Bikes, Bikers and Infrastructure:

Solving Congestion Problems by Getting People Rolling (on Two Wheels)

By Zachary Carlstrom and Alex Vasquez

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1. Introduction

This project was conducted and undertaken for a GIS II course at DePaul University in conjunction with the Enlace Community Group in Little Village, Chicago. Enlace has been attempting to deal with traffic and congestion problems on W 26th Street for some time, so we decided to direct our efforts toward the congestion problems by doing research into bicycle traffic on the thoroughfare. It was our hope to provide Enlace with enough data to lobby for the improvement of the biking infrastructure on 26th St. - thus eliminating some of the congestion on the road and providing the citizens with a better option for getting around the neighborhood than automobiles - with the ultimate goal of improving the quality of life of the citizens of Little Village.

The data we collected concerned three things: First, the estimated travel times on W 26th St. to go from Kedzie Ave. to Kostner Ave. by car, by bus, on a bike, or on foot. Second, to find the locations of bike racks on 26th St. and find the locations where bikes are often parked. Third, to record the amounts of bike traffic at the intersections of 26th and Central Park and 26th and Pulaski during rush hour. We then took the collected data and created a series of maps and charts to represent what we had found.

In the sections that follow we will detail certain aspects of the project in length. The Needs Assessment includes information behind the project and an explanation of how the projects goals were generated. The Systems Requirements section includes the information about the types of data we needed to collect to accomplish our goals. The Data Acquisition section details the methods we used to collect our data throughout the course of the project. The Data Analysis section includes the maps and charts we created, and an analysis and explanation of the maps and charts. The Results section explains the impact and implications of our data. The Summary, Conclusions, and Recommendations section expands and sums up the main ideas developed in the project and provides insight into the directions that future groups should go when aiding Enlace in the future.

2. Needs Assessment

Background:

The first order of business during the project was to conduct some groundwork to put the most amount of purpose into our actions that we could. From our initial meeting with Jaime, to a literature review on similar subjects, we developed the goals for our project and the potential methods we could use to accomplish those goals. We then met with Jaime again to discuss the formulation of our problem and to see if he had any other directions in mind.

Information from Jaime de Leon About Enlace and Its Needs:

- There has been a push for many years to make Little Village a safer and more family friendly community.
- Enlace is an integral part of the push to improve the community.
- Currently, alternative forms of transportation are being strongly supported by Enlace in order to improve the health of the community.
- There has been a grievous amount of oversight on the part of the Chicago Government and Mayor Daly.
- The oversights are mostly due to the fact that Daly continually wins Little Village and Little Village has many citizens who cannot or do not vote, so Daly does not feel that he needs to divert any funds to improve Little Village.
- The alderman of Little Village also has opposed some of Mayor Daly's decisions and operates somewhat independently from the larger body of Chicago's governing system, and, therefore, has less of a chance of having his voice heard.
- Enlace, as a result of these bureaucratic problems, has had problems having their initiatives approved or even noticed, and they lack the funding to produce studies.
- 26th Street is incredibly dangerous for bikers due to the lack of width, lack of adequate bike lane length, and very few bike racks (to the point that bikes were locked to anything from store signs to street carts).
- 26th St. also is incredibly congested. This problem causes damage to the environment in the area with an increase of smog, lowers travel times down the thoroughfare, and creates disgruntled drivers who are a danger to other drivers and especially bikers.
- An analysis of the amount of bikers moving down the road could show that there is already a significant enough amount of bikers to warrant the promotion of more biking infrastructure along the street.

Stakeholders:

Direct stakeholder:
- Enlace for actually utilizing the GIS data and the analysis

Indirect stakeholders and those who stand to benefit from the potential successes of Enlace:
- Bicyclists
- Business owners on 26th street and the immediate area

- Automobile drivers on 26th street
- The pedestrians of little village

Literature Review:

Krizek, Kevin J. and Johnson, Pamela Jo(2006) 'Proximity to Trails and Retail: Effects on Urban Cycling and Walking', Journal of the American Planning Association, 72: 1, 33 - 42

The point made in this article that was most useful to our thinking, and that gave our ideas a more potent sense of purpose was that there is a direct correlation between the proximity of retail shops and the propensity of people to take their bikes to the store. This is important to us because, as Jaime pointed out, this study is being done to benefit people in the neighborhood, any benefit to outsiders is purely coincidental. The article confirmed our suspicions that any retailers close in proximity to peoples homes - just as all of the 26th street retailers are to the densely populated residential areas of little village - and increased the stakes surrounding our project. The fact that people do not have an easy time moving up and down the length of 26th street is now even more unacceptable. If we play a part in the increase of safety for bicycle riders on 26th street in little village, the positive impact - according to this article - could be exponentially greater than we had previously expected.

Su, Jason G., Meghan Winters, Melissa Nunes, and Michael Brauer. "Designing a Route Planner to Facilitate and Promote Cycling in Metro Vancouver, Canada." Elsevier (2010): 495-504.

