Effects of a Chicago Complete Streets Project on Travel Behavior and Perceptions

Environmental and Urban Studies BA Thesis

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Molly Fortnow

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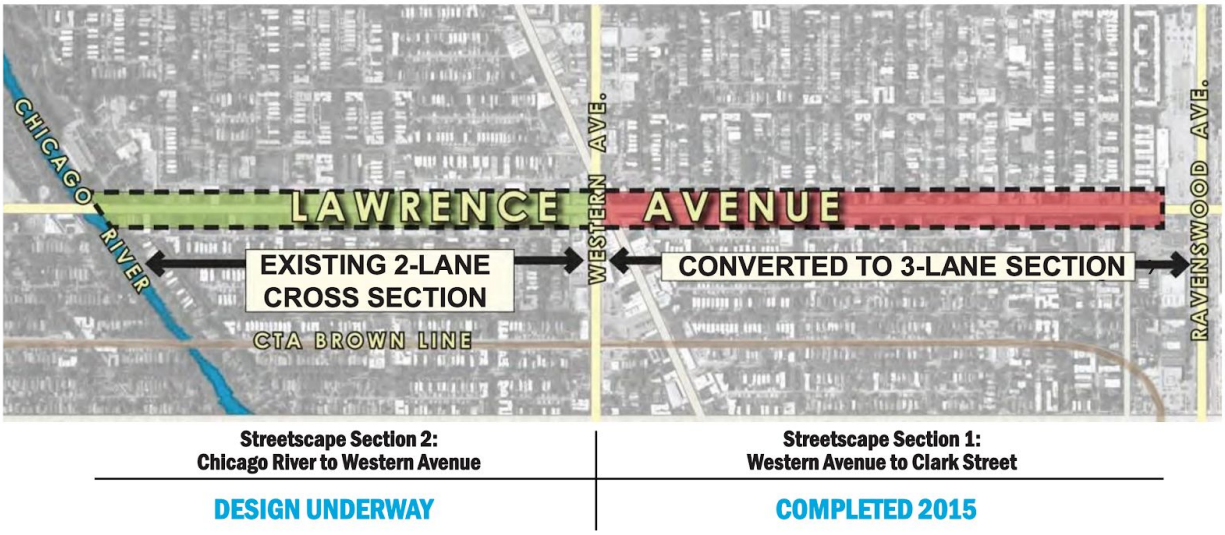
Introduction

American street design took an autocentric approach in much of the 20th century, designed for *mobility* above all other metrics. This meant prioritizing "fast, cheap travel" over other aspects of the streetscape, which often meant designing streets to maximize automobile speeds over all else (Burden and Litman 2011). Over the course of the last couple of decades, however, the conversation surrounding street design has shifted dramatically. The focus has moved from mobility alone to *accessibility* of multiple modes of transportation, with special attention on how the paradigm of mobility affects users' "ability to reach desired goods, services, and activities safely" (Burden and Litman 2011). Out of this desire for streets that could be safely used by multiple modes of transportation, including bikers and pedestrians, the Complete Streets movement has taken hold as a standard for American cities in building and retrofitting streets around the country (McCann 2013). Barbara McCann and others founded Complete Streets on the idea that streets should be designed with considerations of safety for multiple types of users by prioritizing those without motorized vehicles over those in cars (McCann 2013).

The City of Chicago has been implementing these principles in projects around the city, prioritizing the goals of the Complete Streets movement by adopting "a pedestrian-first modal hierarchy" ("Complete Streets Design Guidelines" 2013). One such project is the Lawrence Avenue Streetscape, located on the north side of Chicago in the Ravenswood and Lincoln Square community areas. One stretch of Lawrence Avenue, from Clark Street to Western Avenue, shown below in red, was completed as a Complete Streets project in 2015, and will hereafter be referred to as the "complete" or "completed" segment. An adjacent segment of Lawrence, from Western Avenue to the Chicago River, shown below in green, is currently in the design process

to be constructed in spring and summer 2020. This segment will hereafter be referred to as the "incomplete" segment.



The City of Chicago's plans to retrofit the "incomplete" segment indicate that the city has identified a need for such a project on that stretch. This situation allows for a remarkable opportunity for a case study of a municipal retrofitting project because this street offers a quasi-natural experiment between a "complete" street and an "incomplete" street. By comparing differences between the two segments, this study shows how the Complete Streets design framework has changed how Lawrence is used and perceived and whether the City of Chicago has achieved its goals by implementing these changes. This case is well-suited as a natural experiment because studying two design patterns on one continuous street mitigates certain confounding variables, such as the pool of potential users of the segments and the urban amenities available to users.

To be certain, the distinction between the "complete" and "incomplete" segments is not to imply a dichotomy or binary between the "completeness" and "incompleteness" of the

segments, nor the concepts of "completeness" and "incompleteness" more generally. This distinction is also not meant to imply that either of these segments exemplifies everything which defines the Complete Streets movement or what it is working against; certainly, each segment includes elements which might be found on any street in America, regardless of its design framework. Additionally, distinguishing the segments as "complete" and "incomplete" is not to insinuate that one side is inherently better or more "whole" than the other. Rather, this distinction simply serves to point out two stages of a project to retrofit Lawrence Avenue under a specific framework which goes by the name Complete Streets. Though this study could just as easily refer to these two segments as "East of Western" and "West of Western," it uses these labels both for clarity about on which segment this retrofitting has been "completed" and which it has not, and for simplicity and consistency throughout.

Many studies have attempted to say which elements of the built environment have had greater and lesser effects on transportation behavior — some of these elements include land use (Cervero 2002), population density (Ewing and Cervero 2010), and prior biases of users of the street (Bagley and Mokhtarian 2002) alongside street design. In the particular Lawrence Avenue case study, street design is not only the primary difference between the two sides of the street but also the only factor controlled by the City of Chicago's retrofitting project. Some literature claims that design changes can have a direct positive effect on multi-use travel (Burden and Litman 2011), but many empirical studies show that this might not always be the case. In effect, this case study isolates street design as an independent variable. This provides the opportunity to study the direct effect it has on travel behavior given many other similarities in the urban environment.

Ultimately, this study serves as a response to the larger question of whether or not street design, under the Complete Streets framework in particular, has a direct effect on travel behavior and perceptions thereof. In addressing this question, this study hopes to investigate how the City of Chicago uses street design to encourage use of various modes of transport, feelings of safety, and a sense of place. It also hopes to analyze the extent to which this endeavor is both feasible and positive. In order to address these questions, this study investigates four specific inquiries regarding Lawrence Avenue:

- What are the physical factors designed and implemented by the City of Chicago which distinguish the "complete" and "incomplete" segments of Lawrence?
- Is there a substantive difference in levels of pedestrian activity, biking activity, and/or automobile activity between the two segments? What might be confounding factors that influence these differences?
- Are there differences between how the two sides are perceived? Is there a substantive difference between the perceived ability to walk, bike, and/or drive between the two segments?
- How do these differences (or lack thereof) reflect the goals of the City of Chicago and the Complete Streets movement more broadly?

This study found very little difference between levels of pedestrians, bikers, and cars in the two segments and that specific location seemed to have more of an impact on these levels than whether that location was located in the "complete" or "incomplete" segment. While there was a slightly higher rate of pedestrians on the "complete" segment, overall, this study contradicts the notion that street design alone will influence travel behavior. Furthermore,

perceptions measured failed to form a consensus about which side was more walkable, bikeable, or drivable; while they skewed towards the "complete" side being more walkable and the "incomplete" side being more drivable, the mixed responses show a number of factors at play in these perceptions. Broadly, the "completed" design thus promoted accessibility for both pedestrians and cars, and the City of Chicago should reframe their approach and make it more holistic in order to obtain its desired modal hierarchy.

Complete Streets in America

Jane Jacobs's seminal book, *The Death and Life of Great American Cities*, originally published in 1961, is often cited as a turning point in the American viewpoint about city planning. Jacobs contests modernist ideas of planning, which emphasize car use and isolated buildings. Rather, she argues that active streets with present people make for safer and healthier pedestrians and advocates for diversity of use and building type, short blocks, and density (Jacobs 1992).

These ideas have continued to heavily influence thinking about city planning and street design in response to the prevailing modernist theories emphasizing automobile use and reliance. Towards the end of the twentieth century, this pushback was already emerging; projects like that of William H. Whyte, who observed and analyzed public spaces for pedestrian use and cited sitting space, access to trees and sun, and retail as some factors which encourage human presence (Whyte 1980), show a growing awareness of the role of pedestrians on and around city streets during this time period. Additionally, many have advocated for third places, places outside of home or work which help foster community and placemaking, which seem to be absent in many suburbs (Oldenburg 1999).

As perceptions about urban planning began to shift, new ideas about what to prioritize in cities began to codify into movements. One example is New Urbanism, a school of thought around urban planning that encapsulates frustrations with modernist designs and implementation. Founded in 1993, according to the website for the Congress for New Urbanism, the organization seeks to design public spaces in cities sustainably and to a human scale ("What Is New Urbanism?" 2015). These ideas have not gone without their own controversy; some have criticized New Urbanism for its lack of connection to environmental conservation (Duany and Brain 2005). Others have disapproved of New Urbanism for its seeming lack of sense of social responsibility for marginalized groups as they attempt to create livable spaces for communities in contexts implementers of New Urbanist ideas sometimes do not understand (Brain 2005). Still, New Urbanist frameworks have become popular as a prevailing approach to city and street design, and many employ these ideas when retrofitting places which seem to be designed with mobility of cars in mind.

These changes in thinking about the urban landscape also began to influence street design in particular towards the end of the century. National policies in the '90s, including the Americans with Disabilities Act in 1990 and the Intermodal Surface Transportation Equity Act (ISTEA) in 1991, mark important steps toward designing streets with accessibility and safety for different users in mind, including bicyclists, pedestrians, and those with disabilities ("Complete Streets: The Basics" 2015).

