

Problems and Solutions for Public Transit in Sprawling Regions:
Perspectives from Transit Officials

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Introduction

Urban sprawl – also known as urban encroachment - has become an increasingly significant problem in the United States over the last century. This is worthy of attention because the negative outcomes associated with sprawl are considerable. Even within the relatively narrow confines of transportation, the ramifications of sprawl extend to issues concerning public health, the environment, and the economy. A driving factor behind the consequences of sprawl is its tendency to prioritize personal automobiles as a primary means of transportation. These consequences will be reviewed in further detail in the following pages. In an attempt to combat the negative effects of sprawl, public officials, transit agencies, and planners have made significant investments in public transportation over the last several decades, but these efforts have shown little progress in increasing transit ridership and reducing automobile dependency in sprawling cities.

Past research on public transit in US cities is largely comprised of broad, quantitative analyses on the influences of ridership. Various case studies have been conducted on transit ridership in the US, but they are often limited in that they a) focus solely on quantitative data, b) limit their scope to a single city or comparison between a few cities, and c) don't address the unique challenges that sprawling cities face in increasing transit ridership (Boisjoly, 2018; Mudigonda, Ozbay, & Bartan, 2019; Griffin & Sener, 2016). Additionally, there is a lack of qualitative research on transit ridership in sprawling regions across the United States. This paper offers promising solutions to declining public transit ridership in sprawling areas by collecting and analyzing qualitative data – in the form of interviews - from transit experts in sprawling regions. I examine the relative successes and failures of transit systems in sprawling regions in

order to determine policy recommendations that are best suited for transit systems dealing with urban sprawl.

Background

Urban planning and development in the United States has evolved significantly since the first urban planning conference in 1898, but planning agencies will need to embrace intuitive ideas to fight the environmental, health, and mobility issues confronting sprawling urban areas today. The spatial makeup of cities has changed dramatically over time, and new trends in urban growth and transportation need to be taken into consideration to battle the problems raised by 21st century urbanism. In the following paragraphs, I develop a framework to define and understand a popular form of urban growth today: urban sprawl. Using this framework, I will demonstrate our need to rethink the function of transportation in order to combat 21st century issues regarding the environment, mobility, and health outcomes.

A Definition of Urban Sprawl

Urban encroachment is a term that has become a popular buzzword to describe rapidly expanding cities across the United States, but the causes, consequences, and conditions of sprawl are still widely debated today. Over the years, academic studies have sought to define and understand sprawl using a variety of methods – I will draw from a number of these studies in order to find appropriate regions to examine. For example, researchers from the Indian Institute of Science in Bangalore conceptually defined sprawl as the result of unplanned and uncontrolled growth (Sudhira & Ramachandra, 2007). Using this definition, the researchers mapped out

changes in developed land in Bangalore to test for increases in sprawl. While this definition provides helpful characteristics of sprawl, it a) fails to present an operational definition of sprawl and b) ignores the multifaceted nature of sprawl. In contrast, a 2001 study developed several variables that were used to both define sprawl and understand its causes and consequences. The researchers used 8 dimensions of land use - density, continuity, concentration, clustering, centrality, nuclearity, mixed uses, and proximity – in order to provide arguably the most detailed operational definition of sprawl to date (Galster et al. 2001). This is perhaps the best definition of sprawl thus far, and I drew from the results of this study when determining which US regions to study.

While the study done by Galster et al. (2001) is very well done, the researchers only examined 13 cities. Thus, in the interest of selecting a larger number of sprawling regions, I also drew from a study in 2014 by Hamidi and Ewing. This study used four variables – development density, activity centering, land use mix, and street accessibility – to define sprawl, finding that sprawl increased and density decreased between 2000 and 2010 on average across 162 urbanized areas (Hamidi & Ewing, 2014). Although the purpose of this study was to examine changes in sprawl over time, the researchers also cited cities with the highest and lowest indicators of sprawl. Using the results of these two studies, I was able to develop a sufficient list of sprawling urban areas to consider for this research.

Consequences of Sprawl

Understanding the consequences of urban encroachment is important because the urban form of sprawl fosters increased environmental, health, and mobility issues. A study published in the *American Journal of Health Promotion* used data from a metropolitan sprawl index, the U.S.

census, and several hundred thousand self-reported respondents in order to determine the relationship between urban sprawl and various health outcomes. After controlling for covariates such as age, education, gender, and race, the researchers found that residents living in more sprawling metropolitan areas had worse health outcomes such as higher rates of obesity, heart disease and diabetes, and lower rates of physical activity (Ewing et al. 2003). The reliance on cars – as opposed to healthier options such as biking or walking - as the main form of transportation can help explain the poorer health outcomes witnessed in sprawling areas. Lower physical activity is not the only cause of worse health outcomes in sprawling regions – external factors play a role as well. Drawing from multiple studies, Howard Frumkin (2002) noted that vehicle emissions were higher in car-centric metropolitan areas with low population density, thus leading to a variety of increased emission-related health hazards such as asthma, cardiovascular disease, and mortality.

The environmental effects of a car-centric, sprawling city can be seen clearly in Los Angeles, where the transportation sector alone accounts for 62% of the city's greenhouse gas (GHG) emissions (Department of Regional Planning). To make matters worse, traffic exacerbates urban sprawl by encouraging residents to move further outside of the city to escape from road congestion (Nechyba & Walsh, 2004). These studies collectively point to a common theme: urban encroachment – and its tendency to favor personal automobiles as the primary form of transportation – has considerable repercussions for both the environment and human health.

Urban encroachment in the United States isn't going away anytime soon. This trend is expected to continue - the amount of land consumed by urbanization in the United States is projected to increase from 3.1% in 2000 to 8.1% by 2050 (Nowak & Walton, 2005). In other words, urban development will continue to expand horizontally instead of vertically, which is a

common sign of sprawl. As a result, air pollution, road congestion, and poorer health outcomes – all of which are related to the prevalence of automobiles – will increase as urban sprawl expands across the country. The consequences of urban growth have not gone unnoticed, and many officials at the local, state, and even federal level have begun championing a potential solution: public transit.

Literature Review

Previous Research

There has been a growing interest and investment in public transit systems across the United States in recent years. Many public officials and transportation experts claim that public transit can mitigate the congestion, pollution, and health risks associated with urban living. There is a great deal of academic literature on this subject, but most comparative research on public transit is conducted simply by selecting urban areas that share a specific region, similar population size, or density. For example, a study conducted on 25 major US cities over a 14-year period found that higher fares, increasing car ownership, and declining bus service resulted in a decrease in ridership over time (Boisjoly et al. 2014). Unfortunately, this study grouped transit agencies together solely based on the population they serve and the number of transit modes they provide. As a result, cities with vastly different urban forms, like New York and Dallas, are compared with little thought to how their urban form affects ridership.

Another problem that most transit-related studies in the US have is that they rely almost entirely on quantitative data. Quantitative data is valuable in that it evaluates and quantifies problems and solutions, but qualitative data helps us understand *why* something is happening. As a result, this research uses qualitative data to help provide valuable insight into *why*, for example,

transit ridership has been declining in spite of massive transit investments over the last decade. Before examining the qualitative data collected from this study, it may prove helpful to first examine the benefits of public transit and proposed solutions to declining ridership trends.

Benefits of Transit

The environmental, health, and mobility problems in sprawling cities mentioned previously are noteworthy in the context of this research because public transit use has shown some promise in reducing the consequences associated with urban sprawl. Traffic congestion, for instance, is an issue that continues to plague sprawling cities that have a propensity to favor automobiles, but recent research suggests that public transit may be a viable solution to this problem. In an article published by the *American Economic Review*, Michael Anderson used freeway speed data to test the change in traffic speeds on all major Los Angeles freeways during a 35-day strike by the Los Angeles County MTA that shut down all bus and rail lines. This research found a noticeable increase in congestion (47%) during this period, demonstrating the tangible effects that transit can have on traffic reduction along major freeways (Anderson, 2014).

