Context Matters: Attitudes and Perceptions of Proposed Bike Lanes in Memphis, TN

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Abstract

This research leverages a City of Memphis dataset of over 1,700 survey responses with over 2,400 comments for understanding how people make decisions regarding support for or opposition to bike lanes in their communities. The survey comments were analyzed using both descriptive and thematic analyses along with unbiased computer-generated topic models. Six primary themes were identified along with six major intersections of these themes that provided important insights for understanding respondents’ perspectives. The primary themes are: People on bikes deserve a space on the road, Danger and safety, Roadway is for cars and drivers, No real need for bike lanes, Money and funding, and City and area benefit from bike lanes. The results of this research can be used to inform local agencies’ public engagement and communication strategies to ensure more effective discussions take place regarding expansion of a community’s transportation network. To have productive conversations with people opposing government spending on bike lanes, agencies need to emphasize that bike lanes’ benefits extend beyond people who bike.
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Introduction

Currently, many cities in the United States are expanding their on-street bike networks. Conversations about changes to streets can be challenging. Especially given the limited interaction between local agency representatives and the public and the difficulty of effectively conveying project benefits. Despite these challenges, public discussions about bike lines are increasingly relevant.

In 2017, the City of Memphis received over one thousand seven hundred responses to a survey about proposed bike lanes. Many of the respondents left comments on multiple project proposals. Their opinions ranged from enthusiastically supportive to adamantly opposed. Collectively, these comments constitute a rich dataset of perspectives and attitudes towards bike lanes.

This kind of community feedback is important to public agencies working to create more livable communities. State and local agencies must decide when and how to prioritize multimodal access such as bike lanes. They must also effectively communicate options to residents and local stakeholders. While, nationally, there is broad support (69%) for bike lanes, many people are “somewhat supportive” and view other transportation needs as more important (People for Bikes, 2018).

This research leverages this rich dataset for understanding how people make decisions regarding support for or opposition to bike lanes in their communities. The survey comments were analyzed using both descriptive and thematic analyses along with unbiased computer-generated topic models. The findings provide insight on why people support or oppose bike lanes. The discussion addresses the question of whether responses are fundamentally about the people themselves, or fundamentally about the type of bike lane and the street’s context. The
results of this research can be used to inform local agencies’ public engagement and communication strategies to ensure more effective discussions take place regarding expansion of a community’s transportation network to include a bicycle network.
Literature Review

Cities promote transit, walking and cycling in hopes of reducing congestion, limiting air pollution, decreasing fuel dependency, and improving human health and overall community livability (Henao et al., 2015). The League of American Bicyclists’ 2018 Benchmarking Report lays out health, safe transportation, strong economics, connected routes, and infrastructure for physical activity as benefits of bicycle infrastructure (League of American Bicyclists, 2018). Many of these benefits are contingent on people biking and walking, so is there a link between levels of biking and space on roads for bikes?

Biking Levels

According to a national survey of over 21,000 participants, 32% of Americans rode a bike in the past year; however, only 21% of Americans rode six or more times (People for Bikes, 2019). Many people rode for both recreation and transportation purposes. However, of those who rode bikes, 55% rode exclusively for recreation, and only 9% rode exclusively for transportation (People for Bikes, 2019). Only 0.6% of people regularly use a bicycle to get to work in America (League of American Bicyclists, 2018). This percentage is quite small in comparison with some countries and cities in Europe including the Netherlands at 27%, Copenhagen, Denmark with 26%, Munich, Germany with 13%, and even the United Kingdom with 2% of commuters cycling (Wang & Liu, 2013).

Nationally, there is a shortage of benchmark data for how many people biked in general 30 or 40 years ago (Henao et al., 2014). On a national level, the Census Bureau and American Community Survey (ACS) data is collected only for trips to work, not for other trips people take (Henao et al., 2014). Some cities collect data on bike trips through surveys or counters, but many places data collection is still limited or sporadic (Henao et al., 2014). In Memphis, Tennessee,
the absence of historical data extends to within the last decade, and to this day there are only a few permanent bike counters, mostly on off-street trails (Smith, 2020).

Bicycle Infrastructure

Several cities have invested heavily in active transportation and have exceptional levels of bicycle commuting. Among them are Boulder, CO, and Portland, OR (Henao et al., 2014). First, Boulder will be examined. A study of 20 years of Boulder’s transportation budget shows significant investment in pedestrian, bicycling and transit infrastructure (Henao et al., 2014). Henao and his research partners do not attempt to establish causality, but rather show that there is a strong correlation between the large sustained investment that Boulder made and the continued increase in bicycle and transit mode shares with a simultaneous decrease in single occupancy vehicle mode share (Henao et al., 2014). In fact, they report that Boulder had public advocates supporting multi modal transportation since the 1960’s, so it is unclear whether the demand (people cycling) drove the increase in supply (bicycle infrastructure), or if the increased supply grew the demand, or both contributed in a cyclic manner (Henao et al., 2014). Boulder has not always had extraordinary levels of cycling. As recently as the early 1980’s it was not that different from neighboring communities (Henao et al., 2014). In 2009, Boulder’s bicycling mode share had grown to about 13% according to the ASC and Census Bureau (Heano et al., 2014).

In Portland, Oregon, the city increased its developed bike network by 215% from 1992 to 2005, and saw a 210% increase in bike trips across major bridges connecting residential and commercial areas (Birk & Geller, 2006). Birk, who served as Portland’s Bicycle Program Manager from 1993-1999 and Geller, who was Portland’s Bicycle Coordinator at the time of publication found a “…strong correlation between a connected, bikeway system constructed to the highest standards and increases in bicycle use” (Birk & Geller, 2006). The focus for
recommended best practices is to plan entire networks as opposed to individual bike lanes and bike paths (Buehler & Dill, 2015).

The link between bicycle infrastructure and cycling levels is not limited to a handful of cities. Through examining 90 large American cities, Buehler and Pucher (2012) found that there is certainly a correlation between the number of miles of bike facilities a city has and the number of bicycle commuters it has. They show that “Cities with safer cycling, lower automobile ownership, more [university] students, less sprawl, and higher gasoline prices had more cycling to work (Buehler & Pucher, 2012). By comparison, annual precipitation, the number of cold and hot days, and public transport supply were not statistically significant predictors of bike commuting in large cities.” (Buehler & Pucher, 2012). They also found that, while not a large factor, higher temperatures and precipitation levels do have slight negative impact on commute cycling (Buehler & Pucher, 2012).

It is not surprising that many people choose to ride on streets with bike lanes over those without (Lott & Lott, 1978). Lott and Lott published this decades ago, and that fact has not changed. As part of a study in Portland, Oregon, cyclists were tracked with GPS, and they rode on streets with bike facilities 50% of the time, and on streets with no facilities the other half of the time, despite the fact that roads with bike facilities accounted for only 8% of roads in the city (Buehler & Dill, 2015). Revealed preference studies found that when cyclists do ride on streets, they choose streets with fewer lanes and lower volume, so about half of street cycling miles in North America are on local or neighborhood streets (Buehler & Dill, 2015). Land use densities are also influential on biking levels, but network connectivity measures are more important (Kuzmyak et al., 2014).
Typical bike lanes are separated from vehicle travel lanes by a single white line, while cycle tracks, another name for protected bike lanes, are separated from traffic by a physical barrier - like curb or concrete barriers or bollards (Buehler & Dill, 2015). Bike paths are off-street bike facilities that may go through a park or follow a river (Buehler & Dill, 2015). Some studies have found that bike lanes and bike paths have a statistically similar positive effect on bicycle commuting (Buehler & Pucher, 2012). Others have shown that bike paths are preferred compared to on-street bike lanes, particularly among women and inexperienced cyclists (Garrard et al., 2008). Both bike paths and bike lanes are strongly preferred to roads with no bike facilities (Garrard et al., 2008). For utilitarian trips, people tend to bike the shortest distance and minimize exposure to traffic (Kuzmyak et al., 2014).

Public infrastructure for biking extends beyond bike lanes. Increasing options for trips that are a combination of bicycle and transit use can increase both transit and biking rates (Krizek & Stonebraker, 2010). Providing options for bringing bikes onto transit is the most beneficial for increasing combined bike and transit trips, followed by providing secure bike parking to facilitate biking to transit (Krizek & Stonebraker, 2011).

