Getting to the Grocery Store: Planning Transportation Systems for Food Access

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ABSTRACT

Prior food access research has tended to focus on identifying areas with limited healthy food retail options. We know much less about how residents travel to grocery stores and how this relates to transportation systems. This thesis analyzes survey data from Somerville, MA to understand how transportation experiences to the grocery store differ by food insecurity and car ownership status. In addition, I interview 15 transportation planners in the Greater Boston Area about how transportation systems function as both barriers and opportunities to food access. Transportation planners believe the following proposed strategies to increase food access, identified in policy reports, are feasible and effective: pedestrian/bike infrastructure, public transit, and master plans. Understanding more about food access in a transportation planning context can increase collaboration and innovation among planners to address inequities across food and transportation systems.

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CHAPTER 1: INTRODUCTION

In the wake of the COVID-19 pandemic, food insecurity—the lack of access to healthy, affordable, culturally appropriate food—is worsening and widening in communities across the country. While planners and policy makers in government and the emergency food system have worked to reduce food insecurity, it remains a significant issue for communities that warrants continued attention. In 2019, according to the Department of Agriculture's Economic Research Service, 10.5% of US households experienced food insecurity (Coleman-Jensen, Rabbitt, and Christian 2020). The Greater Boston Food Bank projected an increase in food insecurity in Eastern Massachusetts due to the pandemic from one in 13 households in 2018 to one in eight households in 2020 ("Food Insecurity Across Eastern Massachusetts at an All-Time High" 2021).

There are two aspects to food access: affordability of food and one's ability to physically access food, both of which impact food insecurity. Planners and policymakers can choose to address one or both parts of food access—the cost of food and/or accessing food retail locations. Up until this point, policy and planning interventions have favored the affordability aspect of food access, particularly through the Supplemental Nutrition Assistance Program (SNAP), funded by the federal government and administered at the state level. In terms of the physical access component of food access, policy makers have focused on the availability of affordable, healthy foods in neighborhoods with high levels of food insecurity. Focusing on availability of foods often includes measuring the distance between where food insecure people live and the nearest grocery store with healthy, affordable food. This identification of low-access areas, often referred to as food deserts, acknowledges that the location of food retail matters (Ver Ploeg et al. 2009; Jiao et al. 2012; Breyer and Voss-Andreae 2013). However, such studies pay little attention to how people get to the grocery store.

Community Food Systems Assessments, a tool used by food systems planners to understand and begin to build a stronger local food system, have pointed to transportation as a key barrier to community food access based, in part, on geospatial analysis and resident focus groups (Fowler, Robinson, and Satin-Hernandez 2018; Murphy, Findley, and Driscoll 2017). At the same time, some academic literature has

begun to consider transportation and food access beyond a food desert framework. This more recent literature has converged around the finding that food insure households have a more difficult transportation experience to food retail compared to food secure households (DeMartini et al. 2013; Shannon 2016). However, there is little research into why that is the case, and there is much more to learn about how individuals get to the grocery store. It is particularly relevant to study transportation to the grocery store in a planning context now since the pandemic poses an opportunity to alter our transportation systems with food access in mind as individuals' mobility has shifted due to social distancing and other restrictions imposed by the pandemic (De Vos 2020).

One way this thesis aims to address this gap is to compare transportation to the store on the basis of food insecurity and transit dependence, and their correlates. The project is informed by my internship with the Healthy Food Retail Project, a collaboration between MIT and Tufts Researchers and the City of Somerville. In this role, I spent months developing, implementing, and analyzing a survey to understand how Somerville residents get to and from the grocery store and changes they would like to see to reduce transportation barriers to the grocery store. The Healthy Food Retail Project, as well as this research, focuses on transit-dependent individuals and households—since they have little or no access to a car, live in areas without food retail options, must use several transit lines to reach an affordable grocery store, and/or are limited by how much food they can purchase based on what they can carry—because they are more likely to experience transportation barriers to food access (Centers for Disease Control and Prevention 2014). Given the documented transportation barriers to food access, and the lack of research on transportation to the store and how transportation systems intersect with food access, I set out to answer the following questions:

1. How does transportation factor into food access from residents' perspective?
2. In what ways are transportation planners paying attention to and addressing food access in their work in the Greater Boston Area, if at all?
3. What limitations do transportation planners encounter when considering and addressing food access in their work?

4. How do transportation planners in Greater Boston view the efficacy and feasibility of selected strategies for improving transportation to the grocery store?

I brought attention to the intersection of transportation and food systems planning in two ways to fill an important gap in the literature. First, I analyzed data from a novel survey on transportation habits to the grocery store to expand planners' understanding of residents' experiences of getting to the grocery store. Previous research using these survey data focuses on residents' attitudes toward a number of food access policies and programs developed by the Healthy Food Retail Project (Chomitz et al. Forthcoming). In this inquiry, I focused on residents' transportation experiences to the store to better understand how food insecure and transit dependent residents access food. Second, I talked with practicing transportation planners about how they are part of, and could be part of, the effort to plan for increased food access. By transportation planners, I am referring to urban planners whose work focuses on overall mobility including how individuals get to grocery stores, among other destinations. Since these planners are experts in transportation systems, I presented them with five potential solutions to address food access challenges related to transportation.

I found that transportation to and from the grocery store is different for food insecure residents and that transportation mode to the store affects food access, particularly for transit-dependent individuals. I also found that the built environment at the neighborhood and city level places limitations on how our transportation systems can function and who they can reach, functioning as both a barrier to food access and a facilitator to address it. It was clear in speaking with transportation planners, that they have devoted little to no attention on food access in their work, which stands in stark contrast to my finding that transportation is an important component of food access. At the same time, transportation planning that explicitly considers food access dovetails with the destination framework planners are keen to employ. This framework centers transit-dependent people and the places they want to access, over commute trips and ridership numbers. Based on the findings from the Somerville resident survey and interviews with transportation planners, I recommend that researchers and planners continue to explore

the proposed strategies, particularly pedestrian and bike infrastructure and public transit, and begin to collaborate across-sectors to improve food access outcomes.

The rest of the thesis will be structured as follows. Chapter 2 reviews the literature on transportation to the grocery store and how food access interacts with transportation systems. Chapter 3 presents five strategies derived from policy reports and plans to integrate food access into transportation planning. Chapter 4 outlines the methods used for data collection and analysis for the survey conducted in Somerville and interviews conducted with transportation planners. Chapter 5 presents and discusses how Somerville residents experience transportation to the store, and how that varies based on food insecurity and transit-dependence. Chapter 6 examines transportation barriers and solutions to food access based on interviews I conducted with transportation planners. Chapter 7 summarizes my research findings and offers takeaways for future practice and research.

CHAPTER 2: LITERATURE REVIEW

INTRODUCTION

The food desert literature is slowly expanding to consider household transportation to grocery stores and, to a lesser degree, transportation systems in a food access context. From the published literature, we know that food insecure households are less likely to own cars and more likely to shop at stores farther from where they live than food secure households. There is little research, however, on the transportation systems that are likely part of the explanation for these findings, and potential planning solutions to address transportation barriers to food access at the neighborhood level. This thesis addresses gaps in the literature both about individuals' experiences with transportation systems to access food and configuring transportation systems that improve food access. This section aims to summarize the existing literature about transportation, on the individual and system level, in a food access context, and clarify the gaps in the literature ripe for further exploration. The remainder of the chapter situates my research in the existing transportation and food access literature, revealing the gap in the literature on strategies and barriers to planning transportation systems for food access.

LITERATURE REVIEW METHODOLOGY

There are three main components of the literature review: the issue of food insecurity and why it is important to address, what transportation to the store looks like for food insecure households, and how transportation systems function more broadly in relation to food access. To find peer-reviewed articles about transportation to the grocery store I searched for one transportation-related term—transit, transportation, transit-dependent, transportation planning, travel mode, car/auto—with a food-related term—food access, supermarkets, grocery shopping—on Web of Science. A search for transit in the topic field and grocery or supermarket in the topic field, for example, yields 33 results (limiting to relevant disciplines using the research fields filter).

To further narrow the results to align with my topic of study, I only included articles from North America and excluded articles from rural areas since my thesis focuses on transportation systems in urban

and suburban areas. I excluded articles that use a purely geospatial approach to food access because these fall into the food desert literature which has been more thoroughly written about, and thus not the focus of my research. I excluded articles that focus on food pantries, since I am studying access to food retail locations. I excluded articles that focus on distribution and supply chains, since I am focusing on the consumer-side of transportation. As testimony to the paucity of research on this issue, I found no peer-reviewed articles in transportation journals that include "food access" in the title and there are two peer-reviewed articles in a public health journal that include "transportation" in the title which demonstrates the need to bridge these two academic fields which are very connected in people's lives.

FOOD INSECURITY

Food insecurity—the lack of access to healthy, affordable, culturally appropriate food—has long been a problem in the US (Ver Ploeg, Dutko, and Breneman 2015). In the 1990s the US Department of Agriculture (USDA) created a quantitative food insecurity measure to replace the nebulous concept of hunger for its statistics and economics research (National Research Council 2006). Soon after that, in the mid to late 2000s, the USDA and academic researchers investigated the phenomenon they refer to as food deserts—geographic regions without grocery stores—in a seminal report to Congress (Ver Ploeg et al. 2009). This USDA report acknowledged the severity of food insecurity and set the course for food access research to focus on food deserts for the five to ten years that followed. Food insecurity remains a major problem today, especially in the wake of the COVID-19 pandemic which has hindered mobility and has led to high unemployment and stagnant wages.

Food insecurity is tied to poverty and presents a major public health problem in the US. Food insecurity is associated with stress, obesity, chronic disease, lower quality of life, and lack of focus at school and work (Franklin et al. 2012; Warren et al. 2020). Food recall data reveals that low-income, food insecure adults eat more processed meat, salty snacks, and sugar-sweetened beverages, and fewer vegetables than food secure low-income adults (Leung et al. 2014). In a systematic review of the literature, researchers found a correlation between food insecurity and risk of depression and stress (Pourmotabbed et al. 2020).

Articles documenting the impacts of rising food insecurity on individuals, communities, and food banks have flooded media outlets such as *the New York Times* and *Boston Globe* in the past year or so (Nanos 2020a; 2020b; D'Amato 2020). As early as March, the Globe reported that the emergency food system would have to kick into high gear to respond to the pandemic (D'Amato 2020). Researchers updating Feeding America's Mind the Meal Gap (MMG) study and interactive map, which estimates food insecurity in the US based on American Community Survey data and data supplements, found that an additional 17 million individuals were food insecure in 2020 than in 2018, when MMG was last updated (Gundersen et al. 2020). Researchers recommended that policymakers adjust national hunger relief programs, such as SNAP, to accommodate higher rates of food insecurity, citing the Brookings Institution's finding that 20% of households were experiencing food insecurity in April 2020 (Hernandez and Holtzclaw 2021)

FOOD DESERTS AND CRITIQUE OF THE CONCEPT

Researchers have studied food deserts, areas that lack access to grocery stores, to deepen their understanding of food insecurity. In its seminal report to Congress defining food deserts, the USDA found that 2.3 million households in the US live in a food desert, or more than one mile from the nearest grocery store, and do not have a car (Ver Ploeg et al. 2009). Ver Ploeg et al. (2015) point out the methodological limitations of relying on neighborhood-level census data to identify food deserts, arguing for an increased focus on individual-level food access measures at the national level. Additionally, studies defining the existence and estimating the impacts of food deserts do not take the "social distance" to stores into consideration which includes sociodemographic characteristics, resident-defined neighborhood boundaries, the built environment, safety, familiarity, car ownership rates, and public transit availability (Broad Leib 2013). My research will add to the literature by looking at some of these social distance factors, often absent from food desert studies.

Geospatial analysis central to food desert research depicts maps with fewer and smaller grocery stores in neighborhoods of color and low-income neighborhoods, compared to whiter and higher-income neighborhoods (Walker, Keane, and Burke 2010; Ver Ploeg, Dutko, and Breneman 2015). Food desert

studies, however, do not usually contextualize how this food retail distribution is a direct result of federal transportation policy, a major limitation of this literature. The term "desert" might imply that areas with low food access are naturally occurring, however, Pothukuchi and Wallace argue that federal transportation policy poured money into highways and car-centered streetscapes, to appease white people who were able to move out to the suburbs during urban renewal in the late 1900s (2009). Karen Washington, a community organizer and activist, and others have gone as far as to relabel the swath of food deserts as food apartheid, denoting the systemic racism embedded in our food system and denouncing the claim that communities of color are desolate of food and community (Brones 2018; Dickinson 2019).

Researchers have focused on examining the effectiveness of healthy corner store initiatives which may help alleviate the lack of food access in food deserts. These initiatives are typically run by city governments or non-profits and provide corner stores and neighborhood markets with resources and technical assistance to stock fruits and vegetables. According to an analysis of data from a national survey of SNAP recipients, less than one percent of SNAP recipients purchase most of their groceries at a corner store, while at the same time they live closer, on average, to corner stores than to grocery stores (Mabli and Worthington 2015). Thus, if these initiatives can make corner stores more appealing for at least some of a household's grocery needs, the household may have less distance to travel to get groceries. The literature has found that these so-called healthy corner store initiatives are more successful with input from community health workers (Rollins et al. 2020), resident engagement (Minkler et al. 2019; Ortega et al. 2015), and "intentional decision-making" about which fruits and vegetables to sell and how to display them (Chrisinger et al. 2018). There is a robust literature evaluating healthy corner store initiatives, yet we know less about how residents get to grocery stores outside their neighborhoods.

TRANSPORTATION TO THE GROCERY STORE FOR FOOD INSECURE HOUSEHOLDS

A majority of the food access literature focuses on food deserts, resulting in a limited amount of research on how individuals get to the store, particularly those who are food insecure. The literature on transportation to grocery stores is limited, and can be categorized into studies that look at drivers of store

choice for food insecure households, studies on how SNAP-recipients and transit-dependent individuals get to the store, and studies on the availability of informal ride share alternatives that transit-dependent households may rely on to get to the store.

Store Choice: The typical household does not shop at the nearest grocery store to where they live (Shannon and Christian 2017; Mabli and Worthington 2015; Jiao, Moudon, and Drewnowski 2011; Shannon 2016; DeMartini et al. 2013). This finding contradicts a common assumption of food desert studies that use GIS to measure the distance from census tracts or block groups to the closest grocery store. In fact, the most oft-cited reason for grocery store choice is price (Mabli and Worthington 2015). Other factors that affect food retail choice are customer service quality, extent of harassment from employees and other shoppers, and space to move around in the store (Shannon 2016). There can be a significant difference in distance to the nearest grocery store and the nearest low-cost grocery store, confirmed by research conducted in Portland, OR. Census tracts without access to an affordable grocery store, which the authors labeled food mirages, tend to occur in lower income neighborhoods (Breyer and Voss-Andreae 2013). These studies establish that proximity is not the primary driver of grocery store choice for food insecure households, leaving much to be desired about the transportation experience of these households.

Transit dependence: The literature has found that marginalized populations are less likely to have access to a car, which impacts their ability to access food. Low-income, Black, and Latinx households are less likely than others to shop in the census tract where they live and are less likely to have access to a car (Wood and Horner 2016; Safe Routes to School National Partnership 2017b). In the US overall, SNAP households are also less likely to drive to the grocery store, 66% of whom drive to the store, compared to non-SNAP recipients, 95% of whom drive to the store (Safe Routes to School National Partnership 2017a). A study in Cincinnati, OH found that food insecure residents, compared to food secure residents, were more likely to use a transportation mode other than a household car to get to the grocery store (DeMartini et al. 2013). Even poor households that do have cars are often on the brink of transit-dependency if they are driving cars with high mileage that are prone to need frequent repairs or if they

have to choose between spending money on gas and other necessities, like rent (Shannon 2016). A study focusing on seniors who receive SNAP found that, due to a lack of transportation access, some are forced to shop at more expensive stores that are closer to where they live where their SNAP benefits do not stretch as far (Warren et al. 2020). While these studies establish that food insecure households and those that receive SNAP benefits are less likely to own a car, they do not explore what transportation modes individuals use instead and what the implications are of those decisions.

Shopping Frequency & Informal Rideshare: There is some evidence that low-income individuals and SNAP recipients may shop less frequently. While part of the reason for this may be that SNAP benefits are received once per month, another may be that individuals can only access transportation to the store infrequently. Two recent studies found that one common transportation mode for households receiving SNAP was getting a ride to the store with a friend or family member, which they may be willing to do only on occasion and therefore be unreliable for the ride recipient (Ma et al. 2018; Warren et al. 2020). Relying on family members and friends limits the shopper's ability to control for item price, quality, and type (DeMartini et al. 2013). While informal rides to the grocery store is an understudied transportation mode to the store, it is beyond the scope of my thesis which focuses on formal transportation systems.

TRANSPORTATION SYSTEMS AND FOOD ACCESS

While there is limited research about how individuals get to the grocery store, we know even less about how transportation systems and infrastructure, such as public transit, sidewalk networks, and bike lanes, interact with neighborhood level food access. Understanding transportation systems is crucial to understanding food access since one's ability to access transportation is dependent on the transportation systems in place connecting the neighborhood in which they live to food retail locations.

Unfriendly Pedestrian Environment: Most grocery stores, especially chain supermarkets and big-box stores like Walmart, are not set up for pedestrian access. Instead, developers are required by municipal zoning codes to include big parking lots in front of their stores, creating an unsafe environment for pedestrians (Hanson 2020). For example, in Houston, TX grocery stores are required to have five

parking spaces for every 1,000 square feet of gross floor area, which is higher than other retail store types (Ord. No. 2013-208, § 2(Exh. A), 3-6-2013). A study based on resident interviews in Canada found that three of the biggest challenges for transit-dependent people in accessing grocery stores were the steepness of the roads leading the store, lack of sidewalks, and inadequate snow removal in the winter months (Terashima, Hart, and Williams 2018). Using GIS, the authors found that the percent of the population that was accessible to at least one grocery store decreased significantly when taking the aforementioned factors into consideration.