In addition to potentially reducing traffic, there is some evidence to suggest that public transit can provide significant health benefits. For example, a study published in the *American Economic Review* analyzed 71 one-day public transit strikes in Germany's five largest cities in order to determine the effect transit has on health, pollution, and accidents. The study found that transit strikes were associated with a 14% increase in vehicle crashes, a 14% increase in particle pollution, an 11% increase in hospital visits for respiratory diseases, and an 11-13% increase in traffic congestion (Bauernschuster, Hener, & Rainer, 2017). In other words, this research suggests that an increase in public transit use may correspond to a decrease in pollution and

negative health outcomes. Additionally, the positive relationship between higher public transit use and lower emission levels has obvious environmental and health benefits. There is also some research to suggest that the simple act of using public transit may correspond to better health outcomes and greater safety in travel. A 2014 study collected data from 693 participants - separated by transit and non-transit users - and found that transit users on average had much more daily physical activity than non-transit users (Saelens et al. 2014). This is likely the result of the “first-and-last-mile” problem: i.e., the awkward distance that separates commuters from transit stations and their final destination. In most cases, the first and last mile commute involves walking or biking, which explains why transit users have more daily average physical activity than non-transit users.

Declining Ridership

Despite the multifaceted benefits that public transit provides to cities and residents, transit ridership in the United States is very low and continues to decline. In 31 of the nation’s largest 50 urban areas, transit ridership has dropped by at least 15% over the last decade (O’toole, 2018). The COVID-19 pandemic exacerbated this trend - cities across the US experienced extreme drops in transit ridership from 2019 to 2020 (Bergal, 2021). In severe cases, bus ridership in places like Nashville and Chattanooga fell by more than 60% (Parker et al. 2021). The figure below visualizes this trend by showing ridership statistics in many of the nation’s largest cities, highlighting significant declines in ridership in major cities throughout the U.S. over the past decade (O’toole, 2018).

These trends are particularly problematic in light of the massive investments that local, state, and federal governments have put into transit systems in recent years. To take just one example, an article published by *Curbed LA* noted that Los Angeles Metro saw a 19% drop in ridership from 2014 to 2017 despite pouring billions of tax dollars into service and infrastructure improvements during that same period (Tinoco, 2017). These trends don't bode well for the longevity of transit use in the United States, yet transit agencies and government departments continue to try to reverse the current trajectory of transit ridership.

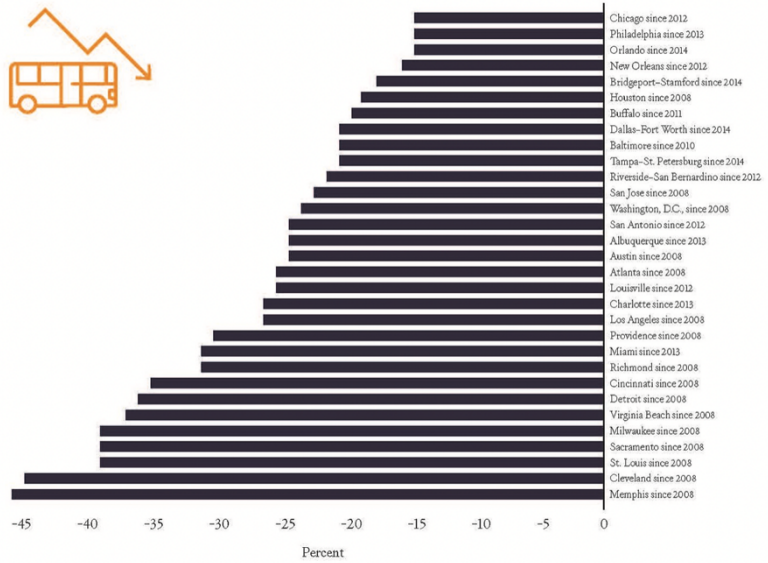


Figure 1

Existing Transit Initiatives

It may be useful to examine existing literature on the best methods for transit systems to see how they correspond to the results of this study. A popular form of transit being implemented in many urban areas – particularly areas with ample automobile infrastructure – is bus rapid transit (BRT). This form of transit provides designated bus lanes, signal priority at stop lights, and a reduced number of stops in order to improve service frequency and reliability. Author and researcher in sustainable transportation policy and planning, Robert Cervero, has encouraged cities like Los Angeles to implement this approach, noting that BRT lines have a strong potential to substantially increasing transit ridership (Cervero et al. 2010). Cervero is not alone in this

conception, an article published in *Transport Reviews* also concluded that BRT systems, when properly implemented, can provide a modern approach to public transit at a fraction of the cost of traditional rail lines (Deng & Nelson, 2011). Given the car-centric and horizontal nature of sprawling regions, investment in BRT may be a viable solution for transit systems looking to improve their service.

An effective public transit system includes multi-modal forms of transportation in order to increase connectivity and access for residents. As noted above, BRT is a good start, but additional modes of transit need to be implemented in order to increase transit connectivity. As previously mentioned, a leading issue with public transit connectivity is called the “first and last mile” problem. One mode of transit that is rapidly being implemented to make the first and last mile of a transit trip more accessible is *bike share*. This form of transit allows people to rent out bikes at select locations across the city, thus giving commuters without a car convenient access to nearby bus and rail stations. This concept has been empirically studied by Elliot Fishman, a director at The Institute for Sensible Transport, and his research suggests that bike share programs are a viable alternative for many who would otherwise use a car (Fishman et al. 2013). To increase the utilization of bike share programs, some researchers have proposed that private companies should work closely with transit operators in order to create connectivity between the two modes of transit (Griffin, 2016). Similar to bike share, e-scooters may also serve as an effective solution to first and last mile transit access. This service allows consumers to easily rent electric scooters for short range commutes, and it may be more effective than bike share in some areas because the scooters don’t have to be picked up or dropped off at a specific location. Bike share and e-scooter programs may help increase transit use and connectivity, particularly in

sprawling, car-centric areas that are less likely to have convenient and affordable first and last mile access.

Of course, many will never opt to use bike share or e-scooters over driving. In response to this, some transit agencies, like LA Metro, have begun instituting ride sharing programs as a mode of transit (Amato, 2021). These programs function like Uber or Lyft, whereby transit riders can pay for a ride to their final destination or to a transit station. Authors have cited the integration of these programs as hugely beneficial in enhancing transit mobility and access (Stiglic et al. 2018).

While these initiatives are focused at making transit more convenient, there are some fairly controversial policies being considered that would make driving a car less convenient. For example, public officials in Los Angeles have proposed implementing congestion pricing, a policy that would charge people for driving on certain roads at certain times of the day (Fonesca, 2021). The goal of this policy would be to reduce road congestion while also increasing demand for more affordable alternatives like rail and bus lines. This tactic has already been implemented in cities like London, where congestion pricing increased transit use and decreased automobile traffic significantly in its downtown area (Litman, 2005).

Sprawling urban areas are likely considering similar transit initiatives due to their comparable urban form. An overview of these strategies is helpful in understanding which approaches transit agencies may be considering, and additional research needs to be conducted to determine the effectiveness of these programs in sprawling cities. Urban sprawl creates unique problems for public transit; a dense city like New York may be perfect for rail, while a sprawling city like Houston may be better suited for bus service. The difference in urban form creates vastly different transportation needs. While it is important to understand what initiatives work

best for all transit systems, it is also important to understand what methods are best suited for specific urban areas. This research examines transit agencies in sprawling regions in order to determine which methods are the most promising for increasing public transit ridership specifically in these areas.

Methods

To better understand how transit systems can adapt to the challenges presented by urban sprawl, this study gathers qualitative data from transit experts in the form of open-ended interviews. This research incorporates in-depth examples of reported issues and successful approaches to public transit in sprawling cities. Transit experts were interviewed in sprawling areas to better understand their perspective on the unique difficulties these regions face. Additionally, the interviews focused on the current opinions transit experts have about improving transit service and ridership. Once the interviews were concluded, the responses were compared to see if there were underlying themes (i.e., if 90% of participants cited the affordability of cars as a hindrance to increased transit use). This research adds valuable qualitative data to the literature on public transit.

