed in the open. Further, increasing the quality and safety of current bike infrastructure through infrastructure investment and education and outreach programs would go great lengths to addressing the concerns that everyday citizens have about biking, and it would cost relatively little money. Connecting existing bikeways to one another, especially on North-South routes, would be the next important, if somewhat

more costly, step to providing mobility and accessibility to jobs and education for those who need it most (i.e., those who rely on biking to get around), and it would meaningfully connect two racially segregated portions of the city. Finally, adopting Trailnet's model for equity-oriented, participatory planning would serve as one way for St. Louis' urban planning bodies to actively work against the city's history of discrimination and segregation that has created inequities in the bike system and made funding for non-car transportation difficult to come by. This may be a difficult task for some governmental bodies because of institutional constraints, but is a worthwhile goal because genuine participatory planning is one of the biggest things that could facilitate the other policy recommendations mentioned here. Planners don't have to take it from me that everyday citizens would like to see more North-South routes connecting disparate parts of the city; participatory planning would allow them to hear these desires for themselves.

Though not all of these specific recommendations would be applicable in contexts other than St. Louis itself, and all urban bike policy should be, to a large extent, rooted in the context of the place in which it is implemented, the broader lessons that come from integrating an analysis of physical infrastructure/proximity, individual experiences, and political processes can be applied to 'ordinary cities' around the world. Looking at any of these factors in isolation would produce a different set of policy recommendations than I have forwarded today. The baseline statistics, the meaning-laden individual experiences, and the analysis of structural political factors each provided value to the analysis of St.

Louis' bike accessibility and mobility for disadvantaged populations, and city policymakers can take a look at these factors in their own contexts to more holistically understand how they can create policy agendas for the future.

Chapter 3: Riding Public Transit in St. Louis

Since the demise of St. Louis' sprawling streetcar network in the 1960s, the region has only slowly built up its public transit, which includes 66 bus routes in Missouri, 18 bus routes in Illinois, and two light rail lines as of early 2019 ("Schedules & Route Maps," 2019). The light rail lines share the same path in the majority of the city center of St. Louis, connecting Washington University and Forest Park with the Central West End, St. Louis University, and Downtown. This rail route helps form an economically lively central corridor that is situated between the majority black and low-income North City neighborhoods and the more socioeconomically diverse South City neighborhoods. The cost to ride public transit in St. Louis is $2.00 for cash-based fare to the bus, $2.50 for rail, or $3.00 for a 2-hour pass across the system; weekly and monthly passes are also available, as are semester passes for university students ("Fares & Passes," 2019). Metro St. Louis offers half-priced fares for seniors aged 65 or older, individuals with disabilities covered under the Americans with Disabilities Act, and those who possess a Medicare ID ("Reduced Fare Programs," 2019). Riders report that the costs of transit are not prohibitive to their mobility, and, on the whole, these fares render traveling by transit much more affordable than owning a car (EWG, 2015). EWG estimates that in the St. Louis metropolitan area, the average annual cost of owning a car is $7,804, while it only costs $936 to buy monthly Metro passes for a year (EWG, 2015).

The ridership on St. Louis' public transit, and particularly the buses, is predominantly made up of low-income, black folks; the American Community Survey

reports that 73% of public transit commuters in St. Louis city identify as black, and the median earnings for transit commuters are $17,615, versus $29,730 for city commuters writ large (US Census Bureau, 2016).[12] At the same time as many disadvantaged people in St. Louis rely on public transit as their main form of transportation, ridership on the Metro St. Louis system has fallen by 20% in the past five years, mirroring trends across the country as gas prices have fallen, some major systems like Washington, D.C.'s have encountered major deferred maintenance issues, and ride-sharing companies like Uber and Lyft have entered the mobility scene (Thorsen, 2018b).

Cities across the country, and St. Louis is no exception, are grappling with how to facilitate social sustainability through transit investments, particularly considering whether to invest in rail lines, and how to dually improve ridership and vital transit service in an era when transit operations are widely and woefully underfunded. In response, scholars have offered policy solutions for making sure public transit is improving an urban area's social sustainability. Whether that means facilitating the grassroots organizing of existing residents near a new transit project to make sure their interests are represented in the plans, adding equity wording to transit-oriented development policies, making buses more frequent and reliable to better serve captive

[12] For the purposes of this chapter, I will be focusing on the buses and light rail that make up the majority of St. Louis' public transit, but there is also a call-a-ride service available at a higher fee than regular Metro fare for customers who qualify for paratransit service under the Americans with Disability Act (ADA) to summon within a metropolitan area-wide service area, as mandated by the ADA. Though this service is open for all to use, people with qualifying disabilities receive preference for reservations and ride at a reduced rate. The service provided by this paratransit is of great importance to people with disabilities, especially people with disabilities who are low-income and don't have access to a private vehicle. Because I am told many people with disabilities ride mainstream public transit because it doesn't require a reservation and is generally more flexible and on-time, this paper will not discuss paratransit in-depth. It will instead focus on the ways in which mainstream public transportation serves the disability community.

riders (and attract new ones in the process), or publishing media campaigns to change attitudes toward transit in the broader populace, scholars have considered these policies best practices from their studies around the country. With the scholarly literature in mind, though, how is public transit providing accessibility and mobility to disadvantaged populations in St. Louis in particular? How is Metro St. Louis dealing with the pressures of limited funding and declining ridership? Are transit dollars being spent to allocate infrastructure, routes, and frequency in places that have high need (i.e. neighborhoods with a high percentage of low-income, racial minority, and zero car households), or are they serving wealthier "choice" riders who aren't dependent on transit? Is St. Louis considering or implementing the policy changes recommended by scholars, and, if so, are they effective at facilitating public transit as a tool for social sustainability?

In order to address these questions and continue to better understand accessibility and mobility through a synthesis of the quantitative scholarly lens of planning engineers, environmental psychology's focus on the personal perceptions, and historians' and political scientists' consideration of structural factors, this chapter discusses this project's empirical findings about the St. Louis public transit system and their implications through those three critical perspectives. First, this chapter provides a review of the scholarly literature around disadvantaged populations' accessibility and mobility within public transit systems before evaluating physical proximity to public transit service for low-income and non-white populations. Then, it analyzes the individual experiences of citizens who ride public transit, including my own experiences during a participant

observation. The chapter next takes a look at political processes that shape the transit system. Finally, the chapter concludes by providing policy recommendations based on these findings.

Literature Review

Whereas the previous chapter showed that the academic literature on biking is broadly skeptical of the possibility of biking to serve as a tool of social sustainability, more authors studying public transit agree on the initial premise that it can provide access to jobs and social integration for historically disadvantaged and car-less populations. Some scholars and practitioners would go so far as to say that the primary founding goal of *public* transit is to provide mobility for those members of said *public* who have few other choices; serving the underserved is in the job description (Wellman, 2013, pp. 140).

One of the scholarly debates with regard to transit, then, centers around what forms of transit investment can best achieve that goal of serving mobility-constrained populations and moving the city toward a broader social sustainability. Advocates worry about gentrification and displacement when the city invests in projects like light rails (LRT), trolleys, and streetcars. Some scholars have been accordingly critical of these forms of transit, which have the potential to sharply raise property values in their wakes, pricing out low-income, longtime residents as they attract development and interest from outsiders (Jones & Ley, 2016; Zuk et al, 2018; Hinners, Nelson, & Buchert, 2018). However, other scholars have argued that the effects of LRT systems on gentrification can be combated by public policies that enshrine processes that explicitly account for

equity considerations and community organizing to make sure that new transit infrastructure benefits existing residents. Dwayne Baker and Bumsoo Lee (2017) found, for example, that while the areas around San Francisco, California's public transit gentrified rapidly, Portland, Oregon's incorporation of equity language and affordable housing clauses into their transit-oriented development was effective at staving off gentrification and displacement. In addition, Gerardo Sandoval (2018) found that communities he studied in Oakland, Los Angeles, and San Diego used ethnic identity to mobilize their political capital and organize grassroots actions in their *barrios* in order to successfully push for community benefits- like increased affordable housing and links to specific bus and train lines that fit their needs- from new public transit projects. These organizing and policy strategies show the way forward, in a broad sense, for making public transit a true tool for social sustainability by serving low-income, historically disadvantaged populations.

Other scholars and advocates are concerned about capital-intensive rail and (certain types of) bus rapid transit[13] development not necessarily because of gentrification, but because of the opportunity cost of spending money on building a flashy project versus making service improvements that could enhance frequency and

[13] The term "bus rapid transit" refers to a "bus-based transit system that delivers cost-effective services at metro-level capacities. It does this through the provision of dedicated lanes, with busways and iconic stations...off-board fare collection, and frequent operations. Because [bus rapid transit] contains features similar to a light rail or metro system, it [can be] reliable, convenient and faster than regular bus services. With the right features, BRT is able to avoid the causes of delay that typically slow regular bus services, like being stuck in traffic and queuing to pay on board" (Institute for Transportation and Development Policy, 2019).

reliability for everyday riders (Giuliano, 2005; Sukaryavichute & Prytherch, 2018). There are public policies that some scholars argue can help address this concern, too. Yingling Fan, Andrew Guthrie, and David Levinson (2012), in their study of how the Minneapolis Blue Line light rail affected job accessibility in the Twin Cities region, found that it was a good investment that increased job accessibility for all income levels, including for low-income people, who are most likely to be transit-dependent. The Blue Line was especially helpful at linking people with employment opportunities in places where it connected to bus routes, suggesting that it is important to integrate new infrastructure into the already-existing transit system in order to make larger capital investments genuinely functional for disadvantaged communities. With that said, it can be difficult for municipalities to find funding to integrate their transit systems. Previously legislated funding mechanisms, particularly at the federal level, favor the construction of capital projects like heavy and light rail, streetcars and bus rapid transit, and have fewer existing venues to assist with operational funding (Mallett, 2018; Taylor & Samples, 2002). Plus, rural-suburban-urban tensions between regional municipal government funders and the city agencies beholden to them can complicate the process of getting any transit funding at all; city-county tensions have put transit funds in jeopardy in places from St. Louis to the Twin Cities to Los Angeles (Kohler, 2018; Coolican & Webster, 2017; Zahniser & Nelson, 2014).

Along with these worries about funding come a nationwide dilemma for public transit operators and policymakers. Ridership, and especially bus ridership, is on the

decline in many cities, including St. Louis, making it difficult for transit agencies to make the case to their already-skeptical funders that they deserve more grants and allocated budget dollars (Medford Miller, 2018). Many scholars argue that the best way to attract new riders- who often may be "choice" riders who are not dependent on transit- while still serving the core ridership group of so-called "captive," transit-dependent riders is to improve reliability and frequency of existing transit lines and expand them, if possible (English, 2018; Giuliano, 2005; Miller, 2018). These scholars say that the only way to make transit a viable mobility option for more people is to expand the reach of transit to places that people need to go for work and play, and make the service to those places frequent enough to be convenient for a casual trip. At the end of the day, increased service benefits low-income, traditionally underserved riders the most because they rely on transit for daily mobility, but it also provides a helpful mechanism for transit agencies to attract more ridership in order to stay financially solvent and justify themselves to regional, state, and federal policymakers (Giuliano, 2005).

The essential problem with this policy option, though, is that it requires transit agencies to either find an innovative way to expand service without more funding (which would likely include a trade-off between routes served and frequency), or to convince their funders to provide more dollars up-front in order to increase the transit system's financial stability in the long-run; both of these could be politically challenging (Medford Miller, 2018). In addition, some scholars push back on the "if you build it they will come" mantra. Steven Spears, Douglas Houston, and Marlon Boarnet (2013) found that

citizens' perceptions of public transit in a predominantly low-income South Los Angeles neighborhood- particularly their general attitudes toward it and their concerns about personal safety while riding- could predict whether or not they use transit, independent of street connectivity and transit service level near them. This suggests that improving service is not the only way that policymakers and planners can increase ridership on public transit; a comprehensive strategy also necessarily includes a media campaign that gives potential riders more information about the safety of the system and works to boost the public image of public transit more generally.

Physical Proximity and Infrastructure

With this background on the conversations scholars are having about public transit equity in mind, this section aims to figure out how public transit in St. Louis provides physical mobility and accessibility to disadvantaged populations. To do this, it first explains the concept of a Transit Score- similar to the Bike Score metric mentioned in the previous chapter- as a way of quantifying an area's accessibility to public transportation. Then, it statistically analyzes Transit Scores by the income and racial makeup of St. Louis neighborhoods, and, finally, it interrogates Transit Scores by neighborhood from a spatial lens by testing for clustering patterns.

Transit Score is a tool developed by scholars working with the Walk Score company, which started as an effort to quantify the "walkability" of a property for the use of real estate professionals, home buyers and renters, and urban planners alike ("About Walk Score," 2018). Transit Score, like Bike Score, extends the idea to another mode of

transportation: public transit. Transit Score is somewhat less mathematically sophisticated than Walk Score or Bike Score because it only takes into account nearby transit service, and it does not include variables that account for the accessibility of destinations via transit- recreational amenities or centers of employment, for example- or less tangible factors that help constitute the transit experience, like intersection density does for walking or the bicycle commuting mode share does for biking ("Transit Score Methodology," 2018).

Transit Score assigns values to the routes nearby a given location based on three major variables. First, it takes into account service level, measured as the frequency of service per week. Then, it incorporates mode weight; light and heavy rail garner the highest multiplier of 2x, then alternate modes like cable cars and ferries at 1.5x, and buses at 1x ("Transit Score Methodology," 2018). Finally, the company includes a distance penalty in the calculation by tracking how far the average citizen living in that location (whether aggregated by city, by neighborhood, or by a single property) would have to travel to get to the closest transit stop ("Transit Score Methodology," 2018).[14] Despite the limitations that come with its relative simplicity- for one, it doesn't help me make any conclusions about a transit system's ability to get car-less people to their jobs- Transit Score does provide a good sense of how well public transit serves a given place.[15]

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[14] This is the finest-grain level of detail that the Walk Score company provides about its Transit Scores. Any further information about the algorithm, according to the company, is "proprietary." Read about the methodology on Walk Score's website at: https://www.walkscore.com/transit-score-methodology.shtml

[15] The current Transit Score calculations do not yet take into account the new Cortex Metrolink rail station that opened on July 31, 2018. This is consistent with the survey responses and interviews for this project, as the qualitative data was collected from May 2018 through mid-August 2018, by which time few people had

This baseline of physical accessibility will lay a foundation upon which later sections on individual experiences and political processes can build in order to add nuance to the discussion of historically disadvantaged populations' transit mobility in St. Louis.

To explore physical accessibility of disadvantaged populations, then, one can first consider how Transit Scores are distributed across neighborhoods that have varying percentages of their populations who identify as white, as black folks have been historically marginalized and are more likely to live in car-less households in St. Louis (EWG, 2015). With biking, signs of disparities in access to infrastructure were present from the initial test of correlation between the Bike Score and racial composition of neighborhoods, so I wanted to see if this would be true with Transit Score too. I ran a Kendall's tau correlation test, which is appropriate for this case because the dataset on percentage white by neighborhood does not follow a normal distribution. It is instead bimodal, as St. Louis' segregation means that there is a high frequency of neighborhoods with a low percentage of people who identify as white and a high frequency of neighborhoods with a high percentage of people who identify as white, with few in the middle. This bimodality violates the assumption of a normal distribution that is required for parametric tests to be robust, so Kendall's tau, a nonparametric test that checks for correlation between two variables by the relative ranks of the data points (as opposed to the absolute values) and is more resistant to outliers, functions effectively in this case.

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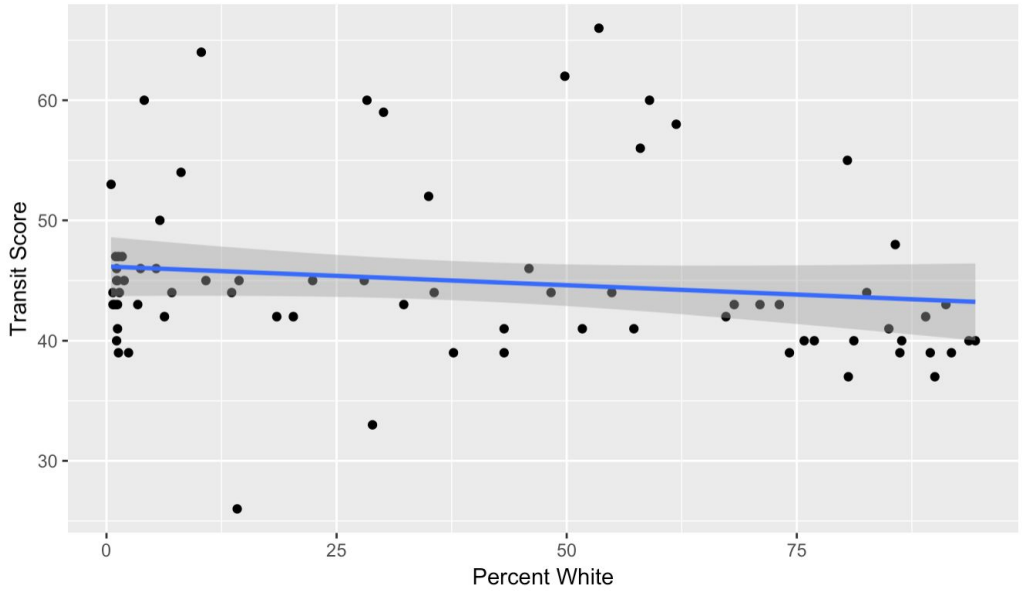
been able to assess the overall impact of the new station on accessibility for disadvantaged populations, though a few did speculate about it.