This journal article described the various techniques that were employed by a team who wanted to create a program that helped bike riders find the proper routes for their preferences in Vancouver. One thing that was amazing was the complexity of the program they developed and the amount of preferential topics the finished product offered to bikers who wanted customize their routes exactly to their individual liking. The article also proved how complicated the idea of effective route planning would actually be - due to the multiplicity of factors (from topology to safety) that must be considered to get accurate stats - if our group decided to try to undertake even a surface level project of the same type. We will therefore be taking from this article a narrower scope of interest with any “suggested route” portions of our final project. Likewise, we will most likely not be including such a wide range of information pertaining to travel times because we will have to narrow our interests on that end too. This is simply due to the difficulty of doing that type of information justice, and the complexities involved with getting accurate and useful information.

Sultana, Selima. "Job/Housing Imbalance and Commuting Time In the Atlanta Metropolitan Area: Exploration of Causes of Longer Commuting Time." Urban Geography (2002): 728-49.

While this article does not pertain to the bicycle side of our study, it does include details concerning the flow of traffic to and from a persons place of employment. The study shows a

correspondence between the distance between urban jobs and urban housing, and higher travel times and levels of congestion. This is an obvious correspondence, but one with interesting implications for the Little Village community. The fact that there are so many jobs on 26th St. that employ people from the area, makes it even stranger that the street remains congested during rush hour and the rest of the day. It points out that there must be a serious problem that is causing the congestion because the existence of the congestion is counterintuitive to Sultana's study. This increases the importance of our study, and the importance of making bicycles more attractive to members of the community. This may be one of the only solutions short of widening the road that could have an impact on the problem.

Meeting to Discuss Our Needs Assessment and Our Intended Goal

After talking to Jaime the first time and creating our needs assessment, we met with him again to talk about what we had decided our goals would be for the rest of the project. He seemed pleased as we explained the goals, and explained that we would try to accomplish as much as we could during our limited time in the course. Therefore, we kept our goals and objectives much the same as we moved forward with the project.

Exact Statement of Goals and Objectives

Goal:
The principle goal of this project is to provide the Little Village community with a study that is informative enough and concise enough to give them the user friendly data they need to approach the Chicago government and receive aid in making 26th street more friendly to alternative forms of transportation (mainly biking).

Objectives:
1) Use available data to find and map the estimated travel times on W 26th St. to go from Kedzie Ave. to Kostner Ave. by car, by bus, on a bike, or on foot. Likewise, find and map the times it would take a biker to go From Kostner Ave. to Kedzie Ave. on recommended bike routes, and portray these two data sets side by side.
2) Find wherever there are actually places that bike racks exist on 26th street. Find locations where bikes are randomly chained. Find the types of existing bike racks, and find how many of them are actually being used to hold bikes.
3) Find and map data for the amount of bikes moving in all four directions at the major intersections of Pulaski Rd. and 26th St. and Central Park Ave. and 26th St. during rush hour.

3. System Requirements

Introduction: The goal of this project again is to aid the community group Enlace in the procurement of additional infrastructure for alternative transportation. These questions are the questions that we must ask in our project to gather the data that will complete our objectives.

Data Requirements

Need to Know Questions and Entities Matrix

Question 1: Where are the bike racks located on 26th street? What size are these bike racks and how many bikes are on each. What locations should have bikes racks because there are bikes chained there not on racks?

Question 2: How long does it take to transverse 26th street by bike, car, foot, and bus?

Question 3: How many bikes are going through the intersection of Central Park and 26th in all directions during a given time period?

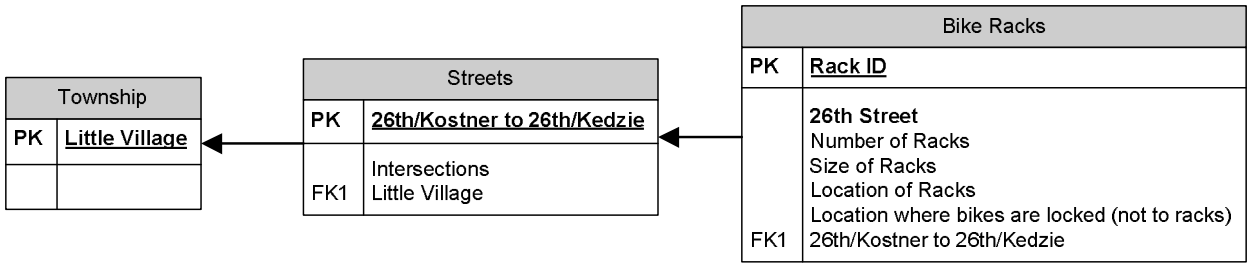
Question 4: How many bikes are moving in each direction at the intersection of Pulaski and 26th during a given time period?