Selection of Urban Areas

In order to determine which sprawling regions to examine in this study, I drew from the work of Galster et al. (2001) and Hamidi & Ewing (2004). As previously mentioned, these studies formed some of the most complete definitions of sprawl to date, and the results found that the metropolitan areas of Atlanta, Miami, Dallas, Phoenix, and Denver all scored highly for indicators of urban sprawl. As such, I considered all of the transit agencies within those regions

as potential case study subjects. Additionally, there are a number of urban areas that don't score as highly for indicators of sprawl (such as Los Angeles), but I still included them in the study. There are two primary reasons for this: a) these metropolitan regions are known for low-density and unplanned urban development and b) the transit agencies within these areas serve a larger, more sprawling region than the city itself. With this in mind, I also considered Houston, Austin, and Los Angeles when reaching out to transit experts.

Sources of Data

Initial data collection began with interviews from transit officials representing the metropolitan regions of Houston, Dallas, Los Angeles, and Atlanta. Due to difficulties securing interviews with officials within transit agencies, interviews were also conducted with experts who have done a variety of research on US transit systems. Interview subjects were first found in public records and transit agency websites, and then through snowballing. I researched the infrastructure, policies, and projects in each region to help inform the interviews. Most of this data was sourced online from transit agency and government websites.

Limitations

While I had hoped to speak with transit experts in all of the sample cities I proposed, I was unable to secure interviews with transit experts from Denver, Phoenix, and Miami. There is certainly valuable data in these regions that could have provided a more meaningful analysis of my research question. Another challenge that presented difficulties was how to choose the scale at which I examined regional transit systems. Some places, like Los Angeles, may be better studied at a county level, while a place like Phoenix may only need to be studied at a citywide

level. I also recognize that many sprawling regions have multiple transit agencies, so some of the interviews I conducted may not be representative of the region as a whole. In the future, this research could be improved by drawing on data from several interviewees in all of the proposed cities in order to gain a more holistic understanding of the perspectives from transit experts.

Findings

I conducted seven interviews with transit experts from four different sprawling cities to explore their perspectives on issues facing public transit in their region. The purpose of these interviews was to determine why transit ridership in sprawling regions was declining and establish shared opinions on how to increase ridership. Over the course of the interview process, I learned that the interviewees believed that the quality of the transit experience (i.e., ease of use, cleanliness, or reliability) was just as important to ridership levels as the coverage of the transit system. In other words, there are several concepts that, at face value, only explore the quality of transit service, but they should also be viewed as factors that directly affect transit ridership. As such, note that the topics discussed below are all considered key determinants of ridership to the participants in this study.

Interviewees

To better understand the unique issues that transit systems in sprawling regions face, I reached out to four high-level transit employees and three transit experts that are well-versed in transit systems throughout the United States. Each subject interviewed is listed in the table below. I have assigned random numbers to the names of the subjects in order to maintain their confidentiality. It is important to note that the views expressed by these individuals are not

necessarily a reflection of the views held by the organization or transit agency for which they work.

Name	Region	Agency/Organization
Interviewee #1	Los Angeles	LA Metro
Interviewee #2	Dallas	DART
Interviewee #3	Atlanta	MARTA
Interviewee #4	Houston	Huitt-Zollars
Interviewee #5	Los Angeles	Southern California Association of Government (SCAG)
Interviewee #6	Houston	Houston-Galveston Area Council
Interviewee #7	Washington DC	Urban Institute

From the data collected through these interviews, I was able to synthesize and compartmentalize the responses into several primary topics. The interviewees provided insight on the main reasons for public transit’s decline in areas suffering from urban encroachment. Additionally, their responses highlighted effective transit approaches taking place throughout the US in sprawling regions. The figure below represents the key themes shared by transit experts about the major challenges and potential solutions for public transit in sprawling regions.

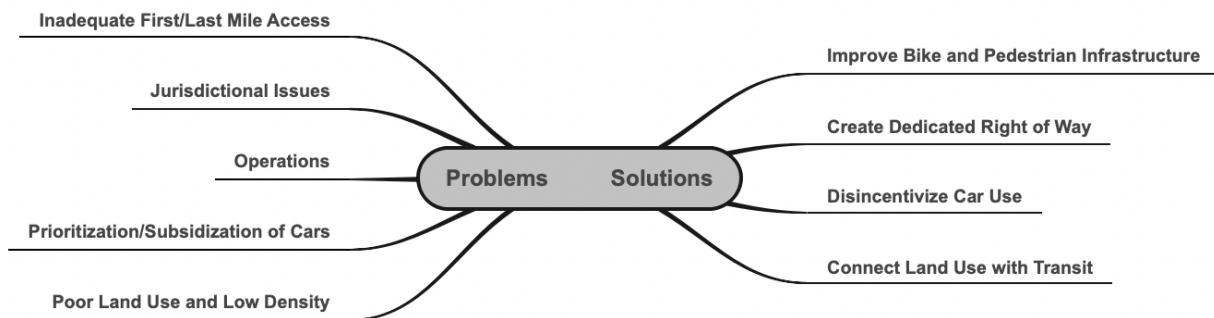


Figure 2

Impediments

Inadequate First and Last Mile Access

Nearly every participant stated that first and last mile access was the biggest impediment to public transit use in their region. Interviewees invariably observed that bike and pedestrian infrastructure was the key determinant of first and last mile access. For example, the poor condition (or, in some cases, nonexistence) of sidewalks and other pedestrian infrastructure around transit stops was cited by every interviewee as a major hinderance to first and last mile access and, consequently, transit use. An official from Los Angeles METRO stated, “it’s often very dangerous to bike or walk to many stations... there are plenty of pedestrian crossings where you have to wait two minutes before you can even get a green light” (Interviewee #1). Despite living and working in cities across the US, all interviewees stated that pedestrian infrastructure in their region was severely lacking. For example, a transit expert in Los Angeles said that sprawling cities “have environments that are very inhospitable for people to walk. Walking is a key element of an effective transit service because the vast majority of people who use transit get to transit stations by walking” (Interviewee #7). An interviewee from Houston also mentioned the lack of pedestrian infrastructure in sprawling cities:

“Even in places where the land use is there, it’s often a very inhospitable environment. I can think of plenty of places that have dense apartment complexes, but the nearest crosswalks are half a mile apart, and the road is five or six lanes of high-speed traffic.” – Interviewee #4

Although the development of high-density housing was cited by every interviewee as an essential part of increasing transit use, high-density housing is less effective at increasing transit use and accessibility if the urban infrastructure around transit corridors is hostile to pedestrians and cyclists. In an interview with a transit official from Houston, I learned that inhospitable

pedestrian infrastructure on the road isn't a mistake – it's often done by design in order to benefit car users.

“[Cities] space out traffic signals every quarter mile. What that means is if I'm trying to cross the street halfway between signals, and I want to cross safely, I need to take a five-minute detour. That's deadly to transit service. If we tried to install the number of signals that would actually make it a good pedestrian environment, many cities design guidelines would say, 'no that's not allowed.’” – Interviewee #4

The design of these roads makes walking across a city street time-consuming and, at times, highly dangerous. This is particularly important as pedestrian safety and walkability was cited by every interviewee as one of the biggest impediments to transit use.

Jurisdictional Issues

Public transit has rarely been viewed positively in the United States – people think of public transit as dirty, unreliable, and even unsafe at times. That being said, the reasons for the poor state of sprawling urban transit systems are more complicated than one might assume.

“Transit agencies are operating within city right of way, and I think it's actually one of the reasons why buses have been neglected in the United States - transit agencies aren't fully in control.”
– Interviewee #4

Participants representing Atlanta, Los Angeles, and Houston explained that their transit agencies often don't own the land where their bus stops are placed, so keeping bus stops clean is the job of the city, not the transit agency. And since transit agencies typically don't own the land, they have little power to make improvements like installing better and safer bus stops. Several transit experts remarked that despite the jurisdictional barriers, the largest part of the issue is lack of communication between cities and transit agencies. For example, a participant from Houston

stated that many cities and transit agencies see the importance of installing good bus stops, but there is often no effort on either side to communicate with one another.

Several participants explained that the difficulties caused by jurisdictional issues go far beyond inadequate bus stops. For example, an official from Atlanta explained that transit investments are made less effective due to communication barriers between cities and transit agencies.