The Complete Streets movement rose from this momentum. While working with urban bicycling activists, Barbara McCann created the term Complete Streets in 2003 as a catchy way to identify their multi-modal approach (McCann 2013). In 2005, the National Complete Streets

Coalition was founded, and the US Department of Transportation began endorsing its ideas over the last decade. The graphic below shows the timeline of how the movement came to be on a national scale:

("Complete Streets: The Basics" 2015)

The Complete Streets movement emphasizes safety for all users of a street, including

bicyclists, pedestrians, people taking public transit, and those with disabilities (McCann 2013). The Active Transportation Alliance, a Chicago-based agency, defines Complete Streets as:

> "a movement that brings together policy and people, networks and neighborhoods, designs, and destinations. The Complete Streets concept reclaims streets for people, reexamines the public realm, and challenges some commonly held perceptions about transportation... A Complete Streets approach combines the physical planning, design, and maintenance of infrastructure with an institutional understanding of project management, funding, and prioritization." ("Complete Streets: The Basics" 2015)

The movement serves as a response to mono-modal streets increasingly present in urban and suburban settings around America in the second half of the twentieth century, which were designed solely for cars and unsafe for any other users (McCann 2013). It strives to be a flexible, non-prescriptive approach to designing streets in a way that prioritizes accessibility for all while also being adaptable for different kinds of streets and places ("Complete Streets: The Basics" 2015).

The Complete Streets movement sets itself up in opposition to what it sees as the prevailing and overwhelmingly accepted mode of designing and thinking about streets. The movement seeks to resist what it views as the "old paradigm," or the prevailing twentieth century mindset, and establish a "new paradigm," as shown in the figure below (Litman 2012). The "conventional" method of street design prioritizes travel speeds of cars above all else, whereas the novel, "multi-modal" paradigm prioritizes accessibility to streets and services for multiple types of travel modes (Litman 2012).

	Conventional (Old Paradigm)	Multi-Modal (New Paradigm)
Definition of *transportation*	*Mobility* – physical travel (primarily motor vehicle travel)	*Accessibility* – peoples' ability to reach desired services and activities
Planning goals	Maximize travel speeds	Maximize overall accessibility
Transport system performance indicators	Roadway level-of-service (LOS), average traffic speed, congestion delay	Multi-modal LOS, time and money required by various people to access services and activities
Roadway design priority	Maximize vehicle traffic speeds and volumes	Accommodate multiple modes and activities
Typical design speed	30-50 miles (50-80 kilometers) per hour	20-30 miles (30-40 kilometers) per hour
Roadway network type	Hierarchical with low connectivity	Highly connected roads and sidewalks
Design vehicle	Heavy trucks (fire truck or moving van)	Heavy trucks for roads, impaired sidewalk user

Conventional planning favors roadway design that maximizes vehicle traffic speeds. Multi-modal planning considers other modes important and so favors complete streets designs.

(Litman 2012)

While the Complete Streets movement posits itself as non-prescriptive, certain design elements are associated with the principles, specifically as it pertains to elements intending to slow traffic, as well as those intending to increase pedestrian and bike mobility by making these activities safer, easier and more inviting. It strives to remain sensitive to locational context while also implementing "traffic taming" devices such as raised medians with landscaping, improved crosswalks, and parallel parking (LaPlante and McCann 2008). Litman (2012) lists some of these features and shows how they might be laid out:

Typical Complete Streets Features

- Wider and better sidewalks
- Universal design features (curbcuts and ramps)
- Crosswalks with pedestrian refuge islands
- Bike lanes and paths
- Bus lanes and shelters
- Center left turn lanes
- Lower traffic speeds
- Landscaping

Complete street projects typically add or improve sidewalk, crosswalks, bike lanes and center turn lanes.

As shown in these figures, some tactics used to accomplish the goals of slowing traffic and increasing bike and pedestrian mobility are shown above, such as having fewer lanes for automobiles, left turn lanes, bike lanes, and wider sidewalks. These design differences reflect the distinctions in goals between the "old paradigm" and "new paradigm," as less space on the street is given to cars and more space is given to other users.

Advocates of Complete Streets praise the movement for effectively making streets safer and residents healthier, inciting higher rates of bicycling and walking as well as economic growth and higher property values, all while being relatively cheap to implement (Anderson et al. 2015). The movement has also received praise for prioritizing accessibility in travel choice over focusing on only speed of transport while addressing public health, safety, environmental quality, and general livability (Burden and Litman 2011).

The design and function of Complete Streets has also been analyzed; Dover and Massengale look to cities designed recently and in the far past for examples of what effectively creates place and fosters walkability with an inviting street (Dover and Massengale 2014). Walkability, a metric which has grown in popularity parallel to the Complete Streets movement,

is another indicator of streets built for pedestrians — common metrics include buffering from traffic, density and diversity of land use, visual interest, and perceived and actual security from cars and crime (Lo 2009). This study uses the concept of walkability, as well as bikeability and drivability, as indicators of perceptions of the two segments; rather than use an official walkability score, this study uses these general concepts as a means to investigate how those who interact with the street often perceive their own ability to travel by different modes.

Like with New Urbanism, there has been no shortage of pushback against the Complete Streets movement. Its opponents and skeptics say that while the movement markets itself as the ultimate inclusive solution to a wide range of issues, like safety, accessibility, and public health, it fails to consider the complexities of the spaces and people it serves (Zavestoski and Agyeman 2015). Complete Streets, they argue, sees "users" of the street as a monolith without considering differences that result from "socioeconomic and racial inequities embedded in and reproduced by the spaces we call streets" (Zavestoski and Agyeman 2015). This countermovement, appropriately titled Incomplete Streets, points out that popular narratives of Complete Streets do not take marginalized people and communities into account, nor their fears of gentrification and the access (or lack thereof) to other urban amenities which may affect their health, safety, and general wellbeing (Zavestoski and Agyeman 2015). By abstracting the street, a real, physical place which people interact with every day, the Complete Streets movement disregards these complexities and gives way to a system which "will inevitably benefit certain people in certain urban spaces and not others" (Zavestoski and Agyeman 2015).

One destination of inquiry for this study lies in whether the Complete Streets project on Lawrence has a positive or beneficial effect on the community, which is addressed through a

survey question regarding general observations about the two segments. While the question of whether the design is positive or negative is incredibly subjective, this study aims to consider not only whether the project meets the goals of the City of Chicago and the Complete Streets movement itself but whether it actually serves the community in a way *they* desire. This one inquiry certainly does not answer the larger questions posed by the Incomplete Streets countermovement. However, it attempts to address some of the complexities pointed out by the movement rather than simply ignoring them in favor of the institutionalized goals outlined by the Complete Streets movement and the City of Chicago.

Street Design and Travel Behavior

In addition to concerns about inclusion, some empirical studies have called Complete Streets principles into question as evidence has arisen that factors other than street design have greater impacts on travel behavior. Many studies do not focus on the Complete Streets framework specifically, especially since there is no definitive guideline on design principles that Complete Streets must have in order to be labeled complete. Rather, many studies look at some factors that are related to and/or implemented by many Complete Streets designs and compare them to other factors.

Some studies looked at three broad factors, the "3 Ds" — density, (land use) diversity, and (urban) design — to determine which factors had the greatest impact on certain variables. Cervero uses this framework to show that land use, specifically mixed land use, had a greater influence on travel choices in Montgomery County, MD than design (Cervero 2002). Later, a more expansive study of changes to the built environment over time used Density as a stand-in for design, destination accessibility, and diversity. It ultimately showed that population density

correlated with a reduction in Vehicle Miles Traveled (VMT) (Cervero and Murakami 2010). This had the notable exception of what they called the "Los Angeles Effect," in which roadway infrastructure increases as density increases, leading to an increase in VMT. This study of Lawrence Avenue similarly uses one of these "3 Ds" as the focus, but it isolates design as the independent variable as opposed to density. While this study does not investigate the other two Ds, it does investigate land use as a potential confounding variable in its analysis, specifically access to retail.

Empirical studies are mixed as to the extent to which certain elements of street design impact travel behavior. Zhang's 2004 study shows that street design may not play such a large role. Zhang's findings in Boston display that population density correlated with transit use, while decreased network connectivity at destinations increased driving rates. The study found that, in Hong Kong, parking availability correlated with driving, while job density at destinations negatively correlated with driving (Zhang 2004). Similarly, Vance and Hedel found that road density, commercial density, and access to public transit were statistically significant indicators of car use (Vance and Hedel 2007).

On the other hand, some empirical evidence has shown there to be a connection between street design and travel behavior. Lawrence Douglas Frank et al. found that increased sidewalk access negatively correlated with VMT and greenhouse gas emissions, and positively correlated with walking (Lawrence Douglas Frank et al. 2007). Using self-reported data, Li et al. showed that density, access to greenspaces and recreational spaces, household density, and number of intersections positively correlated with walking in older adults; many of these factors, especially number of intersections, increased the feeling of safety of pedestrians on the street (Li et al.

2005).

All of the above studies, regardless of their conclusions, share a common thread in their methods — they investigate how elements of the built environment correlate with rates of walking and driving. This study of Lawrence Avenue aims to evaluate similarly by measuring rates of walking, biking, and driving an indicator of whether the project is achieving its goals. Though this study does not test for many of the specific factors above, it goes on to analyze whether some of these factors may confound the results.

Other studies employed other methods to analyze the relationship between the built environment and travel behavior. Lee and Moudon used spatial sampling and phone surveys to find different factors that motivated different types of walking — walking for transportation versus walking for recreation. Destinations correlated with transport walking, sidewalks correlated with recreational walking, and residential density correlated with both (Lee and Moudon 2006). This shows that designs encouraged by complete streets, specifically improved sidewalks, may have a greater impact on recreational walking than on walking for transportation. Similarly, this study of Lawrence Avenue employs an additional method to study the differences between the two segments. It surveys business owners in order to measure the relationship between travel behavior and perceptions thereof.

In a meta-analysis, Ewing and Cervero found that no one factor had a significant impact on travel behavior on its own, but combined elements had a greater impact. Driving was most affected by accessibility of destinations and street network design, while walking was most affected by land use diversity, intersection density, and number of destinations within walking distance (Ewing and Cervero 2010). Due to the nature of the case study, this study of Lawrence

Avenue investigates an agglomeration of many factors that fall under the broad umbrella of Complete Streets retrofitting and looks at their impact on walking as a whole.