Who Rides

When considering ways to increase bicycle usage as a viable transportation option in a community, three important questions to ask are: “Who wants bike lanes?”, “Who needs bike lanes?”, and “Who gets bike lanes?”. Bike lanes have the potential to provide access to people who may be financially restricted in using other forms of transportation such as driving a personal vehicle. People with lower incomes, people of color, and those with lower automobile ownership rates are among disadvantaged populations that are more likely to bike to work (The League of American Bicyclists, 2018; Zimmerman et al, 2015). While low-income residents are
the majority of bicycle commuters, they typically have less access to bike facilities (Cahen, 2016). Lower-income neighborhoods also have less access to recreation facilities (Lee et al., 2017). Bike lanes and bike trails can increase an area’s access to recreational facilities or serve as a means of active transportation and recreation themselves. One concern, and argument against building bike lanes in low-income neighborhoods and around urban cores, is that this change may lead to or accelerate gentrification and displacement, where wealthier people move in, displacing lower-income individuals, and then become those who ultimately benefit from the bike lanes (Stehlin, 2015).

Low-income households spend about twice the percentage of their income on transportation as middle-income households (Zimmerman et al., 2015). Key aspects of equity accessibility, or social inclusion are travel affordability and access to transportation (Di Ciommo & Shiftan, 2017). Most traffic system evaluation, particularly involving car dependency, is based on a framework that does not account for subgroups who cannot afford the cost of using a particular service or who have mobility issues that exclude them (Di Ciommo & Shiftan, 2017). This perpetuates the equity gap – both in terms of direct access as well as inclusion of these needs in the planning and evaluation process.

Women are biking at increasing rates but are still underrepresented among cyclists. In the last 10 years, the percentage of commuter trips and all trips on bikes that are taken by females has increased from 25% to 30% (The League of American Bicyclists, 2018). The highest rates of biking occur among children, with around 3% of trips made by bicycle for those under 16 (Kuzmyak et al., 2014).

A literature review found that perceived benefits of cycling, perceptions of safety, and apparent barriers to cycling played a large role in one’s habits related to cycling (Willis et al.,
The built environment and perceived options for transportation influenced whether or not people use bikes for transportation (Willis et al., 2015).

Roger Geller developed a typology of four categories based on what type of bike facility the four categories of cyclists are willing to use (Geller, 2009): The Strong and Fearless would likely bike on any of these streets in their current conditions, without bike facilities, undeterred by the volume or speed of motor vehicles. The Enthused and Confident would bike on major streets with bike lanes, and on minor streets without bike lanes since there are lower levels and speeds of traffic. The Interested but Concerned, the largest group, feel comfortable riding on protected bike lanes and off-street trails and ride more often for recreation. The final group is called No Way No How, and they do not ride bikes; they may be unable to ride, or simply have no interest in riding. A survey conducted in Portland reported 4% Strong and Fearless, 9% Enthused and Confident, 56% Interested but Concerned, and 31% No Way No How cyclists in the city (Dill & McNeil, 2013).

A national survey of 3,000 adults across America’s 50 largest metros found the following: 7% Strong and Fearless, 5% Enthused and Confident, 51% Interested but Concerned, and 37% No Way No How (Dill & McNeil, 2016).

Benefits of Bike Lanes

Economic Benefits

Protected bike lanes provide economic benefits for adjacent businesses (People for Bikes & Alliance for Biking and Walking, 2015). In Toronto Canada, a survey of merchants and customers showed there was no negative economic impact when on-street parking is lost to provide bike lanes along a business corridor (Yoder & Johnstone, 2018). Some merchants were
concerned when 136 parking spaces were removed as part of a pilot project that introduced bike lanes (Yoder & Johnstone, 2018). However, over the course of the pilot, the number of monthly customers and spending increased (Yoder & Johnstone, 2018). Business owners along the Indianapolis Cultural trail, a string of mixed-use paths for people on bikes and pedestrians, reported increased revenue after the trail was built (Majors & Burrow, 2015).

Health Benefits

A recent review of 21 studies into the “association between bike lane access and childhood obesity” found most studies showed positive associations between children’s weight-related behaviors and outcomes (Pan et al., 2020). They found that overall, children’s physical activity and active transportation were higher when there was greater access to bike lanes (Pan et al., 2020).

The League of American Bicyclists combined data from numerous sources for the 50 largest American cities. US Census Bureau American Community Survey (ACS) shows Memphis, TN, is tied with eight other cities for the lowest bicycle commuting rates at 0.2% and among the 10 lowest percentages of people who walk or bike to work at 2.1% (League of American Bicyclists, 2018). Memphis is among the 10 cities with the largest proportion of population with low income, at 27.6%. Memphis is ranked among the top 10 cities in the U.S. in terms of the percentage of population suffering from obesity, at 40.5%, percentage of adults with diabetes, at 11.5%, and percentage of adults with high blood pressure, at 39.5%. (League of American Bicyclists, 2018). These cities are on the opposite end of the spectrum of other cities that have the top 10 lowest levels of obesity and overweight populations and the highest levels of people who walk and bike to work (League of American Bicyclists, 2018). There is no doubt that income and other factors influence these health conditions, but the report presents a correlation
between levels of active transportation and these health conditions as well (League of American Bicyclists, 2018). While those who use bike lanes and bike paths primarily for recreation may not achieve or need the transportation benefits, they still reap health benefits (Braun et al., 2016).

Safety

Pedestrian deaths across the nation increased by 35%, even as vehicle occupancy deaths decreased by 6% from 2008 to 2017 (National Complete Streets Coalition, 2019). Over this same period, walking as a share of all trips increased by only 1%, and the vehicle miles traveled increased by 8% (National Complete Streets Coalition, 2019). Speed of vehicles and reaction times impact whether crashes occur between drivers and pedestrians or people on bikes (Salon & McIntyre, 2018).

Half of adults are concerned about safety around motor vehicles while biking, and over 40% would be more likely to ride if bikes were physically separated from cars (People for Bikes, 2019). Approximately 36% of adults are concerned about personal safety while riding bikes, with this particularly being true for women, people of color, and those in urban areas (People for Bikes, 2019). People feel much safer when they are riding in protected bike lanes (Monsere et al., 2014).

A study of the risk of injuries to bicyclists found that people riding in bike lanes have half the risk of riding on similar streets without bike lanes, and riding in protected bike lanes reduces risk of injury by 90% (Teschke et al., 2012). The study included 690 residents in Toronto and Vancouver, Canada who had visited the emergency room after being injured while riding a bike (Teschke et al., 2012).
Narrowing travel lanes has been shown to slow drivers down, which decreases the severity of injuries or likelihood of fatalities if there is a collision (Fitzpatrick et al., 2001). If a pedestrian is struck by a vehicle traveling at 40 mph, they will be severely injured, and have only a 15% chance of survival (FHWA, 2013). This is compared to a 95% chance of survival, and possibility of only minor injuries if the vehicle is traveling at 20 mph (FHWA, 2013).

Spending on Bike Lanes

According to the Congressional Budget Office (CBO), about half of all spending on transportation is from the Federal Government and half is from state and local governments (CBO, 2018). The Federal Government spent an average of $64 billion per year from 2007 to 2016 on transportation and water infrastructure (CBO, 2018). Over an overlapping time period, 2013-2017, The Federal Highway Administration spent $832 million per year on biking and walking infrastructure (The League of American Bicyclists, 2018). That is only 1.3% of the total federal infrastructure spending. It is nearly impossible to discriminate how much is individually spent on bicycle and walking, which is why they are considered in one set (The League of American Bicyclists, 2018).

Furthermore, the Federal Government does not collect taxes on approximately $7.3 billion per year because of the commuter parking tax benefit (The League of American Bicyclists, 2018). On its face, one could see that this type of tax benefit would disproportionally benefit wealthier people who can afford cars and drive to work, but it becomes even more clear that this benefits high-income people when looking at who uses this tax credit. According to data from the IRS, companies with the top 25% of earners use the tax credit six times more than those in the bottom 25% (The League of American Bicyclists, 2018).
From 2013 to 2016, Tennessee spent an average of $3.75 per year per person on bicycle and walking and physical activity, which is a 29% increase from the previous three years (The League of American Bicyclists, 2018). In some states spending on these facilities is up, while in others it is down, but for a number of reasons stemming from changes in funding mechanisms, it is difficult to tell if funding is up or down at the national level (The League of American Bicyclists, 2018).