“The city of Atlanta is not a very big city, it's just the center of a big conglomeration of cities... the challenge is working with all those cities to integrate land use with our transit investments”

– Interviewee #3

This was a common theme found among interviews – transit agencies often have difficulties working with cities to incorporate land uses that would be beneficial around transit stops. This is particularly challenging in sprawling regions that have numerous municipalities and transit agencies within the metropolitan area. Figure 3, for instance, depicts a map of all the transit agencies, generally divided by county lines, within the Houston metropolitan region. This map shows that these transit agencies have to work with each other to create regional transit

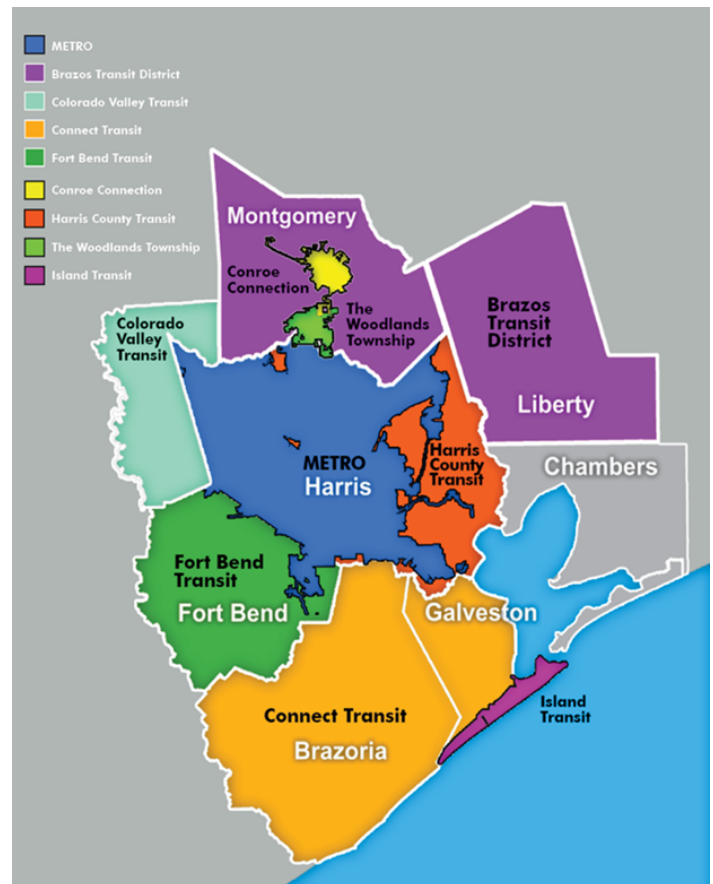


Figure 3 Data source: Houston-Galveston Area Council

infrastructure, but they also have to coordinate with numerous municipalities as well to integrate proper land uses along transit corridors. This is a problem most sprawling regions face, and it

creates serious logistical issues for creating interconnected transit systems. These examples highlight that there are some clear jurisdictional conflicts that reduce the potential quality of public transit in sprawling regions.

Poor Land Use and Low Density

Every participant cited low-density development as a key issue for public transit ridership because it reduced overall access to transit hubs. 60% of Atlanta proper is zoned exclusively for single-family housing (Bellan, 2021). This number is even higher in the greater Los Angeles region, where more than three-quarters of all residential land is zoned for single-family housing (Menendian, Chih-Wei, & Gambhir, 2022). This is relevant to transit ridership because transit corridors are the most effective in areas that serve the greatest number of people. As such, regions that have high rates of single-family zoning around transit corridors are less likely to see high transit ridership because there are fewer people living within a walkable or bikeable distance from transit stops.

Additionally, several interviewees stated that low-density development is particularly problematic in sprawling regions because modern zoning policies often segregate land uses. For example, one interviewee discussed the difficulties that arise when commercial and residential zoning is segregated in sprawling regions:

“We have a set of zoning laws, but also real estate interests and public choices, that encourage the separation of uses. It makes it difficult for people to live a life that is car-less. If people are not able to walk to convenient grocery stores, to bars, to restaurants, to other needs, they become attached to having a car in their daily lives, and once you have a car in your life it's very difficult to convince people to take transit.” – Interviewee #7

Participants stated that the separation of residential and commercial uses, coupled with maximum density requirements that make the region horizontal in nature, makes it inefficient for many commuters to get to a great deal of places in the city using only public transit.

In a similar vein, several interviewees indicated that there is a severe lack of integration between transit development and zoning policy. As noted in the previous section, lack of communication between transit agencies and municipalities can create difficulties for effective transit service. Participants stated that there ought to be a healthy amount of communication between agencies and municipalities in order to ensure that new transit projects be utilized to their fullest potential.

Operations

The efficiency of transit operations was heavily discussed by interviewees. Service frequency and reliability were unanimously viewed as some of the largest issues related to operations. A transit employee in Houston, for example, said “the number one issue in most places is the frequency of transit. There is service, but it only comes once an hour” (Interviewee #4). This appears to be a theme - every transit expert I interviewed stated that service frequency and reliability, particularly for buses, is a leading cause of transit dissatisfaction among riders. Interestingly, several participants stated that increasing the number of buses would do little to increase the reliability of transit service.

“Most of our transit service is bus service operating in mixed traffic that does not run frequently enough to satisfy the need. But that doesn't mean if we put in bus service that ran every two minutes, all of a sudden we would see tremendous increase in ridership...[because] there's very few miles of dedicated right of way for transit in Los Angeles compared to what there is for private automobile”. – Interviewee #1

In other words, participants stated that, in most cases, increasing bus frequency would only serve to increase the number of buses stuck in traffic alongside personal automobiles because most bus service lacks dedicated right of way.

Another service issue that transit agencies often have to contend with is the distribution of funds. Several transit experts noted that basic funding for operations typically takes a backseat to big capital projects (i.e., expansion of rail lines).

“Capital spending is always the priority over operations spending. In organizations like ours, when we need an extra dollar, we go shake down operations because their money is the most fungible.” – Interviewee #2

As a result, the frequency and reliability of existing services suffer. The transit experts I talked to stated that frequent and reliable service is one of the most important aspects of transit, and it is imperative that service doesn't get cut to fund capital projects.

Prioritization and Subsidization of Cars

Six of the seven participants in this study cited the detrimental effects that policies like parking minimums have had on public transit use and accessibility in the city.

“We allow parking everywhere. In fact, we require it through city policies... We prioritize single-occupancy vehicles by incentivizing parking and incentivizing driving.” – Interviewee #2

Parking minimums incentivize automobile usage by requiring buildings to provide a certain amount of parking depending on the number of units or square footage of the property. Parking minimums are just a small part of the larger issue that sprawling regions face: car-centric infrastructure. In short, every participant I interviewed discussed in one way or another how the entire urban fabric of sprawling areas has been designed to accommodate car use. There is legislation in some cities, for example, that prohibit roadway dollars (collected through taxes or

tolls) from going to transit (Interviewee #4). Additionally, local, state, and federal governments spend immense amounts of money to repair and improve roadway infrastructure, further incentivizing automobile usage for daily commuting. With the exception of one participant, every individual I interviewed believed that cars are given too high a priority in terms of funding and policy.

Best Methods

Improve Bike and Pedestrian Infrastructure

Six out of seven participants said that improving first and last mile transit access should be a priority for transit agencies moving forward. Bike and pedestrian infrastructure were unanimously viewed as the best way to increase this access.

"Every community needs to ensure that it has adequate pedestrian and cycling infrastructure available to people. There's no community that does not need the ability for people to walk and bike around, so I think that is priority number one." – Interviewee #7

The majority of transit trips begin and end on foot or by bike, meaning that adequate pedestrian and bicycle infrastructure is essential for a good transit system. Several interviewees mentioned efforts their city or region has already undertaken to improve bike and pedestrian infrastructure, such as the “Action Plan for Safer Streets” initiative in Atlanta. This initiative, launched by the mayor of Atlanta in 2019, raised \$5 million to improve pedestrian and cycling safety on over 20 miles of streets in Atlanta (City of Atlanta, GA). In Houston, METRO adopted the “Universal Accessibility Program”, which allocates funding towards improving sidewalks, bus pads, and shelters (Treviño, 2019). These basic infrastructure improvements are essential for facilitating walkability around transit hubs.