Some studies looked at qualifying variables outside the built environment, such as preference bias of the users themselves. One showed that attitude and lifestyle differences had a larger impact on travel than neighborhood type, which calls into question what impact this bias might have (Bagley and Mokhtarian 2002). A further study showed that physical neighborhood structure in the San Francisco bay area had a significant impact regardless of whether or not people felt at odds with the lifestyle their surroundings promoted (Schwanen and Mokhtarian 2005). Furthermore, it was shown that walkable built environments only had a positive impact on walking for people who did not have a preference for driving (Lawrence Douglas Frank et al. 2007). Though this study of Lawrence Avenue does not measure preconceived opinions, it hopes to use surveys to get a sense of how street users feel about the street in relation to the way it is actually used.

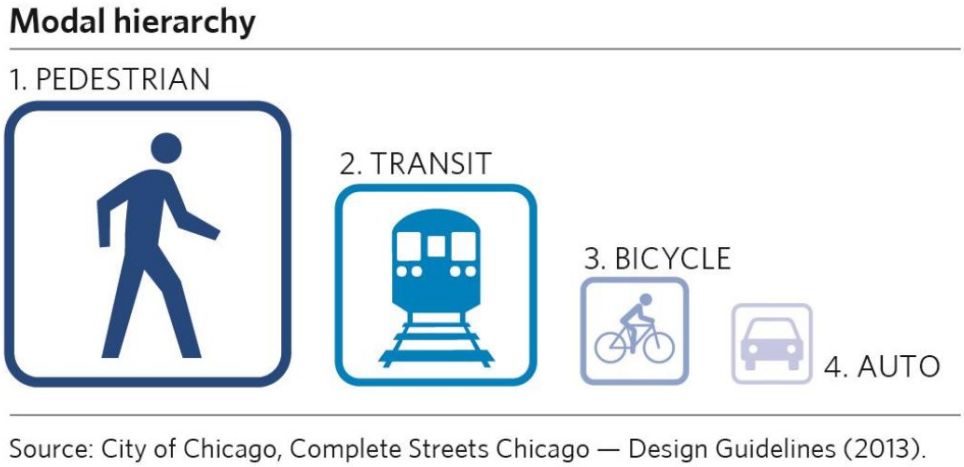
Ultimately, all of these studies seek to determine impacts of different factors on varying elements of travel behavior. This Lawrence Avenue study presents a case study in which only one factor has been implemented, street design. However, street design may also be seen as a combination of several factors, such as sidewalk width, number of lanes, and number of crosswalks. In this way, this study investigates whether a change in street design can have a desired impact on travel behavior. At the same time, it controls many variables by presenting a single street with two dramatically different designs. While not able to study every variable these previous studies looked at, this study hopes to present an understanding of how changing street design can transform a street and the travel behaviors of those who use it, and attempts to

understand how Lawrence Avenue functions in relation to these changes.

The City of Chicago and Complete Streets

The Chicago Metropolitan Agency for Planning (CMAP), in collaboration with the National Complete Streets Coalition, created a toolkit to approach Complete Streets as policy and implementation. This toolkit emphasizes policies which make sure "our transportation system routinely includes the needs of pedestrians, transit users, or bicyclists, and will give people of all ages and abilities more options when traveling," listing lengthy benefits they expect to gain from this initiative ("Complete Streets: The Basics" 2015). Some benefits the toolkit outlines include safety based on reduced speed of cars correlating with reduced pedestrian injuries and deaths; economic benefits that come with creating a more walkable environment; making roads more accessible to elderly and disabled populations; health benefits due to increased physical activity; accessibility for vulnerable populations such as the elderly and those with disabilities; equity for vulnerable communities living with "incomplete streets"; and creating a sense of place by making streets "more than just conduits and storage space for automobiles" ("Complete Streets: The Basics" 2015). The toolkit reiterates the goals of the Complete Streets movement at large, stating that the city hopes to balance the needs of different modes of travel and highlight the importance of walking, cycling, and public transportation.

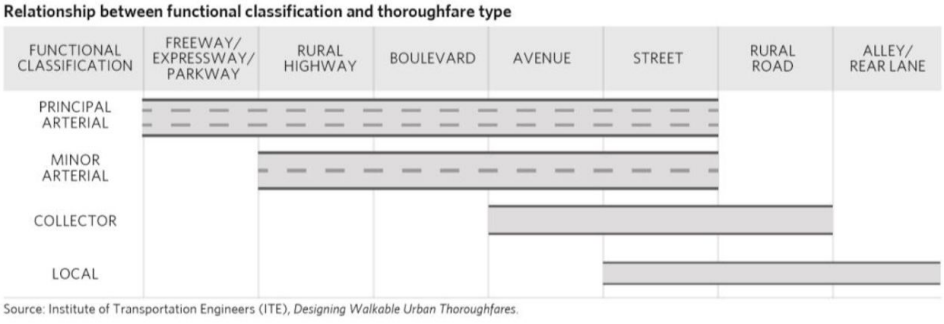
In terms of design, CMAP and the City of Chicago frame their approach with a modal hierarchy that favors walking, public transit, and biking over cars, in that order.



("Complete Streets Design Guidelines" 2013).

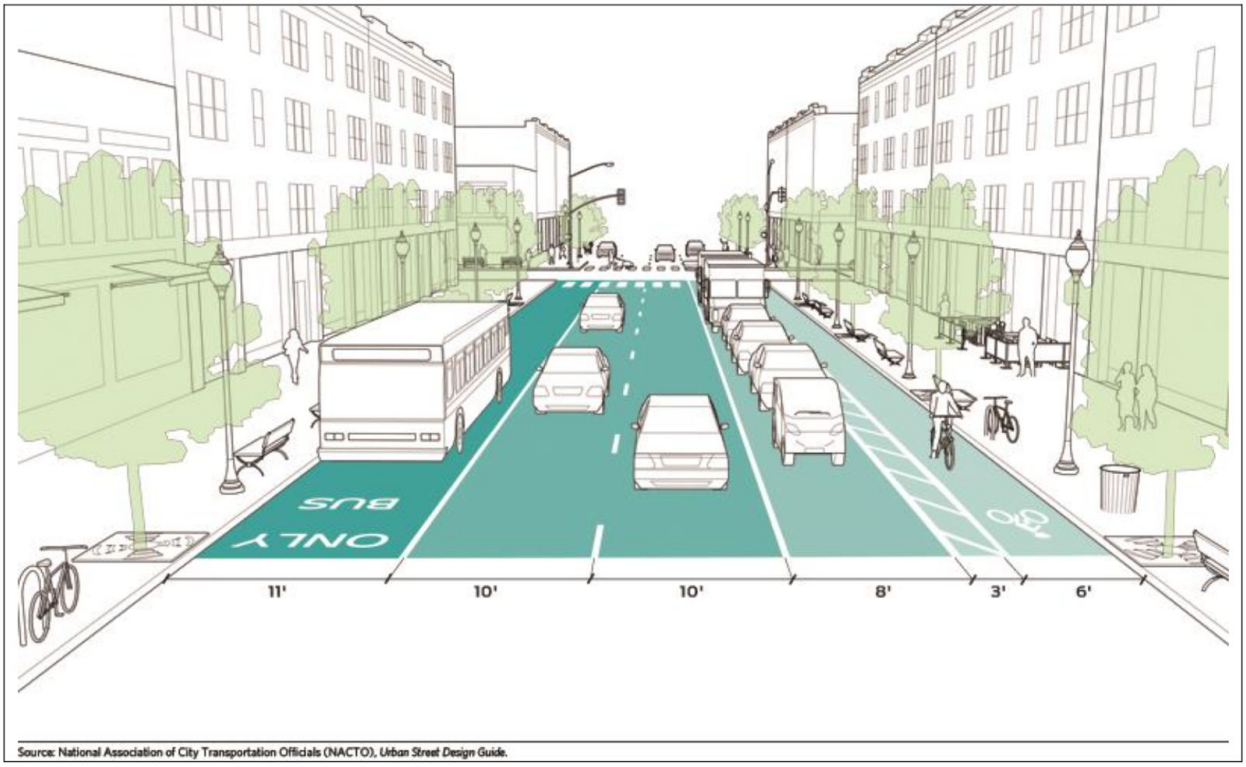
This shows that planners in the Chicago metropolitan area aim to promote various modes of transport above driving with their Complete Streets street designs. Planners in the region would thus likely expect that, should their goals be met, there would be fewer cars and more people walking, biking, and taking public transit on retrofitted streets. As such, as well as in accordance with Complete Streets guidelines, this is the expected outcome of this study, although transit ridership could not be measured.

CMAP also uses Context Zones, which distinguish various design elements by level of urbanness and use, Roadway Typologies (shown below), and the aforementioned modal hierarchy as their guiding principles for designing Complete Streets.



(“Complete Streets: Design Concepts and Considerations” 2015).

By the guidelines laid out in the toolkit, Lawrence would likely be an Avenue, with a higher vehicle capacity, commercial corridors, on-street parking, bike lanes, and sidewalks. CMAP further prioritizes narrowing car lanes, shortening block length, and making the street accessible for disabled populations.