Reasons Some People Oppose Bike Lanes

Bike lanes projects can be contentious among business associations, especially when parking is removed in a business district (Arancibia et al., 2019). A study on the sociotechnical aspects of contested bike lanes in Launceston, a city in Tasmania, Australia, identified several reasons why people oppose bike lanes (Vreugdenhil & Williams, 2013). The city went from about 2km of bike lanes to a network of 50 km of bike lanes as part of a multimillion-dollar funding package from the Australian Federal Government (Vreugdenhil & Williams, 2013). Researchers reviewed news articles and conducted interviews of city leaders, business owners, residents, and cyclists (Vreugdenhil & Williams, 2013). People’s objections centered on confusion caused by the rapid change to the striping of the streets, feelings of exclusion from the process because there was no public outreach before the lanes were painted, and drivers feeling like their space was limited on “their” roads (Vreugdenhil & Williams, 2013). Vreugdenhil and Williams (2013) also cited an Australian Broadcasting Corporation (ABC) News article reporting a case in Adelaide, Australia, where the city faced public opposition and ended up removing bike lanes that they had just spent $400,000 installing. The reasons given in the article about Adelaide were that people could not find parking, there was decreased business, and it was dangerous for pedestrians according to an Adelaide member of parliament (ABC News, 2010).
The article quoted a business owner saying, “the cycling public wasn’t familiar with the concept and they continuously rode on the carriageway [car lane].” (ABC News, 2010).

Reasons Some People Want Bike Lanes

This same study in Australia found cyclists viewed the addition of bike lanes as providing a space where they could ride safely and confidently (Vreugdenhil & Williams, 2013). Cyclists took personal ownership of “their” new space on the edges of the roads and biked with increased confidence due to feeling validated that they had a legitimate space on the road (Vreugdenhil & Williams, 2013). One person interviewed liked that the bike lane served as a constant reminder to drivers that there was the possibility of a cyclist, even if there was none in the lane (Vreugdenhil & Williams, 2013).

Current Study

There have been multiple studies on how perceptions influence one’s practice of bicycling, but there has not been much research into factors that influence public perceptions of bicycle infrastructure (Willis et al., 2015).

This study leverages a rich dataset to gain insight into perceptions of proposed bike infrastructure regardless of individuals’ biking behavior. This study will contribute to the knowledge of how people see bike lanes and can inform future conversations around proposed bicycle infrastructure. Public support for investment into various modes of transportation, including bike lanes, is essential for expanding transportation options for everyone.
Methods

Public comments provided in a 2017 survey from the City of Memphis are examined using the following methods:

- Overview of responses
  - Analysis of responses by street
  - Variation in supportiveness by respondent
- Thematic analysis
  - Development of themes
  - Frequency analysis of themes by street
  - Frequency analysis of theme by supportiveness
- Topic Model
  - Computer generated groupings of frequent words

Data Background

The dataset analyzed for this project was collected by the City of Memphis in 2017. The data was collected through a short survey via Survey Monkey. The survey instrument included a welcome section that introduced the projects and identified the funding source (Surface Transportation Program (STP) Repaving Group 5 and 6, 80% federal 20% local funding). The survey was conducted as a follow up to an open-house public-input meeting held on March 27, 2017 to solicit feedback on design proposals for 10 major streets due to be repaved. The meeting had about 200 people, and was well attended by community organizations that support bicycle infrastructure - about 50 attendees traveled to the meeting by bike (Oyler, 2017). The survey was posted on the city’s bikeway and pedestrian program blog, and was promoted among community bicycle group networks (Oyler, 2017). This likely resulted in a stronger showing of
support for the proposed bike lanes than if the survey had been conducted using random sampling. The streets and project boundaries included:

Group 5:

Hickory Hill: *Mount Moriah to Winchester*

Knight Arnold: *Hickory Hill to Ridgeway*

North Highland: *Summer to Walnut Grove*

North Perkins: *Summer to Walnut Grove*

Riverdale: *Winchester to Shelby*

Riverside: *Jefferson to Beale*

Group 6:

Airways: *Shelby to TN/MS State Line*

Cooper: *Washington to Central*

Getwell: *Park to I-240*

Mendenhall: *Knight Arnold to Mt. Moriah*

The proposals included plans for bike lanes on every street except for Getwell Road. Since all of the projects were just repaving projects and no curb lines were being moved, the space for these bike lanes was created by reducing the width or number of motor vehicle travel lanes. Riverside Drive was the only proposal that included protected bike lanes, reducing the travel lanes from two each way with a center median to one each way, keeping median. Cooper Street was the only other street where the proposal included removing travel lanes (from four—two each way—to three—one each way with a center turn lane).

The Survey also displayed a map indicating the ten streets as well as the existing, programmed/budgeted, and recommended bike network. The programmed/budgeted network
was limited to bike lanes that had funding secured, so they would likely be installed in the following couple of years. Figure 1, below, shows a copy of that map which is available with the rest of the survey streets information on the Bike Ped Memphis blog (Oyler, 2017).
The specific proposal for each street was given its own page, that showed two images: the existing lane configuration and widths and the proposed lane configuration and widths. The bottom of each page read as follows:

“In general, I would describe my sentiment toward this proposal as:

- Supportive
- Not Supportive

Please use the space below to provide your comment. (250-character max)”

After selecting one of the two options and leaving a comment, respondents could proceed to the next question or return to the previous one. Participants were not required to respond to all questions.

On the final page, the respondent was asked to provide their name and address. However, the survey could be submitted even if these sections were left blank.

The city received more comments than typical for this set of streets, which is one reason why this data set was chosen for analysis. While it is a standard practice for the city to hold public meetings when changing the lane configuration of a road, particularly if the number of travel lanes or parking lanes is changed, there is not always such a large response. One reason this set received more public attention may be because Riverside Drive had a pilot project in 2014 and 2015 that moved vehicle traffic to one side of the median and designated the other side as bike lanes. This pilot garnered substantial attention from downtown residents, commuters and the local media.
City staff did some basic sorting of the data for each street. Tables were made showing the percentage of votes for “Supportive” and “Not Supportive” for all respondents and for respondents who submitted home addresses within the City of Memphis. They also noted how many comments were provided for each street.

Initial Data Analysis

The author began by reviewing the data sorting that was conducted by the city. City staff had removed all identifying information such as name and street address, but they left a respondent ID number so that individual responses could be linked.

The first step included a general analysis of the data. The comments and level of support had already been organized by street, so the research team sorted the data by respondent, using the respondent ID. Using Microsoft Excel, the “Supportive” or “Not Supportive” responses were compared for respondents who selected an answer for each of the nine streets with bike lanes proposed. This was used to see if respondents voted the same way for every street, or if their vote varied depending on the street or the proposed change.

Thematic Analysis

The qualitative analysis of survey comments followed the thematic analysis process laid out by Braun and Clarke (2006). Thematic analysis is a form of qualitative analysis that involves the following six steps. First, the researchers familiarize themselves with the data. Then, they generate initial codes – which are the smallest unit of common meaning. Next, they search for themes – which unite multiple codes. After this, they review the themes. The fifth step is to define and name themes. Finally, they produce a report.
Themes are patterns within the data (Braun and Clarke, 2006). The most basic form of thematic analysis is a description of the data, and often extends to interpret portions of the data (Braun and Clarke, 2006).

Three streets: Cooper St., Airways Blvd., and Hickory Hill Rd., were selected to include in the thematic analysis. The selected streets have a variety of existing lane configurations, proposed lane configurations, and different land uses adjacent to them. In broad terms, these 3 streets represent the most common street layouts, major land uses, and varied age of development in Memphis. This sample was selected for analysis so that the streets are representative of the data set and, more importantly, representative of Memphis streets that may have bike lanes added when they are repaved.