Entities

	Time	26th Street	Bike Racks	Bikes	New Bike Locations	Pulaski St.	Central Park St.
Question 1		X	X	X	x		
Question 2	x	X					
Question 3		X		X			X
Question 4		x				x	

ERD

Question 1: Where are the bike racks located on 26th street? What size are these bike racks and how many bikes are on each. What locations should have bikes racks because there are bikes chained there not on racks?



Question 2: How long does it take to transverse 26th street by bike, car, foot, and bus?

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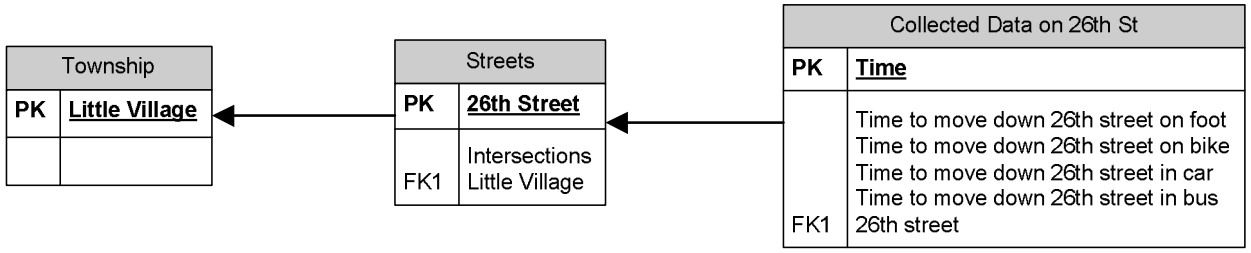
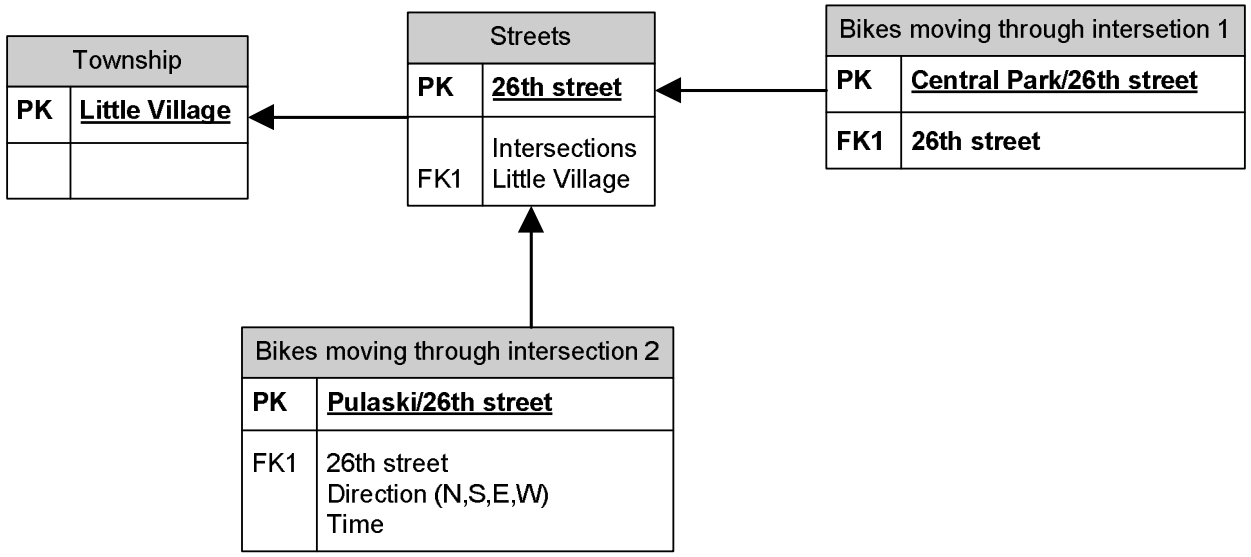


Question 3: How many bikes are going through the intersection of Central Park and 26th in all directions during a given time period?

Question 4: How many bikes are moving in each direction at the intersection of Pulaski and 26th during a given time period?



Operations

Need to know question/	Operation A	Operation B	Operation C	Operation D	Operation E
NTK 1	X	X	X	X	X
NTK 2	X		X	X	X
NTK 3	X		X	X	X
NTK 4	X		X	X	X

Operation A- Data collection, Primary data capture. (GPS, remote sensing)

Operation B- Data manipulation, Coordinate transformation.

Operation C- Data analysis, Network analysis. (routing)

Operation D- Data analysis, Proximity analysis. (buffering, distance measurement)

Operation E- Data Visualization.

Questions

Question 1: Where are the bike racks located on 26th street? What size are these bike racks and how many bikes are on each. What locations should have bikes racks because there are bikes chained there not on racks?

Question 2: How long does it take to transverse 26th street by bike, car, foot, and bus?

Question 3: How many bikes are going through the intersection of Central Park and 26th in all directions during a given time period?