The unfriendly pedestrian environment is experienced acutely by people with disabilities who must factor in store accessibility—such as automatic and lightweight doors, flat entrances at the street level, and seating for rest—in addition to store prices. This population points to a number of built environment factors that make it challenging for them to walk to the grocery store including lack of sidewalks, obstructed roads, and hilly topography on the way to the store (Huang et al. 2012).

Public Transit: Researchers have identified a number of barriers to using public transit for food access. Riding a bus to the grocery store is challenging since there is generally no designated place to put grocery bags, groceries are heavy to carry home from the bus stop, transfers may be required, and wait times can be long depending on when you go shopping (Alexander 2004; Pothukuchi and Wallace 2009). A study conducted in Toronto, Canada found that it is harder to access grocery stores by public transit in the early morning and late evening hours when buses and subways run less frequently. This decreased grocery access likely impacts low-income shift-workers the most, who make up a third of the country's workforce (Widener et al. 2017). The situation is similar in Chicago, where low-income workers live in areas of the city with the least accessible public transit to grocery stores (Ermagun and Tilahun 2020). Such patterns surely also dominate elsewhere. Researchers analyzing transit-travel-time data in Cincinnati, OH argued that it is crucial to incorporate time into spatial food access analyses since public transit access varies throughout the day. They find that older adults and households without access to a car are more likely to reside in census blocks with less spatiotemporal access to grocery stores, where it takes more than 20 minutes to get to the nearest store by public transit (Farber, Morang, and Widener

2014). A study in Minneapolis, MN documents an exception to the finding that public transit for food access is ripe with challenges, proving that it is feasible to design transit systems to accommodate shopping, which will be explored further in the next section. This study finds that participants took the bus to a farmers market downtown since it was located at a transit stop where several bus lines converge (Shannon 2016). These studies, for the most part, rely on census and public transit data, leaving a gap in the literature on understanding how residents experience trips to the grocery store at the individual and community level.

Transportation Infrastructure: There are several studies that find a correlation between transportation infrastructure surrounding grocery stores and the transportation mode used by individuals. One of these studies, unsurprisingly, finds that more parking spots encourages individuals to drive to the store (Jiao, Moudon, and Drewnowski 2011). The same holds for bike infrastructure: safe bike lanes connecting residential areas to grocery stores and other non-work destinations are associated with more non-car trips to non-work destinations (Guo, Bhat, and Copperman 2007). Transit-oriented development (TOD), which I will discuss further in the next chapter, is a zoning and development strategy that pairs mixed commercial and residential development with proximity to transit access. Controlling for selection bias, or the type of people who would be more likely to live in a TOD, researchers found that those living in a TOD are more likely to walk to the grocery store than those who do not (Luz Laham and Noland 2017). There is much more to learn about how transportation systems interact with food access, as the studies in this section do not consider whether transportation barriers to food access present a disproportionate burden to certain communities over others.

PLANNING TRANSPORTATION SYSTEMS FOR FOOD ACCESS

Understanding how transportation systems function for food access at the community level has major implications for urban planning, yet we know very little about this topic. Researchers recognize that transportation planners have the opportunity to make public transit more equitable, which can have a big impact on accessibility: “Accessibility, by definition, is the ease of reaching valued destinations by different modes of travel at different times of the day” (Ermagun and Tilahun 2020). One researcher

points to the intersection of transportation planning and food access as a ripe area for future research, since these disciplines are "natural partners" (Shannon 2016). Only two studies home in on how transportation systems impact community food access, both of which happen to focus on public transit. In Baltimore, researchers investigated a new methodology planners can employ to tackle the issues of food access and transit-dependence, which they label "transportation analysis zones." These zones encompass households that live more than 30 minutes, round-trip, from the nearest grocery store by public transit. Recognizing that transportation policy has contributed to inequitable food access, these researchers conclude that transportation planners should prioritize public transit improvements in the identified transportation analysis zones (Plano et al. 2015). Using national data from the Current Population Survey, Baek finds that an extra bus equivalent (a standardized measure for capacity of public transit modes developed by the author) decreases the risk of food insecurity in a neighborhood by 1.6 percentage points. This decrease in risk of food insecurity is driven by poor black households, underscoring the possibility that public transit may be connected to more equitable food access (Baek 2016).

Grocery delivery: Private sector actors are part of our transportation system, and should be considered when looking at the intersection of transportation systems and community food access. Grocery delivery has the potential to increase food access for transit-dependent households, yet was originally developed to save time for more affluent consumers (Gottlieb et al. 1996). The most oft-cited barriers to low-income customers using grocery delivery are the cost (both mark-ups in food prices and delivery fees) and not being able to pay with SNAP benefits (Dillahunt, Simioni, and Xu 2019; Lagisetty et al. 2017; Martinez et al. 2018). I could find only one study evaluating a municipally run grocery delivery program intended for food insecure individuals. The study found that the grocery delivery program run by the City of Baltimore addressed transportation and food access barriers, yet faced significant barriers with regards to purchasing food online with SNAP benefits and working with residents who are not computer literate (Lagisetty et al. 2017). A more recent study published six months into the COVID-19 pandemic found that shoppers are less likely to shop at a traditional grocery store when COVID rates are rising, opening space in the grocery delivery sector (Grashuis, Skevas, and

Segovia 2020). Little research remains, however, on SNAP recipients' preferences regarding using their benefits online. One preliminary study on this topic finds that an easy system for online EBT payments would make SNAP recipients more likely to use grocery delivery (Gupta and Gunther 2020).

Rideshare: Offering low-cost and free rides to the grocery store using rideshare services or shuttles is another potential way to lessen transportation barriers to food access. Food insecurity is a long-term problem, and thus it has proved unsustainable for rideshare companies to subsidize many short trips to and from the grocery store to food insecure individuals indefinitely (Dillahunt and Veinot 2018). A breakeven study found that only ten percent of transit-dependent residents in low-income, high population density, and low car ownership zip codes in California would need to use a grocery shuttle service to make it financially feasible for stores to operate (Cassady and Mohan 2004), yet very few stores operate shuttles today. There are no evaluations of shuttle programs' effect on food insecurity, and only a small handful of descriptive summaries on this topic. There is a significant gap in the literature on how transportation systems relate to food access at the neighborhood level, which my thesis will begin to address.

CONCLUSION

Researchers recognize food insecurity as a significant problem and have focused on identifying and studying food deserts to better understand and tackle inequitable food access. Some researchers are starting to recognize the limitations of studying food deserts and are looking to better understand how individuals and households get to and from the grocery store. There is little research on how transportation systems impact community-level food access, and even less about how to plan transportation systems for increased food access. My project aims to fill part of this gap in the literature in two ways. First, it increases our understanding of how individuals relate to transportation systems in accessing food. Second, it investigates whether transportation planning solutions to food access barriers would be feasible and effective according to transportation planners.

CHAPTER 3: TRANSPORTATION STRATEGIES TO INCREASE FOOD ACCESS

The academic literature points to a research gap at the intersection of transportation and food access. Thus, I turned to reports and plans, which offer a glimpse into how cities have worked to address food access by focusing on local and regional transportation systems and infrastructure. Five overarching strategies came out of my review of this literature, as outlined below.

STRATEGY SEARCH METHODOLOGY

I searched the grey literature for transportation strategies and programs being implemented across the country to increase food access. I searched for these programs by reading reports at the intersection of food access and transportation written by non-profits, academic research centers, city governments, state agencies, and federal agencies. These reports make recommendations to municipal governments to pass policies and create plans that specifically address transportation barriers to food access. These recommendations are rooted in the pervasiveness of transportation barriers to food access and are based on case study research, community feedback through targeted engagement and surveys, and academic literature, rather than data-driven program evaluations. Some reports are limited to addressing food access through the transportation system, while others look to transportation among a suite of topic areas.

I searched Google for "transportation" and "food access," filtering for pdfs, and looked through the first five pages to find relevant reports, in addition to reports cited in the first five page of search results. I included reports that mention food access and transportation together to get at the intersection of these fields and excluded reports that focus on rural areas since my thesis focuses on planning in urban and suburban towns and cities. I excluded reports that focus on walksheds from grocery stores and the lack of grocery stores in low-income neighborhoods, since these are in line with the food desert literature, which is not the focus of my study. I made a list of the specific tools mentioned in the reports to integrate food access into transportation planning, including examples of cities and states implementing these strategies. Based on my knowledge of transportation planning, I grouped these tools into five strategies—transit-oriented development, master plans, public transit, pedestrian and bike infrastructure, and grocery delivery—each of which corresponds to an aspect of transportation planning work.

TRANSIT ORIENTED DEVELOPMENT

One way to increase food access is to plan and implement a transit-oriented development strategy that incorporates food access at the municipal level. Mixed-use development allows commercial, including food retail, and residential development to be integrated with one another, as opposed to typical zoning ordinances which separate residential areas from commercial ones. Transit-oriented development (TOD) takes mixed-use development one step further—building homes, shops, offices, and, potentially food retail, in close proximity to new and existing transit stations (McCann 2006). Fruitvale Transit Village in Oakland, CA, for instance, came out of a 2002 study pushing for the city to put more resources toward community-led TOD, and includes a food access component. This development, managed by a non-profit Social Equity Development Corporation, is home to many community services, such as a senior center, and weekly farmers markets (Hobson and Quiroz-Martínez 2002).

In order to create an overarching policy for working with developers, municipalities pass Transportation Demand Management (TDM) ordinances which require developers to choose among a menu of options to decrease the municipality's reliance on cars. Typically, these ordinances do not mention food explicitly, however one exception is in San Francisco's TDM ordinance which gives developers an option entitled "Healthy food retail in underserved areas." This option requires the developer to provide space for healthy food retail in an area deemed underserved by the city (Safe Routes to School National Partnership 2017a).

MASTER PLANS

Cities create master plans to outline their goals and plans to achieve them, pertaining to each of the elements included in the plan. Common elements include land use, housing, transportation, climate change and the environment, and economic development. In this subsection and throughout the remainder of this thesis, I will use the term master plan to refer to transportation-specific plans or comprehensive city plans that include a transportation element.

While food systems and transportation planners often work in silos, there are some examples of where they have worked together on master planning efforts. In their healthy food retail toolkit, The

Massachusetts Department of Health called on public health professionals in the state to work with transportation planners to integrate food access into their long-range transportation plans (Massachusetts Department of Health 2017). In Siler City, NC, planners worked with the county health department to integrate food access into their most recent pedestrian master plan. This plan held the municipality accountable to prioritizing sidewalk repairs like filling in gaps in high priority areas, increasing shade and pedestrian lighting, and adding ADA accessible curb ramps at intersections that connect residential areas to food retail (Safe Routes to School National Partnership 2017a). By incorporating food access, and public health more generally, into their pedestrian master plan, the city received more funding than it otherwise would have from state grants. In order to prioritize sidewalk repair locations, the planners conducted a Healthy Foods Assessment which categorized all food retail locations (from corner stores to grocery stores) based on availability of fruits and vegetables, whole grains, dairy, and protein such as meat and beans (Healthy Food Policy Project 2017). Broward County, FL offers education and technical assistance to municipalities that incorporate food access into their comprehensive plans through the Food For All Broward County program (Food for All Broward 2013). The regional transit authority in Philadelphia sends a representative to the regional planning agency's Food Systems Stakeholder Committee meetings, building relationships across the silos of transportation and food access (SEPTA 2011).

A number of cities have taken varied approaches to including food access in their comprehensive planning efforts, without necessarily consulting with food systems planners. In Nashville, TN, the regional planning authority used GIS to map demographic and food retail data to identify areas that would benefit the most from transportation investment, prioritizing neighborhoods with relatively high low-income, minority, and/or elderly populations. Nashville's Regional Transit Authority (RTA), the organizational body that oversees the public transit system in the region, now uses this analysis to rank and fund transportation projects in the region (Robbins, Harries, and Wittman Gramann 2019). The regional planning agency that covers the Seattle metro area, called on the city to include specific food access goals in their transportation plans such as setting targets for mixed-use developments and grocery

store walksheds (Underwood-Bultmann 2012). The City of Austin committed to incorporating food access into their transportation planning to create "safe routes to market," which includes prioritizing dense, mixed-use affordable housing, prioritizing key food access corridors in their sidewalk master plan and Vision Zero plan, and developing guidelines to increase walkable food retail outlets (Athens and Marty 2016). The City of San Francisco has articulated a desire to improve their transit system for grocery shopping in particular, without providing specific details about what that would entail (Schively 2007).

PUBLIC TRANSIT

While it can be challenging to use public transit to access grocery stores, municipalities across the country are working on integrating food access and public transit in creative ways. Regional transit authorities (RTAs) are public or quasi-public agencies in charge of providing public transportation in a particular region. RTAs in Atlanta, Austin, Philadelphia, San Francisco, and Washington, DC have partnered with local farmers markets or food systems organizations to set up farmers markets at transit stops to make food more accessible by subway (Safe Routes to School National Partnership 2017b; Food Law and Policy Clinic 2013). Another key recommendation from reports on transportation and food access is to implement fare reduction programs for low-income residents who receive SNAP or WIC benefits (Vallianatos et al. 2011; Safe Routes to School National Partnership 2017a).

RTAs can play a role in shaping food access through service planning, the subset of transportation planning which sets transit routes and stops. In Philadelphia, when a new grocery store opens, the RTA is required to adjust its bus routes and stops to service the store's customers (Safe Routes to School National Partnership 2017a). Using data from store surveys, community meetings, and GIS mapping, researchers in Los Angeles named public transit as one of their six policy recommendations to improve food access through transportation and land use policies. Specifically, they recommended that RTAs adjust transit stops and schedules on routes that pass major supermarkets to facilitate shopping at grocery stores with healthy options, specifically during off-peak hours (Vallianatos et al. 2011).

RTAs can also play a role in making it easier to ride transit with groceries. In Duluth, MN the RTA installed bins to hold grocery bags on express routes that service a grocery store (Weiss, Goebel, and Letofsky 2016). Researchers in Los Angeles suggested that RTAs partner with grocery stores to distribute free or subsidized lightweight shopping carts that users can take on public transit (Vallianatos et al. 2011). RTAs may also consider partnering with grocery store-operated shuttles and/or rideshare companies to fill in service gaps for food access (Vallianatos et al. 2011; Alexander 2004).

PEDESTRIAN AND BIKE INFRASTRUCTURE

Food insecure individuals are more likely to be transit-dependent, without access to a car, making pedestrian and bike infrastructure crucial for improving food access. When working on bike and pedestrian infrastructure, reports recommend that planners use food access as a criterion for project prioritization (Underwood-Bultmann 2012; Vallianatos et al. 2011; Murphy, Findley, and Driscoll 2017). The Puget Sound Regional Council recommended that the Seattle Department of Transportation add pedestrian and bike infrastructure connecting residential areas to community gardens, food pantries, grocery stores, and farmer's markets to their transportation project evaluation criteria (Underwood-Bultmann 2012). Another report warns planners against building or expanding a major road or highway that would interrupt a highly-used walking route to get to a grocery store since it could impede food access for residents (Food Law and Policy Clinic 2013). The final report from a collaboration between a city planning department, graduate planning program, and community development corporation proposes that planners also think about the ways in which grocery stores are built by creating ordinances that require or incentivize building grocery stores up against the sidewalk to promote a safer and more accessible pedestrian environment (Vallianatos et al. 2011). Ordinances can also focus on bike infrastructure such as an ordinance in Los Angeles which allows grocery store developers to substitute up to 20% of required vehicle parking for bike racks (Centers for Disease Control and Prevention 2014). In Washington DC, commercial developers, which includes grocery stores, are required to install bike racks (Broad Leib 2013).

Complete street policies decentralize cars and support mobility for all transit modes including active and public transit. Implementing these policies can include building and improving bike lanes and sidewalks, implementing traffic calming measures, and providing benches and lighting on routes that connect residential areas to food retail locations (University of Delaware 2020). In 2019, Maryland passed an ordinance to add access to healthy food retail as a design feature of its complete streets policy (Food Law and Policy Clinic 2013). New York City published Active Design Guidelines, outlining best practices in active transportation for the city, which it plans to incorporate into zoning codes, building codes, ordinances, and city plans (Safe Routes to School National Partnership 2017a). While these guidelines do not explicitly mention food access, they can be applied in areas surrounding food retail locations. One of the more recent Complete Streets reports, however, cautions that since implementing this strategy makes a neighborhood more attractive to live in, it can raise property values, leading to displacement (Minnesota Department of Health 2017).

GROCERY DELIVERY

While grocery delivery is typically seen as outside the purview of transportation planning, it has been a part of the food access and transportation conversation since at least 1996 when Gottleib et al. released their report, *Homeward Bound*. Grocery delivery has become increasingly important in light of the COVID-19 pandemic, and thus I decided to include it as one of the strategies to integrate food access into transportation planning. The Food Trust is a well-known non-profit organization with the goal of ensuring everyone has access to healthy, nutritious food. In a report for the North Carolina Healthy Food Retail Task Force, they recommend that the task force support grocery delivery strategies in conjunction with other transportation strategies to improve food access (Robbins, Harries, and Wittman Gramann 2019). The Blue Hills Regional Coordinating Council which focuses on equitable transportation in six municipalities south of Boston, has a goal to increase the amount of food delivery options for residents in their region by partnering with community health providers (Ron 2020).

Another grocery delivery strategy available to municipalities is to partner with a delivery company to offer free or subsidized memberships to residents. Two counties in Michigan partnered with Shipt to

offer a free yearly membership to the service for seniors which waives delivery and membership fees using funding from the CARES Act. Shipt provides same-day delivery from local stores, and program participants only pay for the cost of the food (Oakland County Michigan 2020; Szwarc 2020). Imperfect Foods is a for-profit company that sells food that would otherwise go to waste. It offers its grocery delivery box at a 33% discount to customers who are SNAP-eligible (Imperfect Foods 2021).