The results of the Kendall's tau test for correlation showed that a weak but significant (at the <.01 level) negative relationship exists between percentage white in a neighborhood and Transit Score (*for graphical depiction, see Figure 4, below*). This means that neighborhoods with higher percentages of white population actually tend to have lower Transit Scores. The relationship here, though in the opposite direction from the Bike Score versus percent white relationship, is relatively similar in that there are two major clusters that become obvious in graphical depiction: one of neighborhoods with

Figure 4: Transit Score by Percent White Population in St. Louis Neighborhoods

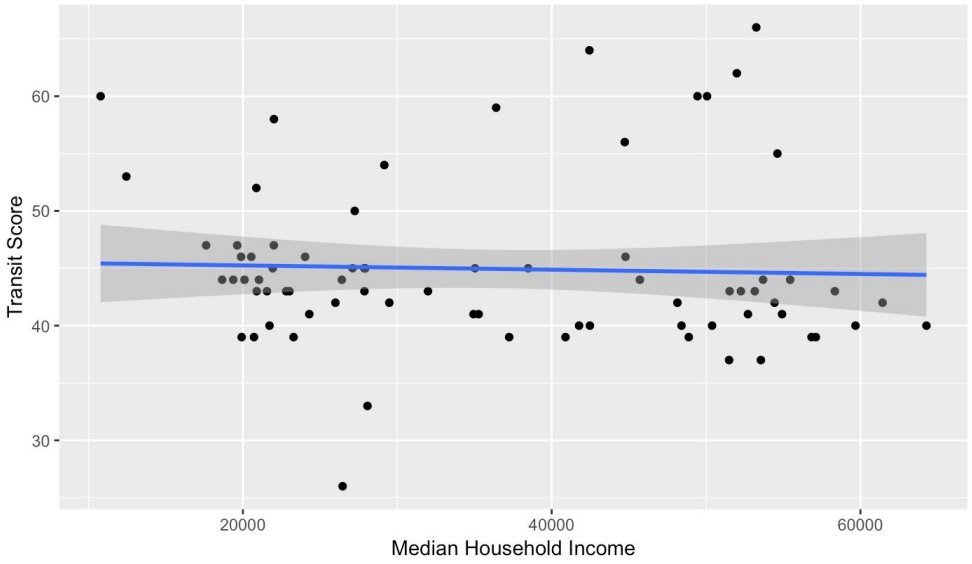


less than 25% white population (particularly under 15%), and the other with more than 75% white population. When I test the correlation between percent white and Transit Score with either the less than 25% cluster or the more than 75% cluster alone, the relationship loses its significance entirely. Because of St. Louis' high levels of segregation, perhaps it is not entirely surprising that these clusters of neighborhoods

would reproduce themselves in various modes of transportation, but it is again notable that this weak negative relationship between percent white population and Transit Score is not constant throughout the distribution.

Next, examining Transit Scores in relation to the median household income in a neighborhood helps capture the physical accessibility of public transit for those who may be most in need of it economically, especially in as much as low-income people are least able to afford a car or pay the maintenance fees for a broken car (Lutz, 2014). The Kendall's tau test of correlation was a better fit for this situation, too, because median household income by neighborhood doesn't follow a normal distribution, so a nonparametric test was necessary. Notably, the Wydown-Skinker neighborhood, an outlier that has a median household income nearly $40,000 higher than any other neighborhood in the City of St. Louis, was removed from the dataset before the final analysis of the relationship; it disproportionately affected the significance of some tests but not others (for example, it was more confounding in the Bike Score analysis), so I left it out in order to keep my methods consistent across transportation modes. The result of Kendall's tau test for correlation showed a weak negative correlation between median household income and Transit Score that was significant at the <.05 level (p=.035), which is just significant enough to meet most scholarly standards. In other words, there is an approximately 3.5% chance that the correlation observed between income and Transit Score in St. Louis neighborhoods is purely due to chance and not a genuine relationship between variables. There is enough evidence to say that the correlation between median

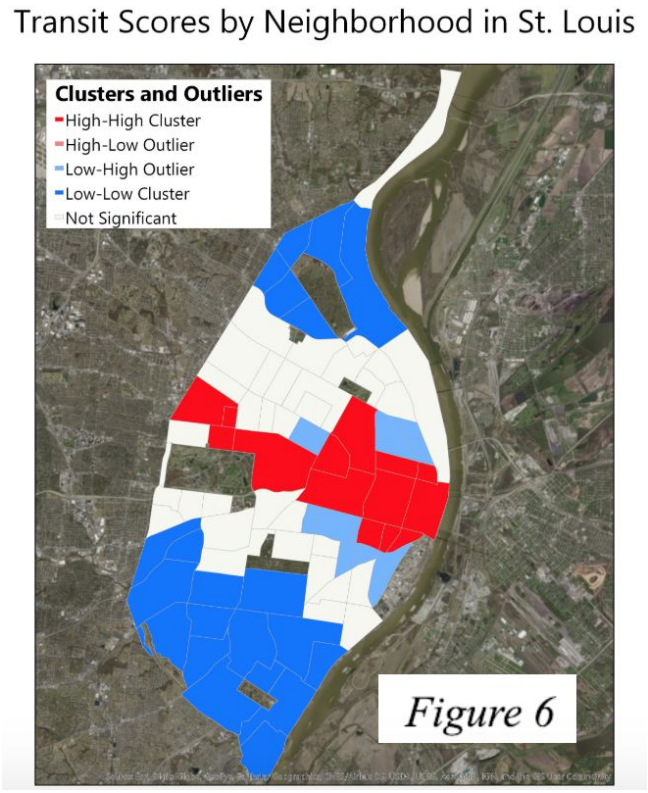
Figure 5: Transit Score by Median Household Income in St. Louis Neighborhoods



household income and Transit Score is statistically different from zero. Note that even in this situation, where the correlation is less statistically significant, *Figure 5 (above)* still clearly displays the two major clusters of neighborhood income groups: one below $25,000 and the other above $50,000. These two income groups still tend to have similar within-cluster Transit Scores.

Because both of the tests found weak but significant *negative* correlations, meaning that low percentage white neighborhoods and lower-income neighborhoods actually have, if anything, better access to transit as compared to their richer and whiter counterparts, I conducted an additional analysis to interrogate this relationship spatially instead of just with numbers. I ran an Anselin Local Moran's I in ArcGIS Pro. This calculation essentially identifies statistically significant clusters of high and low values of a particular variable- in this case, Transit Score- as well as spatial outliers. As denoted in

Figure 6 (*below; see Appendix 1 for labeled reference map of St. Louis neighborhoods*) by the neighborhoods colored red, the test found a significant cluster of high Transit Scores in the central corridor, near-North Side, and near-South Side neighborhoods where the light rail lines stop and which are well-served by bus routes that operate on St. Louis' Downtown-centric hub and spoke system. As denoted in *Figure 6* by the stations colored dark blue, the test found a significant cluster of low Transit Scores in the neighborhoods of the far North Side surrounding Calvary Cemetery and a large portion of the South Side neighborhoods, mostly south of Tower Grove Park. Spatial outlier neighborhoods with low Transit Scores situated next to areas with a cluster of high Transit Score neighborhoods appear in light blue both north and south of the aforementioned high-high cluster that traces the Central Corridor.



While the Local Moran's I did not tell me anything conclusive about whether or not public transit is serving disadvantaged communities, it does help decipher the results from the correlation tests by showing that the areas that have statistically significantly

low transit scores are further from the central light rail corridor and Downtown both on the predominantly black and low-income North Side and on the more diverse South Side. Because Transit Score's "mode weight" calculation privileges, for better or for worse, any form of rail twice as much as bus routes, it's possible that these low-low clusters are primarily disadvantaged because of their lack of access to light rail and not because of a broader lack of access to public transit via buses (this may explain the low-high outliers as well). However, even though numerous southwestern neighborhoods of St. Louis are situated next to suburbs with access to the Blue Line light rail (e.g., the majority of of Lindenwood Park is within Transit Score's cut-off of 30 minutes walking distance of the Shrewsbury Metrolink Station), they are still included in the statistically significant low-low cluster. This suggests that there is some broader lack of access to transit in these neighborhoods, rather than just a lack of access to light rail transit or Transit Score's over-emphasis on rail transit over bus transit.

In the end, the quantitative analysis of accessibility and mobility via public transit for disadvantaged populations in St. Louis leaves us with more questions than answers. Correlation analyses suggest that public transit serves neighborhoods with a higher percentage of non-white inhabitants and neighborhoods with lower-income populations just as well, if not better, than their richer and whiter counterparts. Within the historical context of disinvestment in low-income communities of color in St. Louis and around the country, this result appears counterintuitive. It could signal that St. Louis planners have a recognition of transit as a tool for social sustainability or equity, as Wellman (2013)

would suggest, or it could signal that low-income people move to places that are transit accessible instead of the other way around, as Miller (2018) would suggest. However, the fact that there is evidence to suggest parity (at least) between how disadvantaged and privileged St. Louisans are served by public transit does not answer the question of whether the transit that exists provides accessibility and daily mobility for car-less people to have the kind of freedom of movement that enhances the city's overall social sustainability by allowing them to travel to work, school, and recreational opportunities. It further does not even attempt to broach the vital topic of whether St. Louis planners are using their limited funds effectively to help boost mobility for those who need non-car transportation or are falling into the trap of building projects for the sake of broader economic development that put low-income communities at risk for gentrification (recall Jones & Ley, 2016; Zuk et al, 2018).

Individual Experiences

To answer one of those major lingering questions from the quantitative analysis- whether existing transit service in St. Louis adequately facilitates the mobility of low-income people and people who live in zero-car households- this research goes straight to the source by interviewing St. Louisans about their experiences with public transit (*see Appendix 3 for demographic information on survey respondents*). In addition, I lived without a car and commuted by bus and light rail in St. Louis for two summers. I spent the second summer conducting a more formal participant observation of the system in order to better understand how it provides accessible mobility to residents across the

city, not just along my limited commuting and recreational routes. From my experiences and the interviews and survey responses from residents, a major theme among people who commute via public transit, rely on it for daily needs like running errands, or don't have regular access to a car was that St. Louis' public transportation is generally reliable, but not without its flaws.

A couple of survey respondents deemed the system "decent," while another called it "easy to get around," particularly in neighborhoods with relatively frequent bus service, like the 70 Grand bus corridor, where articulated buses[16] run at rush hour, and buses come every 10-15 minutes throughout the day. Most regular riders noted that the buses usually run on time, which was consistent with my experiences using the transit system; the buses I rode almost all arrived within 5 minutes of their scheduled time, if not slightly before.[17] People were also complimentary of the Metro St. Louis smartphone app, where users can see live bus arrival times. Transit was, by many admissions, not residents' first choice for travel, but it became necessary because they struggled to pay to fix car breakdowns, to fill up their tank during times of high gas prices, or to raise enough money to buy a car in the first place. A few interviewees came to prefer commuting by bus so much after car breakdowns that they never went back to commuting in a personal vehicle, even if they had the funds to do so; they felt that the stress burden from fighting

[16] An "articulated bus" is a longer-than normal, high capacity bus that features two rigid portions for passengers linked by an accordion-like connector (Moore, 2018).

[17] I often ran the block-and-a-half from my apartment to my morning bus stop for the 10 Lindell-Gravois because it was routinely two to four minutes early, and my stop was not a "time point" where the bus driver must wait to leave until the posted time. Once, I even missed the bus and frantically jogged half a mile to catch up to it at its time point.

traffic each day and the repeated financial burden of car upkeep and gas wasn't worth it. Overall, transit riders I spoke with were positive about the ability of transit to get them to and from work, school, doctor's appointments, and grocery stores without a problem.

With that in mind, St. Louisans also had their fair share of qualms with the Metro bus and rail system, even if they found it to be reliable and suitable to their needs overall. To varying degrees, cleanliness, lack of frequent routes, limited transit service in the suburbs, and safety/security were all problems for riders with whom I spoke.

First, though it wasn't a make-or-break issue, people mentioned the cleanliness (or lack thereof) of Metro buses several times when asked about the overall quality of the St. Louis transit system. Cleanliness is a factor that can deeply affect the comfort of a mobility experience. In accordance with 'mobilities turn' scholars' idea that mobility constitutes more than the act of getting from A to B, cleanliness takes on a level of importance in this research because it is less easily measured than other forms of accessibility; it has more to do with the psychology of trip satisfaction (and whether people *feel* that the transit system serves them well) than the tangible fact of whether transit is able to provide accessibility to activity sites (Cresswell, 2011; Sheller & Urry, 2006; Merriman, 2014). As Sheller & Urry (2006) explain, "the corporeal body [serves] as an affective vehicle through which we sense place and movement, and construct emotional geographies" (pp. 216). In this way, people's perceptions of the comfort and cleanliness of the transit system can be a constitutive part of their mobility.

Some frequent riders attributed a part of their satisfaction with the system to the fact that buses are kept clean, while a couple of others remarked that they would encounter trash on buses in the evenings or found them broadly "dirty." In riding different buses around the city at different times, I found that both of these experiences could be true. I would not have identified cleanliness as a particular problem unless others had pointed it out, but there were a couple of instances where I had to dispose of a plastic bag of chips or an orange peel before I could sit down. A transit dependent woman who lives in Fox Park, a neighborhood that is average for St. Louis in terms of its Transit Score, summed up the cleanliness of transit in St. Louis by comparing it to the transit in her former home in Boston, "I think that...St. Louis is...very prone to litter, like there's a lot of litter, whereas Boston there's not. The difference is that I thought St. Louis' public transportation was a lot cleaner than Boston's, both rail and bus." This is an astute observation in that this resident made a distinction between 1) the St. Louis situation, in which a bus or train vehicle is well taken care of and has generally clean upholstery and floors but may sometimes have visible pieces of left-behind trash, and 2) the Boston situation, in which the bus or train vehicle is not well kept-up and has accumulated years of dirt on the seats and floors, but there isn't as much litter. This explanation can account for both those riders who found their experiences pleasant and enhanced by the cleanliness of the vehicles and those who were put off by visible trash.

Though the cleanliness issue is up for debate among riders, one issue upon which regular bus and rail users almost universally agree is that the St. Louis public transit

system has a dearth of routes with adequate frequency of service. This lack of frequency ends up meaning that transit riders need to plan nearly every trip- even, for example, to go to a store or post office that is not within walking distance of their home- in order to make sure that they don't have to wait at the stop for 30 minutes before the next bus comes after they have finished their errand. The absence of built-in flexibility also means that if people dependent on transit are running even a couple of minutes late, they may have to take an Uber, Lyft, or cab in order to make sure they aren't late for work because the next bus takes too long to arrive. A lack of route frequency during non-rush hours, weekends, and holidays means that the transit system can impose hardships on the disproportionately low-income people who work during "irregular" times, often working shifts at places like hospitals, factories, and restaurants. One low-income citizen living in a zero-car household described the way that their commuting situation is impacted by bus service frequency by commenting the following:

> Very specifically, I use bus 46 to get to work in the morning. After 8 and before 4pm the route ends at St Anthony's instead of Met Life. This causes me and sometimes a few other people each week to have to walk an extra couple miles each morning. On Saturdays it never goes to Met Life, and it nevers [sic] runs on Sundays and observed holidays. This limits my and others' work availabilities.

A lack of bus service frequency on this resident's commuting route undeniably took a toll on their freedom of movement and put them in a situation where they were left with little choice. They could either walk the significant part of their route to Met Life that wasn't covered on "off" periods like evenings, early mornings, and Sundays, or not work at all

that day. Based on the situation described, elderly folks or those with a disability that prevents them from being able to walk long distances may be closed off from that job altogether if they don't have access to a personal vehicle. In this way, decreased service frequency is not just an inconvenience, but an injustice that limits certain people's economic opportunities.

Besides frequency, riders voiced that another major shortcoming of the St. Louis public transit system is that it doesn't reach far enough into the sprawling suburbs of St. Louis to be helpful in getting residents to jobs and amenities there; when routes do go to the suburbs, interviewees observed that they seemed inefficient, taking too long to arrive at the desired destination. One transit-reliant man who identifies as black, is blind, and lives in a suburb just south of the the St. Louis city boundary, noted that even though two bus lines travel near his home, it's "difficult to get anywhere in a timely fashion," and he noted that his commute to work takes more than an hour. There are a few existing express routes from suburban locales to the center city and vice versa, but residents and businesses alike report that they aren't sufficient for traveling to all employment centers. One interviewee who was a part of the management team at a construction services corporation said that it had been difficult for his company to attract unskilled workers to their North St. Louis County location because it simply took too long to get there for most people who didn't have access to a personal automobile. He said that his company's leadership had been concerned about their unskilled labor shortage to such an extent that they had considered running a company bus or shuttle to go pick people up.

During the participant observation, I had the opportunity to see the spatial mismatch[18] that this interviewee described, except from the perspective of an employee. To give you a sense of what some folks do every day in order to make the commute to St. Charles, a northwestern suburb of St. Louis and itself the 9th-largest city in Missouri, I'll give an outline of what I did for just four days. I left my apartment at 6:40am to make the over one-mile walk to what, at the time, was the nearest Metrolink light rail station to my apartment,[19] Grand Metrolink Station (I actually rode the entire route to St. Charles with another woman who got on at Grand Station each day). There, I boarded a Red Line train bound for Lambert Airport, rode for 20 minutes, and disembarked at the North Hanley Station (the last stop before the train enters airport terminals). I then waited about 10 minutes for the bus from St. Charles Area Transit (SCAT) to arrive in the loading area. The SCAT I-70 Commuter Service is not affiliated with Metro Transit and so requires a separate fare (50 cents, payable by cash, coins, or a 20-ride punch card). Furthermore, it runs only three times in the morning and three times in the evening for "reverse commuters" who work in St. Charles and live in St. Louis. In order to get to my job by 8:30am, I had to grab the SCAT bus that leaves at 7:34am. I did so, throwing my quarters into the fare collection bin at the front of the small bus and settling into the plush, if

[18] The term "spatial mismatch" refers to a much-studied disconnect between where workers live and where jobs are located, particularly for low-income black people who were (and continue to be) subject to housing discrimination and resulting segregation. As Ihlanfeldt (1994) explains it, "the suburbanization of jobs and involuntary housing market segregation have acted together to create a surplus of workers relative to the number of available jobs in inner-city neighborhoods where blacks are concentrated" (pp. 219).

[19] Since the opening of the Cortex Metrolink Station on July 31, 2018, the walk to Metrolink from my apartment on the edge of the Central West End and Midtown would be about half a mile, instead of the full mile walk to the Grand Metrolink Station.

somewhat run down, seats. From there, the ride to St. Charles took about 25 minutes, and I got off at the first stop at St. Joseph's Hospital complex; for others going to work at the nearby casinos, hotels, and convention centers, the commute took up to 20 minutes more. From my apartment door to hopping off the bus in St. Charles, this commute took about an hour and 20 minutes, and I was nearly 30 minutes early for work. The drive time in a car from my apartment to St. Charles, you ask? Around 30 minutes.

While every part of my commute to St. Charles was perfectly pleasant and on-time, taken together, the trip was lengthy and needlessly complex. SCAT doesn't even show up on Google Maps' transit directions, so I had to go to its website and read the timetable manually to figure out what Metrolink train I needed to take in order to be at North Hanley in time to catch the bus (and how much fare I needed). Certainly, the sheer scale of the suburbanized St. Louis metropolitan area is a daunting challenge for St. Louis' transit system to face, and there are some employment centers already served well by transit, but for both employers and car-less employees' sake, more rapid transit options are needed to remedy the sometimes stark spatial mismatch of jobs and job seekers. Not everyone can expend the time and energy that it takes to make an hour and 20 minute commute; others can't afford not to.