(“Complete Streets: Design Concepts and Considerations” 2015)

Furthermore, the Chicago Department of Transportation (CDOT) has enacted a “Complete Streets Policy”, which states the following:

> “The safety and convenience of all users of the transportation system including pedestrians, bicyclists, transit users, freight, and motor vehicle drivers shall be accommodated and balanced in all types of transportation and development projects and

> through all phases of a project so that even the most vulnerable – children, elderly, and persons with disabilities – can travel safely within the public right-of way."
>
> ("Complete Streets Design Guidelines" 2013)

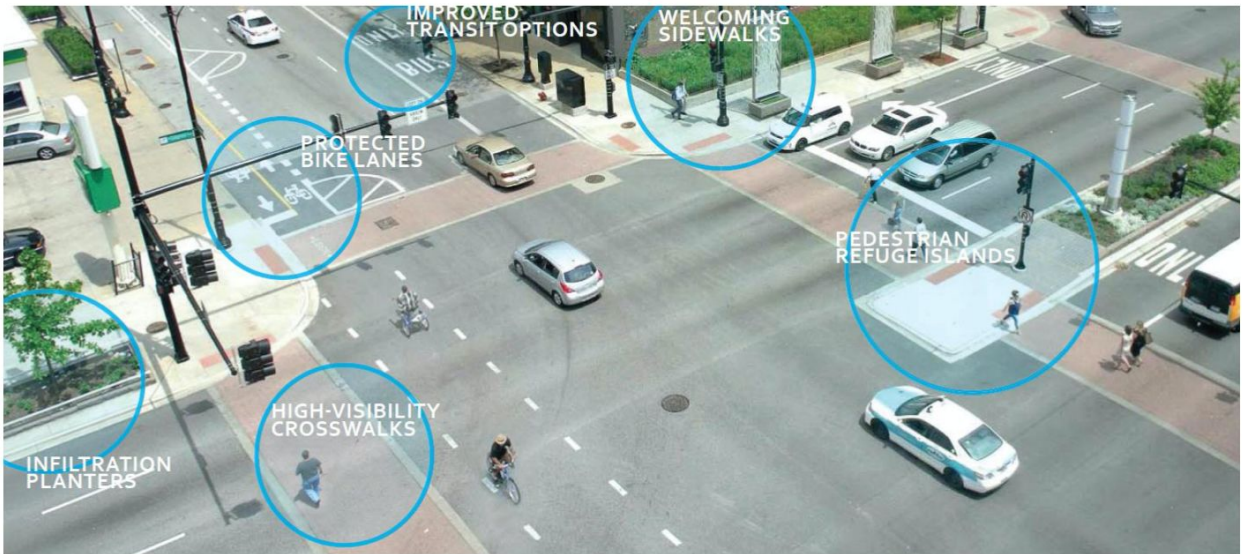
This reflects the values of the Complete Streets Movement at large, and emphasizes the desire for multiple modes of transport to be prioritized. The statement is significant because it shows the City of Chicago's commitment to these principles for its projects; Lawrence Avenue's retrofitting is an example of one such project, controlled by CDOT. This study investigates whether these goals are met by the design changes implemented on Lawrence.

Importantly, The City of Chicago views Complete Streets as "a transportation network approach", and the city acknowledges that one-road projects "will not achieve the objectives or realize the full benefits of Complete Streets unless it is part of a larger network that accommodates all users safely and conveniently" ("Complete Streets: The Basics" 2015). While the city has several projects centered around a single street or a segment of a street, including Lawrence, this study cannot claim to analyze every aspect of the City of Chicago's approach to Complete Streets because it does not take the immediate or larger transportation networks into account. Ultimately, Lawrence Avenue is only one small piece of the larger approach, and the changes implemented on this street cannot be treated as a stand-in for every goal of the City of Chicago.

Complete Streets and Lawrence

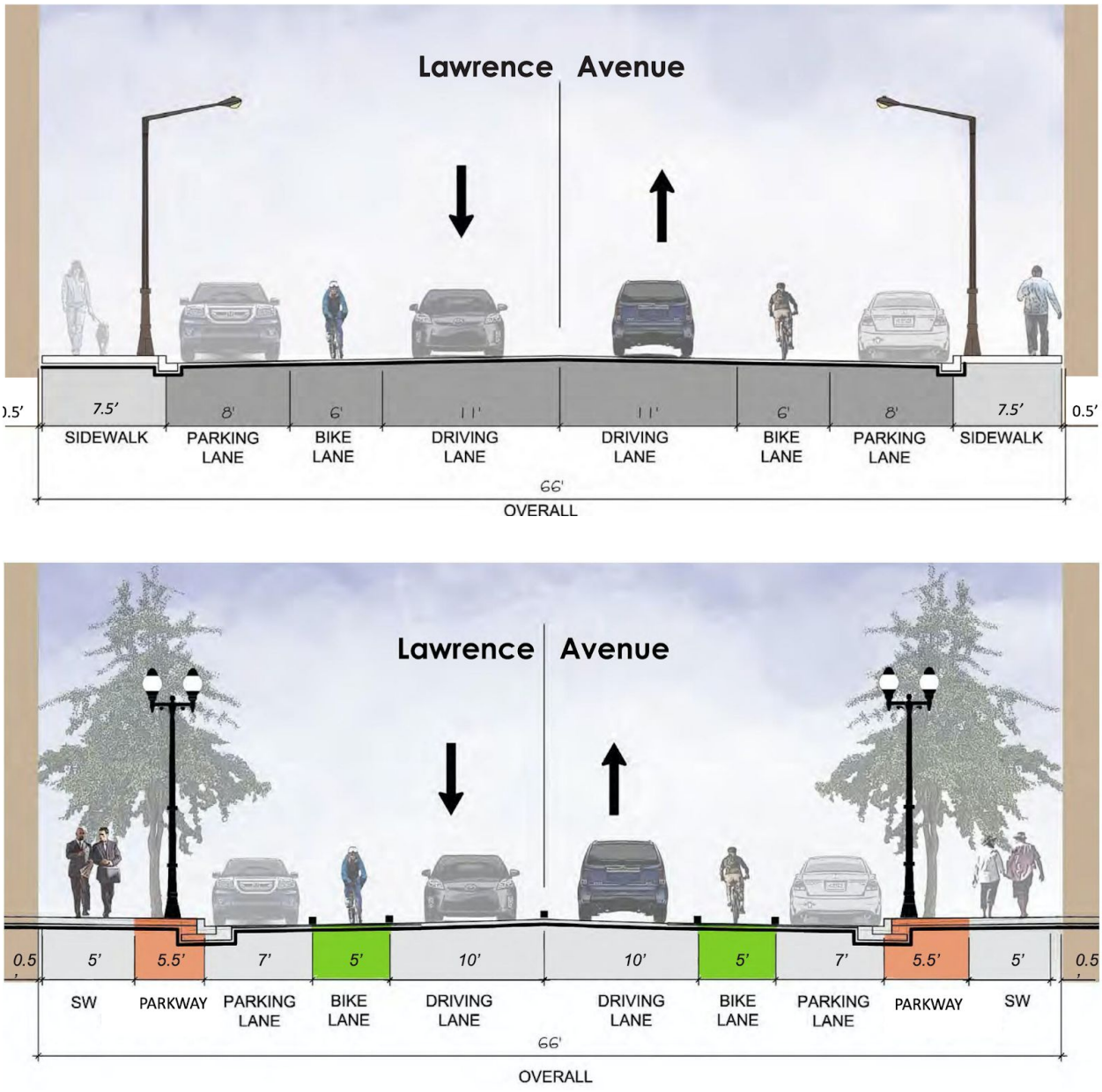
In the original plan for the Lawrence Streetscapes, published in 2008, the City of Chicago outlined its plans for Lawrence Avenue and attempts to find opportunities for "improvements" ("Lawrence Streetscapes" 2016). After the construction of the complete segment, in the design

phase for the second half of Lawrence, the city released notes from a community meeting which outlines their goals for the second project. These goals include to “improve safety for all users, upgrade aging infrastructure, create a livable street and increase walkability, [and] support economic development” (Rodriguez-Torres 2019). It also details their plans for improvements, including replacing street lamps, widening sidewalks, adding trees, creating more visible crosswalks, and constructing bump-outs.



(Rodriguez-Torres 2019).

In addition to the changes outlined above, they also proposed giving more space to pedestrians and bikers by widening sidewalks and narrowing car lanes, as shown below.



(Rodriguez-Torres 2019).

These proposed improvements, set to begin construction in Spring and Summer of 2020, mirror those already constructed in the complete segment. This shows that the City of Chicago believes these improvements had a positive enough impact on the street to warrant its duplication. In this way, Lawrence Avenue study uses the City of Chicago's goals for the second

project as a guideline for what they felt that they accomplished in the first project. It also uses the goals which relate to travel behavior (such as walkability and safety) as a comparison to what is actually present in Lawrence.

Differences Between the Two Sides

There are several observable differences between the two segments, one example being the differences in crosswalks. The crosswalks on the "complete" segment are red, have accessible curb ramps, and have center islands with planters, as shown in these pictures taken on Lawrence in August 2019. The crosswalks on the "incomplete side" have none of these features.

In addition to differences in the features of the crosswalks, there are also more crosswalks on the “complete” side than the “incomplete” side, found using Google Maps for both counting and measuring. There are 17 intersections with crosswalks for the 1.08 miles of the “complete” segment, which amounts to an average block length of .064 miles, and the “incomplete” segment had only five intersections with crosswalks for the stretch of .58 miles, which is an average block length of .116 miles, nearly double that of the “complete” segment.

Other differences which distinguish the “complete” segment include wider sidewalks, the presence of street furniture such as benches, the presence of trees along the street edge of the sidewalks, and more clearly marked bike lanes, as shown in the first two photos, the third being of the “incomplete” segment.


SUBWAY

Ultimately, these differences show a clear effort in traffic taming and promotion of biking and walking in the “complete” segment, while the “incomplete" segment seems more conducive for speed and mobility of automobiles over accessibility and safety of pedestrians and bikers.

Data and Methods

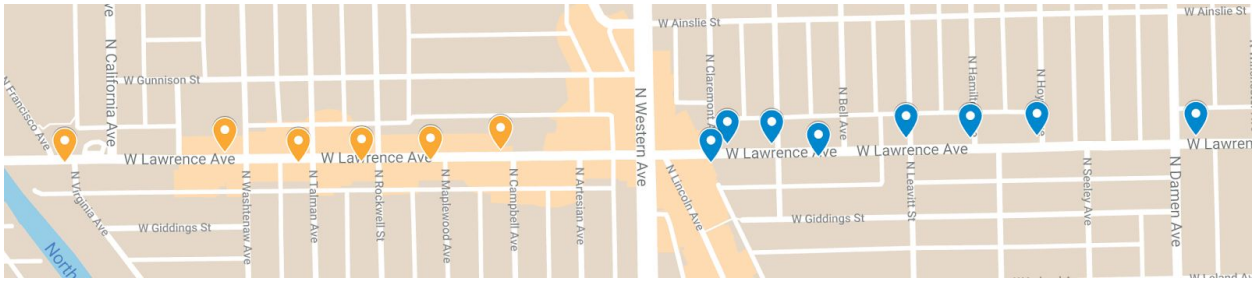
This study uses video observations and a survey of businesses located along Lawrence Avenue to investigate three important aspects of the research questions central to the broader goal of studying the effects of Complete Streets in this Chicago project. 1. Did the changes constructed on the “complete” side succeed in changing travel patterns? 2. Did those changes succeed in changing attitudes about travel patterns? 3. Where they did not succeed, why not? By following this logical path through the methods, this study gets to the heart of the question of

how and why the two sides of the street are different in user experience when the city retrofitted one and not the other. For example, grouping observations by time of day observed and location observed may provide insight as to uncontrolled variables which may be confounding the results.