Question 4: How many bikes are moving in each direction at the intersection of Pulaski and 26th during a given time period?

4. Data Acquisition

For each goal listed below is the description of how we attained the data we needed to complete our project. This will include the times and dates of when we attained certain data.

1) Use available data to find and map the estimated travel times on W 26th St. to go from Kedzie Ave. to Kostner Ave. by car, by bus, on a bike, or on foot. Likewise, find and map the times it would take a biker to go From Kostner Ave. to Kedzie Ave. on recommended bike routes, and portray these two data sets side by side.

Data Acquisition Means

A) There is trip time calculation data available on Google Maps and Map Quest and so we simply compiled and averaged different estimated trip times for different means transportation up and down 26th and then compared them side by side on a map.
B) We also found recommended bike routes through the Active Transportation Alliance and found the times it took to travel these paths as well, and then compared them to the other travel times.

2) Find wherever there are actually places that bike racks exist on 26th street. Find locations where bikes are randomly chained. Find the types of existing bike racks, and find how many of them are actually being used to hold bikes.

Data Acquisition Means

A) We collected the locations of all of the bike racks in 26th Street on October 26th, 2010 using GPS devices to record the data points. We also collected attributes for each point such as what type of rack it was and how many bikes were locked to it. We also collected data points for locations where bikes were locked to things other than racks. We then took the GPS devices and input the data points into ArcGIS. We also manually uploaded the attributes we had collected.

3) Find and map data for the amount of bikes moving in all four directions at the major intersections of Pulaski Rd. and 26th St. and Central Park Ave. and 26th St. during rush hour.

Data Acquisition Means

A) We traveled into Little Village and observed these two intersections during rush hour on Oct. 16 2010 where there is the largest problem with congestion.
B) We kept a record of every bike we saw from 3:40 to 5:00, and recorded the particular direction in which these bikes were traveling.

Data Dictionary

Data Set Name: Little Village Bike Racks

Description: These are the bike racks along 26th Street. We collected data points between Central Park Rd. and Kostner Rd. The racks were of different types and sizes, and they had different numbers of bikes locked to them. These other facets were collected as attributes and attached to their respective data point.
File Name: Racks
Source of Data: Personal data collection
Processing Steps: Collected data using handheld GPS. Converted the GPS data to a shape file and uploaded the coordinates of the bike racks to ARCGIS. Added the attribute information by hand.
Spatial object type: Point
Attributes:
Latitude WGS 84
Longitude WGS 84
Type of Rack
Whether or not the rack has a bike
Data Format: Shapefile

Data Set Name: 26th Street and Intersections
Description: This data was taken from an internet data base, and we used it to convey the attributes that we gathered. This will not only be a layer with which to convey the LVBRacks data, but will also have the data we collected about the number of bikes traveling down 26th street. This data also includes the routes that we collected transportation data for, so we will use it to show the routes that we are going to collect transportation times and make tables for.
File Name: Streets and Main Route and Alternate Bike Route
Source of Data: Created by hand using editor
Processing Steps: Used the orthophotos to draw in the major streets we were focusing on in editor after creating a file to use in ARCcatelog
Spatial object type: Line
Attributes:
Latitude
Longitude
Street Names
Number of Bikes in the Intersection of Pulaski and 26th Street (separate data for bikes going N,S,E, or W).
Number of Bikes in the Intersection of Central Park and 26th Street (separate data for bikes going N,S,E, or W)
Data Format: Shapefile

Data Set Name: Ortho Images for background reference
Description: The satellite photos of the area of Little Village we focused on.
File Name: OrthoStack
Source of Data: Downloaded from the USGS website

Processing Steps: We added the images as Tiff files and then stacked them by their bandwidths in order to make them show up on the display. We then exported the newly stacked files and re-added them to the maps
Spatial object type: Tiff photo
Attributes: None
Data Format: Shapefile

Data Set Name: Bikes Moving through the intersections of Central Park and 26th and Pulaski and 26th.
Description: The amount of bikes moving north east and west through the above mentioned intersections, this is conveyed in the form of arrows on top of the intersection shapefile
File Name: BikeMovement
Source of Data: Collected and processed ourselves.
Spatial Object Type: Poly Line
Attributes:
Direction
Amount of Bikes
Data Format: Shapefile

Fitness For Use

LVBRacks:
Positional Accuracy: There may be problems with the accuracy resulting from the GPS accuracy that we used. We also were not completely consistent with what part of the racks we collected so there may be some disparity, but overall there is a point in the general area of each and every rack.
Logical Consistency: The data may appear slightly inconsistent in this way because some of the data points may appear in the street instead of on the side of the street. This should only be a slight problem though.
Limitations: The limitations of this data set are only that their may be skewed attribute data. We were only able to collect the amount of bikes on the racks a few times so it is hard to say how often their are bikes on certain racks.