On the opposite end of the spectrum of those people who rely on transit service to get them to work in the suburbs or those who need a frequent route in order to do errands in a timely fashion are perhaps the harshest critics of the system: people who seldom ride Metrolink trains and Metrobus buses. Numerous survey respondents reported that they

didn't ride public transit because of concerns for their personal safety onboard. Many St. Louis residents harbor the perception that transit is rife with crime and think that security personnel at Metro do an incompetent job of dealing with the problem, particularly on the Metrolink trains. Metrolink is an open-access system where tickets are checked by roving officers instead of a turnstile system. Though there isn't systemic evidence about fare-jumping in St. Louis, critics say it's rampant and that most of the crime on the system is perpetrated by people who don't pay their fares (Schlinkmann, 2018c). One middle-class white resident of South City who "used to take Metrolink to baseball games" encapsulated her thoughts by saying, "There is no policing of riders. No turnstiles. No accountability." This resident was one of a few who articulated a belief that turnstiles, or some other barrier to entry to the light rail system, would be the remedy to crime issues. Many of the safety concerns I heard in conversations and in survey responses shared a didactic, alarmist tone. Coworkers at my internship, after expressing shock at the fact that I didn't own a car, felt at liberty to give me tips on where I should and shouldn't go on the bus and when I should and should not use it because "it can get sketchy." Notably, the vast majority of people I spoke with who expressed concerns about safety on transit were white folks with access to a personal vehicle, while the majority of public transit users in St. Louis are black- a distinction that is especially clear when riding the bus system.[20]

[20] In fact, there was only one non-white person who mentioned safety concerns in my survey. A man who identified as black, reported a household income of over $150,000, and said that he "never" uses transit commented that the system has a "Bad reputation of crime, very sad."

Frequent riders I spoke with usually acknowledged this perception of crime, and further noted that, especially for women alone, the system was not particularly safe at night (though this is true on or off public transit), but it wasn't a defining feature of their transit experiences. Of the 38 people I surveyed who took public transit in St. Louis at least monthly, only one of them voiced a major concern about safety: a retired white person whose reported household income exceeds $100,000 per year and who only uses the Metrolink light rail- purposefully never the buses- to commute to a part-time job a couple of times per week. This respondent didn't mention any times they personally had felt unsafe, but, rather, repeated the popular idea that alleged fare-evaders were behind the system's crime problem.

Over 22 weeks of living in St. Louis and mostly traveling alone, I never felt unsafe on public transit, either Metrolink or the buses. Most frequent riders I spoke with don't see safety as a major issue. The findings of an independent safety study commissioned by the EWG show that St. Louis' transit system does not have particularly high levels of crime and that the public perceives the issue to be worse than it really is (Schlinkmann, 2018c). The report found that the bigger problem on the system has been small infractions like eating, drinking, and playing loud music, rather than violent crimes or property crimes, and further, that there is little correlation between fare evasion and serious crime (Schlinkmann, 2018c). Yet, the reputation of transit as "dangerous" persists. As one 40-year-old lifelong resident of St. Louis put it, "There seems to be a stigma around buses - I can't say why but even growing up, I had the impression you

were supposed to avoid the bus at all cost." This perception of crime on the system has been propagated for years, and it shows no signs of stopping.

In all, though, people who regularly rode public transit in St. Louis expressed that it met their needs on a day-to-day basis reasonably well, even while their trips were complicated or made inconvenient by the variable cleanliness of buses and trains, infrequency of routes they used, and lack of routes near employment centers in the suburbs. St. Louis area residents who don't take transit, however, largely told me that the buses and trains are unsafe to ride and that crime is the biggest problem on the system. Interviews and survey responses clearly showed a disconnect in perceptions between those who ride transit regularly and those who do not.

Political Processes

St. Louis residents who believe transit is crime-ridden haven't whipped up the negative perception of public transit all on their own. Media and political organizations have propagated an implicitly racist narrative about the crime and security on Metrolink and Metrobus that has created a stigma around transit and imperiled its ability to get adequate funding. This may not be outright discrimination in the same vein as redlining, racially restrictive housing covenants, or destruction of minority neighborhoods for urban renewal, but modern implicit bias against black people in the United States manifests itself in narratives of black people as criminals (Jan, 2017). Hence, the media and government officials deem the predominantly-black public transit system "dangerous" for people to ride, even though the system statistically has the same amount of crime as any

other US transit system (Schlinkmann, 2018). Because modern, "aversive" racism is often unconscious, the negative feelings people experience are typically more diffuse, such as feelings of anxiety; this aligns well with the fear mongering around crime on transit in St. Louis (Dovidio et al, 2002).

The St. Louis Post-Dispatch, the only daily newspaper in St. Louis, has centered the issue of transit security in its reporting on the system, and it not only writes sensational headlines about crimes on the system, but also runs extended coverage in the aftermath of crimes, even profiling victims and covering sentencing for the perpetrators (*see Figure 7, below for examples*). The paper has run a number of Editorial Board articles on how to fix the Metrolink security problem, too. A recent article from December 11, 2018 is entitled, "Editorial: Ban on repeat violators is a good starting point to boost Metro security." Despite previous Post-Dispatch reporting on the preliminary findings of the EWG-commissioned security study showing that crime on St. Louis transit is not particularly high and fare evaders are not a special risk to safety, the Editorial does not mention these facts at all. Instead, the Editorial Board conflates fare

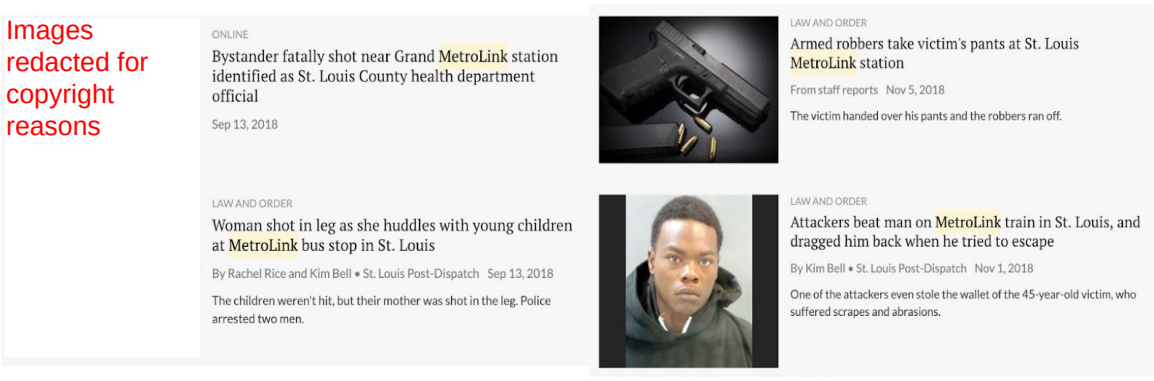


Figure 7

evasion and crime, saying, "...repeat violators have felt free to continue evading fares and committing crimes with little or no consequence." Without any cited evidence, the article also alleges that, "Lax security is without question the top concern of MetroLink riders," an assertion that this research has found to be dubious at best. The Editorial Board goes on to attribute falling ridership on the Metro system to security issues (again contradicting their own previous reporting, which said a variety of issues, including security perceptions, falling transit ridership around the country, stagnant population, and low gas prices were to blame; see Thorsen, 2018b).

When government officials feed into this narrative of security issues on transit, the stigma gains even further legitimacy. Taulby Roach, the recently-appointed head of Bi-State Development, which oversees Metro Transit, outlined his goals for his tenure in late 2018 by saying, "I have three priorities as your president and CEO and that is security, security and security" (Schlinkmann, 2018b). Jessica Mefford-Miller, the Executive Director of Metro Transit expressed a similar sentiment in a podcast interview with the Post-Dispatch in December by saying "...keeping our customers and our employees safe is our highest priority" (Thorsen, 2018a). Mefford-Miller went on to note that strengthening relationships with law enforcement and coordinating law enforcement's interactions with public safety officers, particularly in "hotspots" with both high crime and high ridership, are a couple of Metro's major initiatives to ensure rider and employee safety (Thorsen, 2018a). The issue here is not so much that influential transit planning officials like Roach and Mefford-Miller want to make sure that riders are

safe on Metrolink; that is a noble goal in and of itself. However, they don't push back on the premise that Metrolink is currently a dangerous, high-crime zone by citing the recent EWG-commissioned study or even by leaning on police statistics that have shown a sharp decrease in crime on the trains in the past year (Kohler, 2018; Hemphill, 2018). Their vigor in approaching this perceived crime problem only reinforces that it's a serious one (though they are in a bit of a Catch-22, where they would probably be criticized for not taking the problem seriously enough, too).

All told, though, the outcry about security on St. Louis public transit by individuals, media outlets, and transit officials has made it easier for suburban municipalities and county governments to justify starving Metro of an adequate operating budget, worsening the transit system's funding crisis. Since the so-called "Great Divorce" of 1876, when the city declared home rule and separated from St. Louis County, the two entities have had a fraught relationship, in no small part because of the race-based prejudice of people in of St. Louis County's richer and whiter municipalities (Hartmann, 2014; Bott, 2019). These are, after all, the same communities that promoted racially restrictive housing deed covenants in the post-World War II era so that black people from the city couldn't move there (Gordon, 2010). Though there has always been great diversity within St. Louis County's several dozen municipalities, and many are majority-black, those with anti-city sentiment have largely remained those with governmental power in the County to this day.

The most recent manifestation of city-county tensions has come in the form of a lack of police cooperation over Metrolink security and frustration with the crime on Metrolink in general. St. Louis County, St. Louis city, Metro Transit, and St. Clair County officials have been locked in a number of seemingly petty disputes over how the security operations should be carried out. Saying that cooperation among area police agencies had produced, "little if anything in terms of substantive results in respect to reduction of crime on Metro," despite lower crime numbers on the system in 2018, the St. Louis County Council withheld $5 million from Metro Transit for its 2019 operating budget until the agency could "show progress on fixing safety problems that are keeping riders away" (Kohler, 2018). This action shows that implications of the perception of the St. Louis transit system as dangerous go far beyond the individuals who propagate it. The stigma has and will continue to threaten the operating budget of the system, putting in jeopardy the already-precarious funding for transit service that thousands of people rely upon every day.

Recall that with the St. Louis biking system, the issue of metropolitan fragmentation and city-county clashes, as described above, played a role- but perhaps not the most central role- in limiting equitable planning. Rather, each stakeholder and planning organization in the bike planning process has its own mission and values apart from equity that make it difficult to make equity a major regional priority in the bike system. With public transportation, clashes between organizational missions and equity considerations aren't nearly as much a problem because Metro Transit very clearly

realizes that its main ridership base is low-income, captive riders who are reliant on transit. As one planner put it:

> We do, um, we look at where our transit-dependent populations are when we're planning our routes, and we try to invest more of our service in the areas with more people that are transit-dependent. And obviously that's partly...because that's the right thing to do, but partly...those are our riders. And we want to put our investment where we're actually going to get people riding. (Personal communication, July 26, 2018)

In other words, Metro's organizational best interest aligns with accessibility for its neediest riders, and this is especially true in a political climate where its services have been stigmatized in the eyes of so many potential "choice" riders.

With that said, overall funding tensions are the biggest barrier to a public transit system that serves as a true tool for social sustainability in St. Louis. This is true in as much as the aforementioned local city-county clashes, intensified by the stigma of transit as "dangerous," cause outlying counties and municipalities (as well as state funders) to pull back their support, but also because the federal funding mechanisms run counter to the sort of help that transit systems like St. Louis' actually need. That is, federal transit funding heavily privileges financing capital projects over everyday operating expenses. According to the Congressional Research Service, operating expenditures make up two-thirds of all costs for public transportation, but the federal government supports less than 10% of operating expenditures nationwide; meanwhile, capital expenditures make up one-third of all costs for public transportation, and the federal government supports more than 40% of capital expenditures (Mallett, 2018). At the end of the day, a new bus

or train project means little if the operating agency can't afford to purchase its fuel, hire its drivers and maintenance staff, or run it on a frequent basis. The idea behind the federal funding mechanism is that operating expenses should be within the jurisdiction of state and local funders, but the St. Louis transit system is in a particular bind because 1) as discussed, its service is highly stigmatized, limiting the possibilities for local funding, and 2) Missouri ranks 46th in the nation in terms of transit funding at the state level, with little indication that this will change with a conservative state legislature (Cella, 2018).

The major political and structural processes at play in helping us understand the accessibility and mobility conferred by the St. Louis public transit system, then, are the media- and government-propagated stigma of crime on transit, city-county clashes and the unwillingness of outlying municipalities to provide funding for transit service, and inadequate state and federal funding mechanisms for transit; all of these make it difficult for St. Louis' transit to improve its service for the captive riders who don't have access to a car and rely on buses and light rail to get from place to place.

Policy Recommendations

By synthesizing the scholarly literature, quantitatively analyzing proximity to infrastructure, listening to individual experiences, and further interrogating the political processes affecting public transit in St. Louis, this research has found that while St. Louis is doing an adequate job serving disadvantaged populations with public transportation, the system has significant room for improvement if it strives to help achieve urban social

sustainability. The policies that actors in the region can undertake fall into two major categories: service-related and funding-related.

On the service side, while a quantitative analysis revealed that there seems to be no systemic racial or economic disparities in which St. Louis neighborhoods have physical access to public transit (in fact, infrastructure allocation actually favors the poorer and less-white neighborhoods), individuals who use transit identified two major areas of concern: frequency and reach of service. Increased route frequency, for its part, was the most-mentioned policy change that riders said would improve their experiences with the system; people complimented the routes that are already frequent and wished that other routes came more often so that they wouldn't have to wait around after appointments or errands and could be more flexible in their planning. The transit system's reach, and how quickly people can travel between the suburbs and the central city for jobs, shopping, and the like, was another major issue among transit riders. Neither suburban businesses or city residents who are reverse commuters are being served very well by the transit system at the moment; the system is reliable and can get people to their jobs, but getting them there in a timely fashion is a struggle. There were people interviewed for this project, choice riders, who have a desire to ride the system more, but they just can't justify using transit for shorter trips because of the routes' low frequency at off-peak times or the fact that the buses don't run near their suburban homes. This indicates that these service improvements to frequency and reach would

likely help to attract ridership along with serving captive riders, as scholars like Giuliano (2005) and English (2018) suggest.

Fortunately, Metro Transit is already planning to implement some serious changes to route frequency and efficient service to the suburbs on the system through its Metro Reimagined realignment plan, which has been revised a couple of times after public pushback and is in the final stages of receiving public comment on the revised draft. Because this new plan operates on the same limited budget, it does cut or modify a couple of low-ridership local routes, but the plan is expected to add 12 more high frequency routes that operate at an every 15-minute-or-quicker frequency during the day (there was only one previously) and ensure that the vast majority of its local routes run every 30 minutes, instead of the 40 minute or 60 minute wait times for many of the current bus routes ("Schedules & Route Maps," 2019). Metro Reimagined also attempts to increase the efficiency and timeliness of transit service to and from the suburbs, adding and modifying their express routes based on riders' feedback and ridership numbers, but because this realignment plan is working within Metro's existing budget, it cannot promise to provide the amount of extra service that would be needed in order to adequately serve some outlying suburban employment centers.

The budgetary constraint of the Metro Transit system in St. Louis is the biggest factor holding back its ability to serve disadvantaged populations; the dearth of funding stems from the stigma-fueled reluctance of local municipalities to fund operating expenses, as well as the federal government's transportation funding policy that

privileges capital expenditures over operating expenditures. To combat these issues and obtain more secure funding for the transit service that captive riders deserve, Metro should first focus on a public media campaign to combat the stigma that labels the transit system as ridden with crime by citing new data on how statistically safe the system is, as well as providing positive testimonials from riders to try to break up the constant negative headlines. Research has suggested that attitudes toward public transit and perceptions of safety affect people's mode choice independent of their physical access to transit (Spears, Houston, & Boarnet, 2013), so a media campaign is a vital companion to the improved service under the Metro Reimagined plan if Metro wants to start making a comeback in terms of ridership.

Besides reducing the stigma, a media campaign that produces improved ridership numbers would likely also help sway municipal officials and voters into supporting transit. In addition, it would be a good idea to get the business community in suburban locales more involved in lobbying their suburban representatives for more timely transit service so that they can attract low-income, car-less workers to their job sites. If the past is prologue, the business community would be in a far better position to sway suburban municipal lawmakers than transit-dependent riders from the city (Greenblatt, 2015).

Finally, regional planning partners, led by EWG, which is the federally designated MPO for the region and handles applications for federal funding, should lobby for a change in the federal transit funding mechanism so that metropolitan transit systems are able to receive more operating funds- or at least, funds that don't have to be tied to a

specific capital project- from the federal government. This would be a reliable source of funding that would ease the burden of looking for operating funds from different places and worrying about being able to keep up the current level of service that so many people rely upon.

Chapter 4: Walking in St. Louis

Though walking is a relatively time-consuming form of transportation and requires an able body, it is also the most foundational way that humans can get from one place to another. Walking doesn't require any equipment, charge a fee, or operate on a fixed schedule. These attributes mean that walking can be a flexible and zero-cost mobility option for low-income and car-less populations, but the conversations around the accessibility and mobility of walking in the scholarly community largely do not consider walking a primary form of mobility. There is an implicit consensus that walking is not and cannot be the only way people travel in today's sprawling cities.

Instead of focusing on walking mobility in its most basic sense, then, scholars have tended to focus on walking as a determinant of community health, studying its benefits for obesity reduction (particularly among children) and old-age mobility and longevity (Mitra, Buliung, & Faulkner, 2010; Simonsick et al, 2005; Riggs & Gilderbloom, 2016; Creatore et al, 2016). They also focus on walking as a way in which people connect with public transit and rail lines (Wibowo & Olszewski, 2005; Garcia-Palomares, Gutierrez, & Cardozo, 2013). Besides the health and multimodal benefits, there is also a recognition among academics that by making a neighborhood more "walkable" by building higher-density dwellings, more retail establishments, higher-quality and wider sidewalks, and more greenery, a neighborhood can attract higher property values (Immergluck & Balan, 2018). This gentrification displaces

current, lower-income residents and possibly even inflates the extent to which walkable built environments confer health benefits (Riggs & Gilderbloom 2016).