Analyzing Travel Behavior through Video

One dependent variable of interest in this study is travel behavior, and a method which addresses this variable is the use of video to quantify differences in travel behavior over a week. This method seeks to answer the question of how travel behavior differs between the two segments of the street. Understanding the differences between numbers of walkers, bikers, and automobiles is key to understanding how changes in street design succeeded or failed by the standards set out by the City of Chicago.

This study gathered this data by spending time on the two different segments, alternating between which end (east or west) I visited first in the day, and recording video at these spots for approximately 30-45 minute intervals.



Shown above are all the places I took videos, the incomplete side in orange and the complete side in blue. I chose these sites primarily based on seating availability, either on benches, ledges, or against walls.

This study looks at 16.67 hours of videos taken over six days between August 29 and September 5 and counts how many cars, bicyclists, and pedestrians crossed in the camera's path.

The study then divided these numbers for each individual observation by the exact amount of time spent sitting in each location to get a rate of each type of travel for each observational period. Shown below is all the data recorded by this method, with each row representing an observational period in a given location on a given day. The data includes how many instances of each method of transportation the study observed and the total number of minutes of video I took at that location on that day. The rates listed were calculated by dividing the number of instances by the total time of that observation.

Date	Intersecting Street	Time of Day	Status	Bikers	Cars	Pedestrians	Total Time (in decimal)	Rate of Cars	Rate of Bikes	Rate of Pedestrians
8/29	Hermitage	12:00:00	completed	37	847	98	45.930	18.44111	0.8055737	2.133682
8/29	Hoyne	13:43:00	completed	13	498	30	28.430	17.51671	0.4572635	1.055223
8/29	Rockwell	14:42:00	incomplete	27	740	58	42.230	17.52309	0.6393559	1.373431
8/31	Francisco	11:26:00	incomplete	58	944	79	46.260	20.40640	1.2537830	1.707739
8/31	Washtenaw	12:33:00	incomplete	31	732	77	42.760	17.11880	0.7249766	1.800748
8/31	Claremont	14:13:00	completed	40	676	74	35.670	18.95150	1.1213905	2.074572
8/31	Hamilton	15:48:00	completed	19	282	25	15.670	17.99617	1.2125080	1.595405
9/1	Paulina	11:45:00	completed	46	851	121	43.000	19.79070	1.0697674	2.813953
9/1	Wolcott	12:56:00	completed	37	930	217	33.683	27.61037	1.0984770	6.442419
9/1	Bell	15:07:00	completed	33	815	66	45.450	17.93179	0.7260726	1.452145
9/1	Campbell	16:09:00	incomplete	43	782	43	44.717	17.48776	0.9616030	0.961603
9/1	Washtenaw	17:11:00	incomplete	27	564	57	33.233	16.97108	0.8124455	1.715163
9/2	Washtenaw	11:06:00	incomplete	30	403	58	24.450	16.48262	1.2269939	2.372188
9/2	Maplewood	11:40:00	incomplete	68	766	49	47.350	16.17740	1.4361140	1.034847
9/2	Claremont	13:58:00	completed	37	520	53	30.967	16.79207	1.1948203	1.711499
9/2	Hoyne	14:39:00	completed	81	774	66	48.567	15.93675	1.6677991	1.358947
9/2	Wolcott	15:42:00	completed	26	332	54	17.417	19.06184	1.4927944	3.100419
9/4	Paulina	11:11:00	completed	37	825	56	49.900	16.53307	0.7414830	1.122244
9/4	Damen	12:16:00	completed	24	794	106	44.100	18.00454	0.5442177	2.403628
9/4	Leavitt	14:36:00	completed	42	919	72	48.330	19.01510	0.8690254	1.489758
9/4	Claremont	15:43:00	completed	39	965	111	46.970	20.54503	0.8303172	2.363211
9/4	Campbell	16:32:00	incomplete	51	967	73	46.950	20.59638	1.0862620	1.554846
9/5	Talman	11:37:00	incomplete	25	664	149	41.550	15.98075	0.6016847	3.586041
9/5	Maplewood	13:25:00	incomplete	33	614	56	37.100	16.54987	0.8894879	1.509434
9/5	Oakley	14:13:00	completed	24	827	82	42.800	19.32243	0.5607477	1.915888
9/5	Hoyne	15:07:00	completed	14	359	62	19.180	18.71741	0.7299270	3.232534

I used Pandas and Matplotlib to analyze this data in a few ways. The average rates for

each side were compared, with average rates of walking and biking expected to be higher on the "complete" side and rates of driving expected to be higher on the "incomplete" side. If the rates match this pattern, that would indicate that the City of Chicago succeeded in designing the street such that walking and biking were prioritized over driving. Should these rates not match these patterns, this might indicate that the design might do something unexpected for user experience, or there might be other factors which have larger influences.

In order to get a sense of some potentially confounding variables, I grouped the rates by a couple of factors. I first grouped the rates by time of day, based on what hour during which they began and graphed the average rates for each time of day, as well as the average rates of each segment for each time of day. This shows whether there was some correlation between time of day and travel behavior and whether this correlation was more prevalent for one segment or the other. If a correlation did exist, time of day may be a confounding variable which could explain some discrepancies between the expected outcome and the actual outcome. I then grouped the rates by specific location, based on which intersecting street they were taken closest to, and graphed average rates for each location. By studying how travel behavior correlated to location and what amenities (or lack thereof) were notable in each location, this study investigated what other confounding variables might be affecting the results, such as proximity to certain businesses or greenspace.

It is important to note that this study did not measure the fourth method of transportation, public transit, for several reasons. While a bus route is both present and heavily frequented on Lawrence, the nature of the bus route is such that frequency would be the same on both segments, due to the fact that the bus travels along Lawrence from one segment to the other.

Measuring ridership is also difficult, due to the fact that it is often difficult or impossible to see people waiting for or boarding the bus, depending on where I sat. For all these reasons, this study did not measure public transit, and further research would be needed to measure ridership differences along Lawrence.

Surveying Businesses

In order to get a sense of the less tangible differences between the two sides of the street, this study conducted surveys with business owners and workers along Lawrence. This survey allowed the study to get to the heart of the differences between the two sides through a more subjective, anthropological lense. The data collected through this method served as a different point of reference for qualifying differences (or lack thereof) between the two sides. The study does this in order to try to suss out what design changes are more or less successful at making the street a more "walkable" and "bikeable" and less "drivable" environment.

I conducted the survey by visiting businesses along Lawrence and asking a manager, owner, or worker a few questions about the street. For purposes of privacy and to minimize risk, I did not take down additional identifying information about each business beyond whether they were on the complete or the incomplete side. Though surveys of most storefronts were attempted, some were unable or unwilling to comment. In total, nine businesses of the west side were surveyed, and nine businesses of the east side were surveyed; this does not account for businesses for which interviews began but could not be completed due to language barriers.

For the businesses which did participate in the survey, I began by giving a brief overview of the subject, explaining that each side of Western had a distinct design without giving more information or context which might influence their answers. I then asked about whether they felt

that one side was more walkable, and why, and repeated for bikeability and drivability. I also asked more generally what else they felt was different between the two sides of the street. There was generally not much consensus of whether one side was more walkable, drivable, or bikeable than the other, with many different opinions surfacing.

Results

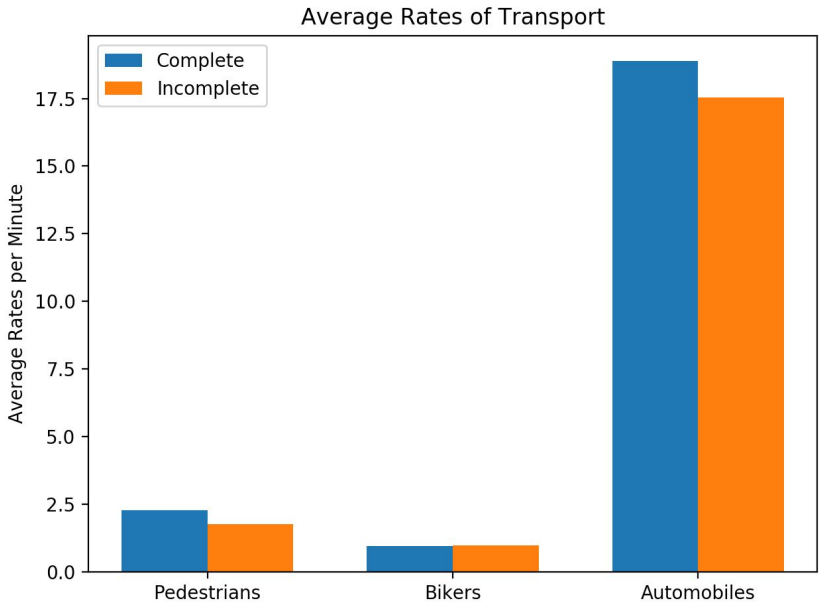
This study asked whether and how the difference in street design between two sides of Lawrence would impact travel behaviors and attitudes on the two segments. The expected outcome was that the "completed" segment of Lawrence would be and feel more "walkable" and "bikeable" and less "drivable," and thus would have more pedestrians and bikers and fewer automobiles. Likewise, the "incomplete" segment was expected to be and feel better for cars and less for pedestrians and bikers, and thus have more cars and fewer pedestrians and bikers. The independent variable in this study was the differences in street design between the two segments for both perception of and actual difference between travel behavior in the two segments.

Overall effects on Travel Patterns

This study focused on how the differences in street design affected travel behavior on the two sides of Lawrence. The videos taken showed a similar average rate of pedestrians, bicyclists, and automobiles on the two sides of Western, with the rates of pedestrians and automobiles being slightly higher on the "complete" side.

This data shows that the reality demonstrated in the videos somewhat contradicts the expected results. While the data displays a higher average rate of pedestrians on the "complete" segment, which matches the expected result, the difference between the two rates is relatively small, with the "complete" segment having a rate only .50 pedestrians per second greater than

that of the "incomplete" segment. The difference between rates of bikers is effectively null, with a difference of only about .02 bikes per minute. The difference between the rates of cars is the greatest, with the "complete" segment having about 1.36 cars per minute more than the "incomplete" segment.