Riverside Drive is the one street in the data set that is not represented by this thematic analysis coding process. This street was not a priority for this research because both the context of Riverside Drive—running between downtown Memphis and a park along the bank of the Mississippi River— and the proposed change—going from four lanes to two lanes plus protected bike lanes— are unique. No other street in Memphis has adjacent land uses that are similar to Riverside Drive. With the added complexity of the background with the trial period, press reports, and current ongoing discussions of proposed changes more than three years later, Riverside Drive is more complex than a typical Memphis street repaving project.

The thematic analysis began with reading through every comment. This allowed the primary researcher to familiarize himself with the data and provided insight into initial codes. Next, about 70 initial codes were drafted based primarily on specific words that were repeatedly mentioned in the comments. These were shared with the research team. With feedback from the team, many of the codes were combined so there were about 50 codes when the process of hand
coding began. NVivo 12 was used to hand code the comments. Comments were coded one at a time, for one whole street, then the next street, so that every comment on those three streets was coded. Each comment was assigned to all applicable codes, and every comment was assigned to at least one code. During this process, new codes were added if a comment brought up different topics that were not already represented by existing codes, which brought the total number of codes to about 100. Each of these comments was also coded as “Supportive” or “Not Supportive” based on what the respondent indicated for that survey question.

Themes are either semantic, at the surface level, or latent, the underlying ideas (Braun and Clarke, 2006). While the codes that were developed are semantic, they are connected by latent themes. The codes that had been developed based on “what” respondents were saying were next grouped based on the apparent or perceived motivation of “why” people were saying it. A crosswalk was created drawing lines linking each of the codes in a column on the left to one or more themes in a column on the right. After sorting codes by theme, each comment was assigned to one or more theme as indicated by the comment’s code. For some codes that were assigned to multiple themes, all comments associated with those codes were assigned to all of the themes. For other codes that were assigned to multiple themes, some comments were assigned to one theme, while other comments were assigned to another. After all the comments were coded to at least one of the six themes, the NVivo matrix coding tool was used to find the intersection of the themes. These intersections were analyzed, and the six major intersections of themes were also identified as themes.

Next, a case study was developed to describe the context and the existing and proposed lane configurations for each street that had comments coded. The case study also examines the
number of respondents who selected “Supportive” and “Not Supportive”, the number of respondents who also left a comment, and the total number of comments for the street.

After developing the themes and the case studies, frequency analysis was conducted at a street level to see if the presence of a given theme varied by street, and at the respondent level to see if there was a correlation between the themes identified in a respondent’s comment and the respondent selecting “Supportive” or “Not Supportive”.

Topic Modeling

In addition to the thematic analysis, topic modeling was preformed based on the Latent Dirichlet Allocation model established by Blei, Ng, and Jordan (2003). This uses what is known as a bag-of-words method, where syntax is not considered. Words are grouped based on the probability they show up together in a comment. It is recommended to use a list of stop words that are based on the most frequent words in the dataset, as stop words are not considered in the analysis (Blei et al., 2003). This helps cut out some of the “noise” by removing words that are so common their presence in a topic would not add clear meaning.

The stop words used in this model were the software’s default English stop words, and a list of the seven most common words: lanes, bikes, traffic, lane, city, need, area. When the words were sorted based on frequency, using NVivo, the eighth word in the list was money. The researchers decided “money” was important to include because of the context, so it was not a stop word. Therefore, the top seven words were used as stop words. The topic modeling tool analyzes the data, and creates the number of specified topics with groups of words that frequently appear together in comments. Because there is no human input into what words are combined into topics, this is an unbiased way of developing topics. Initially five, 10, 15, and 20 topics were created using this tool, which were subsequently analyzed.
Results

Initial Data Analysis Results

Across all ten streets between 70% and 80% of respondents supported the proposed changes, however; of the people who left comments, only about half of the respondents supported the proposals. Below, Table 1 shows summary data that city staff created to inform the decision on which projects to proceed with as proposed. Figure 2, below, is a graph that was made from Table 1. Addresses were removed by city staff, so all further analysis for this research is conducted with data from all respondents regardless of whether or not their residence is inside or outside of Memphis, TN.

![Supportive/Not Supportive by Street](image)

Figure 2: Supportive and Not Supportive by Street
Table 1: All streets - Supportive and Not Supportive and Total Comments

<table>
<thead>
<tr>
<th>Highway</th>
<th>All Respondents</th>
<th>Memphians Only</th>
<th>All Respondents</th>
<th>Memphians Only</th>
<th>All Respondents</th>
<th>Memphians Only</th>
<th>All Respondents</th>
<th>Memphians Only</th>
<th>All Respondents</th>
<th>Memphians Only</th>
</tr>
</thead>
<tbody>
<tr>
<td>Airways</td>
<td>Sup. 75.58%</td>
<td>Not Sup. 24.42%</td>
<td>Sup. 76.16%</td>
<td>Not Sup. 23.84%</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>333 comments</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Getwell</td>
<td>Sup. 73.56%</td>
<td>Not Sup. 26.44%</td>
<td>Sup. 74.45%</td>
<td>Not Sup. 25.55%</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>185 comments</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Knight Arnold</td>
<td>Sup. 75.44%</td>
<td>Not Sup. 24.56%</td>
<td>Sup. 77.22%</td>
<td>Not Sup. 22.78%</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>167 comments</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>N. Highland</td>
<td>Sup. 79.75%</td>
<td>Not Sup. 20.25%</td>
<td>Sup. 81.40%</td>
<td>Not Sup. 18.60%</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>247 comments</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Riverdale</td>
<td>Sup. 75.75%</td>
<td>Not Sup. 25.25%</td>
<td>Sup. 76.37%</td>
<td>Not Sup. 23.63%</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>151 comments</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cooper</td>
<td>Sup. 75.49%</td>
<td>Not Sup. 24.51%</td>
<td>Sup. 76.78%</td>
<td>Not Sup. 23.22%</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>328 comments</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Hickory Hill</td>
<td>Sup. 74.73%</td>
<td>Not Sup. 25.27%</td>
<td>Sup. 76.51%</td>
<td>Not Sup. 23.49%</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>191 comments</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mendenhall</td>
<td>Sup. 77.00%</td>
<td>Not Sup. 23.00%</td>
<td>Sup. 78.45%</td>
<td>Not Sup. 21.55%</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>169 comments</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>N. Perkins</td>
<td>Sup. 79.47%</td>
<td>Not Sup. 20.53%</td>
<td>Sup. 80.65%</td>
<td>Not Sup. 19.35%</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>211 comments</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Riverside</td>
<td>Sup. 70.83%</td>
<td>Not Sup. 29.17%</td>
<td>Sup. 71.86%</td>
<td>Not Sup. 28.11%</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>491 comments</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Before comments are considered, the Supportive and Not Supportive responses will be discussed. Nine out of the ten streets being repaved with STP 5 & 6 are streets recommended for on-street facilities in the regional bicycle and pedestrian master plan. Getwell is the only street that was not, therefore it is the only street that did not have some type of on-street bike lanes proposed. Responses for Getwell were therefore excluded from much of the analysis. Results are presented below for the streets with proposed bike lanes. However, it should be kept in mind that responses to this survey are from people who chose to respond, not a random representative sample, so percentages cannot necessarily be taken to be representative of the larger population of the city and region. A total of 1727 people responded to at least one question on the survey by selecting “Supportive” or “Not Supportive” or leaving a comment. 995 people selected “Supportive” or “Not Supportive” for all nine streets proposed bike lanes. The responses to these nine streets were sorted using Excel to see how many people selected the same response regardless of the street and how many people’s responses varied by street. The results are shown in table 2 below.

Table 2: Supportive, not supportive and split votes for nine streets with proposed bike lanes

<table>
<thead>
<tr>
<th>Responses to all nine streets with proposed bike lanes</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Response</td>
<td>Number</td>
</tr>
<tr>
<td>Spilt Ticket</td>
<td>262</td>
</tr>
<tr>
<td>Straight Not Supportive</td>
<td>123</td>
</tr>
<tr>
<td>Straight Supportive</td>
<td>610</td>
</tr>
<tr>
<td>Total</td>
<td>995</td>
</tr>
</tbody>
</table>

The results show that for this set of diverse streets and proposals, 13% are not supportive regardless of the context, 61% are supportive regardless of the context, and 26% of respondent’s supportiveness is context dependent.
Thematic Analysis Results

For the thematic analysis, 852 comments from Airways Blvd., Cooper St., and Hickory Hill Rd. were analyzed. Each comment was initially coded based on the words or concepts mentioned, with some distinctions made between positive and negative sentiments.