The development of dedicated bike lanes is happening throughout the country, but it is perhaps even more vital in sprawling regions that have high rates of single-family zoning.

“Bikes and transit go together beautifully. And I will say they are especially useful in lower density areas where not everything is going to be within walking distance. Bikes can make up for some real land use issues.” – Interviewee #4

As mentioned in the previous section about land use and density, these regions are extremely horizontal in nature due to the segregation of commercial and residential zoning. As a result, a great deal of transit hubs aren't within walking distance, and thus would be better suited for cyclists. This is why the interviewees believe there should be extensive bicycle infrastructure in place to facilitate safe biking routes to transit.

Although most participants were adamant that bike and pedestrian infrastructure ought to be the priority for increasing first and last mile access, a number of them suggested that micro transit programs (such as METRO Micro in Los Angeles) may also be a viable solution. For example, when asked about various ways to tackle first and last mile access, a participant from Los Angeles stated:

“The experimentation we've been doing with first and last mile access by micro transit through shared rides has been pretty positive. I think there's a lot of value to that.” – Interviewee #1

Most interviewees were hesitant to label micro transit as a solution to first and last mile transit access due to the lack of research on its effectiveness, but they were open to experimenting with micro transit programs in their respective regions.

Create Dedicated Right of Way

When asked about how to improve poor frequency and reliability, every participant discussed the need to build more dedicated transit lanes, particularly for buses, and implement signal priority for existing and future services.

“What we need to get reliability is actually infrastructure. We're not going to make the service more reliable by putting more buses on the street to then get stuck in the same traffic.” –

Interviewee #4

As previously mentioned, a number of interviewees argued that reliability would not dramatically improve by simply adding more buses. Although every interviewee stated that they'd like to see more funding going to operations in order to increase the number of buses on the route, they believed that increasing right of way for transit is equally important.

“We are not spending enough money on operating buses and getting dedicated right of away for buses to blanket the city with coverage and frequency.” –Interviewee #1

In other words, the interviewees believe that transit agencies need to use their resources to both improve operations (i.e., increase the number of buses on a fixed route) and increase right of way (i.e. build BRT lines and establish signal priority for buses).

Disincentivize Car Use

In reaction to car-centric policies like parking minimums, every interviewee stated that it is time to end our century-long subsidization of automobile use. There was some disagreement, however, about the best way to achieve this goal. For example, five out of the seven participants agreed with getting rid of parking minimum requirements, but six of them believed that legislation ought to be put in place within their regions to redirect funds from cars to transit. The

one individual who dissented from this opinion believed that transit ought to be funded more, but not at the expense of car use.

“I don't think cars should be made easy to use by making them subsidized. If we're going to subsidize them heavily, then let's subsidize transit more and make that easier to use. I just don't want to be at war with the car.” – Interviewee #3

The majority of interviewees believed that congestion pricing should be used to reduce car use, but they did not think that charging drivers to enter certain areas of the city (also known as cordon pricing) would make much sense. This is because sprawling regions typically don't have large urban cores like Chicago or New York which draw people into the city center. As a result, cordon pricing would essentially target areas that aren't in need of decongestion. Rather, most interviewees agreed that their freeway systems would be the best place to implement congestion pricing. One transit expert from Dallas explained why freeways are the easiest and best place to implement congestion pricing:

“We already have a huge network of toll roads here... We should be able to regulate the price in such a way that people... won't use it if they don't have to.” – Interviewee #2

Connect Land Use with Transit

Many of the problems related to low walkability and hostile urban design are a result of poor land use decisions. Maximum density requirements, for instance, have been a particularly problematic land use decision in sprawling regions. When asked about how to increase transit use in sprawling regions, every transit expert I spoke with believed that housing density ought to be increased – especially around transit hubs. One interviewee discussed how changing zoning laws may help improve transit use by increasing density:

“The highest and best use may no longer be a single-family home, so opening up the opportunity to change it - should the owner want to - could be a very strong policy.” – Interviewee #5

The problem for transit agencies, however, is that they often don't own the land around their stops and stations. One individual from LA METRO stated:

“We have a limited ability to influence the development around stations, so that's why I think about getting rid of our parking lots - which we do own - and replacing them with high density housing.” – Interviewee #1

This would have the dual effect of increasing housing density while also reducing car-centricity. Unfortunately, most agencies have little control over the zoning laws established by local governments. As a result, transit agencies have little capacity to dramatically change land use around their developments.

Although the interviewees agreed that high density housing is an important part of increasing transit use, many said that high density development alone won't improve transit use. Several participants stated that transit-oriented development around transit corridors is equally important. One transit expert talked about their current efforts to encourage mixed-use development in Houston:

“I'm in favor of [mixed-use development]. We recently worked with METRO in the city of Houston to create a transit-oriented development brochure for developers. We're seeing a little bit more... mixed-use close to light rail.” – Interviewee #6

Every interviewee, in one way or another, talked about the importance of creating vibrant communities around transit hubs by improving walkability and encouraging integrated land use decisions.

Discussion

This study demonstrates that public transit in sprawling areas seem to face very similar problems as a result of their comparable urban form. The data collected provides valuable insight from the perspective of transit experts about how sprawling regions can improve their transit systems. Additionally, many of the themes found within the data support or complement existing literature on public transit. This section presents an overview of how this study compares and contrasts to previous research. Following that, I discuss areas where responses were different from what I expected.

One of the major themes found in this research was the need to increase first and last mile access by improving bike and pedestrian infrastructure. While the participants were largely concerned with just increasing transit ridership and access, this theme fits well with existing literature on the positive health effects of transit use. By encouraging pedestrian and bicycle use around transit, transit agencies would simultaneously be encouraging commuters to switch from car use to healthier options like biking and walking. This could have a positive effect on the cardiovascular health of people living near transit corridors by reducing car emissions and increasing daily exercise for transit users. The focus on reducing car-centricity and increasing bike and pedestrian infrastructure also complements existing literature on the environmental benefits associated with public transit use. Both of these actions could help reduce greenhouse gas emissions by getting automobiles off of the road.

As expected, the implementation and expansion of BRT routes was considered a top priority for the majority of the interviewees. This falls in line with past research on BRT as an effective and low-cost mode alternative to rail (Cervero et al. 2010; Deng & Nelson 2011). The preference for BRT over rail makes sense in the cities examined given the horizontal nature of

their development. BRT could provide significantly more coverage than rail at a fraction of the cost. There were three interviewees, however, that stated that each city has its own specific needs and that there is no “one size fits all” for a quality transit system. As a result, they did not show a preference for BRT over any other modes of transit. It should be noted that two of these participants were not transit officials, but rather experts who have done extensive research on transit throughout the US. This difference could help explain the more wholistic approach these two individuals had. Despite the majority of interviewees showing a preference for BRT, every interviewee agreed that multi-modality is an essential aspect of any efficient transit system.

Another important note is that most participants only discussed pedestrian and bike infrastructure with little to no mention of programs like bike share. In a similar vein, there was no discussion of the role that e-scooters could play in increasing transit accessibility. This seemed to contradict existing literature that has recommended these programs as a means to increase transit ridership and accessibility. When asked about bike share, several participants only discussed the difficulties they’ve had with implementing the programs into their transit system. There was one interviewee who mentioned the growing demand for bike share in Houston, but they did not go as far as to say the program ought to be expanded. In short, no one discussed bike share or e-scooters when asked about ways to improve transit infrastructure or first and last mile access, instead focusing on improving infrastructure like sidewalks and bike lanes in order to help support these programs.

Another topic that was hardly mentioned in the interviews was the potential effect that the COVID-19 pandemic may have had on long-term ridership trends. Only one interviewee even made mention of the pandemic:

“People moved away from transit during the pandemic, which is, of course, ongoing. A lot of our rail riders for commuting haven't come back yet because they're remotely working.”

– Interviewee #3

I was surprised that there was so little discussion of COVID given the significant impact it's had on transit ridership. Figure 4, for example, depicts the overall ridership levels of each transit agency examined in this study from December 2019 to February 2022

(APTA – Ridership Trends).