COMMUNITY ENGAGEMENT

While I did not include community engagement as a potential strategy to integrate food access into transportation planning, it is central to many of the reports I read. One team of academics reflected this desire for community involvement in public processes by forming a working group of community members to come up with and rank several transportation solutions to food access (Vallianatos et al. 2011). Another report proposes a community-led organization that bridges transportation planning and community development to empower communities to address their transportation needs (Alexander 2004). And the Ohio Department of Health published a brief on health equity and mobility justice in 2019, emphasizing the need to lift up the experiences of the most transit-dependent when investing in transportation infrastructure ("Health Equity and Mobility Justice" 2019).

CONCLUSION

While these reports offer a glimpse of potential strategies transportation planners can implement to increase food access, the effectiveness and feasibility of these strategies remains largely unknown. First off, there are few instances of these strategies being implemented, and second, when they have been implemented, they have not been evaluated for their effectiveness in improving food access. This thesis aims to understand the extent to which these strategies are feasible and worthwhile to pursue based on the knowledge and experience of practicing transportation planners.

CHAPTER 4: METHODOLOGY

INTRODUCTION

I used a mixed-methods approach to answer my research questions. First, I look to Somerville, MA to explore transportation barriers to food access because I have access to novel data from an original 600-person survey of the city's residents, with a focus on reaching transit-dependent residents. I conducted a quantitative analysis of transportation mode to the grocery store, and how transportation mode is related to shopping habits and demographics. I examined open-ended comments from the same survey to bolster results from the quantitative analysis. Second, I conducted semi-structured interviews and a brief survey with transportation planners and analyzed these qualitative data. Interviews provided me an opportunity to tailor my conversations to each planner based on their specific role and area of expertise, and to generate in-depth data about food access in transportation planning work. Including the brief survey allowed me to effectively compare the planners' reactions to a set of proposed strategies.

SOMERVILLE RESIDENT SURVEY

Introduction

I conduct a quantitative analysis of transportation and grocery shopping data from a survey of residents in Somerville, MA. Somerville is a relevant city to study food access due to its relatively high rates of poverty, correlated with food insecurity, and the transportation equity challenges it faces. While food insecurity data does not exist at the municipal level, Somerville is located in Massachusetts, which Feeding America, the national organization overseeing food banks, predicts will be the state with the biggest increase in food insecurity as a result of the pandemic (Feeding America 2020). Furthermore, the percent of Somerville's population living in poverty is four percentage points greater than the state average (13% compared to 9%) (U.S. Census Bureau n.d.).

The city's mobility department has recognized transportation equity as an issue, incorporating equity goals into the transportation element of the Somerville master plan, given the city's current transportation infrastructure. The hilly topography in Somerville, coupled with narrow streets and on-

street parking limits direct North-South bus routes connecting certain neighborhoods to key food retailers (City of Somerville 2020). According to a 2009 transportation and infrastructure report, only 20% of residents are satisfied or very satisfied with the frequency of bus service in the city (City of Somerville 2009). The East Somerville neighborhood, which has a higher percentage of minority, low-income, and English isolation residents, is cordoned off from the rest of the city, including food retail locations, by McGrath Highway and I-93 (Fowler, Robinson, and Satin-Hernandez 2018). Numerous transportation reports and plans in the city dating back to 2008 recognize the importance of equitable transportation which includes bringing marginalized communities to the decision-making table (City of Somerville 2020; 2009; Reconnecting America 2008).

Survey Development and Measures

A novel survey was conducted in Somerville in Winter 2019-2020 by an interdisciplinary research team of practitioners from the City of Somerville and scholars from Tufts University and MIT. I served as the research assistant on this team where I coordinated data collection and performed data analysis. The goal of the survey was to better understand transportation habits to the grocery store for Somerville residents, particularly those who may be transit-dependent, and to gauge interest in a number of food access models to address these barriers. I only analyze the former in this thesis, as the food access model data has been analyzed previously as a part of the aforementioned Healthy Food Retail Project (Chomitz et al. Forthcoming).

The survey questions were largely based on the results from six focus group conversations about consumer preferences, patterns, and insights with respect to the food system held as a part of the Somerville Community Food Systems Assessment. Each focus group was held jointly with one of the city's partner organizations, who were responsible for recruitment, and a total of 74 participants came to the focus groups (Fowler, Robinson, and Satin-Hernandez 2018). The survey includes questions about 1) grocery shopping and associated transportation habits, 2) ideal transportation mode for grocery access, 3) willingness to use several food access models, and 4) household demographics. The data analysis

included in this paper will be limited to 1, 2, and 4 above, and will not include results about respondents' likelihood to use proposed food access models.

Respondents were asked which transportation modes they currently use to get to and from the store and could check one or more modes from a list of 12 modes, including "other." Respondents were also asked *What would be your **ideal way** to get to the store where you buy your groceries? [Choose only one option]*. Choices included the 12 modes from the previous question, and *I am happy with how I get to the store*. The survey asks about the likelihood that the respondent will use five proposed food access models, which are not relevant for this thesis. To gauge food insecurity, the two-question Hunger Vital Sign™ screening test is included which is designed to identify households at risk of food insecurity (Hager et al. 2010). The survey also asks whether the respondent's household has a car and whether the respondent has a smartphone, which is required to use most rideshare services.

Two versions of the survey were developed to elicit a high response rate, specifically from priority populations. The research team identified the most important questions on the full-length survey and created a second, brief version of the survey with 15 fewer questions (24 questions total) to use as an intercept survey. By partnering with SomerViva, Somerville's Office of Immigrant Affairs, the survey was translated into Spanish, Haitian Creole, and Portuguese, which are the most common languages spoken in Somerville after English. This paper uses results from both versions of the survey. Data analysis is conducted with results from both surveys if the data comes from questions that are in both surveys. Some data analysis is limited to data from the full-length survey only. The study was approved by the Tufts University Social, Behavioral & Educational Research (SBER) Institutional Review Board (IRB) as exempt human subjects research.

Data Collection and Sample Selection

Residents in Somerville who are most vulnerable to food insecurity (lower income, immigrant, and/or transit-dependent) were the priority respondent group and the data collection methods were tailored to oversample this group. We used both in-person intercept surveys and online self-administered surveys to maximize sample size and our priority population. In-person survey locations were chosen to

capture responses from low-income residents whose transportation and food access choices may be constrained, and users of food assistance programs that are only accepted at select locations, thus possibly constraining their geographic access even while expanding their financial access to food. Some of the survey respondents do not live in Somerville, and we can account for this by limiting our sample to respondents with Somerville ZIP codes. I use all respondents in my analysis, since I hope to learn about transportation to the store for all individuals, in particular for transit-dependent and low-income individuals, who are more likely to shop at grocery stores outside their immediate neighborhood.

We collected data online by sending a Qualtrics survey link to three email list serves maintained by the City of Somerville (Sustainaville, Resistat, and a city councilor's newsletter) and the Health Happenings list serve managed by the Cambridge Health Alliance. Respondents to the online survey were entered into a raffle to win a $50 visa gift card—one of every 50 respondents was chosen randomly to win the raffle. We conducted intercept surveys at 17 sites: two grocery stores over four occasions, two mobile farmers market sites, eight community events, and two social service sites on three occasions. The data collection team received permission from the grocery store manager or event organizer to collect survey responses. In grocery stores, surveyors stood outside the store or at the check-out lines depending on the manager's preference. At the Head Start, the surveyors asked caretakers to participate after drop-off. At the WIC office the surveyors asked those in the waiting area to take the survey before their appointment. Respondents to the intercept survey received $5 in cash as an incentive upon completion of the survey.

Respondents chose whether to complete the intercept survey electronically, on an iPad provided by the data collection team, or by hand, with a printed copy of the survey. In addition, respondents had the option to complete the survey on their own or have one of the team members read the questions aloud and respond verbally. This latter option was always available to English-speaking respondents. Speakers of Portuguese, Spanish, and Haitian Creole only had this option when a translator was with the data collection team. In-person Spanish translation was available at all of the grocery store and social service site locations. In-person Portuguese translation was provided at two of the grocery store survey dates. In-person Haitian Creole translation was available at one community event and one grocery store date. The

survey took less than ten minutes, on average, to complete. Overall, the survey sample reflects the city's demographics well when it comes to race, percent English-speaking, and highest level of education completed as shown in Table 1, which I will discuss further in Chapter 5 where it appears.

Statistical Analysis

Statistical analysis was conducted using Stata, version 16, and Microsoft Excel. I used descriptive statistics and bivariate analysis to understand the sociodemographic breakdown of the sample and how they get to the store. Mean values with standard deviations (SDs) were calculated for sociodemographic characteristics, transportation mode, travel time, ideal transportation mode, and stores frequented. Mean values for whether transportation mode changes quantity and kind of foods purchased, broken down by transportation mode, are plotted using Microsoft Excel. I have data for the full sample for all variables included in this analysis except grocery store frequented and whether transportation influences quantity and kind of food purchased, where there is only data from respondents who completed the full-length version of the survey.

Bivariate analysis was calculated for transportation mode, travel time, ideal mode, and store frequented with eight sociodemographic variables. Eight demographic and socioeconomic variables were selected for bivariate analysis based on their known relation to food insecurity and transit dependence, and I will refer to them as key explanatory variables. Two of these eight variables are proxies for food insecurity and transit dependence themselves. The proxy for food insecurity is answering yes or maybe to one of the Hunger Vital Sign™ questions (see *Survey Development and Measures* subsection), which is more accurately described as being at risk of food insecurity since these two questions alone cannot measure food insecurity prevalence. Food insecurity, by definition, is closely tied to poverty: since I do not have data on poverty nor income, I use low education, not having a college degree, as a proxy for income. Previous research on food insecurity has found higher rates of food insecurity among people of color, households with kids, and older adults (Clay et al. 2018; Gundersen et al. 2020; Odoms-Young 2018), thus I include these three variables. The proxy for transit dependence is not having access to a household car. I include large household size since it requires feeding more people, which affects the total

cost of food and how one chooses to get to the store. I did not conduct a regression analysis with data on transportation to the grocery store due to probable collinearity issues between the variables of interest. Furthermore, bivariate analysis allows me to explore the association between transportation mode and key explanatory variables, as opposed to developing a comprehensive explanation of the factors that predict mode choice to get to the store.

TRANSPORTATION PLANNING EXPERTS

Interviewee Selection

I conducted 15 semi-structured interviews with transportation planners working in the Greater Boston Area about food access in the projects they are working on and potential strategies to explicitly address food access. I used a snowball method and LinkedIn to select interviewees, starting with alumni of the Tufts Urban and Environmental Policy and Planning (UEP) program since alumni would be more willing to talk with me and are more likely to think holistically about transportation planning given the UEP curriculum. I made sure my selection of planners included those who work for city government, transportation-focused non-profits, private planning firms, regional transit authorities, and regional planning organizations in order to hear from planners across the transportation field. I interviewed planners who work exclusively on transportation, a subset of which focus on public transit and/or active transit, and planners who serve a variety of functions including transportation. I recorded each interview on Zoom which outputs an audio recording, an audiovisual recording, and a transcript of the conversation. I also took comprehensive notes during the interviews.

Six planners I spoke with work for a municipal government, a town or city. These planners work in Boston, Everett, a predominantly immigrant community just outside Boston, Watertown, Somerville, and Stow, a small town in the outer lying suburbs of Boston. Four planners I spoke with work at consulting firms, where they consult with municipalities and states on transportation projects. Two planners I spoke with work for the Metro Boston Transit Authority (MBTA), which is the Regional Transit Authority (RTA) for the metro Boston area. One planner I spoke with is a student at the Urban and Environmental

Policy and Planning program at Tufts focused on transportation planning and with previous work experience in the field. I spoke with two planners at the Metropolitan Area Planning Council (MAPC) which is the regional planning organization for metro Boston that consults with cities and towns in the region. I conducted one interview with the coordinator for the Blue Hills Regional Coordinating Council, a council working on community transportation in Braintree, Hingham, Hull, Milton, Quincy, Randolph and Weymouth. Lastly, I spoke with a planner who works at a transportation research and policy non-profit as the head of their Boston Bus Rapid Transit (BRT) program.

Interview Guide Creation

The overall goal of the interviews was to guide transportation planners through a conversation to think about how food access is relevant to their work. There were three lenses through which I wanted the interviewees to think about this intersection in order to answer my research questions: awareness of food access, the limitations to incorporating food access, and transportation strategies that address food access. Questions one and four of the interview guide, included in the appendix, touch on this first lens. In question two, I list six transportation barriers that the academic literature identifies to food access and I ask the planners whether and how these barriers resonate with their work experience. The barriers are carrying groceries home from the store, location of transit stops, long wait times for buses, transferring buses, unsafe pedestrian access around grocery stores, and lack of safe bike routes to grocery stores. In question five, I list strategies to integrate food access into transportation planning that I gleaned from the grey literature search I conducted. I did not include rideshare among the strategies, even though it is part of the transportation system, since it is an expensive transportation mode, and thus, financially unsustainable to subsidize for food insecure individuals (Dillahunt and Veinot 2018). I did not include shuttle programs as a strategy either since grocery-operated shuttles reached their peak in the late 1990s, and have since declined (Gottlieb et al. 1996).

The planners I spoke with are representing their thoughts, opinions, and experiences as transportation planners, and do not represent the agency, office, or company for which they work. They

all provided written consent for their thoughts and quotes to be included in my thesis. They agreed to be referenced by their workplace and job title, and not by their names.

Qualitative Analysis

I analyzed the qualitative interview data using grounded theory and issue-focused analysis. I implemented open coding to analyze the interview data, creating categories that would become the sections and subsections of my thesis chapter on transportation experts, drawing from established coding methodology (Weiss 1995; Corbin and Strauss 1990). Throughout the coding process, I paid attention to differences and similarities of interviewee's comments within and between the data categories I devised. Awareness of these similarities and differences led me to find patterns and variations in the data (Corbin and Strauss 1990).

Directly following each interview, I read through my notes to fill in any gaps and add headers for each of the topics we talked about for a first pass at coding the data. After all the interviews were conducted, I used NVivo Version 12 to do the remainder of the coding. I went through the notes from each interview and assigned specific sentences and sections to codes representing themes based on the interview questions and topics that came up in multiple interviews. I repeated this process two more times, adding sub-codes within each of the first-level codes.

Survey Design and Analysis

In order to better compare how planners viewed the proposed strategies to integrate food access into their work, I designed a survey to complete at the end of each interview. The survey was created and taken using Qualtrics software licensed by Tufts University. All survey questions were set up with a five-point Likert scale to gauge transportation planners' opinions. The first two questions in the survey were designed to determine how much unfulfilled potential there is to integrate food access into transportation planning. Then, the planners were asked to rate each strategy on two dimensions, feasibility and effectiveness, in the context in which they do transportation planning work. This part of the survey was designed so I could analyze the planners' beliefs about the relative feasibility and effectiveness of the

strategies. See Appendix II for a complete list of the survey questions. I downloaded the survey data from Qualtrics into Excel and completed data analysis using Microsoft Excel. I counted the number of responses for each point in the five-point Likert scale to determine the distribution of how planners responded to each question.

CHAPTER 5: SOMERVILLE RESIDENT SURVEY

This chapter uses novel data from the survey conducted with Somerville residents in Winter 2020 to help answer the question of how transportation to food retail matters for Somerville residents, particularly those vulnerable to food insecurity. The first section gives background about the city and summarizes why it is relevant location to study this topic. The second section reports survey results in six subsections: demographics, transportation mode to the store, travel time to the store, ideal transportation mode to the store, differences in quantity and kind of groceries purchased, and which stores respondents shop at by transportation mode. The first four subsections include data from all survey respondents, whereas the last two subsections only include data from the full-length survey, a smaller and less representative sample than the sample of all respondents. The final section discusses the results in relation to the literature on transportation to the grocery store.

ABOUT SOMERVILLE

Somerville, MA lies just across the Charles River from Boston, and with a population of over 80,000 people is the most densely populated municipality in New England. Somerville is home to many young adults, partly because Tufts University sits on its border with Medford, as well as a sizeable immigrant community that is threatened to be displaced as rents and home prices continue to rise. Thirteen percent of Somerville residents live in poverty and the rate is higher for children, the elderly, and female-headed households, thus the city struggles with food insecurity, as the two are closely linked (Fowler, Robinson, and Satin-Hernandez 2018). Transportation equity is also an issue in Somerville, especially for residents in East Somerville and those who rely on buses, which often run late and do not run on the city's North/South axis (City of Somerville 2020). The survey data I turn to in this chapter is the first time the city has directly connected food insecurity and transportation, as the current transportation element of the comprehensive plan focuses on commuting, safety, and equity, without mentioning food access.

SURVEY RESULTS

Demographics

Table 1: Demographics of Survey Sample Compared to Somerville Census Data

	(1) All Respondents	(2) Somerville Respondents	(3) Somerville Census
Age & Gender			
Female	72%	74%	50%
Under 5 in Household	19%	17%	NA
Under 18 in Household	33%	29%	17%
Older Adult in Household[a]	37%	31%	26%
Education			
Less than HS	5%	4%	8%
High School or GED	10%	8%	13%
Some College	11%	9%	9%
Graduated College	29%	30%	39%
Masters or Higher	45%	49%	31%
Race			
American Indian	1%	1%	0%
Black	9%	6%	7%
White	65%	74%	76%
Asian	9%	9%	10%
Native Hawaiin	0%	0%	0%
Hispanic	11%	9%	11%
Brazilian	3%	3%	NA
Household			
HH Car	71%	71%	58%
Own Smartphone	90%	93%	NA
Language Survey Taken			
English	88%	92%	85%
Spanish	6%	4%	NA
Haitian Creole	0%	0%	NA
Portuguese	6%	5%	NA
N	578	418	NA

Notes: NA stands for not available; HH stands for household; Data from columns (1) and (2) are from the survey; Data for column (3) comes from the 2019 American Community Survey and was accessed by the author on data.census.gov

[a]Adults older than 60 for columns (1) and (2); adults older than 65 for column (3)

There were 578 respondents to the survey, about half of whom are non-white and have a bachelor's degree or higher, and a majority of whom are female. Just under three quarters of the respondents live in Somerville (72.3%)—we did not make living in Somerville a condition of responding to our survey, as people often shop in a different municipality from where they live. The survey respondents are more racially diverse and less educated than Somerville as a whole. A little over half of the survey respondents (N=385) completed the full-length version of the survey, which is less representative of the target population. For example, 87% of the full-length survey sample has a bachelor's degree or higher, 77% is white, and 94% took the survey in English.