Some examples of the 100 codes are as follows:

- bikes treated like cars
- connectivity
- danger – cars and drivers,
- danger – crime
- danger to drivers
- door zone
- economic mobility
- environment
- family
- health
- here
- high speed of cars
- high volume of cars
- intersections – concerns for people on bikes and pedestrians
- maintenance
- narrow lanes – opposed
- narrow lanes – support
- needed
- not here
- protected bike lanes suggested
- recreation
- referencing existing bike lanes negative
- referencing existing bike lanes positive
- referencing other cities negative
- referencing other cities positive
- slow traffic - which is unwanted delay
- slow traffic - is safer
- sufficient space for cars and bikes
- traffic better
- traffic worse
- underutilized
- waste of money
Figure 3: Crosswalk connecting codes to themes
After detailed review and synthesis of codes, six overarching themes were identified as the main drivers behind the comments. Figure 3, above, displays a draft of the “crosswalk” connecting the codes to the themes. The six themes are as follows:

A. People on bikes deserve a space on the road
B. Danger & safety
C. Road is for cars & drivers
D. No real need for bike lanes
E. Money & funding
F. City & area benefit from bike lanes

Some words have multiple sentiments and are therefore coded differently for the initial codes, and for the themes. For example, many people noted that adding bike lanes may slow down traffic. However, some people were glad because it would make the street safer for pedestrians, people on bikes, and people in cars, and other people opposed it because it might cause delays for drivers. These were initially coded as different nodes, one as “slow traffic - is safer” and another as “Slow traffic – is unwanted delay”. The first was then coded as two themes, theme A *People on bikes deserve a space on the roadway* and theme B *Danger & safety*. The second was coded as theme C *Roadway is for cars & drivers*. Table 3 below provides examples of the types of comments for each of the six themes. In the survey, respondents were told that their comments would not be published. That is why these are types of comments, not direct quotes.
Table 3: Sample comments by theme

<table>
<thead>
<tr>
<th>Theme</th>
<th>Paraphrased sample comments</th>
</tr>
</thead>
</table>
| Theme A: People on bikes deserve a space on the road                | • Bike lanes would be great on this street. I and many others would use them.  
• Bike lanes need more separation than just paint. Use bollards to keep people from driving in them like they do on North Parkway.  
• I would prefer the bike lane be between the sidewalk and parked cars  
• It is great to see multiple modes of transportation                                                                                     |
| Theme B: Danger & Safety                                            | • People drive recklessly on that street  
• Narrowing lanes is a bad idea. Too many 18 wheelers use this road. Not safe for pedestrians!  
• Traffic slows down in skinner lanes, which is a good thing  
• Please make it safer for cyclists and pedestrians in this city                                                                              |
| Theme C: Road is for cars and drivers                               | • Bikes shouldn’t be on main-multilane roads.  
• Adding bike lanes at the expense of drivers is absurd in this area  
• The traffic is already too bad, and it is dangerous for pedestrians. This is a bad idea.  
• Proposed lane widths are concerning                                                                                                          |
| Theme D: No real need for bike lanes                               | • I prefer shared lanes. Anything that removes cyclists form the rest of traffic gives credence to the idea that cyclists shouldn’t be in the road.  
• People don’t use bikes for transportation. They can find more enjoyable places to ride for recreation.  
• I have not seen enough cyclists anywhere to justify creating bike lanes in this city  
• There are other transportation needs, like pedestrian safety that should be focused on instead.                                                                                        |
| Theme E: Money & funding                                           | • Bikes need to pay a wheel tax  
• Money should go to MPD  
• A lot of cyclists and pedestrians come to this area for the shops and restaurants. This proposal will improve access and safety.  
• This is a waste of resources. How many people bike here?                                                                                       |
| Theme F: City & area benefit from bike lanes                       | • I live on a street where this was done. It feels safer for everyone, and it looks nicer.  
• Please add more bike lanes  
• Bike lanes are good. More people with the option to be out of their cars could lead to less traffic  
• This proposal would definitely help that area                                                                                                    |
The number of comments that were placed in each theme are as shown below in Table 4. The number of comments in the table totals to 1274, which is more than the 852 comments coded. This is because some of the comments are coded to two or more themes.

Table 4: Number of comments in six themes

<table>
<thead>
<tr>
<th>Theme</th>
<th>Number of Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>A. People on bikes deserve a space on the road</td>
<td>290</td>
</tr>
<tr>
<td>B. Danger &amp; safety</td>
<td>299</td>
</tr>
<tr>
<td>C. Road is for cars &amp; drivers</td>
<td>220</td>
</tr>
<tr>
<td>D. No real need for bike lanes</td>
<td>183</td>
</tr>
<tr>
<td>E. Money &amp; funding</td>
<td>152</td>
</tr>
<tr>
<td>F. City &amp; area benefit from Bike lanes</td>
<td>130</td>
</tr>
</tbody>
</table>

Figure 4 shows the percentage of comments coded as each theme per street.

Figure 4: Themes per Street

The six themes were then placed into a matrix to determine the major intersections of themes, which is shown below in Table 5.
Table 5: Intersections of Themes

<table>
<thead>
<tr>
<th>Theme</th>
<th>A. People on Bikes and Pedestrians deserve a space on the roadway</th>
<th>B. Danger &amp; Safety</th>
<th>C. Roadway is for cars &amp; drivers</th>
<th>D. Not a real or justifiable need for bike lanes</th>
<th>E. Money &amp; Funding</th>
<th>F. City and Area benefit from Bike lanes</th>
</tr>
</thead>
<tbody>
<tr>
<td>A. People on Bikes and Pedestrians deserve a space on the roadway</td>
<td>290</td>
<td>147</td>
<td>18</td>
<td>7</td>
<td>31</td>
<td>52</td>
</tr>
<tr>
<td>B. Danger &amp; Safety</td>
<td>-</td>
<td>299</td>
<td>61</td>
<td>30</td>
<td>20</td>
<td>13</td>
</tr>
<tr>
<td>C. Roadway is for cars &amp; drivers</td>
<td>-</td>
<td>-</td>
<td>220</td>
<td>52</td>
<td>20</td>
<td>3</td>
</tr>
<tr>
<td>D. Not a real or justifiable need for bike lanes</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>183</td>
<td>85</td>
<td>2</td>
</tr>
<tr>
<td>E. Money &amp; Funding</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>152</td>
<td>21</td>
</tr>
<tr>
<td>F. City and Area benefit from Bike lanes</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td></td>
<td>130</td>
</tr>
</tbody>
</table>

The major intersections of the initial six themes are named as the following themes:

AB. Bike lanes increase safety
BC. Busy & fast main roads
CD. Keep space for cars
DE. Waste of money
EF. Economic growth
AF. Transportation & recreation

The major intersections are highlighted in gray. The center diagonal is the intersection of a topic with itself, and therefore the total number of comments in that particular topic. Every cell below the center diagonal is left blank because it is a duplicate of another cell in the table, for example: AB = BA = 147. All the intersections that are highlighted as a theme are those with the highest percentage of comments based off the number of comments in source themes. They all
also have the greatest number of comments, except for EF. BD and AE both have more total comments than EF. However, EF is identified as a major intersection because it contains a larger percentage (15%) of comments from the two intersecting themes is larger than the percentage of comments from source themes in BD (12%) or AE (14%).

A diagram with the six themes, and the six major intersections of the themes is shown in Figure 5.

![Diagram showing six themes and intersections](image)

**Figure 5:** Six themes and six major intersection themes
Table 6 below shows the frequency analysis that describes the correlation between comments that fit into each theme and whether or not respondents support the proposed changes. For the 852 comments, 839 respondents also selected “Supportive” or “Not Supportive”.