Figure 4

Even two years after the start of the pandemic, all four transit agencies are still well below pre-pandemic levels of ridership. Although it wasn't explicitly mentioned in the interview questions, I expected there to be some discussion of the pandemic when the participants were asked about key determinants of falling transit ridership. Given the major shift to remote work over the last two years, it was surprising that interviewees were not more concerned about how changing work patterns may affect transit ridership.

In addition, it was also surprising that there was almost no mention of potential solutions to the jurisdictional issues raised by the interviewees. This was particularly interesting because a great deal of time was spent talking about communication and jurisdiction barriers between cities and agencies, yet there was almost no discussion of this topic when asked about solutions to

political and legislative issues. Only one person made any mention of potential solutions to jurisdiction issues, but they stopped short of saying they supported it.

When the Utah Transit Authority built its mega rail program under the leadership of Mike Allegro up until about 2016 and wrapped up, they actually got legislation that allowed UTA to collaborate with other jurisdictions, but in essence override them... That's not something that you commonly see, but that made a big difference in executing that program on time and on budget.

– Interviewee #3

The fact that no participants offered solutions to this issue could be, at least in part, due to the sheer size of the problem. It may have been difficult for transit officials and experts to confidently propose ideas that would require new legislation or jurisdictional restructuring. Additionally, despite having described it as an issue, some may not have seen it as something that can be fixed by a single solution. Even though the participants didn't propose any specific solutions, it is clear that jurisdictional issues are a significant problem that transit systems in sprawling regions face.

Interestingly, when asked about the issues facing transit operations and infrastructure, almost all participants centered their responses around the state of bus service and walkability in their respective regions. This suggests that participants believe agencies ought to focus

Transportation Infrastructure Development (\$ in thousands)	Forecasted Expenditures Through FY21 ⁽¹⁾	FY22 Adopted
Transit Expansion		
Rail		
Airport Metro Connector	\$ 222,370.8	\$ 143,169.2
Crenshaw/LAX Light Rail Transit	2,258,001.9	123,015.8
East San Fernando Transit Corridor ⁽²⁾	89,691.4	256,876.7
E Line (Expo) Light Rail Transit ⁽³⁾	2,296,798.1	4,211.5
L Line (Gold) Foothill Extension 2A to Azusa	918,436.0	3,503.3
L Line (Gold) Foothill Extension 2B	490,300.8	182,055.2
Regional Connector	1,519,593.7	260,998.2
Westside D Line (Purple) Subway Extension Section 1	2,636,483.6	534,612.7
Westside D Line (Purple) Subway Extension Section 2	1,335,876.8	292,622.7
Westside D Line (Purple) Subway Extension Section 3	1,001,173.7	511,888.4
Systemwide ⁽⁴⁾	80,681.3	64,622.7
Bus		
G Line (Orange) BRT Improvements ⁽²⁾	36,791.9	12,196.6
Transit Planning ⁽⁵⁾		
BRT Connector B Line (Red)/G Line (Orange) to L Line (Gold)	13,290.7	1,725.6
C Line (Green) Extension: Redondo to South Bay	19,296.2	18,221.9
Crenshaw Northern Extension	4,206.0	15,309.7
Eastside Extension	47,898.6	9,643.3
Eastside Extension - Light Rail Vehicles	31,527.3	-
Eastside Light Rail Access Phase 1 & 2	22,326.7	1,818.9
Eastside Light Rail Access Phase 3	3,300.0	8,181.8
North San Fernando Valley BRT	7,065.5	2,363.8
San Gabriel Valley Transit Feasibility Study	1,500.0	1,551.0
Sepulveda Pass Corridor	28,898.1	60,091.1
Vermont Transit Corridor	4,999.2	4,160.6
West Santa Ana Branch Corridor	60,691.2	24,870.4

Figure 5

on these issues, but an analysis of recent budget expenditures shows that some agencies prioritize rail over bus service or pedestrian and cycling infrastructure. Figure 5, for example, shows LA Metro's adopted budget for fiscal year 2022 – the vast majority of expenditures are for rail expansion projects, with very little money dedicated to BRT or other non-rail projects (LA Metro, 2022). Given how little the interviewees discussed rail during the interviews, it is interesting to see transit agencies prioritizing rail investments in their regional plans.

Recommendations

Drawing on existing literature and the findings from the interviews, I have developed several policy recommendations for transit systems in sprawling regions. The recommendations include specific projects and strategies that both transit agencies and city governments should implement. While these recommendations would likely be beneficial for most transit systems in the US, the responses from interviewees suggest that they would be particularly effective at improving transit in sprawling regions.

Encourage High Density Housing

Since the vast majority of interviewees cited low-density housing as a key issue for transit in sprawling regions, a key policy goal for these areas should be to increase housing stock around transit investments. As previously mentioned, segregated and low-density development in sprawling regions can make public transit inefficient and inconvenient. The high levels of single-family zoning in sprawling regions means that they must expand horizontally in order to grow, which further exacerbates urban sprawl and car-centricity. Consequently, local and state governments need to pass laws that will increase density, or upzone, along transit corridors.

There are a number of ways this could be implemented, such as through California's SB 9, a bill passed in 2021 that allows homeowners to build additional dwelling units (ADU's) on properties zoned for single-family housing (Payne, 2021). A policy like this may be more effective than traditional upzoning policies because it is less likely to be met with strong pushback from homeowners and community groups. That being said, there has been some success with passing more extreme upzoning policies in the US. (Kahlenberg, 2019). There are other small scale upzoning policies that could be achieved, such as creating special districts around transit corridors that allow for, or even encourage, the development of medium or high density housing. Another suggestion, put forth by a participant in this study, would be to sell the parking lots that transit agencies own to high-density housing developers. Given the many different ways that municipalities and transit agencies can increase density around transit, it is important that they consider all of these options to determine which ones are best suited for their region.

Integrate Land Use with Transit Investments

In addition to providing more housing around transit corridors, it is imperative that transit agencies and municipalities in sprawling areas make transit investments as accessible and comfortable as possible. Based on the findings from my interviews, bike and pedestrian infrastructure needs to be at the forefront of the planning process when building or improving transit systems. Transit agencies should consider implementing ride-sharing services in certain areas that cannot feasibly improve their bike or pedestrian infrastructure. Furthermore, new high-density zoning should also include mixed-use development that would fall in line with modern transit-oriented development practices. These recommendations would help to create vibrant, walkable communities around transit corridors.

Unfortunately, the jurisdictional issues described by interviewees highlight how difficult these goals can be – in many cases, transit agencies don't control the rights to streets and property their transit investments are built around. For this reason, cities and transit agencies within sprawling regions need to work collaboratively to develop concrete and actionable regional plans. By taking this approach, transit agencies can develop better communication with municipalities (a subject several participants stated as being a significant problem). By establishing a clear line of communication between transit agencies and local governments, it will be easier to integrate land use decisions with transit investments.

Government and transit agencies alone cannot stimulate investment around transit corridors – these areas need strong participation from the private sector as well. In the interest of encouraging transit-oriented development, public-private partnerships (PPP's) should be arranged to facilitate greater participation from the private sector in the development process. These partnerships have the dual effect of incentivizing development along transit corridors while also transferring some of the financial risk from the public to the private sector. By giving the private sector a direct stake in the success of a transit project, the area is more likely to thrive economically. Moreover, it would not be wise to restrict transit partnerships to just public agencies; creating public-private partnerships could ease resistance by more business-friendly stakeholders who oppose “government”. Cities like Portland, Toronto, Miami, and Atlanta have used PPP's to increase transit ridership by encouraging private investment in and around transit stations (Schneider & Davis, 2006). To foster greater innovation and expedite the building of more infrastructure around transit, the public and private sector need to collaborate on transit projects.

Every sprawling region can, and should, tackle land use problems differently depending on its political and jurisdictional makeup. The table below provides general recommendations for regions looking to build better, more connected transit systems.