In accordance with the scholarly literature's assumption that walking is few, if anyone's, only mode of transportation, in a notoriously spread-out metropolitan region like St. Louis, it's likely that not every single need can be met by walking. When jobs, appointments, or errands are located in the suburbs or even across town, these places are simply not accessible without access to a car, bus, light rail, a bike, or an unreasonable time commitment. That said, within the City of St. Louis, the street system is gridded and compact with short blocks. Most streets have sidewalks, though they vary in quality. Property owners are required to keep their sidewalks in passable conditions themselves, though the city operates a 50-50 sidewalk cost sharing program, wherein the City of St. Louis will pay half the costs for sidewalk repair if the owner is in good standing on their property taxes and the requests from an individual ward have not yet exceeded that ward's allocated dollars for the year ("50-50 Sidewalk Program," 2019). Beyond pure sidewalk infrastructure, the City of St. Louis has, after an abysmal year for pedestrian deaths in 2015, made attempts to make the crosswalks at intersections safer to use by adding more visible paint on the roads, flashing lights at selected intersections, and special walk lights where pedestrians get a five-second head start before cars get a green light (Schlinkmann, 2018e).

Physical Infrastructure and Proximity

With these contextual features of the St. Louis pedestrian system in mind, this section of the chapter aims to figure out how walking in St. Louis provides physical mobility and accessibility to disadvantaged populations. To do this, it first explains the concept of a Walk Score- similar to the Bike Score and Transit Score mentioned in the previous chapters- as a way of quantifying an area's "walkability." Then, it statistically analyzes Walk Scores by the income and racial makeup of St. Louis neighborhoods, and, finally, it interrogates Walk Scores by neighborhood from a spatial lens by testing for clustering patterns.

Walk Score was the original tool developed by the Walk Score company to help quantify the walkability of a property for the use of real estate professionals, home buyers and renters, and urban planners alike ("About Walk Score," 2018). For the creators of the Walk Score, walkability includes the distance to nearby amenities by foot, population density, and road metrics, like block length and intersection density, that can affect the ease of walking trips in much the same way as sheer distance ("Walk Score Methodology," 2018).[21] The key difference in the approach of the Walk Score versus the Transit Score and Bike Score developed by the same company is that Walk Score explicitly takes into account nearby amenities by calculating scores for 7 equally-weighted categories: Dining & Drinking, Groceries, Shopping, Errands, Parks, Schools, and Culture & Entertainment ("Score Details," 2018). Walk Score's algorithm

[21] Read more about the methodology on Walk Score's website at: https://www.walkscore.com/methodology.shtml.

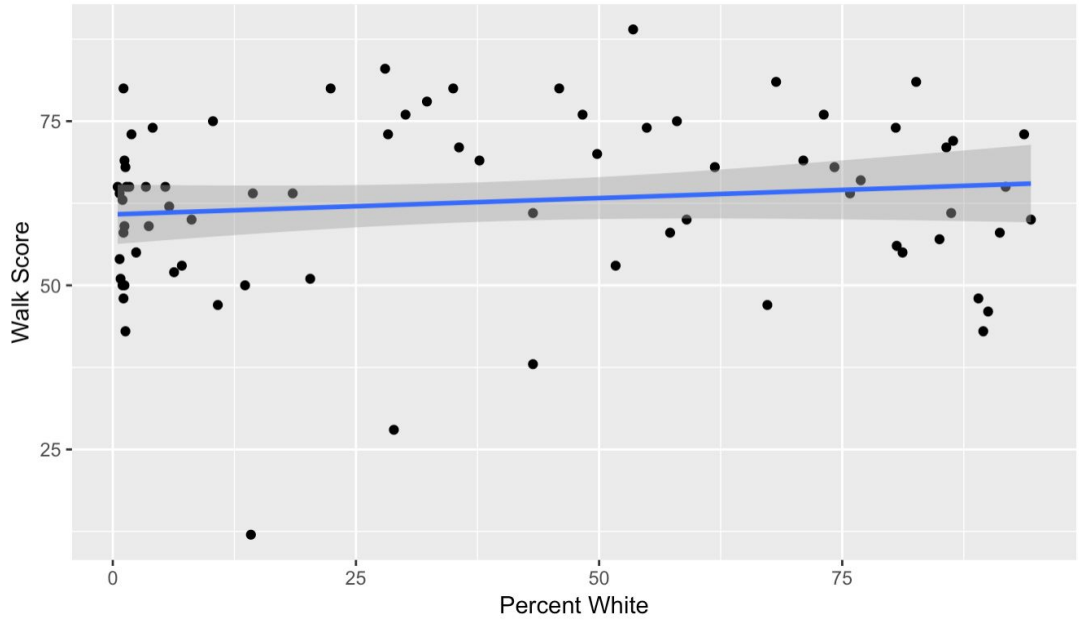
includes amenities found via Google, Education.com, Open Street Map, the U.S. Census, Localeze, and places added by the Walk Score user community that are new, or for one reason or another had not yet shown up on the Walk Score map ("Walk Score Methodology," 2018). Though Walk Score was certainly invented with property developers and real estate interests in mind, its calculation takes all amenities into account in the same way, whether they tend to cater to higher- or lower-income clientele. A place with an Aldi and a BP gas station nearby can be rated similarly to one with a Whole Foods and a luxury home goods boutique, for example. This provides evidence that Walk Score as a metric can represent the mobility needs of people from a variety of backgrounds, even if some of the stakeholders for which it was created have a financial interest in selling real estate and raising property values in an area.

To explore physical accessibility of disadvantaged populations to walking mobility, one can first consider how Walk Scores are distributed across neighborhoods that have varying percentages of their populations who identify as white, as black folks have been historically marginalized from economic opportunity and are more likely to live in zero-car households in St. Louis (EWG, 2015). With biking, signs of disparities in access to infrastructure were present from the initial test of correlation between the Bike Score and racial composition of neighborhoods. With Transit Score, on the other hand, there were not disparities present, and people living in lower-income, less-white neighborhoods actually had marginally better access to public transit (at a statistically significant level) than their wealthier and whiter peers. I was interested to see if

walkability- as it has some of the same gentrification-related connotations as biking does but is also seen as an inherently *public* activity, like riding public transit- followed either of the two previous trends.

I first ran a Kendall's tau correlation test to explore the relationship between the percentage white in a neighborhood and its Walk Score. Kendall's tau is appropriate for this case because the dataset on percentage white by neighborhood does not follow a normal distribution. Therefore, the data does not meet the assumptions for parametric tests like the Pearson's correlation. The results for the Kendall's tau test for correlation showed that there was no significant correlation between a neighborhood's percentage white population and its Walk Score. The correlation coefficient was very small and positive (.08). With a p-value of .306, there is a more than 30% chance that the

Figure 8: Walk Score by Percent White Population in St. Louis Neighborhoods



association observed is due to random variation, so we do not have enough evidence to say that any true correlation exists. The graph of the situation only further underscores this conclusion, as the visible trend line is almost completely horizontal, and the neighborhood points largely vary from Walk Scores of approximately 40 to 80, no matter the neighborhood's level of white population (*see Figure 8, above*).[22]

Next, examining Walk Scores in relation to the median household income in a neighborhood helps capture the physical accessibility of walking mobility for those most in need of it economically, especially because as low-income people are least able to afford a car or pay the maintenance fees for a broken car (Lutz, 2014). The Kendall's tau test of correlation was a better fit for this situation, too, because median household income by neighborhood doesn't follow a normal distribution, either, and a nonparametric test was necessary. The Wydown-Skinker neighborhood, an outlier that has a median household income nearly $40,000 higher than any other neighborhood in the City of St. Louis, was removed from the dataset before the final analysis of the relationship; it disproportionately affected the significance of some tests but not others (for example, it was more confounding in the Bike Score analysis), so I left it out in order to keep my methods consistent across transportation modes.

The Kendall's tau test of correlation between a neighborhood's Walk Scores and its median household income found no significant correlation between the two variables.

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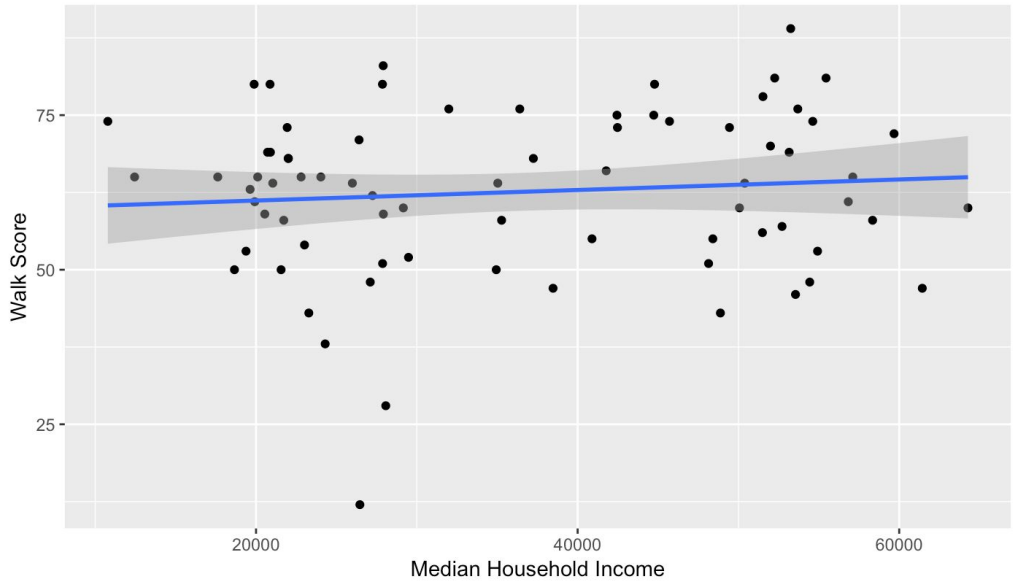
[22] The outlier point on the lower left of *Figure 8* with a Walk Score of 12 is the North Riverfront neighborhood. Most of the neighborhood's area is filled with industrial land uses like manufacturing and heavy freight transportation, and this land use pattern accounts for its particularly low Walk Score. Notice this point on *Figure 9* as well.

The correlation coefficient was, like the previous coefficient with percent white population and Walk Score, very small and positive (.0291), but with a large p-value of

Figure 9: Walk Score by Median Household Income in St. Louis Neighborhoods

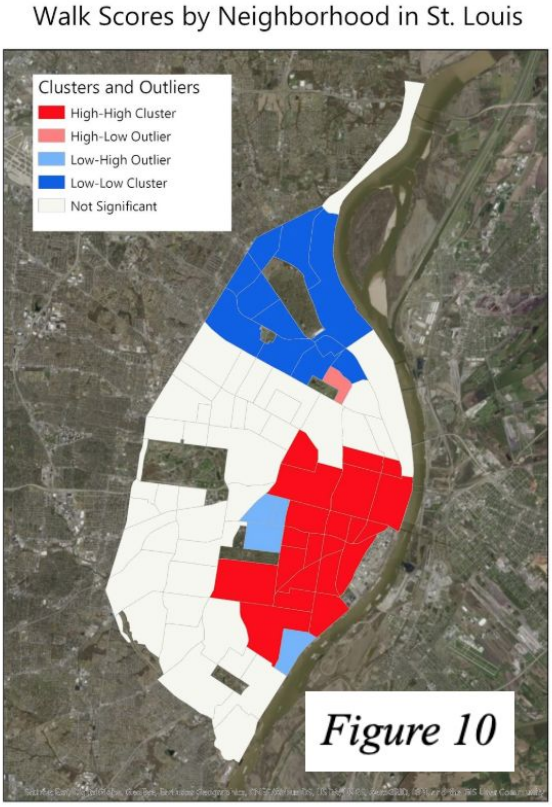


.7142, there is a more than 70% chance that the association observed is due to random variation, so we do not have enough evidence to say that the correlation is statistically different from zero. The graph of the situation (*see Figure 9, above)* bears out this finding, as there is a great deal of variation in Walk Scores across income levels, and no strong visual trend is apparent.

These statistical findings that Walk Score has no significant correlation with a neighborhood's median household income or its percent white population led me to believe that underserved populations' accessibility and mobility within the St. Louis pedestrian system may follow some of the same spatial patterns as public transit, with clusters of accessible areas in the central corridor, and low-Walk Score clusters on the far

North and South extremities of the city (as opposed to Bike Score's neighborhood level disparities that run along race and class lines). The lack of correlation also signals that better pedestrian accessibility and mobility may not be a major gentrifying force in St. Louis, meaning that the city has so far avoided a major problem that scholars have identified in other American cities. With these hypotheses in mind, I ran an Anselin Local Moran's I in ArcGIS Pro to find out more.

This analysis (*see Figure 10, below; see Appendix 1 for labeled reference map of St. Louis neighborhoods*), showed that Walk Scores follow an entirely different pattern from either Bike Scores or Transit Scores in St. Louis. While there is a low-low cluster of values in the same far North St. Louis region where there was also a low-low cluster of transit service, this is not surprising given that the area is known broadly for its industrial land uses that are often not compatible with pedestrian-friendly infrastructure. A high-high cluster of Walk Scores appears in the central-eastern and south-eastern neighborhoods of St. Louis (including a couple of neighborhoods considered to be in



North City), which also makes intuitive sense to those familiar with the city because these neighborhoods are older areas of the city with gridded streets and mixed residential, retail, restaurant, and commercial uses throughout and are therefore well-endowed for walking. Interestingly, these neighborhoods in the high-high cluster are extremely diverse in terms of racial makeup and median income, corroborating the idea that there is little to no relationship between the privilege of a neighborhood and its walkability in St. Louis.

Individual Experiences

There seem to be few racial and income disparities with regard to physical proximity to the pedestrian-friendly environments that Walk Score quantifies: amenities nearby, number of crosswalks, and block length. Residents concurred that these physical features were important for walking mobility, and, further, emphasized that St. Louis was "built to a human scale" as an old, gridded city. However, survey respondents and interviewees who walk on a daily basis in St. Louis said that these numbers leave out key parts of the experience of getting around by foot in the city (*see Appendix 3 for demographic information on survey respondents*). The varying quality of the sidewalks in St. Louis, concerns about violent crime in some neighborhoods, and the safety and logistical concerns that come with walking in car-dominated environments affect the lived experiences of pedestrian accessibility and mobility for underserved populations just as much, if not more, than people's physical proximity to desired destinations. These factors can acutely impact the level of mobility that people have in even the neighborhoods that have the highest Walk Scores in the city.

First of all, the most common observation that the Walk Score might miss but residents told me time and time again is that the quality of the sidewalks in St. Louis varies widely depending on where you go. A white South City resident, for example, reported that sidewalks are "patchy" in areas, while several other respondents saw the opportunities for walking as "dependent upon where you live," or "where you need to go." A black South County resident summed up the views of numerous others on St. Louis' pedestrian infrastructure when he remarked, "we still have a long way to go when it comes to duplicating the same type of models everywhere." I experienced this firsthand during the participant observation component of this research. Some places have wide pavers and well-manicured pavement that seems like it was poured yesterday, while other places, sometimes just a few blocks away, have cracking, uneven pavement with grass growing in the middle and pieces chipping off. *Figure 11, below* (photos taken by author, June 3, 2018) shows an example of this phenomenon in Grand Center, a neighborhood

Figure 11: Photos of sidewalk conditions on Grandel Square, just west of Grand Boulevard

that is known for its theater district and has the 5th-highest Walk Score in the city. Just a block to the west of a new, highly manicured park and pedestrian plaza on the corner of Grand Boulevard and Grandel Square lies an area with torn-up sidewalks that have gravel filling their large cracks along with weeds large enough to be tripping hazards. At one point, the sidewalk narrows to such an extent that any pedestrians would have to squeeze past the parking pay station to get through (*see Figure 11, photograph to the far right*).

This area is not anomalous, either. Off of main thoroughfares, especially as you head toward the lower-income North Side of St. Louis city, the sidewalks can become quite suddenly impassable for anyone people with physical mobility issues using a cane, walker, or wheelchair to get around, or even for families with strollers. St. Louis city mandates that individual property owners take care of their own sidewalks but has few funds to enforce its policy across the city. At the same time, the City of St. Louis estimates, as of mid-2018, that vacant lots and buildings constitute about 1 in 5 properties within the city limits (O'Dea & Barker, 2018). The same negligent homeowners and (especially) absentee landlords who have contributed to St. Louis' epidemic of vacant, dilapidated homes and lots leave the sidewalks in front of their properties to entirely grow over with grass or otherwise fall into disrepair with no consequences, and the city's Land Reutilization Authority (LRA) struggles to keep up with sidewalk maintenance at the approximately 10,000 vacant properties under its ownership, too (Walker, 2018). This creates the "patchy" system of sidewalks that residents observe and that people who live

in those mostly lower-income neighborhoods where vacancies are clustered have to live with every day ("STL Vacant Properties Portal Map," 2018).

Another facet of the experience of walking in St. Louis that Walk Score cannot capture is that violent crime in certain neighborhoods can prevent people from enjoying their neighborhood's walkability to its fullest extent. St. Louis city has, over the past several years, consistently reported one of the highest violent crime rates of any city in the country, and that has an effect, both real and perceived, on people's freedom of movement in their neighborhoods (Danielson, 2018). Though violent crime rates are down from a historic high in 2017 and vary considerably by neighborhood, in the second half of 2018, every single neighborhood that lies north of Delmar Boulevard (the colloquially-considered "dividing line" between North and South St. Louis) has a violent crime rate at least twice as high as the most recently reported national average (Renaud & Buchanan, 2018; Federal Bureau of Investigation, 2018).

One city resident of Native American descent reported taking the bus because it is "more safe" than her other options as a person without access to a car, even though there are sidewalks in her neighborhood. Another city dweller, an elderly black resident of the North Side's St. Louis Place neighborhood, when asked about the ease of getting around her neighborhood without a car, reported that there is "danger in my neighborhood, especially for women alone," and, further, that her neighborhood has many opportunities to bike and walk, but she has to be careful because of her "family ties." The fear of

violence on the streets has prevented this woman from taking full advantage of the pedestrian infrastructure that she sees around her.

In St. Louis, as around the country, violent crime consistently plagues places that have lower median incomes and are historically marginalized, meaning that the people for which this disconnect between walking opportunities and the safety of walking has the most serious implications are the already underserved communities that have the highest levels of zero-car households. Whether people walking down the street are routinely targeted by violent criminals or not, studies show that people's perceptions of safety can affect how much they actually can walk for mobility and their positive or negative perceptions of walking as a mode of transportation; the built environment, perceived safety, and walking behavior are interconnected (Hong & Chen, 2014). Making basic safety provisions, like lighting and repairs on sidewalks and walking paths could make a tangible difference in disadvantaged communities' freedom of movement by foot. Jim Uttley, Aleksandra Liachenko Monteiro, and Steve Fotios (2018), for example, found that while there is conflicting evidence as to whether more street lighting reduces crime in an area, improved lighting certainly boosts residents' comfort with walking in an area at night, and these feelings of comfort are key for facilitating mobility in people who don't have access to a car.