Streets:
Level of Cartographic Generalization: there seems to be a certain degree of generalization since we sketched the streets by hand using editor. This creates some generalization, but the difference is negligible and there is enough accuracy for our purposes.
Limitations: The detail of the photographs we traced off of is good, but not clear enough for our images to come out perfectly.

Orthostack:

Up to date data: The data was collected in 2005, so it is possible (though unlikely) that the streets have changed since the collection of the data.

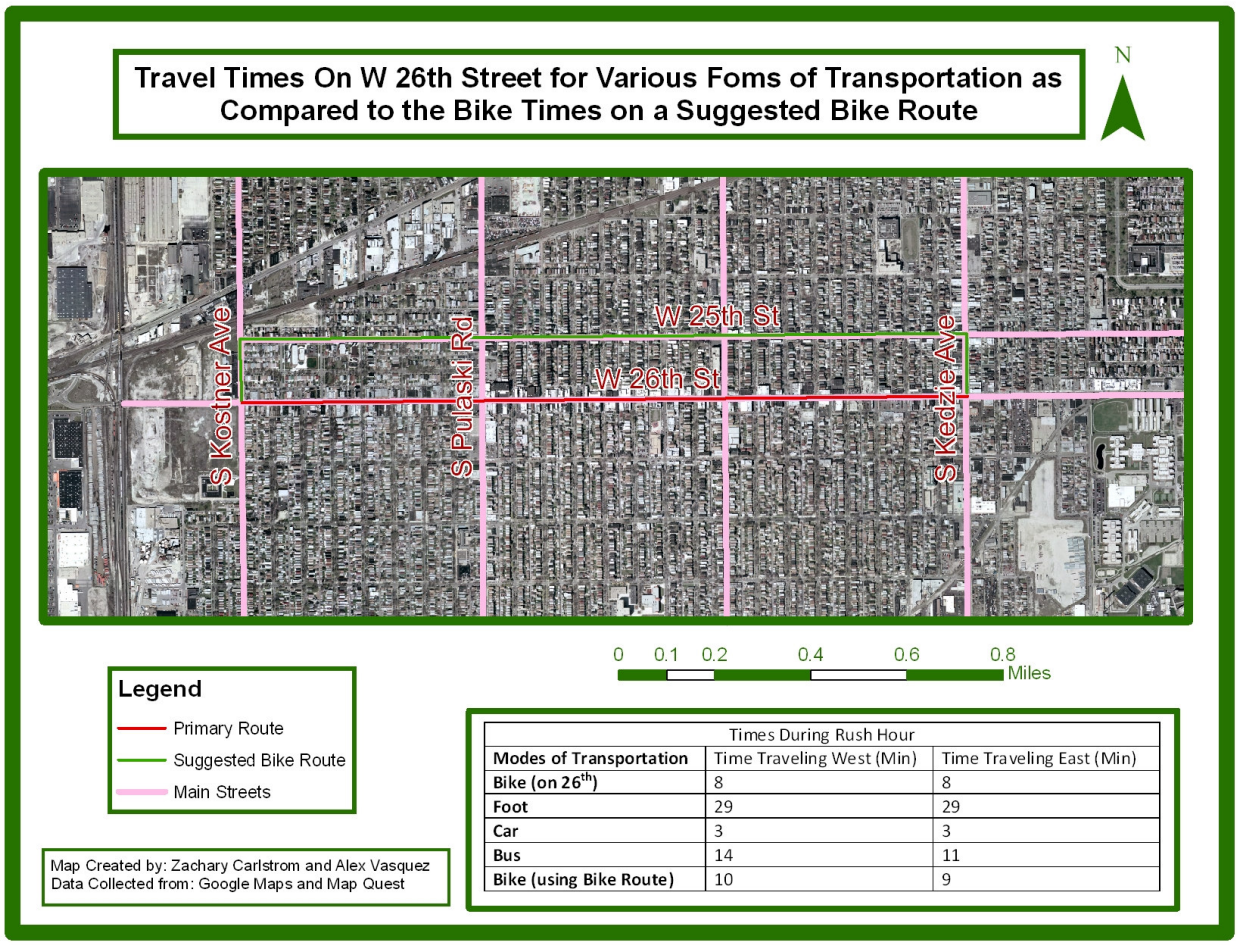
Bike Movement:
Attribute Accuracy: Because of the limited times we have been able to collect bike data at the intersections included in this file, we cannot say with any absolute certainty that the times we checked for bikes were not abnormalities.
Attribute Completeness: For the same reason as above, there may be many more or less bikes going through the two intersections at the same times on different days.
Limitations: There has not yet been enough bicycle data collected for these intersections to make the data a strong representation of bike movement on 26th and around Little Village.