- Help encourage private investment by providing tax incentives for mixed-use and high-density development around transit corridors.
- Establish formal partnerships between transit, street, and government agencies in order to determine shared priorities, goals, and action plans.
- Don't just think about specific projects – develop a wholistic regional plan for transit that considers density, mixed use, and multimodality.
 - These plans should prioritize pedestrian and bicycle infrastructure, BRT, and dense, mixed-use development around transit corridors.
- Create dedicated staff that are tasked with maintaining frequent communication between agencies about short- and long-term transit projects.
- Develop a clear plan with partners that outlines who takes responsibility for funding of operations, street improvements, and maintenance.

Discourage Automobile Use

There are several policies that could be implemented to help reduce the social, environmental, and financial costs of car-centricity and urban sprawl. In line with the results from this study, I recommend that parking minimums be eliminated in sprawling regions in order to promote other modes of transportation such as biking, walking, and public transit.

Additionally, I also suggest instituting parking *maximums* in various transit-rich areas, thus disincentivizing car use in areas where they're not necessary. Both of these policies have already been accomplished in cities like Berkeley, where off-street parking maximums were instituted, with certain exceptions, on lots less than .25 miles away from a transit corridor (Anderson, 2021). In a similar vein, cars can also be disincentivized by establishing congestion pricing along major freeways. That being said, there are several conditions that need to be met in order to make congestion pricing effective and fair:

- Implement congestion pricing only at peak hours in order to dissuade commuters from making “non-essential” trips during those periods.
- Enforce congestion pricing along routes that have existing transit alternatives. In other words, it would be inequitable to punish people for using a car if they have no other transportation choices along that route.
- All revenues from congestion pricing should go towards improving and expanding transit lines on and around the chosen route.
- Work closely with communities that would be most affected by congestion pricing in order to determine their needs and desires for transit.

Prioritize Bus Infrastructure and Operations

The emphasis interviewees put on subpar bus infrastructure and operations was a clear indication that transit agencies need to do more to invest in their bus systems. As recommended by existing academic literature and the participants in this study, transit agencies in sprawling regions should leverage existing car-centric infrastructure by developing and enhancing BRT lines along major transportation corridors. In some regions, this may even require a transfer of funds from future rail projects to BRT. There are a number of resources that provide general guidelines for transit agencies looking to invest in BRT systems (LA Metro, 2020; Rickert, 2007; Levinson et al. 2003). In areas where only BRT may not be feasible, transit agencies should still implement priority signaling for basic bus service in order to increase bus reliability and efficiency. These recommendations are cost-effective ways to help improve existing services and incentivize transit use.

Conclusion

Transportation has significant health, mobility, and environmental impacts in all urban areas throughout the United States, but these effects are even more consequential in sprawling regions due to car-centricity. Given the known benefits of public transit use, this study sought to determine potential solutions for declining transit systems in sprawling areas in order to increase ridership and combat the negative effects of car-centricity and sprawl. Interviews were conducted with transit officials and experts from several sprawling regions across the US in order to learn, from their perspectives, how to contend with the unique problems that sprawling transit systems face. Their responses, combined with existing literature on transit, were then used to inform policy recommendations for improving transit quality, service, and ridership.

Some of the policy recommendations are not unique to sprawling regions, such as increasing density and mixed-use development along transit corridors. Other recommendations, like prioritizing bus service and disincentivizing cars, are policies that are far more specific to this research due to the car-centric infrastructure and policies that are present in sprawling areas. This research may help inform decision makers, such as transit agencies and planning departments, about the unique challenges that other transit systems face in sprawling regions. The insights put forth can be used to help local governments and transit agencies avoid the mistakes made in areas with similar urban form. Additionally, the recommendations present viable transit-based solutions for areas struggling with sprawl.

Although this study has shown that there are a number of promising solutions to declining transit ridership, transit agencies and planning departments must contend with the fact that ridership has changed dramatically as a result of COVID-19. Ridership statistics are still well below pre-pandemic levels, and there is no certainty that they will ever return. With that

being said, it is still important that transit agencies and planners act on these recommendations in order to keep existing transit users and entice previous users back. While the recommendations put forth in this paper are primarily meant to help increase ridership, the COVID-19 pandemic has highlighted the fact that transit systems must provide better service in order to keep riders.

Works Cited

- Amato, Madalyn. "Need a Ride? Metro Micro Offers \$1 Rideshares around L.A." Los Angeles Times. Los Angeles Times, June 30, 2021. <https://www.latimes.com/california/story/2021-06-30/metro-micro-1-dollar-rides-los-angeles>.
- Anderson, Michael L. "Subways, Strikes, and Slowdowns: The Impacts of Public Transit on Traffic Congestion." *American Economic Review* 104, no. 9 (November 9, 2014): 2763–96. <https://doi.org/10.1257/aer.104.9.2763>.
- Anderson, Ted. "Berkeley Flips Script on Minimum Parking Requirements for Residential Developers." San Francisco Business Times, January 27, 2021. <https://www.bizjournals.com/sanfrancisco/news/2021/01/27/berkeley-no-parking-minimums-for-developments.html>.
- "APTA - Ridership Trends." Transit App. American Public Transportation Association. Accessed April 4, 2022. <https://transitapp.com/APTA>.
- Bauernschuster, Stefan, Timo Hener, and Helmut Rainer. "When Labor Disputes Bring Cities to a Standstill: The Impact of Public Transit Strikes on Traffic, Accidents, Air Pollution, and Health." *American Economic Journal: Economic Policy* 9, no. 1 (February 2017): 1–37. <https://doi.org/10.1257/pol.20150414>.
- Bellan, Rebecca. "Can Atlanta End Single-Family Zoning?" City Monitor, July 13, 2021. <https://citymonitor.ai/government/planning-zoning/can-atlanta-end-single-family-zoning>.
- Bergal, Jenni. "Biden Plan to Boost Public Transit Funding: Visionary or Wasteful?" The Pew Charitable Trusts, April 28, 2021. <https://www.pewtrusts.org/en/research-and-analysis/blogs/stateline/2021/04/28/biden-plan-to-boost-public-transit-funding-visionary-or-wasteful>.
- Boisjoly, Geneviève, Emily Gris , Meadhbh Maguire, Marie-Pier Veillette, Robbin Deboosere, Emma Berrebi, and Ahmed El-Geneidy. 2018. "Invest in the Ride: A 14 Year Longitudinal Analysis of the Determinants of Public Transport Ridership in 25 North American Cities." *Transportation Research Part A: Policy and Practice* 116 (October): 434–45. <https://doi.org/10.1016/j.tra.2018.07.005>.
- Cervero, Robert, Jin Murakami, and Mark Miller. "Direct Ridership Model of Bus Rapid Transit in Los Angeles County, California." *Transportation Research Record: Journal of the Transportation Research Board* 2145, no. 1 (January 1, 2010): 1–7. <https://doi.org/10.3141/2145-01>.
- City of Atlanta, GA. "Action Plan for Safer Streets | Atlanta, GA." Government website. Accessed February 20, 2022. <https://www.atlantaga.gov/government/departments/transportation/strategy-and-planning/office-of-mobility-planning/action-plan-for-safer-street-surveys>.