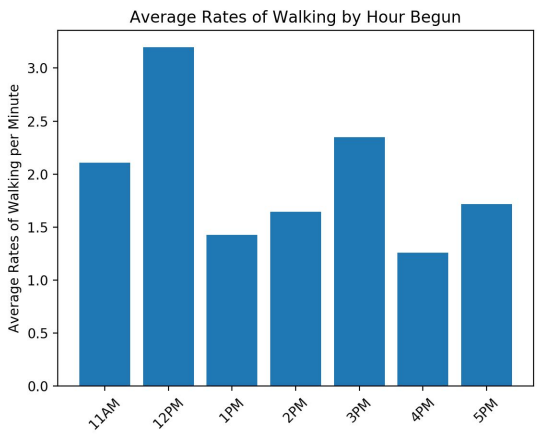


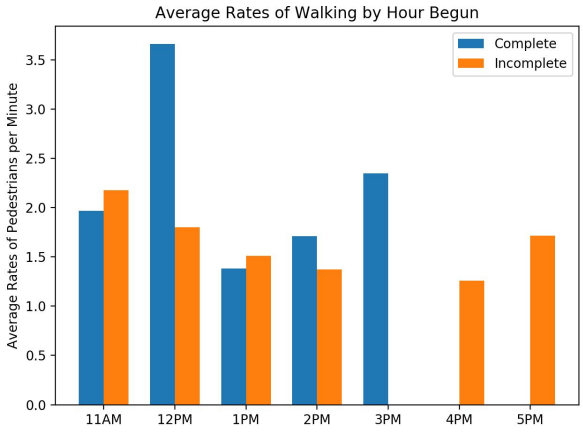
	Rate of Pedestrians	Rate of Bikes	Rate of Cars
Complete	2.266596	0.9451365	18.88541
Incomplete	1.761604	0.9632706	17.52941

Travel Behavior by Time of Day

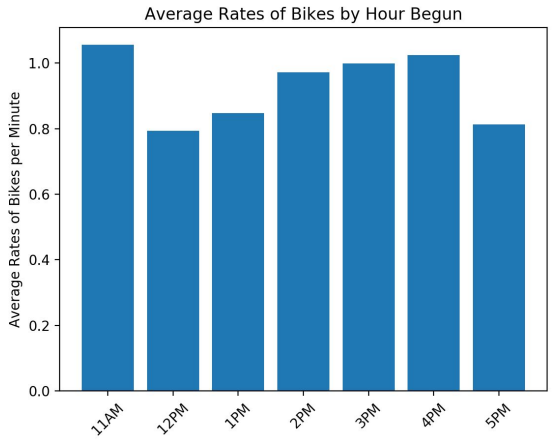
In order to further investigate these results, this study analyzes the time of day at which videos were taken as a possible confounding factor. The following graphs group average rates by the hour in which the video began — for example, if a video began at 12:30pm, it will be grouped under the 12pm umbrella. The first graph for each mode of travel measured shows average rates of instances of that mode captured grouped by time; for example, the bar labeled "11am" for walking shows the average rate of pedestrians per minute in videos captured between 11am and 12pm. In the second graph, these bars are split up by the "complete" and "incomplete" segments; the blue "11am" bar for walking shows the average rate of pedestrians per minute in

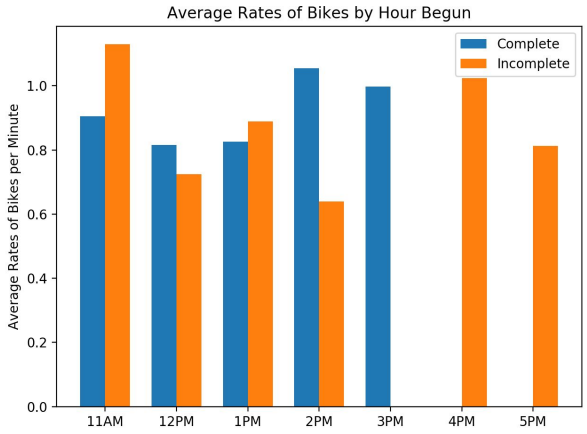
videos captured on the “complete” side between 11am and 12pm. The orange “11am” bar displays this average rate for videos taken on the “incomplete” side during that time. Times in the second graph with only one color indicate data taken only on one side at that time; due to a lack of data, this study will not be making claims about those sides having higher or lower rates at those times.



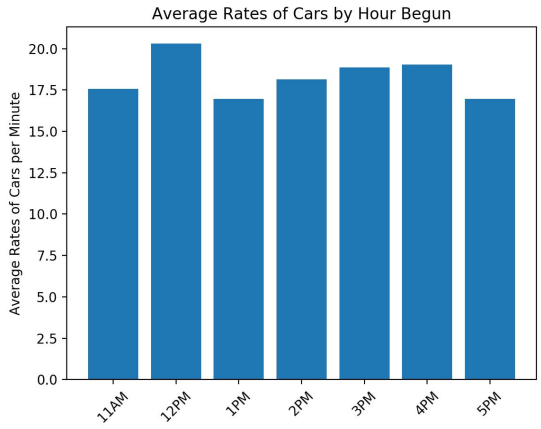


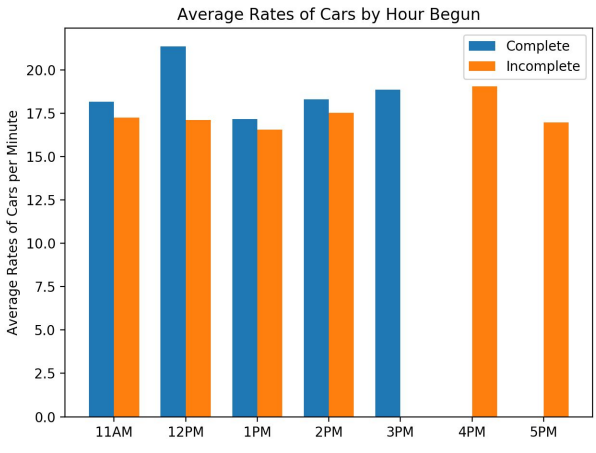
The data shows that peaks in walking rates correlate with the peaks in these rates on the “complete” side, at 11am, 12pm, and 3pm. There are significantly more walkers on the “complete” side at noon specifically, which indicates that the “completed” segment harbored more walkers around lunchtime. This noon discrepancy is the only large one, however, which seems to indicate that time had a relatively large impact on walking patterns at other times.





The data about biking indicate that there was no significant surge in biking at any specific time, though biking seemed to peak at 11am (with a greater rate present on the "incomplete" side) and had a significantly higher rate on the "complete" side at 2pm (with a greater rate present on the complete side). Biking is also high at 3pm and 4pm, which may indicate a commute time via bike on both sides. This data shows high variability of whether the complete side or incomplete side has higher rates at different times, indicating that time is not a large factor for bikers, especially at peak times. Despite the sides averaging out to be almost the same cumulatively, the large differences between the rates at given times show that time is not the greatest indicator for rates of bikers.



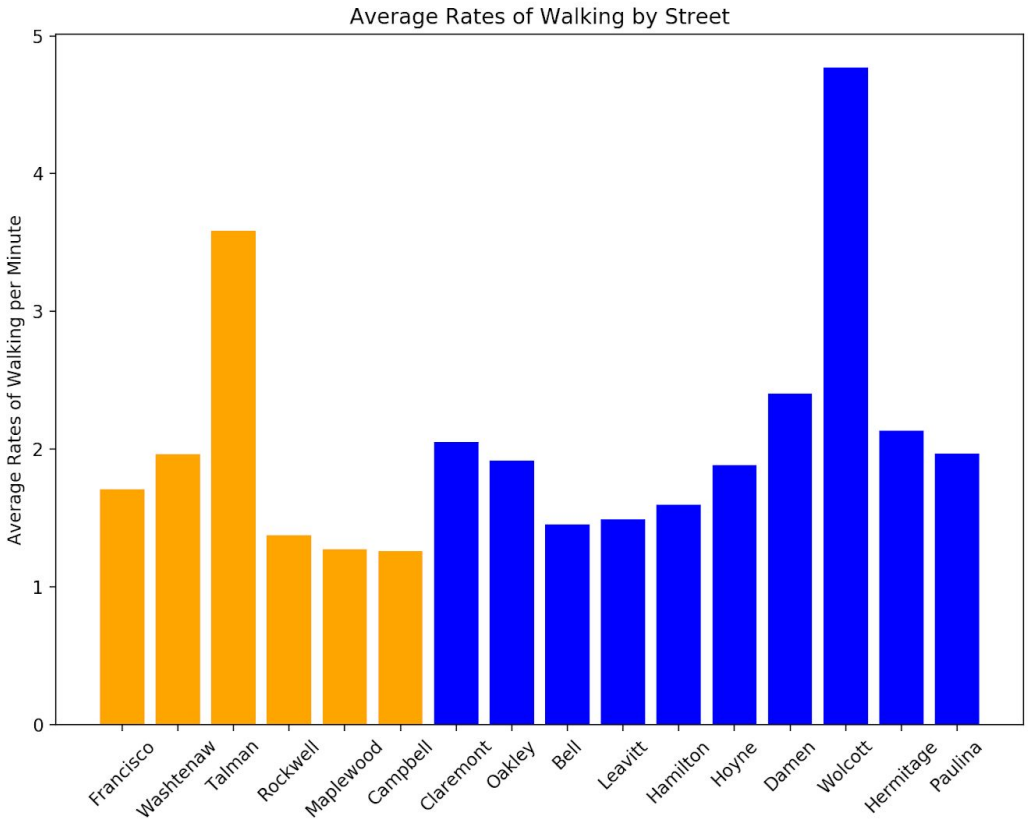


For cars, the data shows that the two sides seem to correlate for all times, and there does not appear to be a clear distinctive peak at any given time. Driving does seem to increase at 12pm, which is also the time with the greatest difference between the segments. Similarity of rates at different times, as well as higher rates of cars on the complete side at all times measured, indicate that time had little bearing on rates of cars.