Data Acquisition Constraints

We would have loved to have collected extensive data based on days of collection as to the attributes in the Bike Rack layer and the amount of bikes that passed by the two intersections we collected data at. We also wanted to collect data for other major Little Village thoroughfares to provide Enlace with a much more complete, comprehensive, and useful collection of data. Unfortunately, due to the time constraints of a 10 week quarter and the balancing act of this project with projects in multiple other courses, we had to focus on 26th street only and had to limit the amount of data we collected there as well. Hopefully future groups can take our data and use expand it in future projects.

5. Data Analysis

Objective 1 Map:



Times During Rush Hour		
Modes of Transportation	Time Traveling West (Min)	Time Traveling East (Min)
Bike (on 26th)	8	8
Foot	29	29
Car	3	3
Bus	14	11
Bike (using Bike Route)	10	9

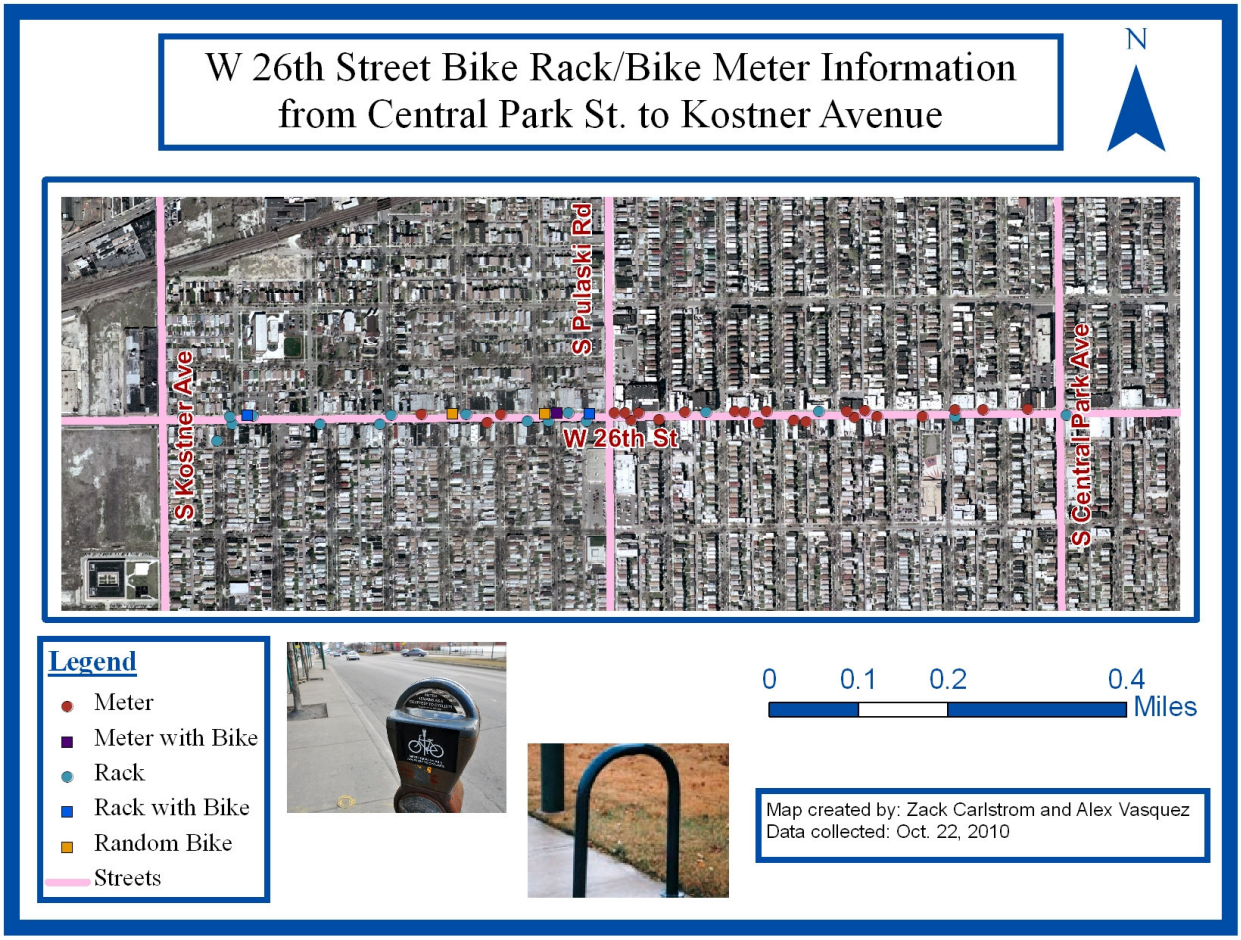
Analysis:

The times we collected for this map and accompanying chart ended up being quite interesting. It seems that the difference in time to travel the distance from Kostner to Kedzie on a bike or on foot is quite significant. This showed us that it definitely worth it for a pedestrian - or anyone who wants to get somewhere quickly or simply save time - to ride a bike instead of walking on 26th street. This makes a stronger case for the necessity of better biking infrastructure on 26th. Especially when the biking time is compared to the amount time it takes to travel the distance in a car or in a bus. The car is actually not very much faster, and the bus is actually slower than the bike when traveling in either direction. All of this makes biking seem like a very good transportation option.