- Ewing, Reid, Tom Schmid, Richard Killingsworth, Amy Zlot, and Stephen Raudenbush. "Relationship between Urban Sprawl and Physical Activity, Obesity, and Morbidity." *American Journal of Health Promotion* 18, no. 1 (September 1, 2003): 47–57. <https://doi.org/10.4278/0890-1171-18.1.47>.
- Deng, Taotao, and John D. Nelson. "Recent Developments in Bus Rapid Transit: A Review of the Literature." *Transport Reviews* 31, no. 1 (October 16, 2011): 69–96. <https://doi.org/10.1080/01441647.2010.492455>.
- Department of Regional Planning. n.d. "About Los Angeles County CAP | Climate Action." Accessed November 1, 2021. <https://planning.lacounty.gov/site/climate/about-lac-cap/>.
- "Finance and Budget." LA Metro, January 19, 2022. <https://www.metro.net/about/financebudget/>.
- Fishman, Elliot, Simon Washington, and Narelle Haworth. "Bike Share: A Synthesis of the Literature." *Transport Reviews* 33, no. 2 (February 9, 2013): 148–65. <https://doi.org/10.1080/01441647.2013.775612>.
- Fonesca, Ryan. 2021. "Where (And Why) LA Metro Is Exploring 'Congestion Pricing' (AKA Making You Pay To Use Certain Roads)." LAist. February 11, 2021. <https://laist.com/news/here-are-the-places-la-metro-is-exploring-to-launch-congestion-pricing>.
- Howard, Frumkin. "Urban Sprawl and Public Health." *Public Health Reports* 117, no. 3 (May 2002): 201–17. <https://doi.org/10.1093/phr/117.3.201>.
- Hanson, Royce, Michael R. Ratcliffe, Harold Wolman, Stephen Coleman, and Jason Freihage. "Wrestling Sprawl to the Ground: Defining and Measuring an Elusive Concept." *Housing Policy Debate* 12, no. 4 (2001): 681–717. <https://doi.org/10.1080/10511482.2001.9521426>.
- Griffin, Greg, and Ipek Sener. "Planning for Bike Share Connectivity to Rail Transit." *Journal of Public Transportation* 19, no. 2 (2016): 1–22. <https://doi.org/10.5038/2375-0901.19.2.1>.
- Hamidi, Shima, and Reid Ewing. "A Longitudinal Study of Changes in Urban Sprawl between 2000 and 2010 in the United States." *Landscape and Urban Planning* 128 (2014): 72–82. <https://doi.org/10.1016/j.landurbplan.2014.04.021>.
- Kahlenberg, Richard D. "How Minneapolis Ended Single-Family Zoning." The Century Foundation, October 24, 2019. <https://tcf.org/content/report/minneapolis-ended-single-family-zoning/>.
- LA Metro. "Visioning BRT: Bus Rapid Transit Vision & Principles Study." Los Angeles County Metropolitan Transit Authority, November 2020. https://www.dropbox.com/sh/wax1hmpl3sdx31z/AADhCEGBhvBjFYSCsi0zgZCAa?dl=0&preview=Nov_2020_BRTV%26P+Final+Report.pdf.
- Levinson, Herbert S., Samuel Zimmerman, Jennifer Clinger, James Bast, Scott Rutherford, and Eric Bruhn. "Bus rapid transit, volume 2: Implementation guidelines." (2003).

- Litman, Todd. "London congestion pricing—implications for other cities." *CESifo DICE Report* 3, no. 3 (2005): 17-21.
- Menendian, Stephen, Chih-Wei Hsu, and Samir Gambhir. "Single-Family Zoning in Greater Los Angeles." Othering & Belonging Institute, March 2, 2022. <https://belonging.berkeley.edu/single-family-zoning-greater-los-angeles>.
- Mudigonda, Sandeep, Kaan Ozbay, and Bekir Bartin. "Evaluating the Resilience and Recovery of Public Transit System Using BIG DATA: Case Study from New Jersey." *Journal of Transportation Safety & Security* 11, no. 5 (2018): 491–519. <https://doi.org/10.1080/19439962.2018.1436105>.
- Nechyba, Thomas J., and Randall P. Walsh. "Urban Sprawl." *The Journal of Economic Perspectives* 18, no. 4 (2004): 177–200.
- Nowak, David J, and Jeffrey T Walton. "Projected Urban Growth (2000 – 2050) and Its Estimated Impact on the US Forest Resource." *Journal of Forestry* 103, no. 8 (2005): 383–89. <https://doi.org/10.1093/jof/103.8.383>.
- O'Toole, Randal. "Charting public transit's decline." *Policy Analysis* 853 (2018): 1-18.
- Parker, Madeleine E.G., Meiqing Li, Mohamed Amine Bouzaghrane, Hassan Obeid, Drake Hayes, Karen Trapenberg Frick, Daniel A. Rodriguez, Raja Sengupta, Joan Walker, and Daniel G. Chatman. "Public Transit Use in the United States in the Era of COVID-19: Transit Riders' Travel Behavior in the COVID-19 Impact and Recovery Period." *Transport Policy* 111 (2021): 53–62. <https://doi.org/10.1016/j.tranpol.2021.07.005>.
- Payne, Eric. "Housing Reform Bill Would Right Some of Redlining's Wrongs." CalMatters, June 21, 2021. <https://calmatters.org/commentary/my-turn/2021/06/housing-reform-bill-would-right-some-of-redlinings-wrongs/>.
- Rickert, Tom. "BRT accessibility guidelines." *Washington: The International Bank for Reconstruction and Development/The World Bank* (2007).
- Saelens, Brian E., Anne Vernez Moudon, Bumjoon Kang, Philip M. Huvitz, and Chuan Zhou. "Relation Between Higher Physical Activity and Public Transit Use." *American Journal of Public Health* 104, no. 5 (2014): 854–59. <https://doi.org/10.2105/AJPH.2013.301696>.
- Schneider, Michael, and Jonathon Davis. "Public-Private Partnerships in Public Transportation" American Public Transportation Association, November 2006. https://www.transit.dot.gov/sites/fta.dot.gov/files/docs/apta_ppp_white_paper_final.pdf.
- Stiglic, Mitja, Niels Agatz, Martin Savelsbergh, and Mirko Gradisar. "Enhancing Urban Mobility: Integrating Ride-Sharing and Public Transit." *Computers & Operations Research* 90 (February 2018): 12–21. <https://doi.org/10.1016/j.cor.2017.08.016>.

Sudhira, H. S., and T. V. Ramachandra. "Characterising urban sprawl from remote sensing data and using landscape metrics." In *Proceedings of 10th International Conference on Computers in Urban Planning and Urban Management*, pp. 11-13. 2007.

Tinoco, Matt. 2017. "Fewer People Are Taking Transit in LA—Here's Why." Curbed LA. August 29, 2017. <https://la.curbed.com/2017/8/29/16219230/transit-metro-ridership-down-why>.

Treviño, Roberto. "DELIVER THE EXPERIENCE." Houston METRO, May 2, 2019. <https://www.houstontx.gov/council/committees/tti/20190502/Universal-Accessibility.pdf>.

Appendix

Interview Questions

General

- Based on your personal experience working in public transit, can you speak about some of the leading reasons for transit dissatisfaction?
- What do you believe are some key reasons keeping non-transit riders from using public transit?

Infrastructure

- What are the various aspects of the urban form in your region, such as roadway infrastructure or zoning, that you believe present the most difficulties for increasing public transit use?
- Based on the urban form issues mentioned in the previous question, can you cite any examples of past infrastructure improvements – either from the city or an agency you’ve worked with - that have shown progress increasing transit ridership and accessibility?
- What transit infrastructure do you believe in the most important for sprawling cities in order for them to increase and improve their service?
- Can you tell me about any plans your region currently has in the works in order to improve upon the infrastructure difficulties you’ve mentioned?

Policies, Projects, and Legislation

- What transit projects are a priority for your region right now and going forward?
- What projects and/or policies do you *personally believe* are the most promising for increasing transit service and use in your region? Why is that?
- Are there specific sectors of public transit that you believe are underfunded? If so, what improvements could be made with additional funding?
- Have you reviewed or implemented policies from other cities to inform decisions made at the agencies you’ve been a part of? If so, which policies and from what cities?
- In your opinion, which specific policies or laws have been detrimental to transit ridership and accessibility?
- Are there any current policies, projects, or legislation in the works that are aimed at remedying these detriments?

Modes of Transit

- What are the major roadblocks for increasing rail infrastructure and improving the service and ridership?
- Can you discuss the difficulties involved with improving and increasing bikeshare as a way to connect people to transit?
- Have ride-sharing services like Uber and Lyft negatively affected public transit ridership?
- Has your region experimented with any ridesharing programs? How important do you believe a transit-funded ridesharing service is for improving transit ridership?
- Is the implementation of BRT lines a priority for your region?
- If there are multiple transit agencies in the region, do these agencies work together to provide convenient and efficient service?
- What, if anything, do you think needs to be changed to improve efficiency and ease of use?
- What do you think is the best way to improve first/last mile transit access in your region?
- Do you know of other transit agencies battling similar issues related to sprawl? Additionally, do you know of any initiatives these agencies have implemented to improve their transit system?
- Is transit-oriented development currently a priority for your region?