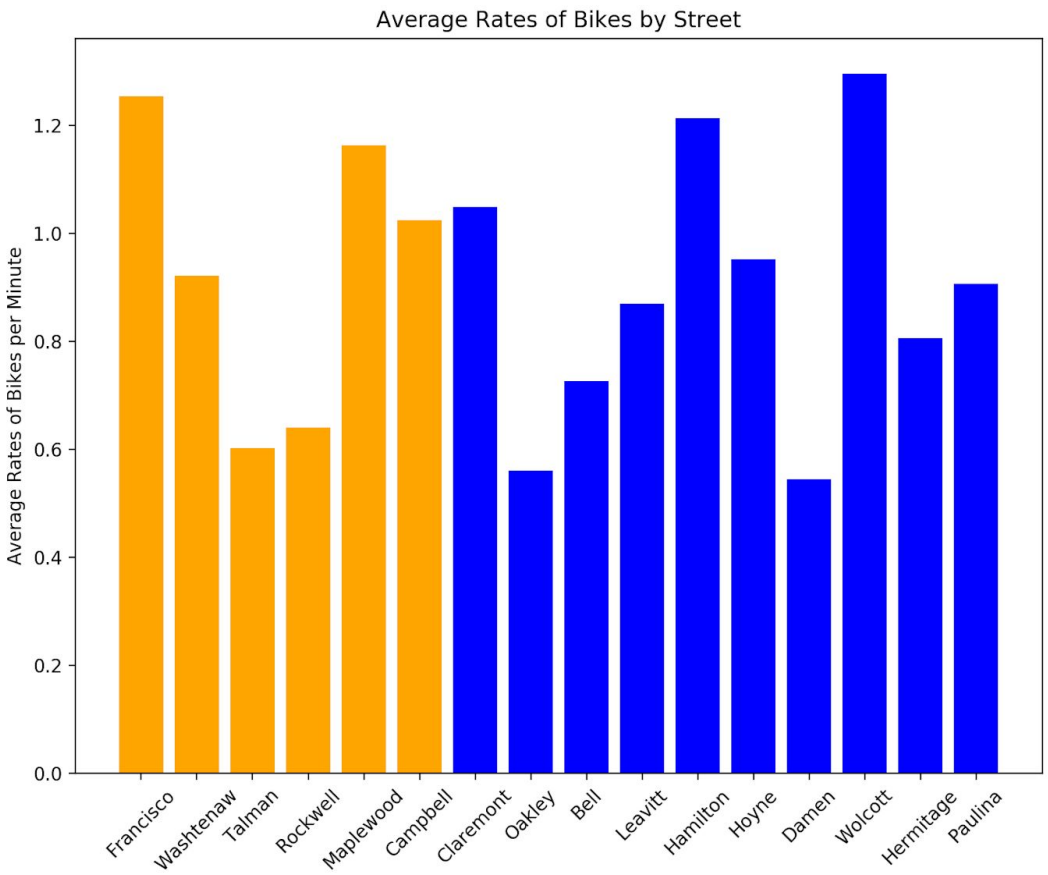
These results show that for all three modes of transport measured, there is some variability of rates at different times, as well as differences between the complete and incomplete side at different times. The mode of transport with the clearest time-related peaks is walking, the mode with the highest variability between which segment had higher rates is biking, and the mode with the lowest overall variability is driving. This data shows that time of day is likely a larger factor than street design for walking and biking, while it is not much of a factor for driving.

Travel Behavior by Location

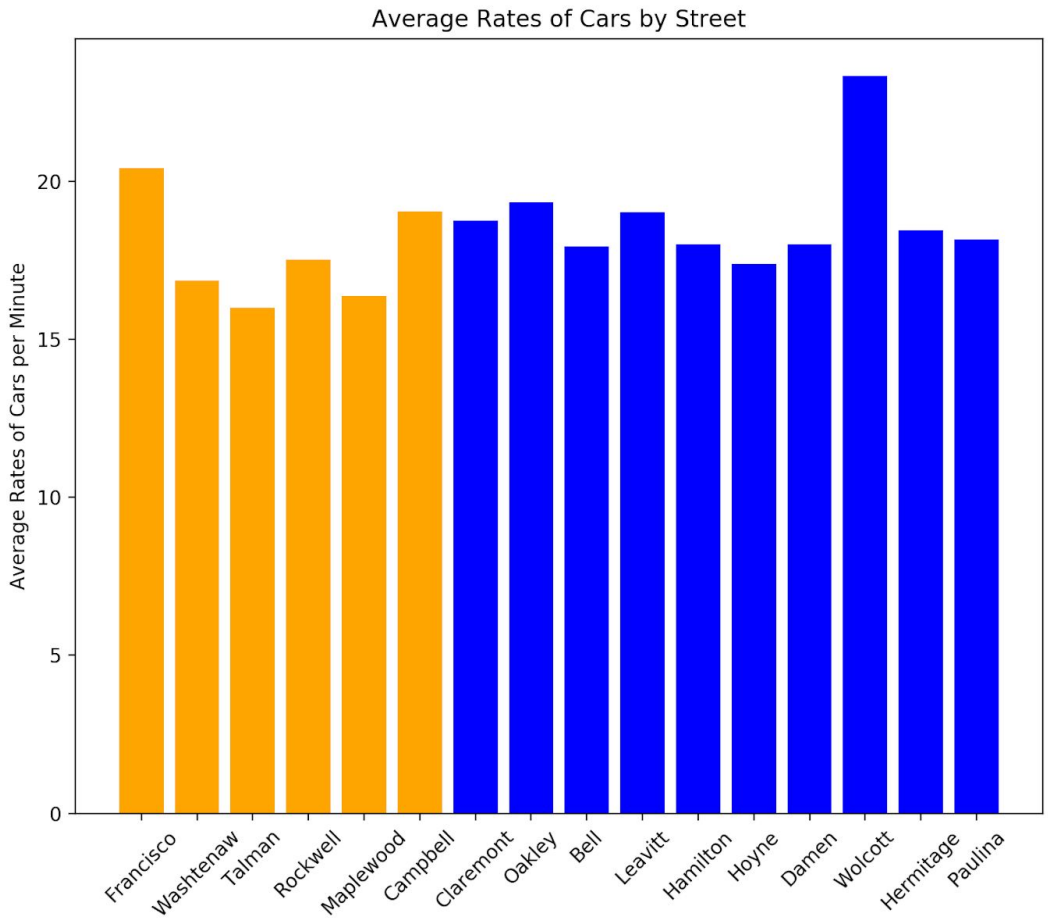
This study also investigates relative rates of travel at different locations. Here, cross-streets indicate location, and the following graphs order the streets from left to right as they appear on a map from west to east, with sites along the "incomplete" segment in orange and sites along the "complete" segment in blue. As an example, the "Francisco" bar in the first graph below indicates the average rate of pedestrians per minute from all videos taken nearest to Francisco, the western-most street that intersects with Lawrence Avenue at which videos were taken.



The data shows an immediate spike in walking just east of Western as opposed to west of Western, which may correlate with an area of commerce directly east of the dividing street. There is a large spike at Talman, which is where a locally owned grocery store is located, and at Wolcott, which is near a Marianos, a Metra stop, a Chase, and some local businesses. This shows that there may be a correlation between rates of pedestrians with businesses and public transit, in addition to a small correlation with the difference in street design.



The data about biking shows a much less clear correlation between certain intersections and rates of biking. Similarly to trends in foot traffic, Wolcott shows high rates of bikers, as well as around Western. Francisco is right next to a large park which borders the Chicago River, and Hamilton is a block away from a park (located on Hoyne), though there is no obvious reason why Hamilton should also be a peak, nor Maplewood.



The results pertaining to location data and driving show that location has almost no bearing on car rates, as they remain fairly even throughout. A spike at Wolcott could be due to the aforementioned Marianos and Chase, as well as a Sears which also has a large parking lot attached.

These results show that location seems to have a direct impact on walking, likely because rates of pedestrians will correlate with businesses or other destinations they will walk to, which is indicated here by location. While rates of pedestrians are higher overall on the "complete" side, this shows that location is a higher factor for pedestrians than street design. The data in biking and driving show this affect even more starkly; although location does not have as

obvious an impact on either mode as on walking, it does seem to be a greater factor in biking and driving rates than whether the street is "complete" or not. Overall, location seems to play a larger role than street design for all three modes of transport, especially biking and driving.

For all of this data, there are certainly confounding variables, such as time and location, which show patterns which inform that street design alone is not a factor in travel behavior. However, street design does factor into location as well, which seems to have a greater impact on walking than on biking or driving. Still, these results seem to contradict the expectation that street design itself would create a built environment which would harbor more pedestrians and bikes, and fewer cars, all other things being equal.

Survey of Businesses

In order to show the more intangible effects in a broader sense of the two sides of the street, this study conducted a survey with business owners and workers on both segments. In order to ensure anonymity, the names of participants and businesses were not recorded, and each is only identified by the segment on which they are located, "complete" or "incomplete."

When asked which side they believed to be more walkable, many participants gave different answers. Participants from the "complete" side who felt that their side was more walkable gave reasons such as access to restaurants and a "browsy" feeling, a greater safety on the "complete" side rather than the "more residential" "incomplete" side, and the wideness of the sidewalks. Those from the "complete" side who felt the "incomplete" side was more walkable gave reasons such as frequent construction on the "complete" side, and access to public transit and small businesses and stores such as "the supermercado," referring to the small supermarket on the "incomplete" side. Those from the "incomplete" side who felt the "complete" side was

more walkable explained their reasons with the look of the landscape and design, retail options, and access to trains. Participants on the "incomplete" side who believed their side to be more walkable said that there was access to a walkable grocery store, access to public transit, and an overall "nicer" look. While no clear consensus emerged, more than half of the respondents tended towards labeling the "complete" side more walkable. Some respondents who felt the "incomplete" side was more walkable lived on that side, which may also have played a role in their opinions.