Table 1 compares the demographics of the complete survey sample, the survey sample who lives in Somerville, and Somerville as a whole. The survey sample has a higher percentage of females than Somerville overall by 20 percentage points, and a higher percentage of people without access to a car by 13 percentage points. The average age of survey respondents is 10 years older than the city average. There are a higher percentage of households with individuals under 18 and over 60 in the sample compared to the city as a whole. We designed the data collection process to oversample transit-dependent residents and people of color; thus it is logical that the survey sample has a higher percentage of people without access to a car. Females and households with older adults and children have higher levels of food insecurity, so it is not a concern that these populations are overrepresented in the survey sample.

Table 2: Key Explanatory Variables

	Percent	#
At risk of food insecurity	22%	127
No household car	29%	168
Older adult (60 or over) in household	37%	214
Have children or teens under 18	33%	188
Have children under 5	19%	110
Large household (5 or more members)	19%	110
Less than college	25%	146
Not white	35%	201

Note: percent of respondents calculated based on total respondents to the survey, 578

Table 2 reports the percent and number of respondents that fall into each of the key explanatory variable categories introduced in the Methodology chapter, chosen since they represent or are correlated with food insecurity and transit dependence as determined by previous research (Clay et al. 2018; Gundersen et al. 2020; Odoms-Young 2018). A little under a fifth of the survey respondents have children under five, and about the same amount live in a large household, defined as five or more members. Just over one fifth of the sample is at risk of food insecurity, and 29% of the sample does not have access to a household car, my proxy for transit dependence. While the in-person survey targeted food insecure individuals, the data used in this analysis also includes respondents to the online survey which has a lower rate of food insecure individuals. The most prevalent of the key explanatory variables is having an older adult in the household, which is true for 37% of the sample, followed by non-white respondents, 35% of the sample.

Looking at the overlap of food insecurity and transit dependence, respondents who are at risk of food insecurity are more likely to be transit dependent, not have access to a household car, compared to those who are not: 33% compared to 17%, as reported in Table 3. Also reported in Table 3, is a bivariate analysis for each of the key explanatory variables listed in Table 2 by risk of food insecurity and transit dependence. Prevalence of all key explanatory variables are higher for respondents at risk of food insecurity compared to those not at risk. A higher percentage of food insecure respondents have less than

Table 3: Key Explanatory Variables by Food Insecurity and Transit Dependence

	Food Insecurity		No Household Car	
Explanatory Variable	Yes	No	Yes	No
At risk of food insecurity			33%	17% ***
No household car	44%	25% ***		
Older adult (60 or over) in household	46%	34% **	40%	35%
Have children or teens under 18	47%	28% ***	21%	37% ***
Have children under 5	29%	17% ***	13%	22% **
Large household (5 or more members)	32%	15% ***	19%	18%
Less than college	57%	16% ***	34%	22% ***
Not white	61%	27% ***	40%	33% **
Total	22%	78%	29%	71%

*** p<0.01, ** p<0.05, *p<0.1

N=578

a college degree and are non-white, whereas a lower percentage of food insecure respondents have children and young children.

Transportation Mode to the Store

A majority of the survey sample drives to and from the grocery store, followed by walking and taking public transit. Table 4 reports the percent of respondents who use each of transportation modes listed on the survey to get to and from the store, sorted by the most popular mode. We were interested in distinguishing between travel to and from the store because the burden of carrying the groceries on the return trip might have implications for transportation choices. However, since less than 10% of the sample take different transportation modes to and from the store, the rest of the analysis will look at transportation to the store only. Driving a household car is the most common way respondents get to the store (61%) and 14.5% of households with a car do not typically use their car to get to the store. The second most common way that respondents get to the store is by foot (48%), followed by the public transportation (22%) and car/ride share (18%).

Table 4: Transportation Mode to and from the Store

Transportation Mode	To Store		From Store	
	%	N	%	N
Household Car	61%	355	61%	353
Walk	48%	280	46%	263
Public Transit	22%	124	18%	106
Bus	16%	90	13%	77
T	6%	34	5%	29
Car and Ride Share	18%	104	19%	108
Drive friend/family's car	8%	44	6%	35
Rideshare (Uber or Lyft)	4%	25	6%	36
Taxi	4%	20	4%	24
Borrow friend/familys' car	3%	15	2%	13
Bike	12%	69	11%	61

Note: Respondents can choose more than one transportation mode so totals and percents do not add up to 100%; N=578

The transportation mode breakdown for each of the key explanatory variables reported in Table 5 reveals that there are significant differences in how households get to the store. Over a third of respondents who are at risk of food insecurity and with no access to a household car take public transit to the store, significantly higher than food secure and car-owning respondents (10% of whom take public transit to the store). About a quarter of respondents without a college degree and who are not white take public transit to the store, significantly higher than respondents with a college degree or higher and who are white.

Table 5: Transportation Mode to the Store for each Explanatory Variable (%)

Explanatory Variable	Walk	Bike	Public Transit	Household Car
At risk of food insecurity	42% *	9%	35% ***	45% ***
No household car	66% ***	16% *	41% ***	4% ***
Older adult (60 or over) in household	41% ***	10%	21%	62%
Have children or teens under 18	43% *	10%	19%	72% ***
Have children under 5	48%	12%	17%	69% *
Large household (5 or more members)	36% ***	9%	24%	60%
Less than college	27% ***	7% **	28% ***	52% ***
Not white	38% ***	6% ***	25% ***	54% ***
Total	48%	12%	19%	61%

*** p<0.01, ** p<0.05, *p<0.1

Note: Respondents can choose more than one transportation mode so percents do not add up to 100%; N=578

Respondents in large households are significantly less likely to walk to the store than their counterparts in households with under five members, and households with children are significantly more likely to drive. Respondents with less than a college degree and respondents of color are different from their counterparts, those with a college degree or higher and white respondents respectively, for all four transportation modes. It is logical that respondents with older adults in the households, who are in large households, and who have children, drive to the store at higher rates than their counterparts, households without an older adult, with less than five members, and without children, given limited mobility and the amount of groceries needed respectively. Respondents of color and without a college degree are more

likely to take the bus and less likely to take a household car, which tracks with the fact that poverty and food insecurity affect these groups disproportionately. These data point to clear equity concerns for accessing both food and transportation—marginalized populations are disproportionately taking public transit to the store and they are driving to the store at a lower rate than white, car-owning, food secure households.

Travel Time to the Store

A higher share of transit dependent households, households at risk of food insecurity, and households with factors that correlate to these outcomes, have longer travel times to the store, as reported in Table 6. The only groups without a significantly longer travel time to the store are households with children (both 18 and younger and 5 and younger). Overall, it takes 18% of respondents 20 minutes or more to get to the grocery store, the cutoff I establish for a long travel time to the store. Non-white respondents have longer travel times to the store for all transportation modes. For instance, 50% of non-white respondents who use the bus or T have long travel times compared with 31% of white respondents. One respondent of color who takes the bus to Market Basket wrote the following: "Market basket is down a large hill. Hard to walk. I use a cart. Bus is two transfers 87 to 88 very indirect. Takes too long. Low-cost ride up and down the hill would be great." This pattern holds for driving to the store—20% of non-white respondents have a long travel time compared to 6% of white respondents—and walking to the store—28% of non-white respondents have a long travel time compared to 13% of white respondents.

Table 6: Percent of Respondents with a Long Travel Time to the Store (20 minutes or more) for each Key Explanatory Variable

Key Explanatory Varaible	Yes	No	
At risk of food insecurity	35%	14%	***
No household car	31%	13%	***
Older adult (60 or over) in household	28%	13%	***
Have children or teens under 18	20%	17%	
Have children under 5	21%	18%	
Large household (5 or more members)	27%	16%	***
Less than college	32%	14%	***
Not white	28%	13%	***
Total (N=578)	18%	82%	

*** p<0.01, ** p<0.05, *p<0.1

The results on travel time to the store by transportation mode for respondents at risk of food insecurity compared to those who are not at risk are equally stark. For example, 39% of respondents at risk of food insecurity have a long walk (20 minutes or more) to the store compared to 12% of respondents not at risk. A larger share of respondents in large households and older respondents also have longer travel times to the store compared to their counterparts, an important finding since getting to the grocery store could be particularly onerous for these groups.

These data point to inequities in the transportation and food systems as a greater share of vulnerable populations spend 20 or more minutes getting to the store. The survey does not ask about the distance traveled to the store, and thus we do not know for certain whether the longer travel times for vulnerable populations can be attributed to longer distances, inadequate transit for their routes, other factors, or a combination of these factors.

Satisfaction with Current Modes of Transit and Ideal Ways to Travel to the Grocery Store

Overall, only just over half of the respondents are happy with how they currently get to the store, leaving 43% of respondents unhappy. Happiness data comes from a survey question asking respondents their ideal transportation mode to the store with one of the options being that they are happy with their current mode. Thus, the 43% of respondents who are not happy with how they currently get to the store, selected an ideal mode for how they would like to get to the store. Overall, the most popular transportation modes for respondents who are not happy with how they get to the store are walking (45%), driving a household car (22%), and taking public transit (10%) (bus or T). The biggest difference

Table 7: Ideal Transportation Mode (or happy with current mode) by Key Explanatory Variables

	Risk of Food Insecurity			Have Children			Less than College Degree			Nonwhite		
Ideal Mode	Yes	No		Yes	No		Yes	No		Yes	No	
Happy	65%	60%		61%	61%		65%	60%		67%	59%	*
Walk	12%	23%	***	18%	23%		7%	26%	***	14%	25%	***
Bike	0%	4%	*	1%	4%		0%	4%	**	2%	3%	
Public Transit	7%	4%		4%	5%		8%	3%	**	4%	5%	
Household Car	16%	9%	**	16%	8%	***	19%	7%	***	13%	9%	*

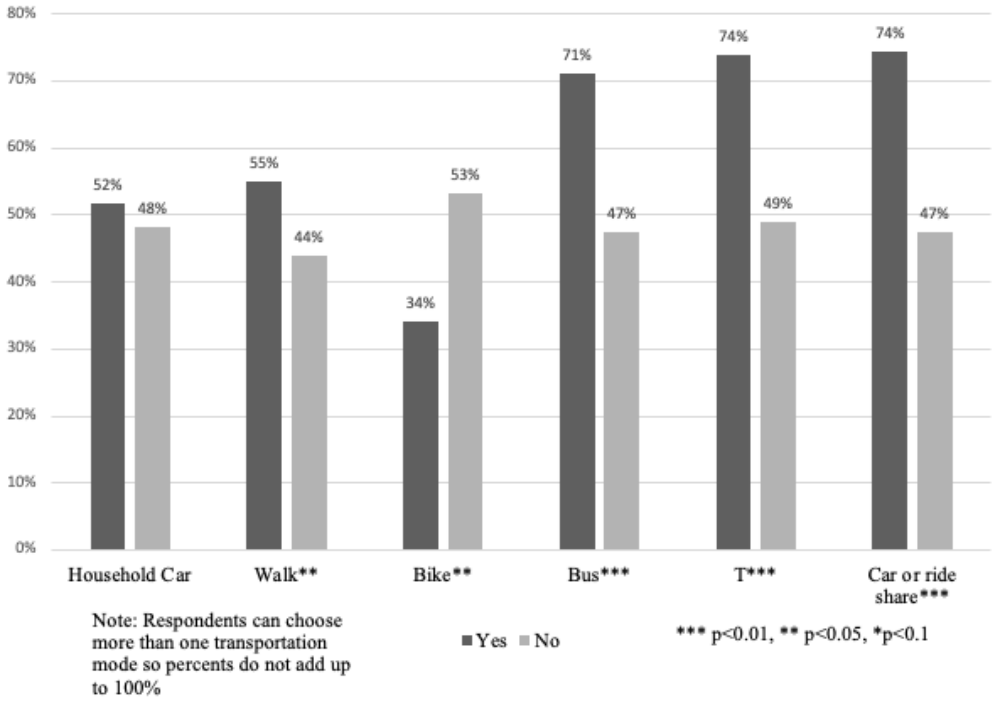
*** p<0.01, ** p<0.05, *p<0.1 N=578

in happiness by current transportation mode is between respondents who take public transit to the store, of whom 27% are unhappy, and those who do not, of whom 12% are unhappy. In terms of travel time to the store, 60% of respondents who spend 20 or more minutes getting to the store are unhappy with their current transportation mode compared to 40% of respondents who spend less than 20 minutes. The data for ideal transportation mode for respondents without access to a household car reveal that just over half are happy with their current mode, 15% would prefer to walk, while 8% would prefer to drive their own car.

Counter to our expectations, respondents at risk of food insecurity, or whose demographics correspond with higher risk of food insecurity, are about equally as happy with how they get to the store compared with respondents who are food secure as seen in Table 7. The majority of respondents at risk of food insecurity who are unhappy with how they get to the store would prefer to drive, whereas food secure respondents who are unhappy would prefer to walk to the store, as shown in Table 7. This finding holds for respondents without a college degree and who are non-white—a greater share of these respondents who are unhappy with their current mode would prefer to drive compared to walk to the store. The survey data do not provide a clear answer for why food insecure respondents would prefer to drive compared to walk to the store, though it reflects car culture in low-income communities and communities of color where having a car is often associated with "making it." The survey data also do not reveal whether the 65% of food insecure respondents who are happy with how they get to the store, would, under ideal circumstances, use another transportation mode to get to or from the store, a limitation of the study based on the survey construction.

Quantity and Kind of Groceries

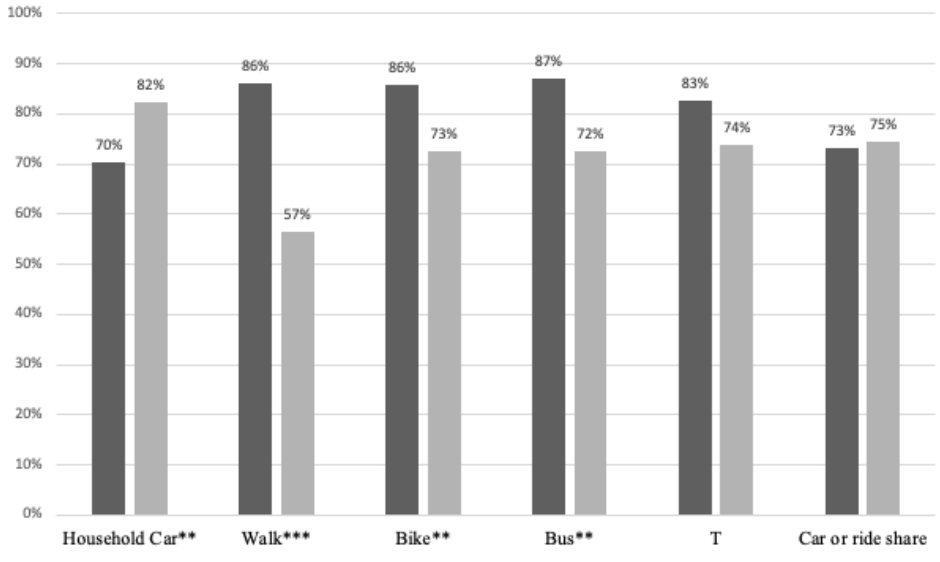
Figure 1: Percent of Respondents Reporting that Transportation Mode Affects the **Kind** of Food they Purchase by Transportation Mode



Note: Respondents can choose more than one transportation mode so percents do not add up to 100%

*** p<0.01, ** p<0.05, *p<0.1

Figure 2: Percent of Respondents Reporting that Transportation Mode Affects the **Quantity** of Food they Purchase by Transportation Mode



Note: Respondents can choose more than one transportation mode so percents do not add up to 100%

*** p<0.01, ** p<0.05, *p<0.1

The survey results indicate that transportation mode affects both the quantity and kind of groceries one purchases at the store, as shown in Figures 1 and 2. A greater percentage of respondents who travel to the grocery store by foot, bus, T, and car/rideshare compared to people who do not take these modes indicated that the transportation mode they took to the store influenced the *kind* of groceries they bought. The results are most stark for public transit and rideshare. For example, 71% of respondents who take the bus to the store report that taking this transportation mode to the store modified the kind of food they buy compared to 47% of respondents who do not take the bus. We do not know what kinds of groceries respondents avoid or substitute if they indicated that their transportation mode to the store influenced the kind of groceries they purchased, though it would be reasonable to assume that individuals carrying groceries purchased less bulky and lighter foods.

A greater percentage of respondents who travel to the store by foot, bus, and bike compared to people who do not use these modes said that they modified the *quantity* of groceries they bought based on the transportation mode they took to the store. These results reflect what we would expect since when using these modes, one has to carry groceries (or attach them to a bike), which is not true for modes involving a car. One respondent articulated limitations to walking home with a lot of groceries, and how that relates to affordability:

> The ideal would be if supermarkets had delivery services like they used to. I can only buy what I can carry home. I also pay more because I can't carry the larger sizes of groceries. Sometimes I end up buying things at expensive convenience stores.

Respondents at risk of food insecurity and who are transit dependent are more likely to walk and take public transit and are thus more limited in both the quantity and kinds of food they can purchase. This is a compelling indication that inequities in the transportation system influence the kind and quantity of food that individuals purchase, which are directly related to whether someone is at risk of food insecurity.