However the alternative bike route, which is ideally much safer than biking on 26th street regardless of new biking infrastructure, is almost as fast to use as 26th street. This makes the

situation more complicated because it raises the question: would it really be worth adding more bike lanes or other forms of biker protection or would it be more worth it to add signs to make the alternate bike route much more well known to bikers? In fact, it may be that the bike lanes on 26th might actually be more unsafe because they encourage bikers to ride in 26th street traffic instead of taking the bike route on 25th.

Objective 2 Map:



Analysis:

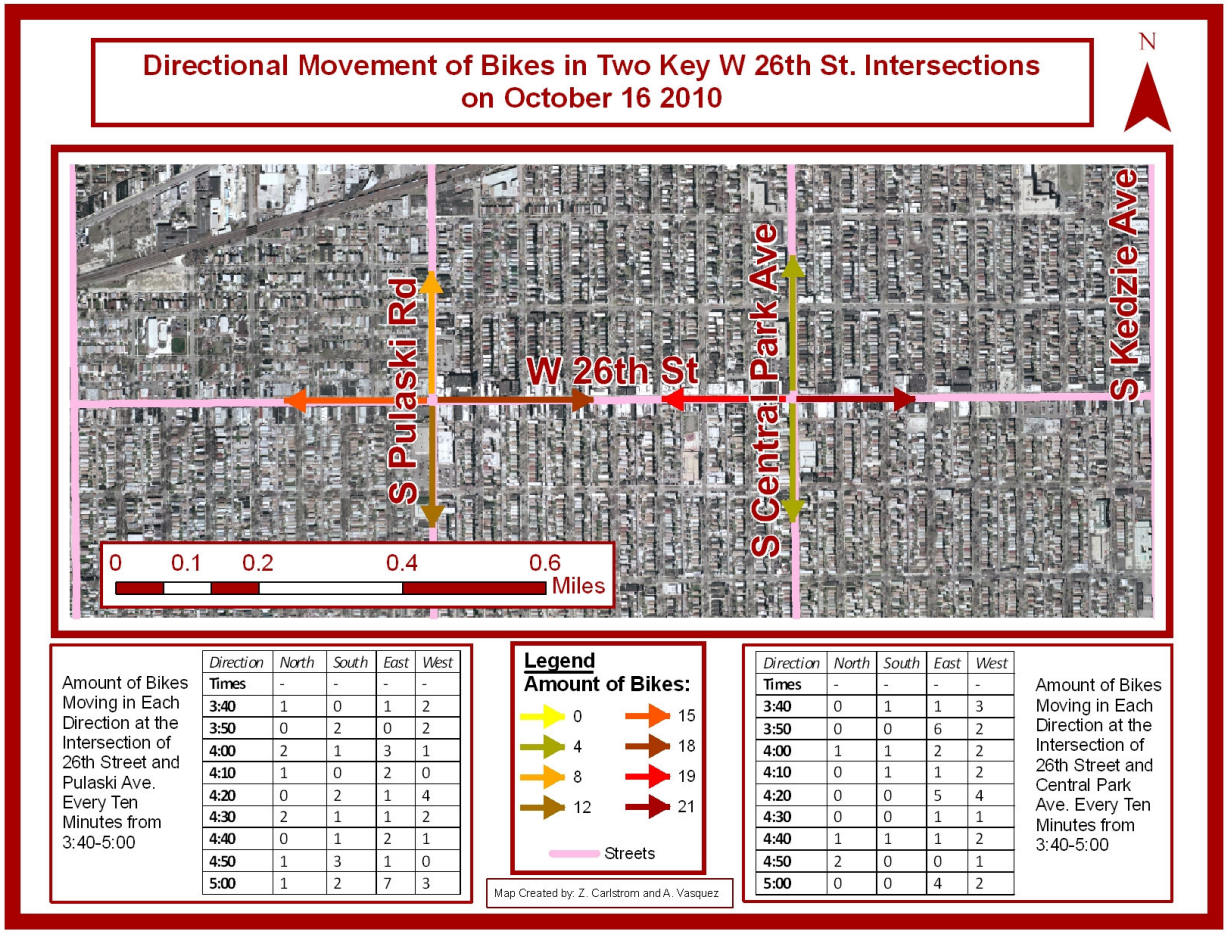
This map showed some interesting things, despite the limited time frame we were able to gather data between. The time constraints certainly skewed this data because we only collected one data set for the amount of bikes locked up along 26th street. Nevertheless, there are two different ways to interpret the data we did collect.

To start, there seem to be quite a few places where bikes are supposed to be able to be parked along 26th street. However, most of these racks did not have bikes attached to them when we collected the data. The few bikes that were parked when we collected the data, were attached

to things other than racks. Also, the bikes not parked on racks were often parked close to racks that were there. This was strange because it made us wonder why the racks were ignored.