Similarly, respondents were mixed about biking as well. Several declined to give an opinion because they felt they could not speak to the question as they did not bike. Participants from the "complete" side who felt that their side was more bikeable said that it was due to potholes and the general lack of road maintenance on the "incomplete" side. Those from the "complete" side who felt the "incomplete" side was more bikeable blamed it on congestion of traffic on the "complete" side. One participant from the "incomplete" side who felt the "complete" side was more bikeable explained that the sidewalk and access to businesses helped make biking easier. One participant on the "complete" side and three on the "incomplete" side judged the two sides to be the same. Ultimately, the data shows quite varied responses and displayed a clear lack of a prevailing opinion. Interestingly, no one surveyed mentioned bike lanes while answering this question, the addition to the "complete" side which the city expected to add a sense of bikeability.

Responses about driving were also very mixed. Those who believed the "complete" side to be more drivable gave reasons such as not getting backed up by an outlet like the 94 and commercial parking available on the complete side. Those who believed the "incomplete" side to

be more drivable attributed that feeling to construction on the "complete" side, number of stoplights and other stops, a feeling of the "complete" side being "more urban," ease of finding parking (including free parking) on the "incomplete" side, narrowed lanes on the incomplete side due to cement medians, and slower traffic due to bike lanes and center planters. Several respondents said they found no difference or that they preferred not to drive on Lawrence at all. Ultimately, this shows that, while more respondents than not noticed the design differences in place for traffic calming and thus believed the "complete" side to be less drivable, there were some similar factors which made others believe the "incomplete" side was actually less drivable.

Lastly, this study surveyed participants' observations about more general differences between the two segments. Responses from the "complete" side included more businesses on the "complete" side, demographic differences (with the "complete" side being majority white and the "incomplete" side being majority minority), higher diversity of population and businesses on the "incomplete" side, greater affordability on the "incomplete" side, more lights and a feeling of safety on the "complete" side and "gang activity" on the "incomplete" side, "improvements" such as benches and planters on the "complete" side, and a majority "hispanic" population on the "incomplete" side and "residential suburban" on the "complete" side. Responses from the "incomplete" side identified a wealth gap, with more lower income families and immigrants on the "incomplete" side and "yuppies" and "hipsters" on the "complete" side, more businesses on the "complete" side, and the "complete" side being "better looking;" several did not see much of a difference between the two sides at all. These observations and opinions indicate a feeling of gentrification on the "complete" side, which may indicate consequences, intentional or not, beyond affecting travel behavior.

Discussion

This study asked whether the City of Chicago achieved its Complete Streets goals by implementing a "complete" street on Lawrence. This study investigated the "complete" and "incomplete" segments of Lawrence, which represent a quasi-natural experiment of Complete Streets implementation in Chicago. The broader goals of the Complete Streets movement, creating a safe space for different users of the street and prioritizing accessibility to and safety for multiple modes of transportation over automobile speed mobility (McCann 2013; Litman 2012), are only partially achieved on Lawrence Avenue. My findings that the updated street design on the completed sign had a somewhat positive effect on walking and driving and very little effect on biking show that these desired effects were only partially addressed. The results of the survey showed that perceptions were similar, with perceptions about walkability skewing towards the "complete" segment, while opinions regarding bikeability and drivability remained more mixed. This displays that this project affected both perceptions and reality about walking but had little or no impact on those about biking or driving. Because the survey respondents showed no consensus in regards to walkability, it is hard to say whether the city fully met that goal. Thus, the City of Chicago's goals to prioritize walking and biking over driving in their modal hierarchy ("Complete Streets: Design Concepts and Considerations" 2015) seems to only have been partially met.

It is important to note the ambiguity of the City of Chicago's Complete Streets goals as to whether Complete Streets is meant to promote mobility and accessibility for pedestrians and bikers over that of cars or if it is meant to do this for all users and modes of transport on a given street. Certainly the city failed to promote biking based on the data taken, but it succeeded in

promoting both walking and driving. The obvious expectation was that driving rates should go down on the "complete" side, based on the modal hierarchy outlined ("Complete Streets: The Basics" 2015) as well as "traffic taming" efforts meant to slow cars down (LaPlante and McCann 2008). However, a closer look at the goals of Complete Streets reveals that there may be more focus on promoting accessibility for *all* users rather than on prioritizing pedestrians and bikers to the point of hindering cars. While opinions skewed towards the "incomplete" side being more drivable, the data shows that the "complete" side actually saw more cars. This may be because by prioritizing non-automobile travel in the modal hierarchy, planners are simply giving those users a chance to use the street more safely while still allowing for and even promoting automobile travel. This begs a few questions, the first being, should the City of Chicago's goal actually be to reduce car use? And, if so, would it be beneficial to reframe their approach from simply looking to promote non-automobile travel, or making the streets more pedestrian- or bike-friendly, to also going on the offensive *against* cars? Perhaps by expanding their goals to lower car usage, the city could have an even greater impact on pedestrian and biker activity, though further research is needed to assess if that might be the case.

In terms of the more ambiguous goal of placemaking, this may be indicated by responses to the final question in the survey regarding general differences between the two sides. Responses indicated that the "complete" side felt safer and more aesthetic but also wealthier and less diverse, with fewer small, locally-owned businesses. This gets to the question of whether these changes benefited the community. Certainly, an increase in feelings of safety are positive. However, there remains a question of whether changes in street design will negatively impact aspects of the area which the community cares about, such as diversity of residents and

businesses and lower costs of living. Changes to the "incomplete" side scheduled for 2020 will have an economic impact that might push out residents or businesses that may not be able to afford an economic surge, though this would require further research. This economic impact. However, this possibility cannot be ruled out as a potentially negative impact of this Complete Streets project.

This gets to a broader question the purpose of changes like Complete Streets, or retrofitting more generally. Are these changes for people to notice and appreciate them, or should users of the street be able to benefit from streets without ever noticing? If users are focused on potential downsides of retrofitting, such as gentrification, does that negate potential positives? For example, several survey respondents reported that they do not bike, but, if marked bike lanes protect bikers in their community from cars, is that a valid rationale for urban planners to implement these changes? Street safety in general, an explicit goal of the City of Chicago ("Complete Streets: The Basics" 2015), is not something users necessarily always notice when it works well and they are safe from traffic accidents. However, they may be more likely to notice differences in diversity and the types of businesses available. Furthermore, how does the City of Chicago implement these changes equitably, another goal of theirs ("Complete Streets: The Basics" 2015), when users of the street are inevitably going to benefit unevenly?

Another point which complicates the benefits of Complete Streets is whether the actual construction of the street, or the act of "completing" the street, is harmful in some way to the community. Those interviewed mentioned construction on the "complete" side several times, indicating that such work is a hindrance to those who use the road most. Could closing the street for some amount of time hurt businesses who may lose customers who do not want to be

inconvenienced? Could that chain of events accelerate already potentially harmful gentrification? And how might this disproportionately affect those who use the street most frequently?

The discrepancy between results expected by the goals of the City of Chicago Complete Streets movement and the results this study found may also be explained by some confounding and uncontrollable factors; though using two adjacent segments of a single street naturally accounts for some of these confounding variables, there is still no way to truly account for others. Some studies found that land use and density had greater impacts on travel behaviors than street design (Cervero and Murakami 2010; Cervero 2002), which may be another explanation as to why travel behavior seemed to correlate more with specific location than with whether the observation occurred on the "complete" or "incomplete" side.

This study was unable to cover several other variables. Network Connectivity (Zhang 2004) and access to sidewalks (Lawrence Douglas Frank et al. 2007) are factors shown to affect travel behavior (Lawrence D. Frank et al. 2011); this study was not able to cover these factors because it focused on one continuous street which was entirely lined with sidewalks. Other factors included density, access to greenspaces and recreational spaces, household density, and number of intersections (Li et al. 2005), and while I was able to take into account number of intersections and note access to green/recreational spaces, the study was not able to control for them or quantify their effect on travel behavior. The study was also not able to note or quantify any of the other factors listed. One note of interest is that while proximity to greenspace may have been a factor in biking numbers, especially near the Chicago River (at Francisco), rates of walking seemed to correlate much more heavily with retail elements than with proximity to greenspace. Additionally, this study was not able to account for predetermined biases of people

living near or interacting with the street, another factor noted to change peoples' travel behavior (Bagley and Mokhtarian 2002; Schwanen and Mokhtarian 2005; Lawrence Douglas Frank et al. 2007). In addition to these factors, the study was unable to control for business density or weather (which changed quite frequently over the course of recording).

This study cannot make claims about Complete Streets as a whole, nor definitive claims about Lawrence given the small sample size. Further studies would be needed about other projects around Chicago to make claims about how Chicago's approach changes from community to community, or other broad trends about Complete Streets in Chicago. Additionally, further research could be done to examine changes to Lawrence after the city completes construction (scheduled in spring and summer of 2020, unknown at the time of writing if it has been affected at all by the coronavirus). However, given the data, this study supports the theory that implementing Complete Streets design has some effect on travel behavior, while also supporting the idea that it may not be the primary factor.

Conclusion

This study sought to find how a Complete Streets retrofitting project in Chicago promoted walking, did not affect biking, and counterintuitively promoted driving. These findings are important to our understanding of street design as an isolated change and its impact on streets and communities. This also has implications for the Complete Streets movement as a whole, which claims a substantial amount of power in street design but ignores many other aspects of the holistic street.

The City of Chicago is an example of an entity trying to change neighborhoods and streets by implementing these retrofitting projects without any regard for other aspects of the

built environment. In fact, this is not a novel idea; many municipalities implement similar projects with similar goals of safety and accessibility. This study shows that these kinds of projects have some benefits but that some reframing of the Complete Streets approach may be more fruitful. One point of reframing is in taking a more holistic approach than just focusing on street design; this may include ensuring storefronts, amenities, and access to greenspace are accessible to anyone who may be using the street in question, or expanding public transit access. Another point in reframing is how to promote accessibility for walkers and bikers by mitigating car use, perhaps with narrower lanes, or with a policy such as a congestion tax. The last key point of reframing is in being very explicit in plans for equity in designing, constructing, and implementing Complete Streets, which might include gathering input from frequent users, ensuring continued access to amenities during construction, and rent-controlling certain businesses and residences so that they are not pushed out. Overall, there are many changes which can be made to a street or neighborhood to attempt to achieve the goals that cities desire, but design alone cannot address these issues in their many complexities and achieve every goal. Complete Streets cannot be used as an end-all solution to transportation accessibility in Chicago, or in general, nor should it be viewed that way.

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