Table 6: Supportive and Not Supportive percentages of all comments

<table>
<thead>
<tr>
<th></th>
<th>Supportive</th>
<th></th>
<th>Not Supportive</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Number of comments</td>
<td>Percent</td>
<td>Number of comments</td>
<td>Percent</td>
</tr>
<tr>
<td>All Comments</td>
<td>415</td>
<td>49%</td>
<td>424</td>
<td>51%</td>
</tr>
</tbody>
</table>

As was mentioned earlier, there are 1,274 themed comments, because a comment could be assigned to multiple themes. Of these, 1,266 themed comments are associated with a “Supportive” or “Not Supportive” response. The themed comments are sorted by theme and percentage in Table 7. The boxes highlight the clear majority for five of the six themes. The Danger & safety theme is the only theme that is evenly split between supportive and not supportive.

Table 7: Themed comments by Supportive or Not Supportive

<table>
<thead>
<tr>
<th></th>
<th>Supportive</th>
<th></th>
<th>Not Supportive</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Number of Comments</td>
<td>% of comments on that theme</td>
<td>Number of Comments</td>
<td>% of comments on that theme</td>
</tr>
<tr>
<td>A. People on Bikes and Pedestrians deserve a space on the roadway</td>
<td>262</td>
<td>90%</td>
<td>28</td>
<td>10%</td>
</tr>
<tr>
<td>B. Danger and Safety</td>
<td>157</td>
<td>53%</td>
<td>138</td>
<td>47%</td>
</tr>
<tr>
<td>C. Roadway is for cars</td>
<td>38</td>
<td>18%</td>
<td>179</td>
<td>82%</td>
</tr>
<tr>
<td>D. Not a real or justifiable need for bike lanes</td>
<td>10</td>
<td>5%</td>
<td>173</td>
<td>95%</td>
</tr>
<tr>
<td>E. Money and Funding</td>
<td>40</td>
<td>26%</td>
<td>112</td>
<td>74%</td>
</tr>
<tr>
<td>F. City and Area benefit from bike lanes</td>
<td>126</td>
<td>98%</td>
<td>3</td>
<td>2%</td>
</tr>
<tr>
<td>Total (% of all themed comments)</td>
<td>633</td>
<td>50%</td>
<td>633</td>
<td>50%</td>
</tr>
</tbody>
</table>
Table 8 shows the streets broken up by Supportive and Not Supportive. The total comments for each street are as follows: Airways Blvd. 333, Cooper St. 328, and Hickory Hill Rd. 191. The totals in the table are slightly less because, as was previously mentioned, not all comments had Supportive or Not Supportive selected as part of the response.

Table 8: Street by support and not support

<table>
<thead>
<tr>
<th></th>
<th>Airways Blvd.</th>
<th>Percentage</th>
<th>Cooper St.</th>
<th>Percentage</th>
<th>Hickory Hill Rd.</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Supportive</td>
<td>157</td>
<td>47%</td>
<td>179</td>
<td>56%</td>
<td>79</td>
<td>42%</td>
</tr>
<tr>
<td>Not Supportive</td>
<td>174</td>
<td>53%</td>
<td>142</td>
<td>44%</td>
<td>108</td>
<td>58%</td>
</tr>
<tr>
<td>Total</td>
<td>331</td>
<td>100%</td>
<td>321</td>
<td>100%</td>
<td>187</td>
<td>100%</td>
</tr>
</tbody>
</table>

Topic Modeling Results

In addition to the thematic analysis, a topic model was completed using all of the comments from all ten streets in the dataset. All ten streets were included for this analysis because the topic modeling tool requires large datasets. Getwell was included, even though it did not have bike lanes proposed, because many of the comments still related to bike lanes.

In the topic model, words are grouped based on the probability they show up together in a comment. The list of stop words, or words excluded from the analysis, are as follows: lanes, bikes, traffic, lane, city, need, area. After the initial model runs using 5, 10, 15, and 20 topics, none appeared to be a great fit to the data, but the five and 10 were the closest. Table 9 provides an example of the data that did not fit well with five topics. Some topics contain more than one main thought. However, even though this may not fit the data as well as a different number of topics, the same ideas of money, danger, safety, protected lanes, and police are still seen.
Table 9: Five Topics

<table>
<thead>
<tr>
<th>Topic ID</th>
<th>Top Words...</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>bike drivers busy bikers good encourage riders safety change side</td>
</tr>
<tr>
<td>2</td>
<td>bike make street support people cooper car ride great safer</td>
</tr>
<tr>
<td>3</td>
<td>money crime south police waste spend cordova services spending areas</td>
</tr>
<tr>
<td>4</td>
<td>cars streets don dangerous road cyclists roads bikers speed space</td>
</tr>
<tr>
<td>5</td>
<td>riverside drive park downtown protected bicycle memphis pedestrians proposal time</td>
</tr>
</tbody>
</table>

Because six themes were developed through the thematic analysis, and six additional themes were identified at the major intersections, models for six topics and 12 topics were also created to see if those topics fit the data better. From the resulting models, the one using 12 topics was selected as the final model because it had the clearest single idea behind the topic words for each category. The categories aligned fairly closely with the 12 themes identified through thematic analysis. The process of performing the thematic analysis using hand coding provided significant insight into the connections between the words in the topics found with the topic modeling.

Table 10 presents the model results for 12 topics with the top words generated by the topic modeling tool, and the theme that best describes the topic.
Table 10: Topic Model Results and Themes

<table>
<thead>
<tr>
<th>Topic ID</th>
<th>Top Words</th>
<th>Theme</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>speed high road support space foot travel bad 10 cars</td>
<td>Busy &amp; fast main roads</td>
</tr>
<tr>
<td>2</td>
<td>access greenline great river perkins highland love line big improvement</td>
<td>Transportation &amp; recreation</td>
</tr>
<tr>
<td>3</td>
<td>good stop increase encourage growth economic increased spent health attract</td>
<td>Economic growth</td>
</tr>
<tr>
<td>4</td>
<td>bike riders roads airways road place public north long south</td>
<td>Roadway for cars</td>
</tr>
<tr>
<td>5</td>
<td>cyclists crime put areas bicycles turning difference motorists funds make</td>
<td>No need for bike lanes</td>
</tr>
<tr>
<td>6</td>
<td>riverside downtown drive park cross lee tom dr pedestrians leave</td>
<td>Keep space for cars</td>
</tr>
<tr>
<td>7</td>
<td>bicycle cyclists barrier drivers 2 debris auto vehicles protect pedestrian</td>
<td>People on bikes deserve a space</td>
</tr>
<tr>
<td>8</td>
<td>street bike streets bikers dangerous busy needed cars drivers safe</td>
<td>Danger &amp; Safety</td>
</tr>
<tr>
<td>9</td>
<td>money police south spend cordova services spending crime entire level</td>
<td>Money &amp; funding</td>
</tr>
<tr>
<td>10</td>
<td>waste people money provide turn don time major cars making</td>
<td>Waste of money</td>
</tr>
<tr>
<td>11</td>
<td>bike protected make car road ride parking add proposal cars</td>
<td>Bike lanes increase safety</td>
</tr>
<tr>
<td>12</td>
<td>cooper memphis support number park overton bicycle extremely pedestrian accidents</td>
<td>City and area benefit</td>
</tr>
</tbody>
</table>

The topics and associated themes will be discussed in the discussion section.
Discussion

Analysis of all Responses Support or Not Support at High Level

Responses by Street

Overall, most of the survey respondents were supportive of the proposed lane configurations. There is not a significant difference between all responses and responses from people who provided a Memphis address for their residence. Some streets received stronger support, including N. Highland and N. Perkins, with around 80% supportive, while other streets, such as Riverside, received around 70% support. For every single street, the amount of support was greater from those who say they live in Memphis then all respondents, however this difference was not statistically significant. This is in the same range as a national survey that found 69% support for bike infrastructure, which increases to 80% when that infrastructure is paired with transportation improvements for other modes like driving (People for Bikes, 2018).