Grocery Stores Frequented

Respondents to the full version of the survey were asked to list up to three grocery stores at which they typically shop. Table 8 reports which transportation mode respondents used to get to the store for the eight most popular stores frequented by respondents. To understand the implications of these data, it helps to be familiar with the grocery stores in and bordering Somerville in relation to the demographic makeup of each store's location. Map 1, developed for the Somerville Community Food Systems Assessment, shows the location of all the grocery stores listed in Table 8, except for Neighborhood Produce which is a newer neighborhood market, as opposed to a full-service grocery store, and median income at the census block group level. Market Basket is located near the Union Square neighborhood of Somerville, over a 20-minute walk to the nearest T stop, and is known for having low prices and culturally diverse products. There are two Stop & Shop locations in the city, one of which is off McGrath highway, which is not far from relatively poor block groups in the city. The other is across the street from Clarendon Towers, a public housing site. Both Star Market locations, one Whole Foods location, and Bfresh market are all located in relatively high-income block groups, yet have varying levels of access to the T: Bfresh and one Star Market are a less than two-minute walk from the closest T station, while the other two markets are

Table 8: Transportation Mode used to get to the Eight Most Popular Stores (%)

Store Name	N	Car	Walk	Bike	Bus	T	Ride Share
Markt Basket	202	64%	56%	16%	13%	4%	13%
Stop & Shop	102	75% **	54%	10%	19%	8%	19% *
Trader Joe's	87	70%	63%	15%	15%	8%	17% *
Star Market	87	61%	74% ***	15%	11%	10% *	13%
Whole Foods	77	74% *	64%	16%	10%	5%	5% **
Wegmans	38	87% *	45%	16%	11%	5%	11%
Bfresh	34	44% **	91% ***	6% **	18%	15%	6%
Neighborhood Produce	29	72%	72%	17%	10%	3%	3% **
Full Sample	360	64%	60%	14%	15%	7%	12%

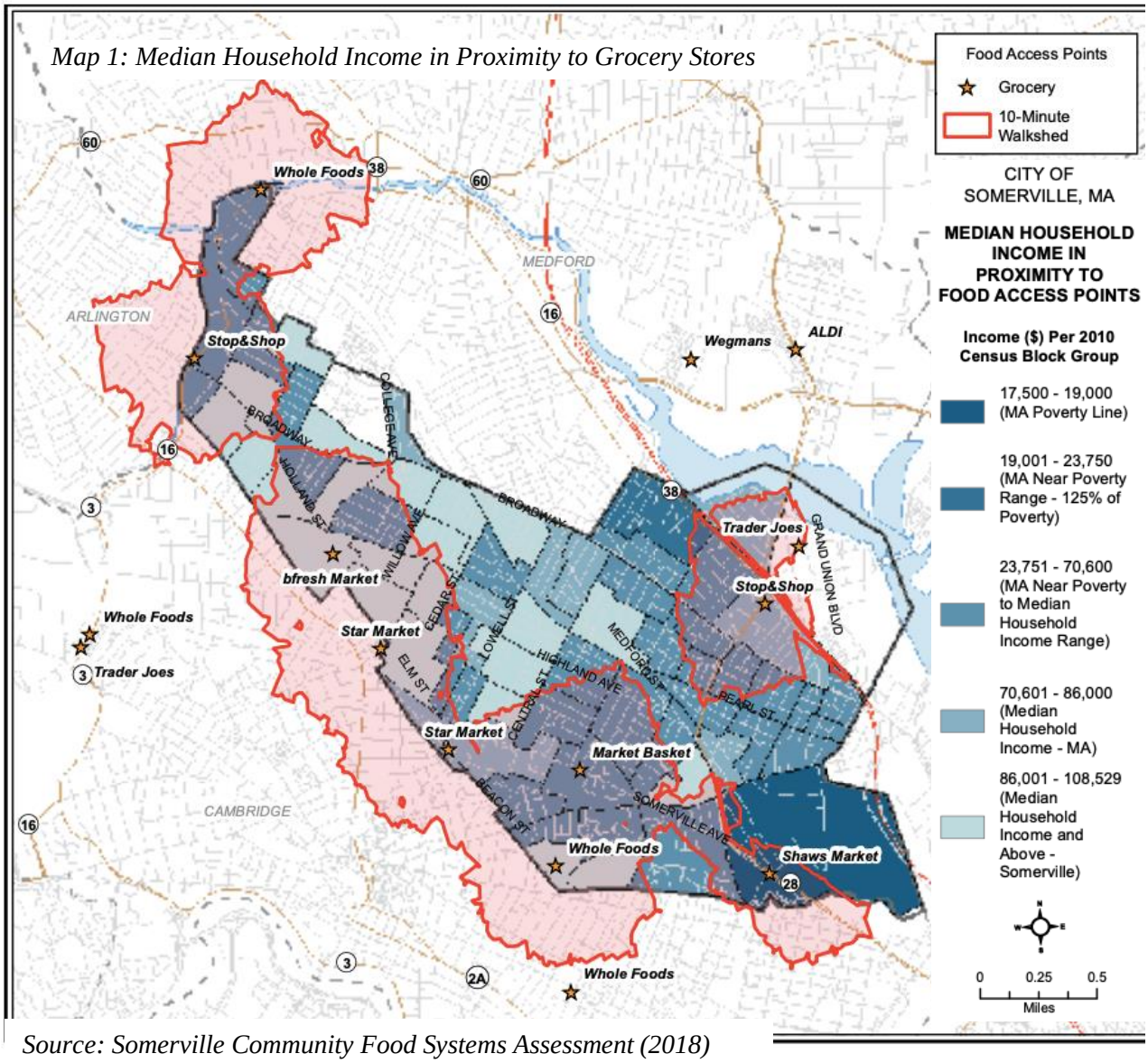
*** p<0.01, ** p<0.05, *p<0.1

Note: Respondents can choose more than one store and transportation mode so totals and percents do not add up to 100%; N=385

farther from a T. Both Bfresh and Whole Foods are targeted to higher-income consumers: they have a large selection of organic foods and relatively high prices. Stop & Shop and Star Market are more traditional grocery stores, with a limited selection of organic foods, and average prices.

A significantly higher percentage of respondents walk to Bfresh (91%) and Star Market (74%) compared to the overall average (60%). There are no significant differences with respect to public transit, likely due to the small sample size for this mode, except for Star Market to which a higher percent of respondents takes the T (10%) than the overall average (7%). A higher percentage of respondents use a rideshare app, take a taxi or borrow a car from a friend/family member to get to Stop & Shop and Trader

Map 1: Median Household Income in Proximity to Grocery Stores



Source: Somerville Community Food Systems Assessment (2018)

Joe's (19% and 17% respectively) compared to the overall average (12%). A lower percent of respondents drives to Bfresh (44%) than the overall average (64%), whereas the opposite is true for Wegmans, Stop & Shop, and Whole Foods. Some of the variation in transportation mode by store may be due to the built environment surrounding the store. For example, Bfresh abuts the sidewalk and is located two blocks from the Davis Square T station, whereas Wegmans, in neighboring Medford, is located off I-93 and Route 16, in a shopping center with a large parking lot. One respondent speaks to the built environment surrounding Wegmans, in relation to affordability: "The selection at local grocery stores is limited and priced more highly than at larger stores. It is extremely difficult to get to lower-cost stores like Wegman's from Somerville by foot or public transit."

Nine respondents commented on the lack of safe infrastructure on the way to and surrounding some of the most popular grocery stores. One respondent calls attention to the pedestrian environment surrounding Market Basket: "I walk to the grocery store and given how many other people walk to Market Basket as well, the parking lot and crossing can be somewhat hairy for pedestrians." Another respondent would like to see a "safer, easier, more pedestrian friendly way to walk to and from" the grocery stores in East Somerville: the Stop & Shop off of McGrath Highway and Trader Joe's in Assembly Square. Another offers a specific suggestion to make the Stop & Shop in West Somerville more pedestrian-friendly: "It would be nice if Somerville added a traffic light at Stop & Shop in West Somerville, like the one by Foss Park. It would only need to be green if cars were leaving Stop & Shop and the [Clarendon] towers."

DISCUSSION

The survey results shed light on transportation behaviors and barriers Somerville residents experience getting to and from the grocery store. The breakdown of demographic characteristics and shopping habits by transportation mode and travel time to the store reveals inequities in the transportation system that may carry over to inequitable food access outcomes. Furthermore, data on the stores where respondents go grocery shopping hints at potential correlations between the built environment surrounding and leading to a store and the transportation mode people use to get to it. These findings must

be interpreted in light of the limitations of using a survey sample that oversamples women and does not claim to be representative of the city as a whole. Nor should this sample be taken as generalizable to other municipalities. In addition, this study analyzes self-reported, rather than observed, behavior which may be biased from inaccurate recall or a desire to be perceived in a better light based on responses.

A greater share of respondents at risk of food insecurity and who are transit dependent rely on taking public transit and walking to the store compared to food secure respondents and those with access to a household car. My study affirms prior research based on spatial analysis of census data that suggests that food insecure households are less likely to have access to a car (DeMartini et al. 2013; Wood and Horner 2016). My individual survey data also adds nuance to this understanding. For the most part, public transit systems and pedestrian infrastructure are not built for food access (Pothukuchi and Wallace 2009; Terashima, Hart, and Williams 2018), which, my study finds, may lead to inequitable food access outcomes, because food insecure residents are, disproportionately, forced to rely on these transportation systems to get to the grocery store. Food secure residents, on the other hand, are more likely to have a car and therefore drive to the store, the easiest and safest way to get to the store given the current transportation system (Pothukuchi and Wallace 2009; Terashima, Hart, and Williams 2018).

Respondents who get to the store by foot, bike, and public transit, disproportionately food insecure and transit-dependent respondents, are more likely to report that their transportation mode influences the kind and quantity of food they purchase. These data reveal that the way individuals get to the store impacts the type and amount of food they are able to purchase for their household, implying that transportation mode, in addition to store proximity and prices, may impact food security. The modes that have biggest influence on kind of food purchased are taking the bus, T, and car/rideshare which are used by a greater share of food insecure, transit-dependent, non-white, and low-education households. The biggest difference in terms of influencing the quantity of food purchased is between respondents who walk to the store and those who do not, which is unsurprising given that carrying heavy grocery bags is a barrier to walking and taking public transit to the store (Alexander 2004; Pothukuchi and Wallace 2009). Another contribution of my analysis is the finding that a greater share of grocery shoppers who do not

drive to the store shift the quantity and kinds of food they purchase based on how they get to the store compared to those who drive. One limitation of the survey instrument is that I do not have data on what types of food were not purchased as a result of these access issue. I also do not have data on the extent to which transportation mode influenced grocery quantity.

Respondents at risk of food insecurity, who are transit dependent, or are at disproportionate risk for these outcomes, have longer travel times to the store. Whereas previous studies have found that food insecure households travel farther to get to the store, my findings suggest that it takes food insecure individuals longer to get to the store. These longer travel times cannot be fully attributed to a different breakdown in transportation modes since it takes these respondents longer to get to the store for all transportation modes. Furthermore, these longer travel times are evidence of an inequitable transportation system that advantages some over others. This result provides additional evidence for the finding previously established in the literature that households receiving SNAP benefits travel to grocery stores with the lowest prices, even if they are farther from where they live (Mabli and Worthington 2015; Shannon and Christian 2017; Jiao, Moudon, and Drewnowski 2011).

Respondents at risk of food insecurity, who have children, do not have a college degree, and who are non-white would prefer to drive a household car to the store if they are unhappy with their current transportation mode, whereas those not in these groups would prefer to walk. Previous literature finds that food insecure and low-income households travel farther to get to the grocery store than food secure and higher-income households (Shannon and Christian 2017; Mabli and Worthington 2015; Jiao, Moudon, and Drewnowski 2011; Shannon 2016; DeMartini et al. 2013). This study takes that finding a step further, to suggest that food insecure and low-income households who are unhappy with how they get to the store would prefer to drive there, likely because they currently travel farther to get to the store. This finding reveals potential equity concerns of prioritizing pedestrian infrastructure for food access, since the most marginalized would prefer to drive to the store. In addition, the survey results find that a greater share of respondents who take public transit to the store are more likely to be unhappy than those who do not, adding to the literature on transportation to the grocery store which has not incorporated satisfaction with

transportation mode. The literature does provide a possible explanation for this finding, in addition to the aforementioned barrier of carrying heavy grocery bags on public transit, which is that in areas where residents rely on public transit to go grocery shopping, stops are farther away from residences and transit runs less frequently (Ermagun and Tilahun 2020; Farber, Morang, and Widener 2014).

Respondents who report that they walk to the grocery store tend to benefit from trips in relatively pedestrian friendly environments. In contrast, those who drive for grocery shopping tend to frequent stores with large parking lots. The data on how respondents get to the eight most popular grocery stores provides some insight into the ways in which the built environment may factor into transportation decisions, which then impact food access. A greater percentage of respondents drive to stores which have big parking lots in front of the entrance, confirming the finding that more parking spaces at a grocery store is associated with more people driving to that store (Jiao, Moudon, and Drewnowski 2011). A significantly higher percentage of respondents walked to Bfresh and a significantly lower percentage drove to this store, which borders the sidewalk, is two blocks from a T station, and does not have its own parking lot. While there is research confirming that increasing the amount of parking spaces increases the percentage of people who drive to a store, cited above, there is little research on whether a pedestrian-friendly built environment can have a similar effect on increasing the share of people who walk to a store. One study finds that people who live in transit-oriented developments are more likely to walk to the grocery store than those who do not—my research expands this finding beyond people who live in TODs, to all residents of a neighborhood (Luz Laham and Noland 2017).

Analyzing responses from a novel survey on transportation experience to the grocery store in Somerville reveals that a greater share of food insecure and transit dependent residents have longer travel times to the store, take public transit and walk to the store, and would prefer to drive a household car to the store if they had the choice. In addition, the survey data reveal that transportation mode affects the kind and quantity of groceries purchased and differs by store shopped at. The next chapter will delve more into the relationship between the built environment, transportation systems, and food access.

CHAPTER 6: BARRIERS AND SOLUTIONS TO PLANNING FOR FOOD ACCESS

INTRODUCTION

This chapter will present findings from interviews and brief surveys I conducted with 15 transportation planners. I will refer to the planners I spoke with by the organization or agency where they work and the focus of their work. Six of the planners I interviewed work for a municipality, four work for planning firms that consult with state agencies and municipalities, and the others work for regional organizations—Boston's transit authority and the Greater Boston Area's planning agency (refer to the methodology section for further details). According to the brief survey I conducted with the planners I interviewed, 13 out of 15 only consider food access in their work to a small degree. After our conversation, all of the planners agreed that they think it would be valuable or very valuable to consider food access in their work. The intention of conducting these interviews is to begin to make the prospect of incorporating food access into transportation planning more tangible. My overarching finding from the interviews is that transportation planners believe that it would be valuable for them to consider food access in their work, even though only a couple have acted on this intention to date. I also gleaned that there is a lot of potential for collaboration between food systems and transportation planners to actualize food access improvements.

The planners I spoke with are expanding the transportation planning framework to one that centers people and places in addition to ridership numbers and work commute trips. Emphasizing people and places positions planners well to address food access, which is a destination-oriented issue. The rest of this chapter will be structured as follows. I will start with a brief section describing the framework transportation planners use to achieve transportation goals. The next section will examine the ways in which transportation planners responded to the five barriers to food access I proposed from the food access literature. Then, I will walk through how planners reacted to and conceptualized seven potential strategies to incorporate food access into their work and conclude with a discussion of the overall results.

DESTINATION FRAMEWORK

Before discussing the transportation barriers to food access and potential solutions to these barriers, it is helpful to gain an understanding of how the planners I spoke with conceptualize and approach their tasks and goals as transportation planners. One planner I spoke with expressed how he saw the field of transportation widening its focus:

> Also, increasingly so, there is more and more awareness that you have to be more critical about the who and what, in addition to questions of where and when. Making sure that we think about who has access to what destinations and making sure we are prioritizing locations that have importance to the community.

One planner expressed a similar sentiment with regards to the destinations people want to reach: "What is a transportation system if it doesn't have points on either side that people want to go to?" With regards to "who," one planner brought up the tension he is forced to navigate between public transit, making sure transit-dependent individuals can get where they need to go, and mass transit, trying to move as many people as possible in a given amount of time. He did not have an answer for whether planners should have one goal or the other, rather raised the point that planners are thinking about "who" questions.

Several planners connected the dots between the destination framework they apply to their work and our conversation about food access in a transportation context. The Boston Program Manager at a transportation policy institute stated that "transportation is one of those lynchpin issues. How it functions determines how people are able to live their lives; and accessing food, and what kind of food, is a critical determinant of one's health and quality of life." Two planners I spoke to offered a practical approach to connecting food access to the destination framework—the concept of a food access asset map. An asset map is a tool used in transportation planning to visualize a transportation project area. An asset map focusing on food access would visualize how full-service grocery stores, neighborhood markets, community kitchens, and food banks are connected to residential areas, schools, and parks with active and public transit infrastructure. The fact that transportation planners I spoke with were able to conceptualize a food-focused asset map suggests that it is possible to apply a destination framework to food access goals.

TRANSPORTATION BARRIERS TO FOOD ACCESS

As outlined in the literature review, transportation is one the major barriers to food access identified by food systems researchers and planners, as well as food insecure individuals. Transportation planners see this barrier in a land-use, in addition to a transportation context. One clear place of agreement between transportation planners I spoke with and the food access literature, is that the experience of going grocery shopping for transit-dependent individuals is often undignified. Transit-dependent individuals, often low-income and/or people of color, according to one planner I interviewed, overwhelmingly have low-wage jobs, pay a high percentage of their income on rent, and do not have access to a car. This section will first describe the planners' conceptualization of the six barriers to food access I proposed, which center around the unsafe and car-centric built environment of shopping centers, where grocery stores are often located, and the routes that individuals must use to get to them. Next, I will introduce the culture, discussed by the planners, that comes out of this car-centric built environment that exacerbates barriers to food access, among other destinations. Finally, I will unpack the relationship between density and built environment barriers to food access through the lenses of the planners I talked to.