We also wondered why there were so few bikes parked on the street period. This could have been due to a lack of bike traffic at that time, a lack of bikers using 26th street period, or perhaps a distrust in the ability of the bike racks to protect a person's bike. We concluded, though, that there were adequate amounts of bike racks along the road. We did notice that the bike meters that have been converted into racks may be misleading, however, and may appear in bad enough shape to be useless for locking a bike to. The two ways to interpret the data we collected, then, are that either there is not enough bike traffic on the street and more should be encouraged or the racks that are on 26th street are not very appealing bike protection options.

Objective 3 Map:



Amount of Bikes Moving in Each Direction at the Intersection of 26th Street and Pulaski Ave. Every Ten Minutes from 3:40-5:00

Direction	North	South	East	West
Times	-	-	-	-
3:40	1	0	1	2
3:50	0	2	0	2
4:00	2	1	3	1
4:10	1	0	2	0
4:20	0	2	1	4
4:30	2	1	1	2
4:40	0	1	2	1
4:50	1	3	1	0
5:00	1	2	7	3

Direction	North	South	East	West
Times	-	-	-	-
3:40	0	1	1	3
3:50	0	0	6	2
4:00	1	1	2	2
4:10	0	1	1	2
4:20	0	0	5	4
4:30	0	0	1	1
4:40	1	1	1	2
4:50	2	0	0	1
5:00	0	0	4	2

Amount of Bikes Moving in Each Direction at the Intersection of 26th Street and Central Park Ave. Every Ten Minutes from 3:40-5:00

Analysis:

This data had a simple but important purpose for our study: it allowed us to see how much bike traffic there actually is on 26th street. What we found was that there actually was a fairly high amount of bikers traveling from east to west on 26th street during rush hour. There was also a significant amount of traffic moving north and south on Pulaski. This proved, in conjunction with the bike racks and parking data, that there is no shortage of bike riders using 26th St. but there may be a shortage of them parking and shopping. Once again, perhaps this is due to a distrust of the safety of the dilapidated, old parking meter-racks.

6. Results

The data we collected, upon analysis and consideration, has yielded some interesting results. As far as the first objective goes

Map 1: This map showed the current bike route, the ideal primary bike route, and major streets along the 26th street corridor. The Map also shows four of the modes of transportation along 26th street with time it takes to travel East to West and West to East.

Map 2: This map showed location of bike racks, temporary meter racks, both bikes locked to racks and not to racks and major streets along 26th street. The map shows that further infrastructure, i.e. permanent larger bike racks are needed. This is evident in that none of the temporary meter racks had bikes locked to them. It was also seen that larger bike racks attracted more bike uses.

Map 3: This map showed at two intersections, 26th and Pulaski and 26th and Central Park, the direction and frequency of bike travel. The map highlights the data shown in the two tables at the bottom of the map by displaying directional arrows at the intersections that correspond to the data.

7. Summary, Conclusions, Recommendations

In summation, the project we conducted over the last ten weeks was both very informative and limited by the time constraints we had to deal with. Therefore, knowing that the time constraints would be a difficulty before we even began the project, our objectives were mostly directed toward doing some groundwork for future groups who wish to do research on the same subject we did.

There is much to be discovered by groups who seek to collect more data on the use of bike racks on 26th street. More collection times and data for every day of the week is required to draw conclusions that will be more illuminating. There is also a great deal of bike rack research to do for the rest of Little Village. We compiled a complete set of bike racks for 26th street alone, but there are many streets to look at before every rack is accounted for. Only after all of the racks have been located can the question as to whether or not a lack of bike racks is restricting the use of bikes in the area. There certainly was not a lack of racks on 26th street itself.

The travel time data is probably the most complete data set we have, especially due to the accuracy of Google Maps' and Map Quest's data. We now know that biking is definitely a valid transportation option for people in Little Village because its travel speed is comparable to cars and public transportation. This makes it a very attractive option and makes it reasonable to encourage biking as an option for lowing the amount of congestion.

More bike traffic data should also be collected. This will simply make the data more accurate. It is difficult to say that the data we have adequately represents the actual amount of bike traffic there is on 26th Street. This is because we only collected one days worth of data on the subject, during a narrow time frame. There are also many more intersections along the road that would be conducive to research. These things should all be considered by future groups working with Enlace.

The principle conclusion that we have made, in light of all of this, is that more research needs to be done to determine the exact state of biking infrastructure in Little Village, and to understand how that infrastructure should evolve in the future. That being said, we do know that there is a significant amount of bike racks and that they seem to be underused. There is also a high enough amount of bike traffic around rush hour to warrant due consideration. We also know that biking is a useful mode of transportation, and that it may be worth looking into the existing bike route on 25th street and diverting bike traffic onto that street. Going forward, we hope this information is helpful to Enlace, and useful for group who wish to do further research.