The number of comments range from 151 on Riverdale to 491 on Riverside, with the other streets having close to 200 or 300. There is no direct correlation between the number of comments and the level of support. The fact that Riverside received more than twice as many comments as most of the other streets demonstrates a high level of public interest. As was previously mentioned, this may be due to the combination of the trial period, accompanying media coverage, and the street’s prominent location connecting two interstate highways while passing between downtown Memphis and a large riverside park. This street, and its political context, is fundamentally different than the other streets considered in this project, so it will not be discussed further.
Responses by Individual

When considering Table 2: Supportive and not supportive and split votes for 9 streets with proposed bike lanes several details stand out. First, the number of individuals who voted for all nine of these streets (995) is slightly more than half of the total number of people who responded to at least one question and submitted the survey (1727). This means that nearly half of respondents chose not to select “Supportive” or “Not Supportive” for each question. Perhaps they were unfamiliar with some streets or had no preference on those configurations. With 61% of the 995 respondents always supportive, and 26% supportive on some streets, the total supportiveness could easily vary from 70% to 80% as shown in Table 1. So, this sample is generally representative of the dataset.

These nine streets have a wide range of contexts and proposed bicycle facilities. The land uses around the streets include commercial, low-density residential, higher-density residential, park land, industrial zones, and undeveloped or vacant land. The age of developments and annexation into Memphis range from the 1800’s street car suburbs, including Cooper, to 1950’s and 1960’s post-war suburbs, including Perkins and Airways, to 1990’s and 2000’s suburbs, including Hickory Hill and Riverdale (Mercuro, 2015). The number of existing vehicle travel lanes ranges from four to seven (two or three in each direction with a center turn lane in some locations). The proposed changes include narrowing lanes to create bike lanes, removing travel lanes to create space for a center turn lane and bike lanes adjacent to parallel parking, and removing travel lanes to create protected bike lanes.

The most noteworthy finding from Table 2 is the high percentage (26%) of people who voted “Split Ticket” (note that some of the respondents who completed only part of the survey may also have voted split ticket, but that data is not included). The high percentage (26%) of
those surveyed who varied their vote based on the street’s context contributes to the lower number of people who responded Straight Not Supportive (13%) given the total Not Supportive range (20%-30%). This shows that two thirds of the respondents who did not support bike lanes on one or more streets did support of bike lines in a different context. This finding demonstrates that for many people, support or opposition to bike lanes is conditional. Therefore, if discussion of why bike lanes are or are not appropriate on a particular street has the potential shift perspectives of a street, it could influence people’s support for bike lanes. This is especially true for those respondents whose support for bike lines is already context dependent. Furthermore, the conditionally supportive demographic could potentially be enlarged by the following discussion of themes.

The city and those who advocate for bike lanes recognize that not every street is the correct context for bike lanes, and some people who would not ride themselves support the addition of bike lanes on some streets. So, what makes the difference? To better understand this, comments on three streets with different contexts and different proposals were examined in detail, and themes drawn out from them.

Discussion of Thematic Analysis

The following points are discussed for each of the six themes established from the comments. First, a general description and some examples of codes and comments that fit the theme are provided. Next, any literature review that is related to it is discussed. Finally, reasons a theme is used to support or not support proposed bike lanes are described. Although comments for only three streets within the dataset were analyzed, they were selected such that the streets should be representative of the overall set. While some of the comments on the remaining streets in the dataset may have had a different specific “what” that was not part of the initial 100 codes,
the reasoning or “why” driving the comments are likely represented in the six primary themes and six major intersection themes.

Theme A – *People on bikes deserve a space on the road*

Theme A *People on bikes deserve a space on the road*, includes comments that express that the roadway is for biking and walking in addition to driving. Some of these comments, those that express that the respondent themselves or others, used bikes for transportation and recreation, are also a part of Theme AF – transportation and recreation. Lack of car ownership was listed as one reason travel by bicycle may be an important option. According to the ACS 5-year estimates, approximately 9% of households in Shelby County (where Memphis is located) do not have access to a working vehicle (U.S. Census Bureau, 2018).

Other comments expressed support for narrowing lanes and proposed road diets. Some comments even suggested road diets on streets where they were not proposed. Respondents expressed that the proposed designs would likely slow traffic, making walking and biking safer, or they expressed a preference for protected bike lanes. Both of these comments also fit into Theme AB – *Bike lanes increase safety*.

Using the types of bicyclists described by Roger Geller (2009), about 50% of the population interested and concerned (Dill & McNeil, 2016). The 147 comments in Theme AB demonstrate that people want safer conditions for riding bikes. People who commented with items included in Theme A likely either personally walk or bike along streets - or would like to - and would like to feel safer doing so, or see that other people use streets in ways beyond driving a car and want to improve the experience for people on the street outside of cars.
Theme B – *Danger and safety*

Theme B *Danger and safety*, includes comments that mention that the street is dangerous either in the existing conditions or proposed configuration, suggest safety improvements, or remark that the proposed conditions will be safer. The perceived high volume and high speed of cars are popular topics, which are included in Theme BC *Busy and fast main roads*. Essentially, comments in theme BC are saying that main roads should stay busy and fast and since that is dangerous to pedestrians and people on bikes they should stay away from those roads. There are some contexts, like interstates and freeways, that exclude pedestrians and people on bikes and have the capacity to allow large quantities of cars and trucks to pass through quickly. However, that is a different context that is not conducive to livable communities. Some people noted that the bike lanes on Cooper St. are adjacent to parked cars in the area where doors open, commonly referred to as the door zone. Some of the comments said that it would be dangerous to ride a bike there because of drivers, while others said it would be dangerous to bike on some streets because of crime.

Theme B *Danger and safety* is mentioned about as often by people who support the proposals as by those who do not support the proposals. Some people recognize the potential for speed reduction and associated safety improvement, and the benefit of dedicated space for people on bikes. Other people see that there are still significant safety concerns with unprotected bike lanes, especially on streets with multiple lanes in each direction and dangerously high speeds.

Theme C – *Roadway is for drivers and cars*

Theme C *Roadway is for drivers and cars*, consists of comments that cars use the space on the road, and they need the space on the road. These comments express opposition to narrowing lanes or taking away lanes from motor vehicles because this could lead to more
congestion and unwanted delays for drivers. People also express that more narrow lanes can create increased stress for drivers, and reference other streets that have narrow lanes like Poplar Avenue. The lanes on Poplar Avenue in East Memphis are 9 feet or 9.5 feet wide. The lanes on these proposals are 10 or 11 feet wide down from 12 feet or larger. Lanes on freeways are designed at 12 feet, so it is not surprising that people feel comfortable driving fast in lanes of this width (FHWA, 2020).

Comments which indicate that there are not very many people who bike on the street or not many people who need to bike on the street (and therefore space should not be taken away from the many drivers who do use the road) fit into Theme CD – *Keep space for cars*.

Not surprisingly, as shown in Table 7, most (82%) of the comments that are included in Theme C *Roadway is for cars & drivers* oppose the proposals that reduce motor vehicle roadway space to provide dedicated space for people on bikes. However, a significant amount (18%) of comments that fit in Theme C are supportive of the proposals. These comments may mention that a road has a high volume of vehicle traffic, but still support giving space to people on bikes, or explicitly say that there is sufficient space on the road for bike lanes and vehicle lanes.

**Theme D – No real need for bike lanes**

Comments in Theme D *No real need for bike lanes* focus around the idea that there are not people who will ride in the bike lanes, or that people have other options and do not need bike lanes. People reference existing bike lanes that they pass where they do not see people on bikes, or mention that they travel on the street in question often and do not see people riding bikes there. Table 5: Intersections of Themes, shows that there are 85 comments that say the bike lanes will not be used and therefore installing them is a waste of money, which is Theme DE.
respondents recognize that people bike but say that they can bike in a park or on the bike paths for recreation.

When respondents express that not enough people will use the bike lanes to justify giving money or space to bike lanes, it raises the question: “How many is enough?” While no comments expressed a target usage for justifying bike lanes, some respondents did say that single digit riders would not be justifiable. On most streets, no data is collected on how many people ride along the street. However, even if those data were available, people might still conclude that the lanes are not used if they do not personally see people riding bikes in them. The author has heard this argument multiple times while attending public meetings while working for the City of Memphis Bikeway and Pedestrian Program (January 2019-December 2019) and since as a member of the public.

There are several reasons why the number of people using bike lanes may actually be larger than perceived. First, when driving, one’s attention is generally on the road in front of them and other vehicles around them. Drivers may also be thinking about where they are going or be interacting with distractions in the vehicle with them, and not primarily watching for people on bikes. Failing to notice bike ridership is particularly likely if a driver is in an inside lane on a multilane road. Additionally, people often travel shorter distances on bikes than in cars, so when counts are conducted, the number of people passing points with counters on a corridor may be smaller than the number of people who bike somewhere along that corridor.