Unsafe Pedestrian Environment: Six planners I spoke with resonated with the barrier I shared about unsafe pedestrian access surrounding supermarkets, in the context of grocery stores located in shopping centers. According to these planners, shopping centers are built for cars with large parking lots, and inadequate or no sidewalks, bike lanes, and/or bike racks. In cases where there are bike lanes and sidewalks that lead to a shopping center, the active transportation leader at a consulting firm noted, there are rarely bike lanes and sidewalks within the large and unsafe shopping centers themselves. According to two planners I spoke with, the high amount of free and convenient parking in these shopping centers has two main effects: it is attractive and easy to drive to the grocery store, and it is unsafe and inconvenient to get there any other way. On the other hand, in denser parts of the Greater Boston Area, schools, restaurants, and other retail destinations are, for the most part, integrated into the sidewalk network of the neighborhood in a typical, New England "square." Grocery stores used to be in the squares as well,

continued Somerville's Director of Mobility, and it was the invention of the large-scale, urban shopping centers that displaced grocery stores from a pedestrian-friendly environment to a car-friendly one.

Public Transit to Shopping Centers: According to the planners I spoke to, grocery stores in shopping centers are also unsafe and inaccessible to transit users, who are inherently pedestrians as well since they must walk to the bus or T stop from their origin and destination points. An MBTA planner I spoke with noted that from a service planning perspective, designing or adjusting a bus route to take a detour into a shopping center increases safety for the riders who are getting groceries, yet adds a significant amount of time to the overall bus route. The Director of Transportation in Everett and a planner who works in Revere brought up specific locations in those cities where riders are forced to get off popular bus routes at dangerous locations outside of a shopping center. An MBTA planner mentioned that on Blue Hill Ave in Boston's Grove Hall neighborhood, it is impossible for service planners to build a safe bus stop without halting all other traffic at the intersection, a tough trade-off to justify when seniors and other residents are driving to the grocery store. Planners shed new light on the barriers to using public transit to access food, and hinted at the fact that addressing those barriers requires considering tough trade-offs.

Unsafe Pedestrian Routes: Planners, for the most part, agreed that unsafe pedestrian routes that connect residential areas and grocery stores are a barrier to food access. In Somerville, according to the city's Director of Mobility, residents run across a ten-lane highway to access Star Market because using the only underpass that connects the residential neighborhood to the store is in an inconvenient location to access the grocery store. Similarly, there is a lack of access for people who live in Somerville to get to Assembly Square, according to another planner I spoke with, as it is cordoned off by three-lane highways. One planner had a different take on pedestrian access, expressing that distance is a much more significant impediment to accessing food by foot than unsafe or inconvenient pedestrian infrastructure. Planners articulated that in either case, dangerous crossings or long walks to the store, transportation systems are, for the most part, set up so that drivers feel safe, and pedestrians do not.

Car Culture: Another theme that emerged in the interviews was that the car-centric built environment transportation planners contend with and individuals navigate, has produced a pervasive car culture, which can make it tough to equitably deprioritize cars. For example, Everett's Director of Transportation has seen in his city, a majority immigrant community, that residents derive status and respect from owning a car, which is how he explains the increase in car ownership rates from 2000 to 2010 in the city, even as incomes went down. Somerville's Director of Mobility articulated that any framework he would implement to deprioritize cars and driving needs to be within the context that many transit-dependent people are striving for a better life and cars make life easier in many ways. Planners recognize that cars impart the sense of dignity that is all too often absent from other modes of getting to the grocery store for transit-dependent individuals.

Defying the Built Environment: While the planners emphasized that the built environment in Boston is designed for cars, they noted that it is not accurate to assume that everyone drives to the grocery store. According to a planner who has worked on complete streets projects in Somerville, residents tore a hole through a fence surrounding a park to shorten their route to the grocery store demonstrating the need for better pedestrian connectivity. In Stow, an outer lying suburb of Boston, people assume that no one walks to the grocery store, but the town's planner sees numerous residents walking from the business district to the less dense residential areas with grocery bags.

The Role of Density: From the perspective of three planners I spoke with, density begets better access to transportation. Dense urban areas like Boston have a "certain level of accessibility baked into" their design, especially when compared to cities with higher levels of sprawl such as Atlanta. One planner contrasted this "baked-in accessibility" to the more sprawling land-use patterns of suburbs which rarely have continuous sidewalks, making it difficult to get around without a car. Another planner goes as far as to say that transit, bike, and pedestrian infrastructure are only feasible and effective where there is density, making it much harder to serve those in the suburbs in terms of transportation. He followed this thought with the statistic that 50% of people in poverty live in the suburbs. While significant transportation barriers to food access exist, they may be less prevalent in denser parts of Greater Boston.

According to the planners I spoke with, the built environment can function as both a challenge and opportunity to planning transportation systems for food access. On the one hand, the planners articulated, the built environment constrains their ability to make buses easy to use for grocery shopping, for example. On the other hand, three planners mentioned that dense development patterns can enhance the ability of pedestrian infrastructure and public transit to meet food access needs.

STRATEGIES

I conversed with planners about five strategies to incorporate food access into transportation planning that I distilled from the grey literature. These strategies match up with several domains of transportation planning work. For example, transportation planners write and design transportation master plans for town, cities, and regions which corresponds to the proposed strategy to incorporate food access into those master plans. The planners were very familiar with the domains the strategies sit in, however, had little experience applying food access to these domains until our conversations. Two additional strategies came out of the conversations I had with planners—zoning and land use, and community engagement. This section will outline, for each strategy, ways transportation planners have already implemented and envision implementing the strategy.

Relative Effectiveness and Feasibility of Strategies

In the survey I conducted with planners, I asked them to rate the five strategies for integrating food access into their work I proposed in the interview in terms of feasibility and effectiveness. Table 8 reports counts for the number of planners who thought each strategy fell into each level of feasibility, panel a, and effectiveness, panel b. In panels a and b the strategies are ranked from most to least effective and feasible based on the planners' ratings. Overall, the planners feel positively about the proposed strategies, as the counts are weighted toward feasible and effective. There is the most doubt about grocery delivery in terms of both feasibility and effectiveness, and the most optimism about pedestrian and bike infrastructure.

Table 9: Counts of transportation planners ratings of (a) feasibility and (b) effectiveness

(a) Strategy	Very Feasible	Feasible	It Depends	Somewhat Feasible	Not at all feasible
Pedestrian and Bike infrastructure	5	6	3	0	0
Public Transit	2	6	2	3	1
Master Plans	7	6	1	0	0
Transit-Oriented Development	3	5	6	1	0
Grocery Delivery	2	3	4	3	3

(b) Strategy	Very Effective	Effective	It Depends	Somewhat Effective	Not at all effective
Pedestrian and Bike infrastructure	7	6	2	0	0
Public Transit	4	10	0	0	0
Master plans	3	3	4	5	0
Transit-Oriented Development	4	4	4	3	0
Grocery delivery	5	3	3	2	1

Notes: One planner abstained from rating certain stratagies, thus some strategies sum to 14

The planners rated the master plan strategy highest in terms of feasibility, and lowest in terms of effectiveness. There is strong consensus among the planners that the pedestrian and bike infrastructure strategy is effective; all 14 planners who answered that question rated it as very effective or effective. There is also consensus among planners that this strategy is feasible, though to a somewhat lesser extent, with ten of the planners rating it as very feasible or feasible to implement. Transit-oriented development falls in the middle of the spectrum in terms of both feasibility and effectiveness and has the highest number of planners rating it in the "it depends" category for both feasibility, five planners, and effectiveness, three planners. In terms of public transit, there is a lack of consensus around the feasibility of the strategy with seven planners rating it as very feasible or feasible, and six rating it as it depends, somewhat feasible, or not at all feasible. There is strong consensus, on the other hand, that public transit is an effective strategy as all 14 planners who answered that question rate it as effective or very effective. Grocery delivery is at the bottom of the list in terms of both feasibility and effectiveness, with planners falling across the board on both dimensions. I cannot comment on the two strategies that came out of my

conversations with transportation planners because they were not included in my survey: community engagement, and zoning and land use.

Pedestrian and Bike Infrastructure

The pedestrian and bike infrastructure strategy encapsulates infrastructure improvements surrounding and on the way to food retail locations and incorporating food access into complete streets policies. Complete streets are streets designed for all mode-types with an emphasis on pedestrians, cyclists, and bus riders over automobile users. Several planners I spoke with are currently working on complete streets projects, as the Massachusetts Department of Transportation runs a complete streets grant program funding cities and towns to do this work. A few planners described pedestrian and bike infrastructure projects they completed or would like to complete that are in close proximity to food retail locations. For example, Stow's town planner worked on a pedestrian infrastructure project connecting a popular farm stand with a residential neighborhood of 96 units. Stow's town planner clarified that although the project made a farm stand more accessible, that was not the focus of the project. Rather, it was about addressing safety concerns at that particular intersection. This planner was able to retroactively consider food access implications of this project during our conversation. One of the priorities of Somerville's Mobility Department, according to its director, is redesigning Kensington corridor, a popular, yet unsafe route that connects a residential neighborhood with a shopping center that houses a grocery store, with traffic calming measures. This example illustrates that food access is being prioritized by the mobility department in a dense city where 17.1 percent of households do not own cars (Deloitte 2021).

Two planners brought up the possibility of connecting shared-use paths to food access points. One of them, an Active Transportation Leader at the consulting firm where she works, realized during our conversation that she wanted to include a food access performance metric in the shared-use path guide she is developing, which will be used by municipalities across the state and region. For example, the Stop & Shop in Watertown is not far from the shared-use path along the Charles River, and the city's Senior Transportation Planner expressed that there is an opportunity for the planning department to work on

creating safer infrastructure for cyclists and pedestrians to get from the path to the store. These planners responded to my question with projects they are working on or would like to work on that address food access, evidence that incorporating food access into transportation planning is not all abstract and can become more concrete.

Two planners I spoke with brought up the possibility of including specific food access provisions in the Complete Streets grant program run by the Massachusetts Department of Transportation (MassDOT). A transportation planning consultant I spoke with made the suggestion that municipalities applying for this funding explain how their project would impact food access. She added that MassDOT could also structure the evaluation component of the program to ensure that municipalities measure impacts the complete streets project had on food access one to three years after construction is complete. Another planner noted that, according to the way the grant currently works, municipalities get points on their application for project sites that are close to transit stops, which his town cannot fulfill since they are a small town with limited public transit access. Giving points to sites that are close to food access, he realized during our conversation, would both increase the potential impact of complete streets programs on food access and would make small towns stronger applicants to receive complete streets funding.

Planners noted several ways they could identify and prioritize connections between food access points and residential areas to make them safer. Safe Routes to School is a national movement pushing for safe and easy ways for students to get to school by bike and on foot. A planning student I spoke with who works on Safe Routes programming suggested that municipalities or a non-profit organization could provide a platform for community members to record and share walking routes they use to get to the grocery store. This Safe Routes to Market program, he explained, could provide support for individuals to find safer ways to walk to grocery stores. Another option for prioritizing routes, according to three planners I spoke with, would be to use GIS to map food retail locations, walksheds surrounding them, and identify priority routes based on a demographic overlay. While this analysis may work well for full-service grocery stores, one planner was skeptical of using this method for smaller food retail locations because the data may be inaccurate since they close and move frequently. Thus, a combination of

mapping and on-the-ground knowledge may prove useful when it comes to working on routes that connect residential areas and food retail points.

Public Transit

The public transit strategy includes making changes to bus and subway stops, schedules, and frequencies, referred to as service planning, that align with grocery shopping habits, and other ways to integrate food access with public transit such as holding farmers markets at T stops. Seven planners I spoke with expanded on Bus Rapid Transit (BRT), a subcategory of service planning, as a strategy to increase food access. There was consensus among these planners that BRT inherently provides better food access due to its features which work together to make buses frequent, reliable, and dignified for riders. According to a planner at the MBTA, BRT involves changing an entire bus route, set of routes, or system to give people comfort and control over the bus riding experience, which increases the utility of taking the bus to all destinations, including grocery stores. Another planner proposed a hypothetical example of how to explicitly incorporate food access into a BRT strategy in the future when automated vehicles are more prevalent:

> Maybe the solution is that we have smaller, special routes for certain types of trips that are in smaller buses…that come very frequently, but only come during these specific times…they are not the commute into the city, so it might actually improve the service for the people that need to take these routes.

Everett's Director of Transportation gave an example of when it might be challenging to switch a bus route to BRT. He is grappling with the question of whether to advocate for changes to the bus route that connects residents in Everett with the Market Basket in neighboring Chelsea. The bus currently stops at two subsidized housing developments which results in a circuitous route taking upwards of 25 minutes to travel one mile. If he were to work with the MBTA to transform the route into a BRT route, a much shorter route that could likely run with four times the frequency, the bus would no longer be able to stop at these two housing developments to serve some of the city's most vulnerable residents. Thus, while many planners are confident that BRT would increase food access, this example illustrates the importance of thinking about who BRT routes are able to serve.

The MBTA is currently undergoing a bus network redesign, holistically considering all of its bus routes for the first time since they were streetcar routes in the 1930s. A Manager of Performance, Data, and Technology I spoke with at the MBTA, who has planning responsibilities, mentioned that the goal of the redesign is to increase overall access which will result in an increase in off-peak service and routes that take people to places they want to go, such as grocery stores. At the same time as the redesign, the MBTA is analyzing a new cell-phone dataset to determine where people are going and figure out what types of people and trips are left out of the data the MBTA uses to inform its service planning, including the bus network redesign. The planner I spoke with who is responsible for data analysis clarified that these data are more representative of people's trips than other transportation datasets, such as a subset of questions in the census, and will thus help planners make the case for better service all day and on the weekends. According to a planning consultant I spoke with, the City of Boston is recommending that RTAs make cuts to routes based on need, as opposed to ridership numbers. The MBTA, with the support of the city, is actively working on service planning with the intent of prioritizing non-work trips, which can include food access.

Two planners mentioned that the pandemic could present transportation planners with an opportunity to increase off-peak service since demand is down for downtown, peak-time commute trips. A planning consultant stated that while there is no playbook for making this shift, RTAs outside of metro-Boston have already added fixed-route service (in places where they used to provide on-demand service) with stops at the major destinations people need to access in COVID such as pharmacies, grocery stores, and hospitals. RTAs working on increasing service to grocery stores should consider grocery store workers' shifts when designing the schedules for these routes. According to the co-leader of the Blue Hills Regional Coordinating Council, buses only run frequently to a grocery store in Hull around 9AM and 5PM, and workers start their shift at 11AM.

Two planners mentioned the idea of "grocery routes"—bus or T routes that provide food access by stopping at multiple grocery stores. One such route is the 66 bus that goes from Harvard square in Cambridge to Nubian square in Roxbury. One planner I spoke with uses a grocery route framing

internally within the MBTA to encourage his colleagues to think about food access in their work. A planner I spoke with at the Boston Planning and Development Agency (BPDA) suggested creating a public-facing MBTA map that includes grocery store locations and operating hours to communicate current grocery store transit service to current and potential riders. The manager I spoke with at the MBTA mentioned the idea of implementing a trip-chaining policy wherein riders can exit and re-enter the system without having to pay for an additional trip which would allow riders to add grocery shopping to a trip they are already completing. This same manager expressed that a fare change is possible, as evidenced by the MBTA Youth Pass program which gives free passes to youth 18 and younger in the region.

Master Plans

Master plans are goal-setting documents municipalities, regional transit authorities, and states prepare, which can incorporate food access in myriad ways. According to a planner I spoke with, if municipalities are hiring a consultant to work on their plans, which is common for large planning efforts and for municipalities with a small planning staff, they should include food access in their Request for Proposals (RFP). This change would require consultants to include an outline of how they would integrate food access into their master plan from the outset. One planner articulated that planners could include specific food access goals in their master plans, to which their policies and projects can work toward. For example, a city may say they want to increase access to grocery stores for pedestrians by building safer infrastructure in a certain neighborhood with a high transit-dependent population, in the next two years. Master plans could also include action items for a safe route to markets program, according to a BPDA planner, outlining markets and neighborhoods to prioritize based on mapping transit-dependent populations and other indicators.

My conversations with planners revealed that they have worked on a number of master plans that explicitly include food access. For example, one planner referenced the state-wide bike and pedestrian plan in Rhode Island that used proximity to food retail, both full-service grocery stores and corner stores, as a criterion in prioritizing infrastructure improvements. The MBTA included a destination map, which

contained grocery stores, in its 2019 statewide bike and pedestrian plan. The Boston Health Equity Zone plan uses a number of criteria including transit-dependence, income, and food deserts to establish equity zones in which to prioritize transportation projects. According to the planner I spoke with who is working on this plan, creating equity zones holds a lot of promise because it embraces a destination framework, and uses food access as part of a set of criteria to establish zones where the city should prioritize transportation—actualizing equity with data in a way that will greatly impact food access. Watertown was finalizing their bike and pedestrian master plan when I spoke to their Senior Transportation Planner, who stated she had not explicitly considered food access in the plan and suggested I submit a comment to the city about incorporating food retail locations in the plan's maps and goals.

Two of the planners I spoke with warned that plans are often not implemented, decreasing their effectiveness. This warning was reflected in the results from the survey I conducted with the planners in which five planners rated master plans as being only somewhat effective. On the other hand, the BPDA planners I spoke with told me that the projects they work on are almost always embedded in the city's comprehensive plan, and thus if food access is not explicitly considered in those plans, especially *Go Boston 2030* which is the city's long range transportation plan, their work will reflect that.