Notably, I did not hear about this same sort of disconnect between a lack of walking safety and a plethora nearby pedestrian infrastructure from any white survey respondents or interviewees. White, and particularly wealthy white St. Louisans seemed,

by and large, to either enjoy the walkable amenities near their homes (e.g., grocery stores, gyms, parks, and restaurants) or begrudge the fact that their neighborhoods were not pedestrian friendly simply on the merits of the infrastructure.

These safety and logistical concerns that accompany a car-centric built environment were shared by survey respondents across all walks of life, regardless of race, income, or age, and they mirror some of the concerns cited by bicyclists in the city. Residents' infrastructural safety concerns mostly revolved around the ignorance or unkindness of automobile drivers. With walking, as with biking, respondents repeatedly used the word "hostile" to describe St. Louis' drivers, and they suggested that St. Louis drivers don't have the education and tools necessary to handle increased pedestrian traffic. One resident shared an anecdote about almost getting hit by a car while crossing the street at a light, while another noted that broadly, drivers "don't pay attention to pedestrians in [the] crosswalk," and yet another went as far as to say that "crosswalks are completely ignored by most motorists." As a pedestrian in St. Louis, I routinely saw people walking in intersections get beeped at by cars attempting to turn right (even though the walk sign on the stoplight was on), and myself was beeped at least a couple times per week.

Relatedly, residents criticized the lack of obvious intersections or easy pedestrian access to places in general (even if those places are nearby and it would seem on a map as if they're walkable), both because they pose an extra safety risk and make pedestrian trips unnecessarily laborious. I experienced this at one intersection in the North County suburb

of Florissant, where the crosswalk infrastructure was such that I had to cross the street three separate times in order to reach my destination that appeared to be directly across the street. A resident of the Central West End described a similar experience trying to walk to the pharmacy, a Walgreen's, in his neighborhood, where pedestrian access is fenced off from three sides, and the driveway opening for cars serves as the only access point. As he put it, "...that's something that you see sort of again and again where...small things really impede pedestrian connectivity." He suggested that it wouldn't be so difficult or expensive for businesses or planning agencies to facilitate pedestrian entrances through fence gates or simple openings to avoid this burden to pedestrian visitors, but that he seldom if ever sees these fixes in St. Louis.

In all, the pedestrian experiences of St. Louisans tend to vary considerably from what can be measured by a metric like the Walk Score, as the attributes of the pedestrian experience most commonly mentioned by residents were poor sidewalk quality, fears of crime, and concerns about hostile drivers and physical barriers to theoretically nearby amenities. Underneath the lack of statistical disparity in Walk Scores by income and race lies an inequity in walking mobility driven by the low-quality sidewalks in front of vacant properties that are clustered in low-income, predominantly-black neighborhoods and the safety fears while walking in neighborhoods with high violent crime rates.

Political Processes

From the perspective of political processes, there are three major factors that have shaped walking accessibility and mobility for St. Louis' disadvantaged populations:

1) long-standing exclusionary urban design, like private streets, that has purposefully limited mobility for low-income and non-white populations, 2) the fundamental lack of funding for city services like sidewalk upkeep enforcement because of a shrinking population and tax base, and 3) a lack of willingness from planners and government officials to use the political capital necessary to take responsibility for significant improvements to pedestrian accessibility and safety. These factors emerged as most salient from interviews with urban planners, participant observations while traveling around the city on foot, and insights from local reporters and scholars who have studied the longstanding politics and policies of St. Louis.

First off, the City of St. Louis has a history of planning its street system in a way that discourages disadvantaged populations from walking in and around privileged spaces. This trend began when private streets cropped up in wealthy neighborhoods in the 1870s. Essentially, homeowners added gates and signs (i.e., "Private Street") at the entrances to their streets full of huge mansion homes. These private streets persist to this day, and they laid the groundwork for a broader trend in St. Louis transportation planning of closing off streets from one another with concrete balls and "Schoemehl pots" (concrete planters or sewer pipes) named for the former city mayor Vincent Schoemehl, who instituted 104 of the barriers while he was in office from 1981-1993 (*see Figure 12 below for barrier examples*; Thorsen, 2015; Allen, 2014).

Oscar Newman, the Washington University professor who provided a theoretical justification for these barriers and recommended them to the city, found direct inspiration

Redacted for copyright reasons

Figure 12: *Street barriers in South City (left) and North City (right)*

from private streets, with an almost too evident desire to keep "undesirable" people from coming to the neighborhoods where the barriers were to be erected. Of the private streets, he said:

> The residents owned and controlled their own streets, and although anyone was free to drive or walk them (they had no guard booths), one knew that one was intruding into a private world and that one's actions were under constant observation. Why, I asked, could not this model be used to stabilize the adjacent working and middle-class neighborhoods that were undergoing massive decline and abandonment? (Allen, 2014)

This feeling of "intruding" or being under "constant observation" reveals the distinct politics around who feels safe or comfortable or welcome to walk on streets that are closed off by barriers, and the idea that barriers could "stabilize" a neighborhood further hints at the idea that making outsiders (particularly outsiders who are marginalized racial minorities, homeless, or low-income) feel like intruders on these streets is intentional (Allen, 2014). These barriers, then, pose a broad obstruction, literally and metaphorically, for disadvantaged populations to move around the city freely by foot.

Apart from the systematic physical exclusivity of St. Louis streets (particularly for disadvantaged groups), stands the basic fact of lack of funding for quality pedestrian infrastructure in the city. Because the main institutional funding and enforcement functions for sidewalk repairs are carried out by the city government- through its mandate that property owners keep up their sidewalks, the related 50-50 sidewalk repair program, and the LRA, which is city-owned and controls thousands of vacant properties with sidewalks- the burden for keeping the St. Louis pedestrian system in quality condition falls directly upon the city and its notoriously limited budget.

The city proper of St. Louis has been on a steady decline in the post-WWII era; from 1950-1970, close to 60% of its white population fled to the suburbs, while minority populations were excluded and stayed in the city because of racial steering by real estate agents, federal government redlining policies, and racial deed covenants that prohibited people from selling their homes to non-white people (Gordon, 2010). Then, to add insult to injury, from 1970-2010, the city lost just over half of its population, falling from 622,000 to 319,000 inhabitants (Gordon, 2010). The resulting loss of tax revenue has put serious tension on the ability of the city to provide public services at a time when its increasingly low-income and racially marginalized citizens need more of them; just in fiscal year 2019, the city had to make more than $5 million in cuts to address a budget shortfall (Bott, 2018). For the purpose of walking mobility, this means that city officials struggle to allocate sufficient funds for the 50-50 sidewalk program (there is often a

waitlist in needy wards), enforce the requirement that owners maintain their properties' sidewalks, and keep up the sidewalks in front of all LRA-owned properties.

What's more, there is a stark disparity in terms of which communities have the capacity and resources to lobby for their piece of these limited funds. I saw this disparity while attending community meetings throughout the City of St. Louis and monitoring neighborhood social media pages.[23] Neighborhoods with a significant wealthy white population tended to have their city councilperson or city-appointed neighborhood improvement specialists in attendance at their meetings, and residents grilled these representatives on everything from trash pickup to crime and beyond, both in person and online.

Meanwhile, neighborhoods without that vocal bourgeois cohort seemed to focus more on outreach events in local parks and information sessions on topics like home improvement grants and elderly services instead of expending quite so much time and energy on local politics; in my experience, the social media presences of these predominantly-black and lower-income community groups were much less active (and mostly focused on community-building where there was social media activity). Because many low-income residents' time was preciously limited by the number of hours they

[23] I attended the West Pine-Laclede Neighborhood Association meeting on 6/12/2018, the Tower Grove Heights Neighborhood Association meeting on 6/26/2018, the North Newstead Association home repair meeting on 7/25/2018, and the Fox Park Neighborhood Association meeting on 7/26/2018. I followed dozens of community Facebook pages, including the "Lindenwood Park Neighborhood in St. Louis" page, the "Gate District East" page, the "Debaliviere Place" page, the "Fox Park Neighborhood" page, the "Boulevard Heights Neighborhood, St. Louis" page, the "Kingsway East Neighborhood" page, the "Fairground Neighborhood Revitalization Organization" page, the "Clayton-Tamm Community Organization" page, the "Hamilton Heights Neighborhood Organization, Inc" page, and the "McKinley Heights Neighborhood" page.

worked, I got the sense from leaders of community groups in less-advantaged neighborhoods that they only wanted to take up their residents' time with events to help them take advantage of services for which they qualify or that might strengthen the community writ large (e.g.,"Take Back the Park" events aimed at keeping community spaces free of crime). The residents and the leaders alike didn't have much more capacity than that. They had more pressing, visceral needs than the continual neglect of city upkeep. This put lower-income neighborhoods at a relative disadvantage to the wealthier neighborhoods in terms of their ability to lobby for the allocation of city funds and worsened the already-existing divide between rich and poor neighborhoods' pedestrian infrastructure.

To make matters trickier yet, in the press releases and public positions of city officials, walking and pedestrian safety have been highlighted as clear problems, but the Street Department puts some blame on pedestrians being irresponsible jaywalkers instead of placing the blame solely on intersection design or driver awareness/education. Intersections are undoubtedly considered an issue, and the folks at the Street Department are adding, as previously mentioned, more visible crosswalks and pedestrian-friendly signals, but they still don't take the burden completely off the pedestrian. David Prytherch (2019) explains how this phenomenon manifests nationwide through right-of-way policies that privilege cars by noting:

> Human beings in motor vehicles are entitled to broad rights to mobility along the roadway, and their obligations to yield and show duty of care to others is limited to

> subspaces like crosswalks. Pedestrians and bicyclists have preferential rights to limited subsets of the roadway, but often such sidewalks and crosswalks and bike lanes are not present. And even within them they must assume continuous care of duty for their own safety. (pp. 75)

Planners in St. Louis, in line with this sort of differential right-of way policy, focus particularly on the care of duty that pedestrians assume by walking, even while they claim to want to improve safety outcomes by improving infrastructure. Overall, walking appears to be second-class issue for St. Louis transportation planners at this point. No planners would say this outright in my interviews with them, but there are no major pedestrian initiatives in the works that are analogous to the new Cortex Station on Metrolink, the Metro Reimagined plan, dockless bike share, or the Chouteau Greenway project (which pedestrians will be able to use, but is mostly discussed in terms of its implications for the bike system and directly parallels a stretch of the city that already has quality sidewalks).

Policy Recommendations

By synthesizing the scholarly literature, quantitatively analyzing proximity to infrastructure, listening to individual experiences, and further interrogating the political processes affecting walking in St. Louis, this research has found that while there is no evidence of a correlation between a neighborhood's Walk Score and its percentage white population or median household income, the Walk Score metric leaves out key aspects of citizens' walking experiences and the political processes that shape walking in St. Louis.

On paper, St. Louis' walking system has great potential for equity across advantaged and disadvantaged neighborhoods because of these comparable Walk Scores and physically proximate amenities. However, the reality of cracked, grown-over, and uneven sidewalks in low-income and high-vacancy neighborhoods, a reported fear of crime while walking in historically disadvantaged, notoriously high-crime neighborhoods, and the safety and logistical concerns that come with a car-centric built environment show that people who live in less privileged neighborhoods in St. Louis actually cannot enjoy the same pedestrian experiences as people who live in wealthy and privileged neighborhoods, even if those neighborhoods would be awarded the same level of "walkability" as defined by Walk Score. This disconnect between the physical proximity of pedestrian amenities and the on-the-ground mobility for disadvantaged populations is only compounded by the past and present political processes in St. Louis that have 1) facilitated the creation of a host of private and semi-private, barricaded streets that interrupt the street grid and make pedestrians feel like intruders in a neighborhood, 2) placed very little overall planning/government emphasis on improving the pedestrian experience and pedestrian infrastructure in St. Louis, and 3) starved the center city of the requisite resources to provide enforcement and upkeep of sidewalks (and allowed a system wherein vocal wealthy communities can more easily advocate for their share of these limited resources). With that said, there are a few major policies that I believe would help facilitate the accessibility and mobility of the St. Louis walking system for disadvantaged communities. These policy recommendations can be sorted into

camps that align with the above issues- private streets, a lack of urban planning emphasis on pedestrian infrastructure, and budget shortfalls that make sidewalk upkeep prohibitive.

First, in terms of private streets, planners can make some relatively simple and low-cost improvements that would make the pedestrian grid more open. In the short term, planners can remove the relatively recently-erected concrete balls and planters that serve as conceptual and physical barriers to a connected walking system, and they can commit to not erecting more in the future. In the long term, they can work to outlaw the private streets that inspired these barriers in the first place. This could be a tougher task because most of these private streets are controlled by wealthy homeowners who would be reluctant to take down their gates and bring street maintenance back into the city government's control, but it is a worthy endeavor nonetheless.

Second, the work of placing more emphasis on pedestrian infrastructure and combating the emphasis on car safety and car traffic can begin by continuing the policies that planners implemented in the wake of a high number of pedestrian deaths in 2015: making crosswalks more prominent with fluorescent paint, adding flashing yellow lights to signal to drivers that a pedestrian crosswalk exists, and creating a media campaign to make drivers more aware of pedestrians and their rights at intersections. It also could include incentivizing local businesses to make their properties more pedestrian accessible to remedy residents' troubles with the logistic side of a car-centric built environment. For example, the City of St. Louis will provide and install city logo-branded bike racks for businesses upon request (for a fee), and the city could provide a similar service to

facilitate more pedestrian entrances (e.g., by providing city branded fence openings and gates).

On a broader procedural level, planners must stop blaming pedestrians for their own safety woes and instead take this up as an issue just as important as driver safety, which, according to planners I spoke with, is of utmost importance. In order to do this, planners will need to take walking seriously as a sorely needed form of mobility in its own right (and plan for it as more than an afterthought, a form of recreation, or a complement to biking or public transit). This could be a significant culture change within the planning institutions that have for years focused on the needs of cars and their drivers, but it could pay dividends for the walking mobility of everyday St. Louisans that has been neglected in favor of popular or flashy projects like the new Cortex light rail station, the Forest Park trolley, or even the Chouteau Greenway.

Third, policy must work to address the lack of consistent, quality pavement for sidewalks across the city, which poses both logistical and safety issues for residents. With the city's severe yearly budgeting shortfalls that compound the epidemic of vacant plots and houses with little to no enforcement of sidewalk quality policies (or even consistent enough funding to keep up sidewalks on the thousands of properties owned by the LRA), a new source of dedicated funding for sidewalk repair (to increase the allocation for the 50-50 program for example, and increase the number of city workers dedicated to enforcing current policies) is needed. This funding could come by way of a new city

property tax, which would appropriately charge the people who are supposed to be responsible for sidewalk repair for the burden that it puts on the city finances.

Intimately related to the lack of consistent pavement and historic disinvestment in certain areas of St. Louis, particularly on the North Side, are worries about crime that hinder people from using the city's pedestrian infrastructure to its fullest extent. While breaking the underlying cycle of poverty and crime is a noble goal, there are some simpler fixes that can improve citizens' safety while walking. With transit, the perceived concerns about crime could be assuaged by the statistical data and the recent consulting study showing much less crime than citizens perceive, but because in many St. Louis neighborhoods, the threat of violent crime is startlingly real, changes in media outreach are likely not enough. The same sorts of improvements that we might suggest to help remedy some of the safety concerns about walking mobility in car-centric environments could also hold true for discouraging crime, like consistent lighting for paths at night and better quality, wider sidewalks, particularly on places like freeway overpasses and high-automobile-traffic intersections.

Chapter 5: Conclusion

In this analysis, the synthesis of three scholarly approaches- the quantitative, proximity-focused mindset of engineers and city planners, a lens centered around individual experiences, and the structural perspective of historians and political scientists that concentrates on political processes- has produced novel, policy-applicable findings about the current state of the non-car transportation system in St. Louis and how it can better serve disadvantaged populations. For each mode of transportation examined in this thesis- biking, public transit, and walking- integrating these approaches has been crucial to holistically understanding accessibility and mobility for people living in households without cars, people with low incomes, people of color, elderly folks, and populations with disabilities, all of whom make up the segments of the population who most rely on non-car transportation.

In these concluding remarks, I give a synopsis of how each chapter, in turn, demonstrates how physical proximity, individual experiences, and political processes come together to construct accessibility and mobility in non-car transportation systems, utilizing the case study of St. Louis. In doing so, I review the ways in which each mode of non-car transportation provides accessibility and mobility to disadvantaged populations in St. Louis and highlight the particularly comprehensive policy recommendations that can be derived from an approach that synthesizes three existing sets of literature in urban planning/engineering, environmental psychology, and history/political science. Lastly, I relate the specific insights and policy ideas that this

research found from exploring biking, walking, and public transit in St. Louis to Nikolaeva et al's (2019) broad-based vision for accessibility and mobility in non-car transportation systems in "ordinary cities" around the world.

In the first body chapter, which focuses on biking in St. Louis, the quantitative approach using Bike Scores provided an initial set of key evidence that, at an infrastructural level, the St. Louis bike system is more extensive and easily traversable in neighborhoods with a higher percentage of white residents and a higher median household income. The quest to quantify all aspects of bike accessibility fell short, though, when it came to understanding dockless bike share. Without access to proprietary data on aggregate trips taken throughout the city, my options for quantitative analysis were limited. I could only study the academic literature to make informed hypotheses from a proximity-focused lens about the impact of the presence and absence of these bikes on disadvantaged populations in the St. Louis area. Nevertheless, Bike Score analysis provided a tangible jumping-off-point from which this research could then interrogate the ways that inequitable allocation of bike infrastructure manifests itself in people's daily lives.

Talking to people and hearing the personal narratives about their biking experiences in St. Louis helped this research incorporate new facets of disadvantaged populations' bike accessibility and mobility that not only extended, confirmed, and challenged the quantitative analysis, but provided novel insights and lines of inquiry. Interviewees and survey respondents highlighted safety concerns regarding poorly-kept

infrastructure and hostile automobile drivers, as well as dissatisfaction with the bike system's lack of cross-city connectivity, both of which made it difficult for the bike system to provide more than recreational mobility for residents. The political processes component of the analysis, then, helped this research tease out why and how the built environment for biking has been built inequitably, and why, across racial and economic groups, residents have found systemic barriers to using biking as an everyday form of mobility. Chief among the political processes at work here are: funding tensions compounded by municipal fragmentation and disinvestment in the city's black communities, as well as the institutional constraints of governmental organizations that push their planners to privilege the organization's mission (e.g., Bi-State's economic development, EWG's regional applications for federal funding, etc) over equity concerns.