Transit Oriented Development

Transit-oriented development entails including food access in mixed-use development proximate to transit stations and partnering with individual developers to promote walkable and bikeable food access in new residential and commercial development. The five planners I spoke with about this strategy noted two main challenges to working with developers related to food access. First, grocery stores will locate where they will make the most money, which is often not where planners would like. Second, transit-oriented developments need a financially stable anchor tenant, which may not be a grocery store or a grocery store with culturally appropriate food for the area's residents. Despite these challenges, planners think it is worthwhile to pursue the strategy.

Three of the planners I spoke with who represent cities neighboring Boston felt that working with developers is an opportunity for them to draw on funding from the private sector to make more substantial

changes to the transportation systems in their city. One of these planners is working with the developer of Arsenal Yards, in Watertown, to install a Blue Bike station, specifically to connect employees at the development with nearby food access points. Three planners who work on active transit listed other potential asks from developers: bike parking and storage at grocery stores, bike lanes that connect to food retail, and free T and bike share passes to new residents under a specific income threshold. This last possibility will likely be part of Boston's overhauled transportation demand management strategy currently being worked on, according to a planner at the BPDA.

Another example of a mitigation project is a developer providing a shuttle for the community; this is more common for developments that create a lot of jobs. The Director of Transportation in Everett provided me with a clear example of incorporating food access into the agreement he worked on with Encore, a relatively new casino in the city. Part of Encore's agreement with the City of Everett was to operate a commuter shuttle from the city's main street to the casino. He made sure the shuttle stopped at Market Basket to help at least some residents, albeit within a small catchment area, access this affordable grocery store. This example shows that some planners are explicitly considering food access in their work.

One planner made the point that while project mitigation at the individual-development level has the potential to have a positive impact on the community, regulatory guidance is necessary to ensure that these projects are distributed equitably throughout a municipality. He noted that some municipalities have ordinances, like Article 80 in Boston, which require developers to provide a certain amount of mitigation projects to offset their development. Some of these ordinances quantify total mitigation for a development by assigning points to each mitigation project the developer completes. The planner in Watertown I spoke with had the idea to include proximity or connectivity to food access in the point system.

Zoning and Land Use

The zoning and land use strategy extends transit-oriented development beyond the confines of development within a half mile of key transit stops. This strategy encompasses passing ordinances and zoning that regulate and incentivize pedestrian, bike, and public transit friendly grocery stores. While I

did not present land use as a strategy to integrate food access into transportation planning, six of the planners I spoke with brought up what they referred to as a "15-minute neighborhood," which fits under the land use and zoning category. The idea of the 15-minute neighborhood is that residents can access essential services, including food retail, within a 15-minute walk of where they live. In Somerville, the Director of Mobility would like to see food retail located such that residents are no more than a five-minute walk from a convenience store and no more than 10 minutes form a full-service grocery store. Two planners think the pandemic presents an opportunity to accelerate planning and implementation of this strategy as people are encouraged to spend more time in their neighborhood to curb the spread of the virus. The City of Boston's planning department is already working toward a similar goal of having 100% of the city's residents live within a 10-minute walk of car share, bike share, and a key T or bus stop, according to BPDA planners I spoke with.

One planner summarized how he conceptualized food access in the context of the 15-minute neighborhood:

> "I believe that the first step toward a solution, from a planning perspective, is to ensure there's an equitable distribution of good quality (meaning affordable, culturally appropriate, and nutritious), smaller grocery stores throughout neighborhoods. Having that network in place then makes it easier to better serve people using multiple transportation modes. This takes some of the pressure off of transit as a potential cure-all for bridging food access disparities. The challenge is as much about land-use as it is about transportation."

This quote suggests that changes planners can make to transportation systems are limited by zoning which directs the way neighborhoods are laid out. This same planner noted that NYC has addressed this challenge through the FRESH program which gives grocery stores height and other bonuses to locate in areas with low food access.

Grocery Delivery

Options for pursuing a grocery delivery strategy could include partnering with grocery delivery companies to waive fees, incorporating grocery delivery into curb management ordinances, or establishing pick-up sites at transit stops. Unlike the other six strategies, planners had few to no examples of projects they have worked on or could work on when it comes to grocery delivery. One exception to

this statement is an MAPC planner who worked on a grant program offering funding for taxi rides to municipalities in their response to the pandemic. For many cities, this included grocery trips, grocery delivery, and/or food pantry delivery. She noted two main barriers to this program's success: last-minute cancellations because people were less safe using taxis than the grant administrators predicted, and stigma associated with using the rides. Two planners who work mostly at the municipal level mentioned the possibility of including food access in curb management policies. This could include, according to Somerville's Director of Mobility, designating certain parallel parking spaces throughout the city for grocery delivery trucks specifically. The other planners did not react to this strategy or dismissed it quickly, stating that it was not in their domain or was too costly.

Community Engagement

Community engagement, through public feedback processes, is another strategy, according to half of the planners I spoke with, to integrate food access into transportation planning. This strategy captures several ways transportation planners can bring food access into public meetings, hearings, and feedback mechanisms. Inclusive planning processes prioritizing the voices of transit-dependent individuals are crucial, according to Somerville's Director of Mobility, because these processes have been intentionally exclusive up to this point. I heard from the planners I spoke with that, for the most part, food access does not come up at public meetings. One described a public meeting about Dedham's master plan that was an exception to this generalization. Residents expressed their desire to walk to the grocery store, which is currently impossible because it is separated from the residential part of town by a highway. In the neighborhood master plan for East Boston, residents raised frustration with only having one grocery store to shop at and therefore having to shop in neighboring Revere or Chelsea.

Planners brought up two main barriers to community engagement as a strategy to integrate food access into transportation planning. First, few transit-dependent individuals, who are more likely to have a tougher time getting to the grocery store, show up to community meetings. According to one MBTA planner, people who show up to their meetings have often lived in the neighborhood for a while and are more concerned with the aesthetic of their neighborhood than how grocery store workers are getting to

their jobs, to name one example. Another planner who consults with small to mid-size towns in Massachusetts, noted that it is mostly older, white, well-off residents who are interested in transportation from more of an academic standpoint that show up to community meetings she organizes. One exception to this lack of participation, was the focus groups that the Blue Hills RCC held in developing its transportation needs assessment of the region.

Second, according to an MBTA planner, there are limited feedback mechanisms in place for individuals to make suggestions on how the system could serve them better:

> I think what's missing is these sort of little things—if you just moved this stop here, it would work better for so many people and we don't have that feedback mechanism right now; people might not know where to go if they have that kind of feedback.

Implementing more inclusive community engagement processes with multiple ways to give feedback is possible, according to the Founder and Project Manager at Neighborways Design, if there is ample time, money, self-interrogation, and reflection. He went on to say that community engagement is essentially co-designing a project with the community by asking them the barriers they face, providing them with a set of solutions to address those barriers, and working with them to bring one or more of those solutions to life.

This discrepancy between the extent to which planners currently consider food access and the value that they assign to it signifies that there is room for awareness and consideration of food access to grow within the transportation planning field. One planner I spoke to clearly articulated this discrepancy: "Everybody is on the same page that food access is a need the RTA [Regional Transit Authority] must serve so it hasn't been controversial, but it's all very abstract at the moment." Some of the reason that planners are not incorporating food access explicitly into their work is because doing so has felt abstract, without concrete examples to refer to. Talking with these planners about food access was a first step toward making food access strategies tangible for planners.

DISCUSSION

Transportation planners are expanding their focus from solely ridership numbers, job commute trips, and serving all neighborhoods, to emphasize equity populations and the places individuals in those communities want to go, which expands beyond jobs. Since food access is a destination, it follows that a majority of the planners I spoke with are only indirectly considering food access in their work. Planners who are considering food access more explicitly, are mostly doing so on a project-by-project basis, apart from a couple of planners who have worked on master plans that incorporate food retail locations in asset maps and transportation goals based on those maps. The planners I spoke with situate the main limitations to working on food access as a transportation planner in terms of the built environment they are confined by, which centers cars over all other modes of transportation. The planners reacted positively to the strategies I offered for how they could go about addressing food access in their work—suggesting specific ways to improve the strategies and pointing out potential limitations in a way that set their expertise apart from food systems planners.

Planners I spoke with used the concept of a destination framework to conceptualize integrating food access into their work. The public transit planners I spoke with, two at the MBTA and one that works on BRT implementation, focused on thinking about reaching destinations as a framework with which to do transportation planning. Their reasoning for using this framework is to prioritize underserved populations, and because it has numerous social, financial, and public health benefits. Many of the planners I spoke with that work at the municipal level were drawn to the idea of including food retail locations in their mapping analyses and maps that make it into town and city plans. Using a destination framework forces planners to think about a number of factors in order to build and adjust systems to connect people with those destinations, the most obvious of which is distance, which comes up frequently in food access literature (Ver Ploeg et al. 2009; Coleman-Jensen, Rabbitt, and Gregory 2020). By lifting up equity populations and continuing to understand mobility at the neighborhood and individual level, transportation planners are well positioned to put the concept of “social distance” into practice, taking demographics and shopping habits into account in addition to physical distance (Broad Leib 2013).

Applying this concept of "social distance" is particularly important when it comes to food access, since low-income and minority households typically do not shop at the closest food retail location (Wood and Horner 2016).

The planners I spoke with saw transportation barriers to food access through the lens of our car-centric built environment. Furthermore, they interpreted these barriers as limitations to their ability to incorporate food access into their work. This car-centric built environment came out of federal transportation policy that funded highways over other transportation infrastructure, which planners verbalized through their lived experience of working on transportation systems (Pothukuchi and Wallace 2009). For example, planners see the result of funding highways, not only as a loss for funding public transit, but also as a physical barrier between individuals and destinations they want to access such as grocery stores. Planners noted that the barriers to food access are heightened when grocery stores are located in shopping centers, and/or are set back from the sidewalk by big parking lots, which are required for grocery stores of a certain size in many municipal zoning codes (Hanson 2020). My research affirms the literature, as planners I spoke with mentioned that big parking lots and lack of bike lanes and sidewalks create an unsafe pedestrian environment making it harder for transit-dependent individuals to access food (Terashima, Hart, and Williams 2018, Huang et al. 2012).

While planners are reflecting findings from the literature, notably, they are adding a new perspective to the issue of food access by interpreting these barriers as limitations to planning. Which is to say that what food systems planners interpret as transportation barriers to food access, may more aptly be labeled land use barriers to food access. Several planners noted that free and convenient parking at grocery stores makes people inclined to drive to the store (Guo, Bhat, and Copperman 2007, Jiao, Moudon, and Drewnowski 2011). They called attention to what is absent from the literature by pointing out that it is challenging from a design perspective to locate bus stops in a convenient and safe place at grocery stores in shopping centers with big parking lots. Thus, it is no surprise that planners united around the idea of 15-minute neighborhoods as a way to increase food access, since this solution is land-use oriented. One aspect of 15-minute neighborhoods embraces elements from TOD with regards to co-

locating residences, food retail, other commercial space, and a key transit stop. In fact, researchers have found that TOD does promote walking, a goal of the 15-minute neighborhood strategy (Luz Laham and Noland 2017).

The planners I spoke with converged around BRT as a strategy to improve access to food retail by creating a faster, more reliable, and dignified way to get to the grocery store on public transit. This strategy addresses some of the barriers to food access identified in the literature by limiting bus transfers and wait times (Alexander 2004; Pothukuchi and Wallace 2009). While food access research has focused on the barriers to using public transit for grocery shopping, the planners I spoke with shed light on the potential ways public transit, specifically BRT, can improve food access for individuals and neighborhoods, which may include making use of emerging technologies such as automated vehicles.

There was consensus among the planners I spoke with that it is crucial to focus transportation improvements in communities with high levels of transit-dependent populations, emphasizing the goal of making transportation more dignified for the most vulnerable. This focus on dignity is a similar, yet distinct, framework compared to food systems planners' focus on stigma, and is a valuable foundation from which to improve transportation systems with food access in mind. Prioritizing transit-dependent populations makes sense given that food insure households are less likely to use a car to get to the grocery store and neighborhoods with low levels of vehicle ownership have higher travel times to the grocery store (Farber, Morang, and Widener 2014; DeMartini et al. 2013). The Boston Health Equity Zone plan recommends that the city prioritize transportation projects in areas with high rates of transit-dependent populations. The methods used to create the equity zones for Boston does not explicitly take food access into account, and while the current zones may help to improve food access, there is room for planners to be more explicit about incorporating food access, as established by Plano et al.'s study in Baltimore, MD (Plano et al. 2015).

CHAPTER 7: RECOMMENDATIONS AND CONCLUSION

This thesis investigates barriers and opportunities to addressing food access through transportation planning solutions, rooted in the experience of individuals' experiences getting to the grocery store in one Massachusetts city. Highlighting the role of transportation systems in food access goes beyond the well-established food desert literature, which is limited by its use of census, as opposed to individual-level, data and focus on distance, as opposed to transportation mode, to the store. I analyze a novel transportation and food access dataset to compare transportation to the store based on transit dependence and risk of food insecurity, a limitation of the nascent literature on transportation mode to the grocery store. A synthesis of interviews with 15 transportation planners adds to the relatively limited literature on how transportation systems interact with food access. I claim that transportation systems may be part of the solution to address food access, even as they present barriers to food access.

My survey analysis indicates that food insecure and transit dependent households disproportionately rely on public transit and walking to the store and have longer travel times to the store than their food secure and car-owning counterparts. In my examination of transportation to the store on the basis of food security status, transit dependence, race, and educational attainment, I lay the groundwork for understanding the relationship between transportation and food access inequities. The survey results also point to how transportation mode to the store may be related to the built environment. This finding is reflected by the planners I spoke with who articulate that the built environment can function as a significant planning hurdle or facilitator to food access depending on factors such as density, the layout of an intersection, and whether a grocery store is located in a shopping center.

The transportation planners I spoke with interpreted the transportation barriers to food access identified by food systems planners with a distinct lens, viewing them in the context of the built environment and land use planning. There was consensus among the planners I spoke with that it would be valuable for them to consider food access more than they currently are, likely because doing so aligns with the destination framework they already employ. For many of the planners I spoke with, our conversation was the first time they explicitly considered food access in their work. Watertown's Senior

Transportation Planner added food access to the city's pedestrian and bike master plan following our conversation, speaking to the power of cross-silo conversations to precipitate change. Transportation planners, for the most part, supported the strategies I proposed, and added two strategies of their own, with the caveat that many transit-dependent individuals would prefer to use a car to get to the grocery store, since this is the easiest and fastest transportation mode given our land use and transportation system. This caveat reflects my finding that food insecure and transit dependent Somerville residents who are not happy with how they currently get to the store would prefer to drive their own car to the store. Still, planners agree that it is worthwhile to pursue transportation strategies that would improve food access for households without access to a car. These strategies entail integrating food access into pedestrian and bike infrastructure projects (and prioritization of those projects), public transit systems, master planning processes, transit-oriented development policies, and access to grocery delivery.

LIMITATIONS AND OPPORTUNITIES FOR FUTURE RESEARCH

There are several limitations to my findings from the Somerville resident survey research. The dataset used in this analysis does not cover the built environment, other than stores shopped at, and the distance respondents typically travel to the store, which limits the results' connection to previous research that focuses on distance to the store. Lastly, the survey was conducted prior to the COVID-19 pandemic, which has impacted transportation at the system and individual levels. The survey results cannot be generalized to other cities and regions, as many aspects of transportation systems and food access are unique to each city and town. While the data collection team made an effort to conduct intercept surveys to reach our target population, we did not reach people who are not able to get to the store at all. Seventy percent of the survey respondents are women, which may reflect the gender breakdown of who goes grocery shopping, or may be a limitation of the dataset. In terms of the transportation planning portion of the study, I only interviewed planners in the Greater Boston Area, and did not interview enough planners to infer opinions on the proposed food access strategies for the field as a whole. Additionally, I did not assess the planning process, plans, or outcomes of the plans that the planners mentioned with regards to food access.

Given these limitations and the relatively limited prior research on food access within the context of transportation systems, there are many areas ripe for future research in this field. More surveys at the intersection of transportation and food access can add to our understanding of individual-level transportation to the store decisions. Future surveys may also benefit from adding Likert-scale questions that ask respondents about their overall satisfaction with transportation to the store. Surveys may also include questions about barriers specific to public transit such as cost, scheduling, and span of service to understand these barriers in the context of individuals' transportation experiences to the store. Future research can also work to fill the gap in our understanding about how many more or fewer groceries individuals purchase based on the transportation mode they use to get to the store and which types of food they purchase or refrain from purchasing. Additionally, there is an opportunity for future research to examine the role of the built environment in one's decision of how to get to the store. This research may involve pairing transportation infrastructure and built environment data surrounding grocery stores with survey data about transportation mode to the store.

There are opportunities for researchers to examine each of the proposed transportation planning strategies from a food access standpoint. This could include investigating how to integrate food retail locations, broken down by food retail type, the surrounding built environment, and transit accessibility, into transportation asset maps. In addition, researchers can identify federal, state, and local transportation grant programs or other policies that are suitable for incorporating food access elements, such as the MassDOT Complete Streets Grant program. There is also an opportunity for researchers to evaluate the limited number of transportation projects or initiatives that incorporate food access. For projects that may affect food access that are in the initial planning stages or currently underway, transportation planners can collaborate with other planners to conduct an impact analysis of how the proposed changes to the transportation infrastructure will affect access to a variety of destinations and services, such as food. These impact analyses should include an equity framework to understand the proposed changes in the context of historical disinvestment through policies such as redlining that led to the food access inequities in place today.

In terms of community engagement, researchers can study how food systems and transportation planners can collaborate to enhance community engagement processes related to accessing food. Planners can expand on researchers' findings by experimenting with incorporating food access into their work through the strategies proposed in this thesis. Given that many planners are employing a destination framework, there is a window of opportunity for researchers to take a similar approach to this thesis in terms of accessing other destinations like health clinics, community spaces, and green and open space. The literature would benefit from future research that further explores transportation to the grocery store for grocery store workers, who are often low-income and whose shifts may not align with public transit schedules and do not align with grocery stores' hours.

RECOMMENDATIONS FOR POLICY AND PRACTICE

Overall, the transportation planners I interviewed reacted positively to the strategies I proposed to integrate food access into transportation planning based on my review of policy and planning reports. The destination framework planners are starting to embrace provides the perfect platform to incorporate food access into their work, since the physical access part of food access is all about reaching food retail destinations. Furthermore, the COVID-19 pandemic presents a policy window to rethink how transportation systems serve those who need them the most. It would be valuable for transportation planners to explore developing and implementing four of the five proposed strategies—bike and pedestrian infrastructure, public transit, master plans, and transit-oriented development—to incorporate food access into their work, acknowledging that this may require adjustments to existing planning tools and inventing new ones. In implementing these strategies in specific transportation projects and more comprehensive planning efforts, planners may find that certain projects lend themselves to an explicit food access framing, while others, by prioritizing equity populations for instance, have implicit implications for food access. Additionally, transportation planners' prioritization of marginalized populations and the destinations they want to access, opens the door for collaboration with food systems planners. Food access issues are inherently about access to destinations—both in terms of measurable

distance and what some refer to as "social distance" which takes preferences, like culturally appropriate food, and limitations, such as lack of access to a car, into account.

Master Plans: Almost all the planners agreed that it would be feasible to integrate food access into master plans, making this strategy a great candidate for exploration. Two ways planners can start to pursue this strategy is to include food retail locations in asset maps and food access goals throughout the plan. Collaboration with food systems planners throughout the master planning process may increase the effectiveness of these master plans, a concern the planners had with this strategy. By bringing food systems planners into the development stage of transportation projects, transportation planners can strive to increase buy-in across the city and region for their goals. In addition, food systems planners can work with transportation planners to develop more realistic goals when it comes to getting to the grocery store since they have a strong understanding of the food retail environment and food system more broadly.

Public Transit: In terms of the public transit strategy, Bus Rapid Transit, the ongoing bus network redesign, and locations for bus stops stood out as three places ripe for planning innovation. In developing these strategies, planners should look for opportunities to connect public transit networks to multiple food access points and other places transit-dependent populations want to access to build out their understanding of a destination framework that incorporates food access. When seeking public feedback on the bus network redesign, the MBTA might consider embracing the destination framework to hold separate public meetings for specific types of destinations. For the food access meeting about the bus network redesign, MBTA planners can collaborate with food systems planners to plan the meeting and recruit a diverse group of residents to provide feedback on the agency's plans. The meeting organizers may even consider convening the meetings at grocery stores when it is safe to do so. The MBTA and the municipalities it works with may consider developing BRT programs to serve popular food retail locations with affordable and healthy food by increasing the reliability, and therefore use of, buses to the grocery store.

Pedestrian and Bike Infrastructure: There are many potential ways to increase food access through the pedestrian and bike infrastructure surrounding and on the way to food retail points that

planners can explore. First off, municipalities may consider adding proximity to food retail as a criterion for prioritizing transportation projects as it is in line with the destination framework. When working on specific projects that are close to a food retail location, transportation planners can collaborate with food systems planners to learn about the food retail location, and what may be getting in the way of residents getting to that store in particular. My project also points to an opportunity for more conversations between transportation and food systems planners around the potential for shared-use paths to connect to food retail locations to make pedestrian and bike routes to the store safer. My survey results convey that residents' lived-experiences equips them with the knowledge to make informed recommendations for how to improve the pedestrian and bicycle environment surrounding stores, which transportation planners may consider collecting to inform their work.

Transit Oriented Development: In terms of transit-oriented development, transportation planners may think about collaborating with food systems and land use planners to develop a coordinated TOD policy that is structured around the destination framework and/or the 15-minute neighborhood strategy. TOD is an important strategy since it takes advantage of private money for the public good, yet can feel fragmented without an overarching goal. Municipalities may consider the goal of making destinations, including food retail, more accessible to historically marginalized communities to drive their TOD strategies.

CONCLUSION

The inability to access food is a contributor to the high rates of food insecurity across the country. Since transportation is one key barrier to food access for many food insecure households, transportation planning can function as one solution to address these barriers. This research indicates that transportation planners are willing and able to incorporate food access into their work, and points to projects and strategies ripe for collaboration amongst food systems and transportation planners. This thesis serves as a foundation for researchers and practicing planners to explore incorporating food access into transportation planning work, grounded in a destination framework, through the strategies discussed in this paper.

APPENDIX I: SOMERVILLE SUVREY INSTRUMENT

Getting Groceries in and Around Somerville

The Somerville Health Department is **working on ways to make it easier to get groceries** in and around Somerville. The City has received a grant from Tufts University to partner with Tufts and MIT professors to hear from community members about creative ways we can make this happen.
One way we would like to hear from community members is through this survey. All survey responses will inform how we design and prioritize strategies for making it easier to get good food to Somerville constituents.
Surveys are available in English, Spanish, Portuguese, and Haitian Creole, and usually take less than 20 minutes to complete. Anyone who takes the survey has the option to be entered into a raffle for a chance to win a $50 gift card. Your survey answers will be kept confidential. The name you provide for the raffle will not be connected to your survey at all.
By filling out this survey, you are agreeing to participate in this study. Your participation in this study is completely voluntary. You may refuse to participate or withdraw at any time. Doing so will not affect your relationship with Tufts University, MIT or the City of Somerville. Filling out this survey will not directly benefit you, but may serve the larger Somerville community.

Q2 Are you over 18?

- ○ Yes
- ○ No

Section 1: This section will explore grocery shopping patterns in the Somerville area.

Q4 How often to do you shop for food at:

	Grocery Stores (like Stop & Shop and Market Basket)	Neighborhood Markets (like McKinnons, Reliable Market, Minerao, and Amigos Grocery Store)	Other retail options (like drugstores, and Target)
Never	▢	▢	▢
Less than once a month	▢	▢	▢
Once a month	▢	▢	▢
2-3 times per month	▢	▢	▢
Once a week	▢	▢	▢
Two or more times per week	▢	▢	▢
Daily	▢	▢	▢

Q5 How much of your groceries come from neighborhood markets such as like Reliable Market, Amigos Grocery Store, Minerao, Ebisuya, McKinnons, and Sultana? [Choose only one option]

- o All
- o More than half
- o About half
- o Less than half
- o None

Q6 Where do you **currently** shop for food **most often**?
List up to three stores/markets.

_____

Q7 Where would you **like** to shop for your food?

- o List up to three stores/markets _____
- o Same stores/markets as above

Q8 Where do you usually buy your fruits and vegetables? [Select all that apply]

- ▢ Grocery Store
- ▢ Neighborhood Market
- ▢ Farmers Market
- ▢ Other _____

Section 2
This section will address how you get to and from the store where you buy your groceries in Somerville.
Q10 Most of the time, what transportation do you use to **get to the store** where you buy your groceries? [Select all that apply]

- ▢ Walk
- ▢ Bus
- ▢ The T
- ▢ Bike
- ▢ Household car
- ▢ Taxi. How much does this cost, on average: _____
- ▢ Lyft or Uber. How much does this cost, on average: _____
- ▢ Borrow a car from a friend/family member
- ▢ Drive with a friend/family member
- ▢ The RIDE
- ▢ Motorized chair
- ▢ Other, please specify: _____

Q11 How long does it usually take you to get **to the store** where you buy your groceries? [Choose only one option]

- o 0-10 minutes
- o 11-20 minutes
- o 21-30 minutes
- o 31-40 minutes
- o 40 minutes or more

Q12 Most of the time, what transportation do you use to **get home from the store** where you buy your groceries? [Select all that apply]

- ▢ Walk
- ▢ Bus
- ▢ The T
- ▢ Bike
- ▢ Household car
- ▢ Taxi. How much does this cost, on average: _____
- ▢ Lyft or Uber. How much does this cost, on average: _____
- ▢ Borrow a car from a friend/family member

- □ Drive with a friend/family member
- □ The RIDE
- □ Motorized chair
- □ Other, please specify: _____

Q13 How long does it usually take you to get **home from the store** where you buy your groceries? [Choose only one option]

- o 0-10 minutes
- o 11-20 minutes
- o 21-30 minutes
- o 31-40 minutes
- o 40 minutes or more

Q15 Does the way you get to the grocery store change either of the following:

	Yes	No
How much food you buy	o	o
The kind of food you buy	o	o

Q16 What would be your **ideal way** to get to the store where you buy your groceries? [Choose only one option]

- o I am happy with how I get to the store
- o Walk
- o Bus
- o The T
- o Bike
- o Household car
- o Taxi
- o Lyft or Uber
- o Borrow a car from a friend/family member
- o Drive with a friend/family member
- o The RIDE
- o Motorized chair
- o Other, please specify _____

Section 3: This section asks about whether you currently use rideshare and grocery delivery services.

Q18 Does your household have a car?

- o Yes

- ○ No

Q19 Do you have a smartphone?

- ○ Yes
- ○ No

Q20 Do you feel comfortable using rideshare applications (apps) like Lyft and Uber on your smartphone?

- ○ Yes
- ○ No
- ○ Don't know

Q21 Do you use any of the following car services? [Select all that apply]

- □ Uber
- □ Lyft
- □ Taxi/Cab
- □ Other: _____

Q22 Do you use any of the following online grocery delivery services? [Select all that apply]

- □ Peapod
- □ Instacart
- □ Amazon Fresh
- □ Other: _____
- □ None

Section 4

We would like to know your opinions on several hypothetical options.

Q24 If the following options existed, how likely would you be to use these options:

	Not at all likely	Not likely	Somewhat likely	Likely	Very Likely
Low-cost ride through a rideshare service to and from the grocery store where you can do your own shopping	○	○	○	○	○
Low-cost grocery delivery from an established grocery delivery service like Peapod and Amazon Fresh	○	○	○	○	○
An extra $10 with which to buy fresh fruits and vegetables when paying with SNAP (formerly Food Stamps) at your neighborhood market	○	○	○	○	○
Low-cost pre-chopped fruits and vegetables available to purchase at your neighborhood market	○	○	○	○	○

Section 5
The following questions refer to a **farm veggie box**, a box of produce grown at local farms that would be available for you to order and purchase from your neighborhood market every two weeks. Produce included in the box is seasonal and thus, the food in your box will change each time. We use the term "household" to refer to the people you are shopping for.

Q26 How likely would you be to order/purchase a low-cost farm veggie box that you would pick up at your neighborhood market?

- ○ Not at all likely
- ○ Not likely
- ○ Somewhat likely
- ○ Likely
- ○ Very likely

Q27 What factors make you likely or unlikely to purchase a low-cost farm veggie box? For example, not enough room in your refrigerator may make you not likely to purchase it and supporting local farmers may make you more likely to purchase it.

_____

Q28 Do you agree or disagree with the following statements?

	Agree	Disagree
I am comfortable with someone else selecting the fruits and vegetables for the farm veggie box	○	○
I would be willing to adapt my household's meals according to the product's in each week's farm veggie box	○	○

Q29 What would you be willing to pay for a farm veggie box with enough produce to feed your household for two weeks? _____

Section 6
This section asks about your grocery shopping budget. Remember, we use the term "household" to refer

to the people you are shopping for.

Q31 How much does your household spend on groceries per week?

- ○ Less than $100
- ○ $100-150
- ○ $150-200
- ○ $200-250
- ○ $250-300
- ○ More than $300
- ○ Don't Know

Q32 Has your household used any of the following in the past year to buy groceries? [Select all that apply]

- ▢ SNAP (formerly food stamps)
- ▢ WIC
- ▢ WIC farmers market coupons
- ▢ Senior farmers market coupons
- ▢ Other _____
- ▢ None

Q33 Please respond to the following statements

	Never True	Sometimes True	Often True
Within the past 12 months we worried whether our food would run out before we got money to buy more.	○	○	○
Within the past 12 months, the food we bought just didn't last and we didn't have money to get more.	○	○	○

Q34 Is there anything else you would like to tell us about your current experience grocery shopping and/or how you would like to see your grocery shopping experience improve?

_____

Section 7
Lastly, we would like to know the demographics of your household.

Q36 How many people, including yourself, do you grocery shop for in each age range?
0 to 5 year olds : _____
6 to 18 year olds : _____
19 to 60 year olds : _____
Over 60 : _____

Total : _____

Q37 What is your zip code? _____

Q38 Sex

- Male
- Female
- Nonbinary
- Prefer not to answer

Q39 Age: _____
Q40 What is the highest educational level achieved in your household?

- Less than HS
- HS diploma or GED
- Some College
- College degree
- Masters degree or higher

Q41 Ethnicity/Race. [Select all that apply]

- ☐ American Indian or Alaska Native
- ☐ Asian
- ☐ Black or African American
- ☐ Native Hawaiin or Pacific Islander
- ☐ White
- ☐ Hispanic
- ☐ Other _____

APPENDIX II: INTERVIEWS WITH TRANSPORTATION PLANNERS

INTERVIEW QUESTIONS

1. Given the fact that transportation is an oft-cited barrier to food access, in what ways does the awareness of food access factor into your work, if at all?

2. Food access practitioners and researchers have found that food insecure people face the following barriers to food access using the transportation system:
    a. Carrying groceries while walking and on public transit—heavy bags and bag limits imposed by regional transit authorities
    b. Location of stops—bus or T stops are far from food access points
    c. Bus schedules do not align with when people want to do their grocery shopping leading to long wait times or not using buses
    d. Transferring buses adds a lot of time and is inconvenient
    e. Unsafe pedestrian access surrounding supermarkets
    f. Lack of safe bike lanes from one's home to the grocery store and lack of bike parking at the store

    Do one or more of these barriers resonate with your experience of addressing transportation barriers more broadly? Are there any other barriers you would add to this list?

3. What planning solutions have you been a part of implementing that may address the transportation barriers to food access we just talked about, whether you thought about food access explicitly or not?

4. What do you think would be challenging about addressing food access as a transportation planner? Think about both logistical challenges (ie. funding) and theoretical challenges (ie. hard to separate food access from other transportation needs)

5. Here are five strategies that transportation planners could use to address food access:
    a. Work with developers: This strategy entails including food access in transit-oriented development and transportation demand management to promote walkable and bikeable food access in new residential and commercial development.
    b. Transportation & comprehensive master plans: Plans would incorporate food access into the framing of the plan, maps, and action items to hold planners and policy makers accountable to incorporating food into transportation systems. One example would be incorporating food access points into a bike/pedestrian master plan.
    c. Public transit: This strategy involves thinking about food access points when establishing and making changes to public transit routes, schedules, and stops. It can also include innovative ways of pairing food access with public transit systems like holding farmers markets at public transit stops or adding grocery bins to public buses.
    d. Pedestrian and bike infrastructure: The main component of this strategy is prioritizing sidewalk (and bike lane) repairs that would improve access between residential areas and food retail, and ensuring that changes to the streetscape do not negatively impact food access. In pursuing this strategy, one may also consider including food retail access in complete street policies.

e. Grocery delivery: Grocery delivery has surged since the start of the coronavirus pandemic in March and transportation planners could play a key role in ensuring that this option is accessible to everyone. This could entail partnering with regional transit authorities to have groceries delivered to specific transit stops for pickup or partnering with grocery delivery companies to ensure fees are waived for at-risk groups and delivery is available at convenient times.

How effective do you think the following strategies are likely to be in addressing food access in the context in which you do transportation planning?

SURVEY QUESTIONS

Q1 To what extent do you, and those you work with, consider food access in your planning work?

- ○ A great deal
- ○ Considerably
- ○ Moderately
- ○ Slightly
- ○ Not at all

Q2 To what extent do you think it would be valuable for you to consider food access in your planning work?

- ○ Very valuable
- ○ Valuable
- ○ Unsure whether it is valuable
- ○ Not valuable most of the time
- ○ Not at all valuable

Q3 Recall the following five strategies to incorporate food access into transportation planning:

1. **Work with developers:** This strategy entails including food access in transit-oriented development and transportation demand management to promote walkable and bikeable food access in new residential and commercial development.
2. **Transportation & comprehensive master plans:** Plans would incorporate food access into the framing of the plan, maps, and action items to hold planners and policy makers accountable to

incorporating food into transportation systems. One example would be incorporating food access points into a bike/pedestrian master plan.

3. **Public transit:** This strategy involves thinking about food access points when establishing and making changes to public transit routes, schedules, and stops. It can also include innovative ways of pairing food access with public transit systems like holding farmers markets at public transit stops or adding grocery bins to public buses.
4. **Pedestrian and bike infrastructure:** The main component of this strategy is prioritizing sidewalk (and bike lane) repairs that would improve access between residential areas and food retail, and ensuring that changes to the streetscape do not negatively impact food access. In pursuing this strategy, one may also consider including food retail access in complete street policies.
5. **Grocery delivery:** Grocery delivery has surged since the start of the coronavirus pandemic in March and transportation planners could play a key role in ensuring that this option is accessible to everyone. This could entail partnering with regional transit authorities to have groceries delivered to specific transit stops for pickup or partnering with grocery delivery companies to ensure fees are waived for at-risk groups and delivery is available at convenient times.

Q4 How feasible do you think the following strategies would be in increasing food access? Think about cost, logistics, staff time (including new staff needs), and stakeholder buy-in.

	Very feasible	Feasible	It depends	Somewhat feasible	Not feasible
Work with developers	○	○	○	○	○
Master plans	○	○	○	○	○
Public Transit	○	○	○	○	○
Ped/bike infrastructure	○	○	○	○	○
Grocery Delivery	○	○	○	○	○

Q5 How effective do you think the following strategies would be in increasing food access? Think about cost, logistics, staff time (including new staff needs), and stakeholder buy-in.

	Very effective	Effective	It depends	Somewhat effective	Not effective
Work with developers	○	○	○	○	○
Master plans	○	○	○	○	○
Public Transit	○	○	○	○	○
Ped/bike infrastructure	○	○	○	○	○
Grocery Delivery	○	○	○	○	○

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