Together, the findings from proximity analysis, citizens' individual experiences, and the longstanding practices and processes of political institutions facilitated the creation of policy recommendations that work to make current conditions better for disadvantaged populations who bike for mobility (or want to bike for mobility) and simultaneously tackle structural issues that create inequities in the first place. For biking in St. Louis, this means first creating outreach programs that educate citizens about the inequities in the bicycling system and encourage respect of bicycle rights on the roads while also maintaining the bike infrastructure that currently exists. On a longer-term basis, adopting deeply participatory planning processes similar to what Trailnet employs (including working with affected communities all the way from needs assessment to plan

implementation) might provide a way to ensure that disadvantaged communities' bike mobility needs and preferences are considered, as opposed to the current institutional structure wherein planners implicitly assume that community needs are ancillary to budget limitations and institutional constraints.

In the second, public transit-centered chapter, this research used the quantitative, proximity-based approach to test the correlation between a neighborhood's Transit Score and its percentage white population as well as the correlation between a neighborhood's Transit Score and its median household income. This time, instead of blatant inequities, the quantitative analysis showed a weak but negative statistically significant correlation between both Transit Score and a neighborhood's percent white population and Transit Score and a neighborhood's median household income, meaning that if anything, less-white and lower-income neighborhoods had better transit services than their whiter and more affluent counterparts. This finding served as encouraging baseline evidence that the transit system in St. Louis may be providing accessibility and mobility to communities across the city. Yet, this inquiry did not stop there and assume that the statistics about proximity stood for themselves (as planners and engineers focused on quantitative efficiency might be wont to do).

An examination of individuals' experiences in the St. Louis transit system then provided illuminating context and nuance to this quantitative portrait of parity. The people who ride transit in St. Louis, the majority of whom are black and/or low-income, found the buses and light rail generally able to adequately facilitate daily mobility to

work, school, grocery stores, and the like, but at a significant cost of time and planning. In particular, low service frequency on most routes and the difficulty of reaching destinations (particularly job sites) in somewhat distant suburbs were major concerns for frequent bus and light rail riders. Meanwhile, mostly among people who seldom ride public transit, there was a widespread perception that public transit is rife with crime and unsafe to use; safety and security, however, were not major concerns for frequent riders I encountered. The study of political processes put these experiences and perceptions into a broader context, exposing how major media outlets and public officials have propagated a racist narrative of crime on public transit, particularly Metrolink, even when a consultant study commissioned by some of those same governmental actors found that there is no statistical difference between the levels of crime on transit in St. Louis and the levels of crime on other US transit systems (Schlinkmann, 2018c). What's more, the ability of transit to meet people's needs (like the aforementioned frequency and scope of service) is put in peril by local city-county clashes, intensified by the stigma of transit as "dangerous," causing outlying counties and municipalities (as well as state funders) to pull back their support. Plus, the federal funding mechanisms run counter to the sort of help that transit systems like St. Louis' actually need by privileging capital projects over operating expenses.

Again, the three prongs of this examination of accessibility and mobility in St. Louis' non-car transportation system empowered me as a researcher to think more broadly about the possible policy responses than if I had taken any one or two of them

alone; it again allowed me to take account for potential policies with multiple geographic- and time-scales. With public transit, this meant both funding-related and service-related policy recommendations, including continuing on the increased-frequency path that Metro Transit has started with its Metro Reimagined program, combating the crime-related stigma of transit with a media campaign (both aimed at increasing ridership and changing the hearts and minds of municipal officials wary to grant transit funding), and lobbying to change the transit funding mechanism to better support day-to-day transit service.

In the third chapter, the thesis entered its final modal case study of walking in St. Louis. Similar to the transit case, the quantitative approach to analyzing the spatial distribution of pedestrian infrastructure found no significant correlation between either percentage white population in a neighborhood and Walk Score or median household income in a neighborhood and Walk Score. This provided a foundation for the idea that in St. Louis, any inequity in the pedestrian system does not come from a sheer lack of sidewalks or available nearby amenities in some neighborhoods but not others. Rather, as interviews and survey responses elucidated, the varying quality of sidewalks by neighborhood, and particularly the degradation of sidewalks in front of the thousands of vacant properties clustered in high-poverty, majority-black neighborhoods, is a larger problem for walking mobility in St. Louis that disproportionately affects disadvantaged populations. High violent crime rates in many of the same neighborhoods have made residents afraid to use the pedestrian infrastructure available to its fullest extent, creating

a disconnect between technically available opportunities to walk and actual mobility. That is not even to mention residents' widely-cited concerns about hostile drivers and unsafe crosswalk infrastructure that mirror bicyclists' similar concerns about St. Louis' car-centric streets.

In the case of walking, a study of political processes helped flesh out how and why these factors have impacted the mobility of historically disadvantaged populations. It examined the systemic lack of funding for city services like sidewalk upkeep enforcement because of a shrinking population and tax base, as well as the dearth of willingness from planners and government officials to use the political capital necessary to take responsibility for significant improvements to pedestrian accessibility and safety. Looking closely at political processes even introduced further inequities in the pedestrian system- mainly the proliferation of private streets and streets blocked off by concrete balls and planters- that were neither pinpointed by individuals as a specific hindrance from walking (perhaps because they're insidious) nor did they show up in the Walk Score metric.

For this final modal case, policy recommendations informed by quantitative proximity analysis, individual experiences, and political processes allowed me to more deeply understand the problem facing disadvantaged St. Louisans' freedom of mobility by foot, and from that, yet again make a multilayered set of policy recommendations. These included cosmetic changes like painting fluorescent crosswalks, creating well-lit paths, and adding pedestrian entrances to fenced-off businesses, along with deeper-seated

changes to procedures and funding mechanisms, like reopening the street grid, outlawing private streets, and putting pedestrian safety on-par with driver safety for planning.

Thinking Multimodally and Moving Ahead

Taken together, the findings from this research on three major modes of non-car transportation in St. Louis- biking, public transit, and walking- point to two foundational building blocks for a non-car transportation system that provides freedom of movement, and an accordingly high level of accessibility and mobility, to its city's most disadvantaged inhabitants: "commoning mobility" and advocating across scales, the former of which follows from Nikolaeva et al's (2019) work on the concept, and the latter of which provides a more tangible way to approach the many structural changes that building equitable non-car transportation systems would require. Nikolaeva et al (2019) explain "commoning mobility" this way:

> Commoning mobility proposes a reconsideration of the value of mobility and its collective repercussions in addition to the communal management of transport...Mobilities may be the means through which we interact with each other and with the environment around us (Te Brömmelstroet et al., 2017), something we share and can collectively govern rather than something we value only as it is converted into financial equivalent… (pp. 11)

As Nikolaeva et al (2019) see it, "commoning mobility" has to do with creating a path forward, particularly with regard to planning for for low-carbon modes of transportation like the ones this thesis has considered, where mobility is something that entire societies take responsibility and ownership over, rather than a freedom that is ascribed to

individuals alone or a good that inherently requires the use of "scarce" resources that must be saved through cost-saving and efficiency schemes. Exploring St. Louis' non-car transportation systems through the lenses of physical proximity, individual experiences, and political processes revealed a tension about funding and governmental priorities that was consistent across all modes of transportation and that certainly isn't confined to St. Louis (though the city does present a relatively extreme case of the dire consequences of American municipal fragmentation and disinvestment in communities of color in city centers). This persistent narrative of never having enough money or enough space to accommodate non-car transportation falls into what Nikolaeva et al (2019) would call "austere mobilities," which thrive off a logic of scarcity and focus their attention on cheaper and individual-led actions to fix a larger system.

The dockless bikeshare system in St. Louis was a prototypical example of the manifestation of an austere mobilities framework, as it didn't cost anything for the City of St. Louis. However, it also wasn't a stable or long-term fix to people's everyday mobility needs because the private company running the program discontinued it in favor of a more profitable option. Metro St. Louis is further exploring what the organization calls "micro transit" options (akin to city-sanctioned Ubers) that are run by similar logics- maximizing trip efficiency and budget dollars- but have been found elsewhere around the world to be inadequate substitutes for bus and light rail transit (Nikolaeva et al, 2019). Because this research's analysis has shown how St. Louis and so many neoliberal-led cities like it are hurtling toward austere mobilities, it is necessary to provide a viable

alternative to this narrow view of mobility if we are to imagine a future of equitable accessibility and mobility within non-car transportation systems; that alternative is commoning mobility.

This fundamental tactic of "commoning mobility" to build an equitable non-car transportation policy framework is necessarily paired with the idea of working at multiple scalar levels to make change, whether that means the geographic/governmental scale or the timescale. As feminist Carol Hanisch said, "the personal is political," and this inquiry found, accordingly, again and again, that the ways in which St. Louis residents move through the built environment and perceive their non-car mobility experiences are conditioned by longstanding structural forces (Kelly, 2019). Whether "structural forces" mean private streets and the epidemic of vacant properties in historically black and low-income areas of the city, the federal public transportation funding program that privileges capital funds over funding badly-needed everyday service improvements, or even the institutional constraints that bicycle planning organizations run up against as they attempt to engage in more equitable practices, individuals' daily trips are literally and discursively constructed by their neighborhood, municipal, state, and federal government systems. Pretending that only the federal scale or only the grassroots, neighborhood-up scale is appropriate for making sustainable change would be pure folly; change at all scalar levels is needed to enshrine non-car transportation equity in the law for years to come. That said, it is also vital to understand that while certain aspects of that multiscalar change may need to happen in the short-term in order to make sure non-car

transportation conditions are safe and that the systems provide daily mobility for their users (e.g., making pedestrian and cyclist signage more prominent at the municipal scale, or lobbying to increase the frequency on a popular regional bus route), others may require years of dedicated work and institutional change to implement in full (e.g., transitioning toward fully participatory planning practices that engage communities all the way from needs assessment to project implementation, changing federal and state public transit funding policies to better serve the needs of transit agencies, undoing the decades of intentional disinvestment in black neighborhoods that has led to rampant vacant parcels and decrepit sidewalks, etc). Understanding the scalar multiplicity that will be required for this effort to provide accessibility and mobility to disadvantaged populations is key to developing intentional advocacy campaigns whose proponents can distinguish where their struggle fits into the larger struggle for equity in non-car transportation systems.

The idea of "commoning mobility" works well in tandem with the multiscalar approach that emerges from this study because it too acknowledges the need for an expansive view of mobility that includes, beyond the communal "management" that might stem from a need to take into account one's physical proximity to mobility opportunities, also the "value" and "collective repercussions" of mobility as a means of how we "interact with each other," which are all phrases concerned with the experiences of individuals and communities (Nikolaeva et al, 2019). Finally, a proponent of "commoning mobility" sees mobility as something we "collectively govern," which speaks to the political processes component of constructing accessibility and mobility

(Nikolaeva et al, 2019). When advocating at multiple scales for accessibility and mobility in non-car transportation systems, framing one's arguments in terms of "commoning mobility" will be advantageous in that this conception has the potential to bring advocates far closer to the equitable, ideal system they're striving for, and have the potential to be more effective with policymakers by taking them outside of their usual scarcity-driven mindsets and galvanizing them to take larger-scale action.

With these findings and recommendations in mind, opportunities abound for future research about accessibility and mobility in non-car transportation systems in St. Louis and beyond. While I immersed myself in the St. Louis community for three months and attempted to gain as many perspectives as possible in order to understand the infrastructure, lived experiences, and structural factors that construct non-car accessibility and mobility in the city, I recognize that because I as a researcher have not lived as a racially or economically disadvantaged resident of St. Louis, my insights on mobility of disadvantaged populations are influenced by my positionality. Future research could thus use the framework of integrating physical proximity to infrastructure, individual experiences, and political processes to understand accessibility and mobility, and then build on the findings of this thesis by 1) delving into more depth and nuance on a specific mode of transportation (including emerging modes of non-car transportation, like electric scooters), 2) carrying out a more time-intensive method like ethnography to help substantiate or contest this thesis' findings on the political processes of planners and the individual experiences of disadvantaged St. Louisans, or 3) applying this framework to

another city. Using this integrated framework, which has been cultivated through the case study of an "ordinary city," St. Louis, could be particularly illuminating for understanding mobility in other ordinary cities around the world, and it could further help researchers grasp the sorts of insights from transportation/mobility research in ordinary cities that can apply to those cities traditionally considered "global" or "world" cities (Robinson, 2009).

On a policy level, this research lays out a broad framework of "commoning mobility" and working at multiple scales to root out entrenched inequities in non-car transportation systems, along with numerous context- and mode-specific recommendations to improve St. Louis' non-car transportation. Future research could use the recommendations forwarded here to figure out what concrete, multi-scalar steps toward "commoning mobility" look like in places outside of St. Louis, and how individual policy actions recommended here might be applicable or not applicable to other places. Figuring out actionable steps toward an equitable non-car transportation system in as many places as possible will only enhance the robustness of the policy framework that this thesis begins to create.

References

50-50 Sidewalk Program. (2019). *City of St. Louis.* Retrieved from https://192.168.232.59/government/departments/street/streets-sidewalks-traffic/permits-inspections/50-50-sidewalk-program.cfm

About Walk Score. (2018). *Walk Score Company*. Retrieved from https://www.walkscore.com/about.shtml

Adey, P., Bissell, D., McCormack, D., & Merriman, P. (2012). Profiling the passenger: Mobilities, identities, embodiments. *Cultural Geographies, 19*(2), 169-193.

Allen, M. R. (2014). The city body at war with itself: Street blockages in St. Louis. *NextSTL.* Retrieved from https://nextstl.com/2014/10/city-body-war-street-blockages-st-louis-2/

Baker, D. M., & Lee, B. (2017). How does light rail transit (LRT) impact gentrification? Evidence from fourteen US urbanized areas. *Journal of Planning Education and Research*.

Barr, D. (2018). Ofo's yellow rental bikes are leaving St. Louis. *St. Louis Business Journal.* Retrieved from https://www.bizjournals.com/stlouis/news/2018/07/19/ofos-yellow-rental-bikes-could-be-leaving-st-louis.html

Berg, L. D. (2009). Discourse analysis, 215-221. Retrieved from https://www.academia.edu/2044710/Discourse_Analysis?auto=download

Bike Score Methodology. (2018). *Walk Score Company*. Retrieved from https://www.walkscore.com/bike-score-methodology.shtml

Boettge, B., Hall, D. M., & Crawford, T. (2017). Assessing the bicycle network in St. Louis: A place-based, user-centered approach. *Sustainability, 9*(2), 241.

Börjesson, M. (2012). Valuing perceived insecurity associated with use of and access to public transport. *Transport Policy, 22*, 1-10.

Bott, C. (2018). St. Louis officials to grapple with estimated $10M shortfall in fiscal 2019 budget. *St. Louis Post-Dispatch.* Retrieved from https://www.stltoday.com/news/local/govt-and-politics/st-louis-officials-to-grapple-with-estimated-m-shortfall-in/article_484900dc-1a94-5d15-908e-c6e091401eb8.html

Brown, B. B., Werner, C. M., Smith, K. R., Tribby, C. P., Miller, H. J., Jensen, W. A., & Tharp, D. (2016). Environmental, behavioral, and psychological predictors of transit ridership: Evidence from a community intervention. *Journal of Environmental Psychology, 46*, 188-196.

Brunekreef, B., Janssen, N. A., de Hartog, J., Harssema, H., Knape, M., & van Vliet, P. (1997). Air pollution from truck traffic and lung function in children living near motorways. *Epidemiology,* 298-303.

Cahen, C. (2016). "More than paint on concrete": The winding path toward bike equity. *Global Journal of Community Psychology Practice, 7*(3).

Capps, K., & Rabinowitz, K. (2018). How the Fair Housing Act failed black homeowners. *CityLab.* Retrieved from https://www.citylab.com/equity/2018/04/how-the-fair-housing-act-failed-black-homeowners/557576/

Carrus, G., Passafaro, P., & Bonnes, M. (2008). Emotions, habits and rational choices in ecological behaviours: The case of recycling and use of public transportation. *Journal of Environmental Psychology, 28*(1), 51-62.

Cass, N., Shove, E., & Urry, J. (2005). Social exclusion, mobility and access 1. *The Sociological Review, 53*(3), 539-555.

Cella, K. (2018). MO transportation task force report calls for $50-70 million in dedicated funding stream for transit and multi-modal. *Citizens for Modern Transport.* Retrieved from https://cmt-stl.org/mo-transportation-task-force-report-calls-for-50-70-million-in-dedicated-funding-stream-for-transit-and-multi-modal/

Cervero, R. (2001). Walk-and-ride: Factors influencing pedestrian access to transit. *Journal of Public Transportation, 3*(4), 1.

City of St. Louis. (2018a). About Bike St. Louis. Retrieved from https://www.stlouis-mo.gov/government/departments/street/streets-sidewalks-traffic/bicycling/about-bike-st-louis.cfm

City of St. Louis. (2018b). A brief history of St. Louis. Retrieved from https://www.stlouis-mo.gov/visit-play/stlouis-history.cfm

Clarke, K. (1986). Advances in geographic information systems. *Computers, Environment and Urban Systems,* 175-184. Retrieved from https://www.researchgate.net/publication/222231072_Advances_in_Geographic_Information_Systems

Cook, J. (1989,). Harland Bartholomew, 100, Dean of City Planners. *The New York Times.* Retrieved from https://www.nytimes.com/1989/12/07/obituaries/harland-bartholomew-100-dean-of-city-planners.html

Coolican, J. P., & Webster, M. (2017). Metro contributes roughly half of state transportation dollars, gets fewer in return. *The Minneapolis Star-Tribune.* Retrieved from

http://www.startribune.com/metro-contributes-half-of-transportation-dollars-gets-fewer-in-return/416565963/

Cortright, J. (2017). Don't demonize driving, just stop subsidizing it. *CityLab.* Retrieved from https://www.citylab.com/commute/2017/02/dont-demonize-driving-just-stop-subsidizing-it/517044/

Creatore, M. I., Glazier, R. H., Moineddin, R., Fazli, G. S., Johns, A., Gozdyra, P., Manuel, D. G. (2016). Association of neighborhood walkability with change in overweight, obesity, and diabetes. *Jama, 315*(20), 2211-2220.

Cresswell, T. (2011). Mobilities I: Catching up. *Progress in Human Geography, 35*(4), 550-558.

Danielson, J. R. (2018). St. Louis is America's most dangerous city: FBI. Retrieved from https://patch.com/missouri/stlouis/st-louis-americas-most-dangerous-city-fbi

Dovidio, J. F., Gaertner, S. E., Kawakami, K., & Hodson, G. (2002). Why can't we just get along? Interpersonal biases and interracial distrust. *Cultural Diversity and Ethnic Minority Psychology, 8*(2), 88.

East-West Gateway Council of Governments. (2015). *Connected 2045: Long-range transportation plan for the St. Louis region.* (Regional Transportation Plan).

Retrieved from https://www.ewgateway.org/wp-content/uploads/2017/07/Connected2045_1.pdf

East-West Gateway Council of Governments. (2018a). Bicycle and pedestrian. Retrieved from https://www.ewgateway.org/transportation-planning/bicycle-pedestrian/

East-West Gateway Council of Governments. (2018b). EWG background. Retrieved from https://www.ewgateway.org/about-us/who-we-are/ewg-background/

English, J. (2018, Aug 31). Why did America give up on mass transit? (Don't blame cars.). *CityLab.* Retrieved from https://www.citylab.com/transportation/2018/08/how-america-killed-transit/568825/

Fan, Y., Guthrie, A., & Levinson, D. (2012). Impact of light-rail implementation on labor market accessibility: A transportation equity perspective. *Journal of Transport and Land Use, 5*(3), 28-39.

Fares & Passes. (2019). *Metro St. Louis.* Retrieved from https://www.metrostlouis.org/fares-and-passes/

Federal Bureau of Investigation. (2018). Violent crime. Retrieved from https://ucr.fbi.gov/crime-in-the-u.s/2017/crime-in-the-u.s.-2017/topic-pages/violent-crime

Federal Transit Administration. (2016). Metropolitan planning organization (MPO): Overview. Retrieved from https://www.transit.dot.gov/regulations-and-guidance/transportation-planning/metropolitan-planning-organization-mpo

Foda, M. A., & Osman, A. O. (2010). Using GIS for measuring transit stop accessibility considering actual pedestrian road network. *Journal of Public Transportation, 13*(4), 23-40.

García-Palomares, J. C., Gutiérrez, J., & Cardozo, O. D. (2013). Walking accessibility to public transport: An analysis based on microdata and GIS. *Environment and Planning B: Planning and Design, 40*(6), 1087-1102.

Gilderbloom, J., Grooms, W., Mog, J., & Meares, W. (2016). The green dividend of urban biking? Evidence of improved community and sustainable development. *Local Environment, 21*(8), 991-1008.

Giuliano, G. (2005). Low income, public transit, and mobility. *Transportation Research Record, 1927*(1), 63-70.

Goodman, C. B. (2015). Local government fragmentation and the local public sector. *Public Finance Review, 43*(1), 82-107.

Gordon, C. (2010). Mapping decline: St. Louis and the American city. Retrieved from http://mappingdecline.lib.uiowa.edu/map/

Great Rivers Greenway. (2018). About us. Retrieved from https://greatriversgreenway.org/about-us/

Greenblatt, A. (2015, Sept). In politics, Chambers of Commerce carve their niche. *Governing Magazine*. Retrieved from https://www.governing.com/topics/politics/gov-chamber-commerce-politics.html

Griessler, E., & Littig, B. (2005). Social sustainability: A catchword between political pragmatism and social theory. *International Journal for Sustainable Development, 8*(1/2), 65-79.

Hanson, S., & Giuliano, G. (2017). *The geography of urban transportation.* Guilford Press.

Hartmann, R. (2014). The Great Divorce lives on. *Saint Louis Magazine.* Retrieved from https://www.stlmag.com/St-Louis-Magazine/April-2014/Think-Again-The-Great-Divorce-Lives-On/

Hemphill, E. (2018, Aug 24). 2 Metro East reporters take close look at perceptions, realities surrounding transit safety concerns. *St. Louis Public Radio.* Retrieved from http://news.stlpublicradio.org/post/2-metro-east-reporters-take-close-look-perceptions-realities-surrounding-transit-safety

Hinners, S. J., Nelson, A. C., & Buchert, M. (2018). Streetcars and equity: Case studies of four streetcar systems assessing change in jobs, people, and gentrification. *Presented at Transportation Research Board 97th Annual Meeting.*

Hoffmann, M. L. (2016). *Bike lanes are white lanes: Bicycle advocacy and urban planning.* U of Nebraska Press.

Hong, J., & Chen, C. (2014). The role of the built environment on perceived safety from crime and walking: Examining direct and indirect impacts. *Transportation, 41*(6), 1171-1185.

Hosford, K., & Winters, M. (2018). Who are public bicycle share programs serving? An evaluation of the equity of spatial access to bicycle share service areas in Canadian cities. *Transportation Research Record, 2673*(36), 42-50.

Houghton Mifflin Harcourt. (2010). Rust Belt definition and meaning | Webster's New World College Dictionary. Retrieved from https://www.collinsdictionary.com/us/dictionary/english/rust-belt

Ihlanfeldt, K. (1994). The spatial mismatch between jobs and residential locations within urban areas. *Cityscape, 1*(1), 219-244. Retrieved from http://www.jstor.org/stable/20868372

Immergluck, D., & Balan, T. (2018). Sustainable for whom? Green urban development, environmental gentrification, and the Atlanta Beltline. *Urban Geography, 39*(4), 546-562.

Institute for Transportation and Development Policy. (2019). What is BRT? Retrieved from https://www.itdp.org/library/standards-and-guides/the-bus-rapid-transit-standard/what-is-brt/

Jan, T. (2017). News media offers consistently warped portrayals of black families, study finds. *The Washington Post.* Retrieved from https://www.washingtonpost.com/news/wonk/wp/2017/12/13/news-media-offers-consistently-warped-portrayals-of-black-families-study-finds/

Jones, C. E., & Ley, D. (2016). Transit‐oriented development and gentrification along metro Vancouver's low‐income SkyTrain corridor. *The Canadian Geographer/Le Géographe Canadien, 60*(1), 9-22.

Juvers, K. (2018). Why do we let political fragmentation hold back our entrepreneurs? *EQ.* Retrieved from http://eqstl.com/political-fragmentation-saint-louis/

Kelly, C. J. (2019). The person is political. *Encyclopedia Britannica.* Retrieved from https://www.britannica.com/topic/the-personal-is-political

Kenyon, S., Lyons, G., & Rafferty, J. (2002). Transport and social exclusion: Investigating the possibility of promoting inclusion through virtual mobility. *Journal of Transport Geography, 10*(3), 207-219.

Kohler, J. (2018, Sept 19). Concerned about Metro safety, St. Louis County Council wants to withhold security funds. *St. Louis Post-Dispatch.* Retrieved from https://www.stltoday.com/news/local/govt-and-politics/concerned-about-metro-safety-st-louis-county-council-wants-to/article_d069dd80-3fd1-5d3f-bef9-f6057aa52281.html

Lime Access | smart mobility in underserved communities. (2019). Retrieved from https://www.li.me/community-impact

Lime Micro-Mobility FAQs. (2019). Retrieved from https://www.li.me/help

Lubitow, A., Zinschlag, B., & Rochester, N. (2016). Plans for pavement or for people? The politics of bike lanes on the 'Paseo boricua' in Chicago, Illinois. *Urban Studies, 53*(12), 2637-2653.

Lucas, K. (2012). Transport and social exclusion: Where are we now? *Transport Policy, 20,* 105-113.

Lusk, A. C., Anastasio, A., Shaffer, N., Wu, J., & Li, Y. (2017). Biking practices and preferences in a lower income, primarily minority neighborhood: Learning what residents want. *Preventive Medicine Reports, 7*, 232-238.

Lutz, C. (2014). The US car colossus and the production of inequality. *American Ethnologist, 41*(2), 232-245.

Mallett, W. J. (2018). Federal public transportation program: In brief. *Congressional Research Service.* Retrieved from https://fas.org/sgp/crs/misc/R42706.pdf

Mavoa, S., Witten, K., McCreanor, T., & O'Sullivan, D. (2012). GIS based destination accessibility via public transit and walking in Auckland, New Zealand. *Journal of Transport Geography, 20*(1), 15-22.

McKenzie, G. (2018). Docked vs. dockless bike-sharing: Contrasting spatiotemporal patterns (short paper). Paper presented at the *LIPIcs-Leibniz International Proceedings in Informatics, 114.*

Medford Miller, J. (2018). *Metro Transit updates Metro Reimagined plan.* [Video]. Retrieved from https://www.youtube.com/watch?v=uCxdJRifzZg

Merriam-Webster. (2019). Definition of affective. Retrieved from https://www.merriam-webster.com/dictionary/affective

Merriman, P. (2014). Rethinking mobile methods. *Mobilities, 9*(2), 167-187.

Metro St. Louis. (2018). History. Retrieved from https://www.metrostlouis.org/history/

Miller, A. (2018, Jan 8). How public bus routes can deconcentrate poverty and promote equity. *Chicago Policy Review.* Retrieved from

http://chicagopolicyreview.org/2018/01/08/how-public-bus-routes-can-deconcentrate-poverty-and-promote-equity/

Mitra, R., Buliung, R. N., & Faulkner, G. E. (2010). Spatial clustering and the temporal mobility of walking school trips in the Greater Toronto Area, Canada. *Health & Place, 16*(4), 646-655.

Monteiro, A. L., Uttley, J. & Fotios, S. (2018). The science of street lights: What makes people feel safe at night. *The Conversation.* Retrieved from http://theconversation.com/the-science-of-street-lights-what-makes-people-feel-safe-at-night-103805

Nieuwenhuijsen, M. J., & Khreis, H. (2016). Car free cities: Pathway to healthy urban living. *Environment International, 94*, 251-262.

Nikolaeva, A., Adey, P., Cresswell, T., Lee, J. Y., Nóvoa, A., & Temenos, C. (2019). Commoning mobility: Towards a new politics of mobility transitions. *Transactions of the Institute of British Geographers.*

O'Dea, J., & Barker, J. (2018). How many vacant properties does St. Louis actually have? *St. Louis Post-Dispatch.* Retrieved from https://www.stltoday.com/news/local/metro/how-many-vacant-properties-does-st-louis-actually-have/article_c18e3864-7c16-5a3d-a3a3-cc747d40d435.html

O'Neil, T. (2010). A look back • Hodiamont Line streetcar closed out 107 years of service. *St. Louis Post-Dispatch.* Retrieved from https://www.stltoday.com/news/local/metro/a-look-back-hodiamont-line-streetcar-closed-out-years-of/article_3656e70d-0610-5592-90bc-7deebd14331f.html

Phillips, C. (2015). Report: Racial inequality in metro St. Louis continues to outrank most of the country. *St. Louis Public Radio.* Retrieved from https://news.stlpublicradio.org/post/report-racial-inequality-metro-st-louis-continues-outrank-most-country

Preston, J., & Rajé, F. (2007). Accessibility, mobility and transport-related social exclusion. *Journal of Transport Geography, 15*(3), 151-160.

Reduced Fare Programs. (2019). *Metro St. Louis.* Retrieved from https://www.metrostlouis.org/reduced-fare-program/

Reid-Musson, E. (2018). Shadow mobilities: Regulating migrant bicyclists in rural Ontario, Canada. *Mobilities, 13*(3), 308-324.

Renaud, J., & Buchanan, J. (2018). St. Louis city | St. Louis crime tracker. *St. Louis Post-Dispatch.* Retrieved from https://graphics.stltoday.com/apps/crime/st-louis-city/

Riggs, W. W., & Gilderbloom, J. (2016). The connection between neighborhood walkability and life longevity in a midsized city. *Focus, 13*(1), 11.

Robinson, J. (2002). Global and world cities: A view from off the map. *International Journal of Urban and Regional Research, 26*(3), 531-554.

Saelens, B. E., Sallis, J. F., & Frank, L. D. (2003). Environmental correlates of walking and cycling: Findings from the transportation, urban design, and planning literatures. *Annals of Behavioral Medicine, 25*(2), 80-91.

Sandoval, G. F. (2018). Planning the barrio: Ethnic identity and struggles over transit-oriented, development-induced gentrification. *Journal of Planning Education and Research,* 1-15.

Schedules & Route Maps. (2019). *Metro St. Louis.* Retrieved from https://www.metrostlouis.org/system-maps/

Schlinkmann, M. (2018a). Bike-share companies roll into St. Louis Monday. *St. Louis Post-Dispatch.* Retrieved from https://www.stltoday.com/news/traffic/along-for-the-ride/bike-share-companies-roll-into-st-louis-monday/article_0547cfd8-6e0b-560a-94dd-401e122f8b3d.html

Schlinkmann, M. (2018b). Bi-State/Metro formally announces Taulby Roach as new president/CEO. *St. Louis Post-Dispatch.* Retrieved from https://www.stltoday.com/news/local/metro/bi-state-metro-formally-announces-taulby-roach-as-new-president/article_26393029-2e00-5b9a-a513-f3676985b179.html

Schlinkmann, M. (2018c). A safer MetroLink: Consultants recommend officers on trains instead of platforms, but not turnstiles. *St. Louis Post-Dispatch.* Retrieved from https://www.stltoday.com/news/traffic/along-for-the-ride/a-safer-metrolink-consultants-recommend-officers-on-trains-instead-of/article_cf85fe78-a9fc-54d3-9671-5585f3a91e51.html

Schlinkmann, M. (2018d). St. Louis bars electric scooters from sidewalks, requires helmets. *St. Louis Post-Dispatch.* Retrieved from https://www.stltoday.com/news/traffic/along-for-the-ride/st-louis-bars-electric-scooters-from-sidewalks-requires-helmets/article_a7223469-24da-5f03-8d86-6ad05361892d.html

Schlinkmann, M. (2018e). St. Louis tries to make city safer for pedestrians as national report shows troubling trend. *St. Louis Post-Dispatch.* Retrieved from https://www.stltoday.com/news/traffic/along-for-the-ride/st-louis-tries-to-make-city-safer-for-pedestrians-as/article_3dd81465-8f47-51a6-8b40-6d23ab741cee.html

Sheller, M., & Urry, J. (2006). The new mobilities paradigm. *Environment and Planning A, 38*(2), 207-226.

Shi, J., Si, H., Wu, G., Su, Y., & Lan, J. (2018). Critical factors to achieve dockless bike-sharing sustainability in China: A stakeholder-oriented network perspective. *Sustainability, 10*(6), 1-16.

Simonsick, E. M., Guralnik, J. M., Volpato, S., Balfour, J., & Fried, L. P. (2005). Just get out the door! Importance of walking outside the home for maintaining mobility: Findings from the women's health and aging study. *Journal of the American Geriatrics Society, 53*(2), 198-203.

Spears, S., Houston, D., & Boarnet, M. G. (2013). Illuminating the unseen in transit use: A framework for examining the effect of attitudes and perceptions on travel behavior. *Transportation Research Part A: Policy and Practice, 58*, 40-53.

St. Louis Bike Share. (2019). Retrieved from http://www.stlbikeshare.org/

St. Louis Regional Freightway. (2018). Interstates. Retrieved from https://www.thefreightway.com/advantages/interstates-with-national-access/

Stehlin, J. (2015). Cycles of investment: Bicycle infrastructure, gentrification, and the restructuring of the San Francisco Bay Area. *Environment and Planning A, 47*(1), 121-137.

STL Vacant Properties Portal Map. Retrieved from https://www.stlvacancy.com/map.html

Sturdivant-Sani, C. (2018, Jan 9). In D.C., dockless bikeshare earns a more diverse ridership. *CityLab.* Retrieved from https://www.citylab.com/transportation/2018/01/can-dockless-bikeshare-pump-up-cyclings-diversity/549629/

Sukaryavichute, E., & Prytherch, D. L. (2018). Transit planning, access, and justice: Evolving visions of bus rapid transit and the Chicago street. *Journal of Transport Geography, 69*, 58-72.

Syed, S. I., & Khan, A. M. (2000). Factor analysis for the study of determinants of public transit ridership. *Journal of Public Transportation, 3*(3), 1.

Taylor, B. D., & Samples, K. (2002). Jobs, jobs, jobs: Political perceptions, economic reality, and capital bias in US transit subsidy policy. *Public Works Management & Policy, 6*(4), 250-263.

Thorsen, L. (2018a). Inside the Post-Dispatch: Metro Transit's executive director takes questions about crime, route frequencies. *St. Louis Post-Dispatch.* Retrieved from https://www.stltoday.com/news/local/columns/inside-the-post-dispatch/inside-the-post-dispatch-metro-transit-s-executive-director-takes/audio_0914b6e2-fc94-11e8-b7ac-33e53d9068df.html

Thorsen, L. (2015). In a city where street closings are common, 'Schoemehl pots' never seem to go away. *St. Louis Post-Dispatch.* Retrieved from https://www.stltoday.com/news/local/metro/in-a-city-where-street-closings-are-common-schoemehl-pots/article_c191cf1a-4967-5f58-80f4-3d8e3189790f.html

Thorsen, L. (2018b). It's not just crime: Why have so many people quit taking public transit in St. Louis? *St. Louis Post-Dispatch.* Retrieved from

https://www.stltoday.com/news/local/govt-and-politics/it-s-not-just-crime-why-have-so-many-people/article_1719ba71-2d8e-562f-b094-44316cce1385.html

Tighe, J. R., & Ganning, J. P. (2015). The divergent city: Unequal and uneven development in St. Louis. *Urban Geography, 36*(5), 654-673.

Tomer, A., & Puentes, R. (2011). *Transit access and zero-vehicle households.* The Brookings Institution. Retrieved from Social Science Premium Collection at https://search.proquest.com/docview/1820693854

Trailnet. (2018). Trailnet's history. Retrieved from https://trailnet.org/our-backpack/our-journey/

Trailnet. (2019). Connecting St. Louis. Retrieved from https://trailnet.org/our-work/planning/community/

Transit Score Methodology (2018) *Walk Score Company.* Retrieved from https://www.walkscore.com/transit-score-methodology.shtml

Ursaki, J., & Aultman-Hall, L. (2016). Quantifying the equity of bikeshare access in US cities. Paper presented at the *95th Annual Meeting of the Transportation Research Board, Washington, DC.*

US Census Bureau (2016). Selected housing characteristics, 2011-2016 American Community Survey 5-year estimates. Retrieved from EWG Data Center at https://www.ewgateway.org/research-center/data-center/

Walker, M. (2018). Vacancy portal opens door to data on abandoned parcels in St. Louis. Retrieved from http://news.stlpublicradio.org/post/vacancy-portal-opens-door-data-abandoned-parcels-st-louis

Walk Score Methodology. (2018). *Walk Score Company.* Retrieved from https://www.walkscore.com/methodology.shtml

Wellman, G. C. (2015). The social justice (of) movement: How public transportation administrators define social justice. *Public Administration Quarterly, 39*(1), 117-146. Retrieved from http://www.jstor.org/stable/24372045

Wibowo, S. S., & Olszewski, P. (2005). Modeling walking accessibility to public transport terminals: Case study of Singapore mass rapid transit. *Journal of the Eastern Asia Society for Transportation Studies, 6*, 147-156.

Wicentowski, D. (2019). Bike sharing is dead in St. Louis (for now). *Riverfront Times.* Retrieved from https://www.riverfronttimes.com/newsblog/2019/02/04/bike-sharing-is-dead-in-st-louis-for-now

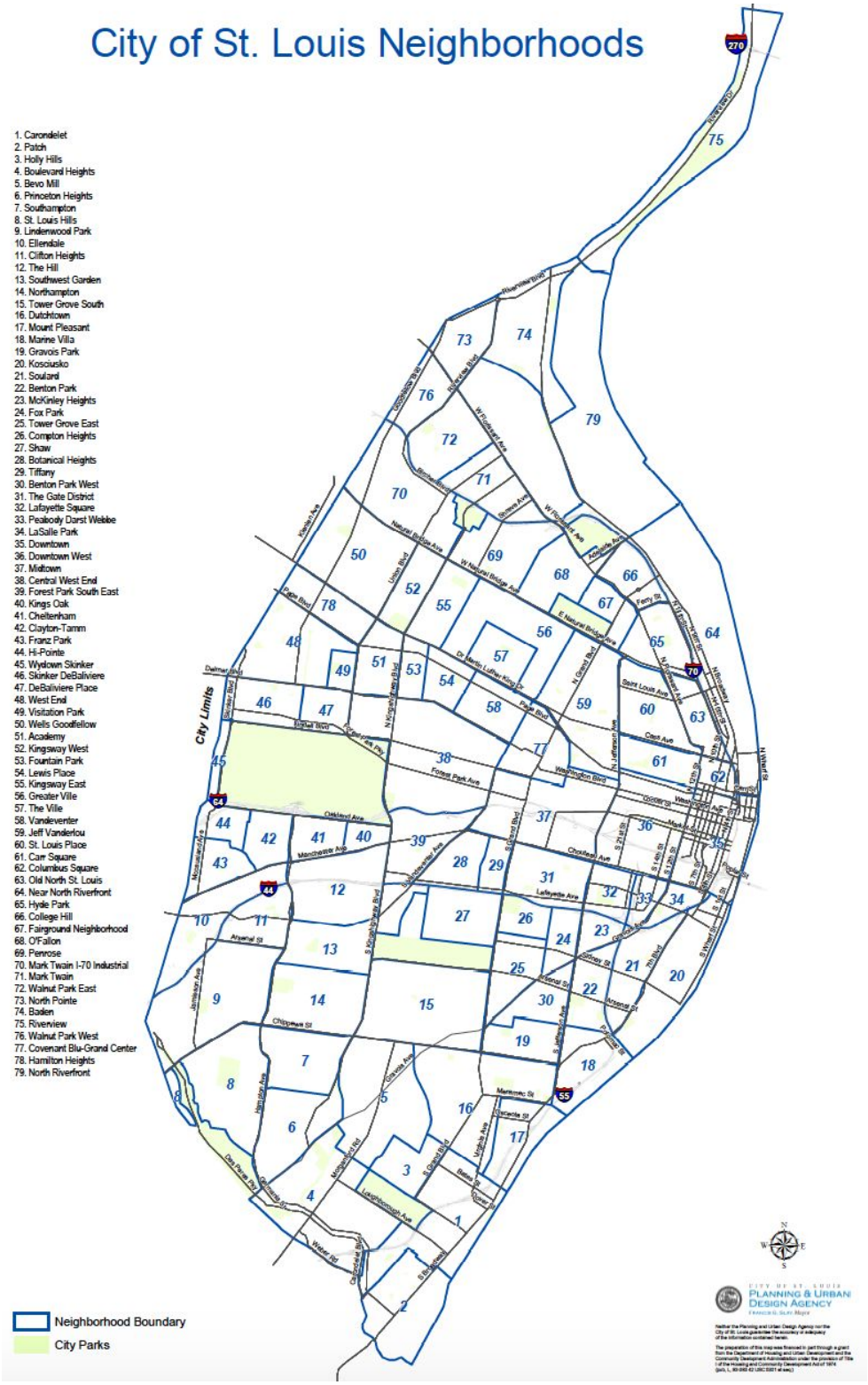
World Commission on Environment and Development. (1987). *Our common future*. Oxford. Oxford University Press. Retrieved from https://macalester.on.worldcat.org/oclc/15489268

Zahniser, D., & Nelson, L. J. (2014, March 31,). L.A. could clash with L.A. County on transit tax measures. *Los Angeles Times.* Retrieved from http://articles.latimes.com/2014/mar/31/local/la-me-0401-transportation-taxes-20140401

Ziari, H., Keymanesh, M. R., & Khabiri, M. M. (2007). Locating stations of public transportation vehicles for improving transit accessibility. *Transport, 22*(2), 99-104.

Zuk, M., Bierbaum, A. H., Chapple, K., Gorska, K., & Loukaitou-Sideris, A. (2018). Gentrification, displacement, and the role of public investment. *Journal of Planning Literature, 33*(1), 31-44.

Appendix 1: Reference Map of St. Louis Neighborhoods



Appendix 2: Survey Questions

Question 1: Most days, how do you commute to work or school?

- Carpooling with coworkers, friends, or family member(s)
- Taking the bus or Metrolink
- Biking
- Walking
- Other…

Question 2: How long is your typical commute to work or school?

- Less than 15 minutes
- 15-30 minutes
- 30-45 minutes
- 45-60 minutes
- More than 60 minutes

Question 3: How do you usually run errands (e.g., go to the grocery store, bank, post office, etc)?

- Driving alone in a personal vehicle
- Carpooling with coworkers, friends, or family member(s)
- Taking the bus or Metrolink
- Biking
- Walking
- Other…

Question 4: Are there sidewalks in your neighborhood?

- Yes
- No
- There are some, but it's not consistent.
- Other…

Question 5: Are there bike lanes in your neighborhood?

- Yes
- No
- There are some, but it's not consistent.
- Not sure
- Other…

Question 6: How far from your home is the closest bus or Metrolink stop?

- Less than 1/2 mile away
- Between 1/2 mile and 1 mile away
- 1-2 miles away
- More than 2 miles away
- Not sure
- Other…

Question 7: How often do you use public transit (i.e., bus or Metrolink) in the St. Louis metropolitan area?

- Every day
- A couple times a week
- Weekly
- Monthly
- Every couple months
- Yearly
- Never
- Other…

Question 8: Under what circumstances do you use public transit? When you don't use it, why do you choose another mode of transportation?

Question 9: Evaluate the following statement: It is easy to get around without a car in my neighborhood.

- Strongly disagree
- Disagree
- Neutral
- Agree
- Strongly agree

Question 10: Explain why you answered the previous question the way you did.

Question 11: Evaluate the following statement: The St. Louis Metropolitan Area provides many opportunities to bike and walk.

- Strongly disagree
- Disagree
- Neutral

Agree
Strongly agree

Question 12: Explain why you answered the previous question the way you did.

Question 13: Evaluate the following statement: The public transit system in the St. Louis Metropolitan Area is of high quality.

Strongly disagree
Disagree
Neutral
Agree
Strongly agree
Other…

Question 14: Explain why you answered the previous question the way you did.

Question 15: What else should I know about transportation and mobility in the St. Louis Metropolitan Area?

Sub-section: Demographic questions

Question 16: In which municipality do you live (e.g. St. Louis City, Clayton, Webster Groves, Florissant, etc)?

Question 17: If you live in St. Louis City, in which neighborhood do you reside?

Question 18: Do you own or have regular access to a car?

Yes
No
Prefer not to answer
Other…

Question 19: What is your total household yearly income, approximately?

Less than $25,000
$25,000 - $34,999
$35,000 to $49,999
$50,000 to $74,999
$75,000 to $99,999

$100,000 to $149,999
$150,000 or more
Prefer not to answer

Question 20: Are you of Hispanic, Latino, or Spanish origin?

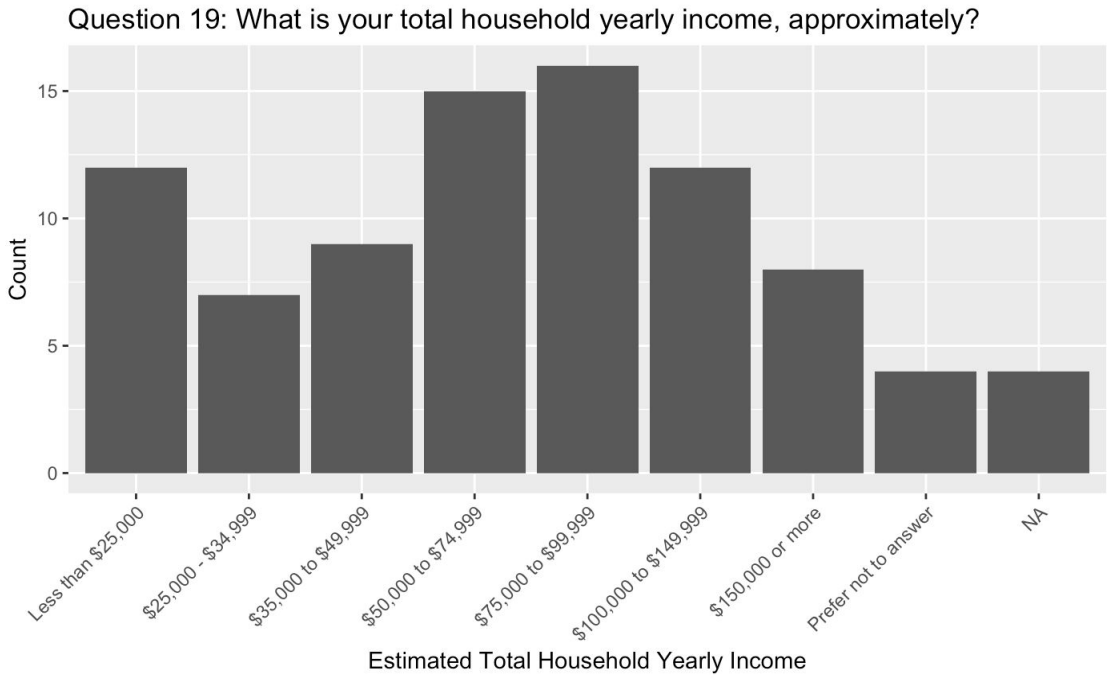
Yes
No
Prefer not to answer

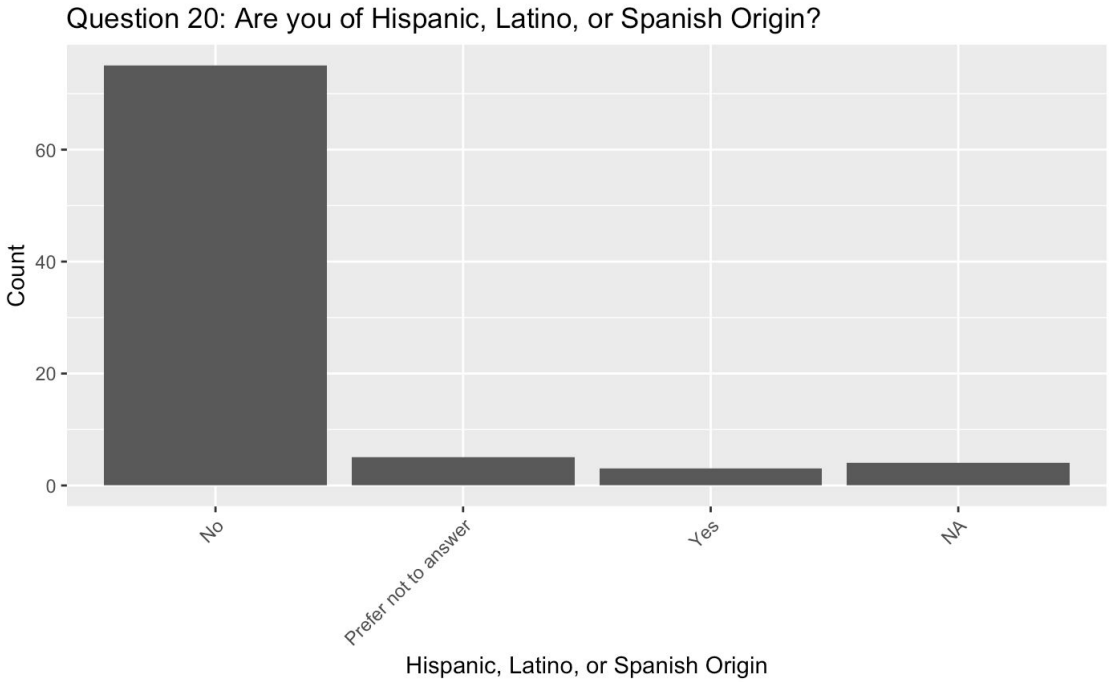
Question 21: What race(s) do you identify as? For purposes of this question, persons of Spanish, Hispanic, or Latino origin may be of any race.

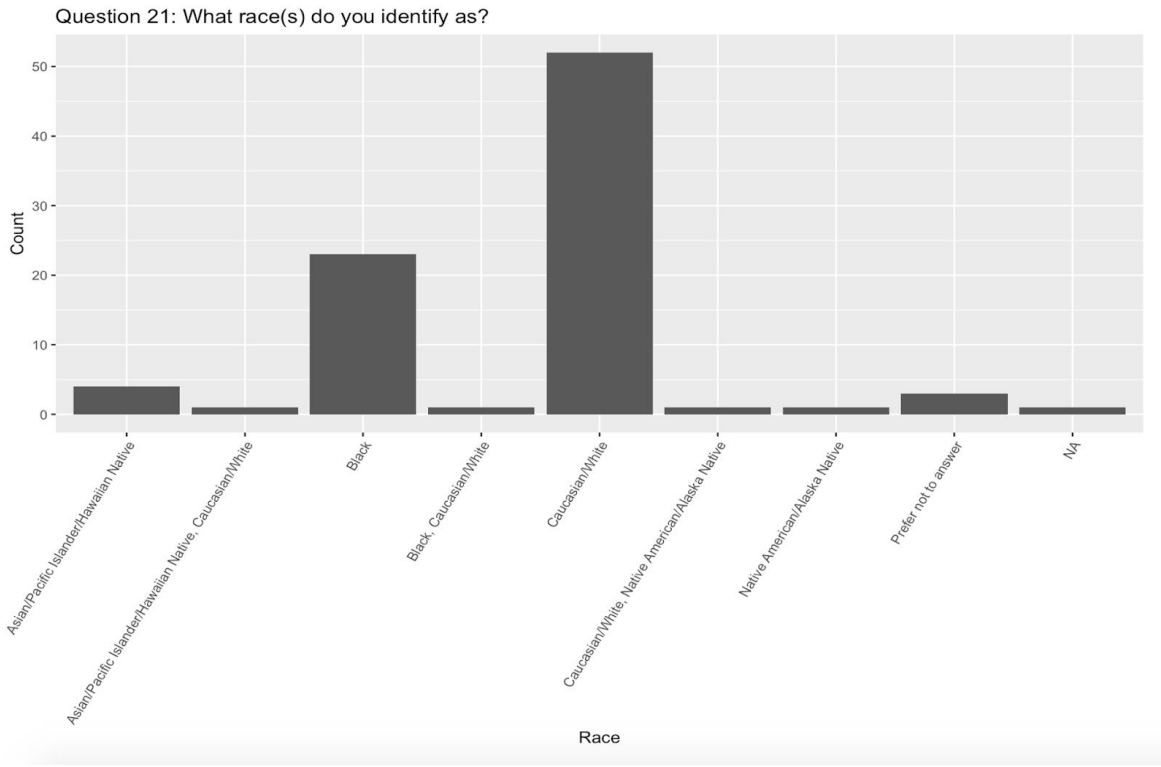
Asian/Pacific Islander/Hawaiian Native
Black
Caucasian/White
Native American/Alaska Native
Prefer not to answer
Other…

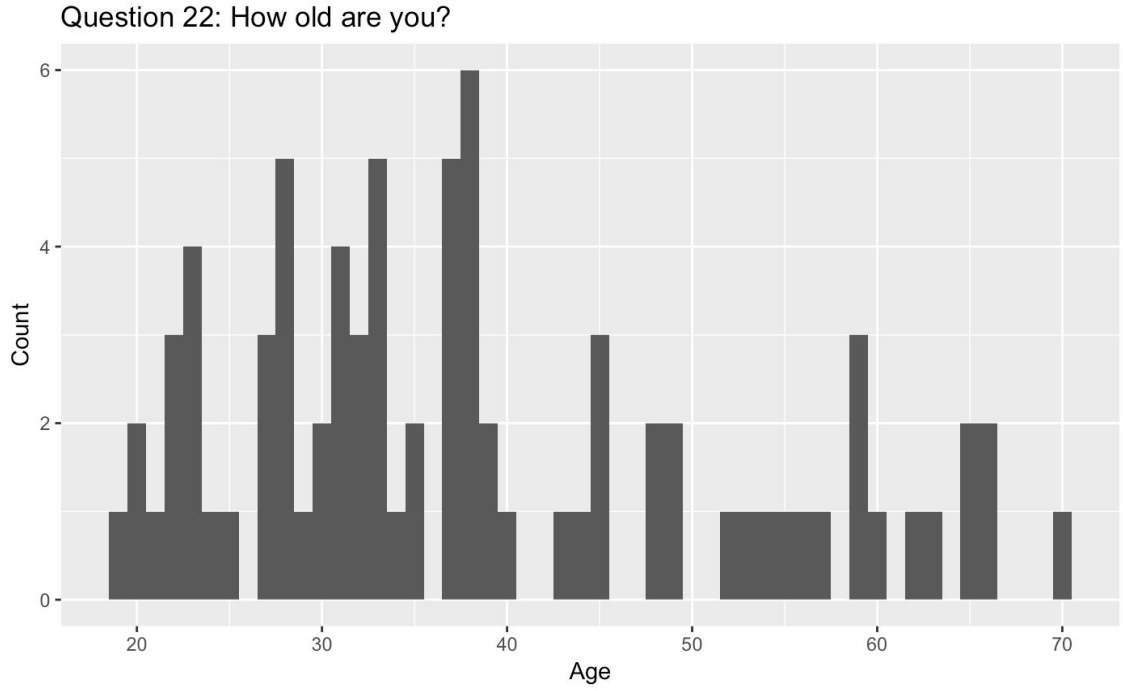
Question 22: How old are you?

Appendix 3: Survey Respondent Demographics






Question 21: What race(s) do you identify as?
Count
50
40
30
20
10
0
Asian/Pacific Islander/Hawaiian Native
Asian/Pacific Islander/Hawaiian Native, Caucasian/White
Black
Black, Caucasian/White
Caucasian/White
Caucasian/White, Native American/Alaska Native
Native American/Alaska Native
Prefer not to answer
NA
Race


Question 22: How old are you?
Count
6
4
2
0
20
30
40
50
60
70
Age