Nevertheless, the number of people who bike is small compared to the number of people who drive cars on these streets. Even in the cities that have the largest bike ridership in the United States, like Portland, OR, Davis, CA, and Boulder CO, a minority of trips and commutes are taken by bicycle (Henao et al., 2015). There are a few places outside of the United States that
have much higher ridership, like Amsterdam in the Netherlands and Copenhagen, Denmark, but it is unlikely that Memphis will reach such widespread use. However, this does not mean that bike lanes should not be built. The number of people who walk on sidewalks is very small on these streets compared to the number of people who drive, but the streets still have sidewalks, and rarely in an urban setting do people object to putting in sidewalks because not enough people will walk on them. Sidewalks are often installed to provide access for pedestrians, not to meet the high volume of pedestrians.

“How many people currently ride on a particular street without bike lanes?”, or even “How many people will ride here when there are bike lanes?” may be the wrong question, however. A better question might be, “How will bike lanes on this street allow more people to access more places?” Bike lines can be compared to the widely accepted transportation network of sidewalks, in that access—not volume—is the main consideration.

Another trend in the comments references existing bike lanes that are seen as not being used as evidence that the proposed bike lanes will not be used. However, this point of view fails to recognize the significance of complete routes. When there is a complete route connecting the start and end points of a trip, and a person feels safe biking along that entire route, then ridership will likely increase (Birk & Geller, 2006). In Memphis, bike lanes are generally installed one street at a time either when the street is repaved or through a project with grant money. As more streets get bike lanes added, a connected network is being formed which provides the ability to make more full trips by bicycle. Some bike lines that currently have low ridership may see increased ridership as this network expands (Birk & Geller, 2006).

Finally, some comments expressed that people already have options for where they can ride, including in the street and on the sidewalk. It is legal to ride on the sidewalk in Tennessee,
and—unless it is a limited access road like a freeway—it is also legal to ride in the road. However, only a small percentage of riders are willing to bike in the same lane as motor vehicles, and dedicated bike lanes enables people to travel by bike without inconveniencing drivers or pedestrians. As People for Bikes (2018) says “Everyone has peace on the road when everyone has a piece of the road.”

Theme E – Money and funding

Theme E, Money and funding, includes two contrasting subcategories: the financial cost of installing the bike lanes, and the financial benefit of doing so. Concerning cost, many comments emphasized that public funding for bike lanes could be reallocated to other municipal services. When paired with the perception that the bike lanes will not be used frequently, the natural conclusion is that funding bike lanes is a waste of money, which is Theme DE.

The funding sources that are used for these projects, as explained at the beginning of the survey, is 80% federal money with a 20% local match. This money is dedicated to transportation projects, and therefore could not be used for schools, the Memphis police department (MPD), or paying firefighter’s pensions, as some respondents recommended. A smaller number of other respondents recognized that the money must be used on transportation projects, and suggested that the money that is proposed to be spent signing and stripping the bike lanes be used to repave more streets.

The other side of Theme E focuses on the economic benefits of installing bike lanes. In particular, the economic growth of adjacent businesses and the potential for increased individual access to employment opportunities were key trends. Together, these sentiments compose theme EF Economic growth, and the intersection of Theme E and Theme A, which is not identified as a unique theme, but is very similar to Theme EF.
The benefits of economic growth may be further expanded by combining modes. Biking can be paired with transit, allowing people to travel farther with less effort. In Memphis, all busses that travel fixed route bus routes have racks for two or three bikes on the front of them (MATA, n.d.). Additionally, through the bikeway and pedestrian program, the city is installing hundreds of bike racks near bus stops across the city, which will further integrate biking and transit (Bike Ped Memphis, 2020). With this integration, commuting by bicycle is potentially a more realistic option for the 9% of Shelby Co. households that do not have access to a personal vehicle (U.S. Census Bureau, 2018). In addition to getting to and from work, other trips such as the grocery store, restaurants, or personal business such as a dentist appointment could be made on bicycle.

In addition to benefiting individuals, bike paths may also encourage investment in businesses along the route, as discussed in the literature review section. In Memphis, streets such as Madison Avenue and Broad Avenue have seen significant business investment along the stretches where bike lines were installed. To the research team’s knowledge, business investment and growth in these areas have not been directly studied at the time of writing, but that could be an area for future research.

The Memphis chamber of commerce recognizes that investing in parks and bike trails can help attract businesses that are looking for cities with a high quality of life (Sells, 2016). The chamber of commerce references bike facilities that target all ages and abilities of bike riders, not bike lanes that are marked by a white line. However, on street unprotected bike lanes, such as those proposed in the survey, broaden the bike network and increase access for riders. People seeking to access protected bike lanes or off-street trails may be willing to ride a short distance on the street in unprotected bike lanes. Some comments describe this exact scenario for Cooper
street—which connects to Overton Park—and Highland and Perkins—which both intersect with the Shelby Farms Greenline. These comments show that even if streets are not on the Mid-south Regional Greenprint, they may extend its reach and benefits.

Theme F – *City and area benefit from bike lanes*

Theme F, *City and area benefit from bike lanes*, comprises a wide range of comments from public health to transportation to environmental impacts, and from economic mobility or growth to simply saying that bike lanes are needed. It was unexpected that this broad topic of general benefits has the fewest number of comments of any topics. These streets had bike lanes proposed, so perhaps some people did not feel they needed to make a case for them, or maybe these reasons are not as important to people as Theme A. There is a substantial amount of literature on the community and city benefits of having bike lanes, as was shown in the research.

There were comments about environmental impacts in regard to local air quality, and global fossil fuel consumption and emissions. On the topic of environment, it appears one respondent had heard arguments that bike lanes would help the environment and offered a counter argument where bike lanes would increase emissions and air pollution. The respondent explained that removing vehicle lanes to add bike lanes would increase congestion and cause cars to idle longer and therefore increase emissions. While this may be possible, it does not account for the human behavior aspect that people will drive further and more often when it does not take them as long to travel, and ignores the possibility of trips in a car being replaced by trips on a bike.

In addition to the economic items discussed above for Theme EF, the public health portion has indirect economic implications. Comments about health were not coded in Theme E, because it is no apparent that economics was a motivation for the respondent, but there is a
connection. If people have access to active transportation and recreation on bikes, not everyone will use it, but some will. Cities that have higher levels of people traveling by bicycle have lower levels of conditions that increase health risks including obesity, high blood pressure and diabetes (League of American Bicyclists, 2018). The goal is not to push behavior change or tell people that they are unhealthy individually, rather the goal is to provide a spaces and access to spaces where people can participate in activities that promote health and wellbeing. Making a quantifiable link between dollars spent on spaces for active transportation and dollars saved on health care is beyond the scope of this project, and may be challenging to do. There could be other covariant factors such socioeconomic differences between these cities that influence obesity and by extension the other health conditions (CDC, 2020). These communities of course also have other differences. Nationally annual health costs related to obesity are well over $100 billion, and medical spending is about $1,400 higher for people with obesity compared to people of normal weight (Finkelstein et al., 2009). However, it is possible that since there is a significant difference between levels of these health differences, and since these health conditions are correlated to health care costs, then there may be a connection between access to outside recreation or active transportation and healthcare costs. If expanding access to active transportation and recreation helped reduced the levels of obesity by a few percentage points, the monetary savings for residents and federal budgets could be substantial.

The potential impacts on healthcare is an area where there could be researched further, and could may helpful for local, state, and federal government officials to consider when making budget decisions for how much money to put towards bike lanes, but it may not be helpful to discuss at brief public meeting. People for Bikes discourages emphasizing vague general things like environmental impact or trying to convince individuals that they should bike for their health.
Rather they encourage focusing on the topics that received the largest number of comments in this study, Theme A and Theme B, that bike lanes, particularly protected bike lanes provide a save dedicated space for people on bikes which allows people the option of taking trips on a bike and increases safety and comfort for all road users.

Frequency Analysis

There are about the same number of supportive comments as not supportive comments as seen in Table 6 (49%-51%) and Table 7 (50%-50%). Below, Figure 6 shows the themes that correlate to supportive comments in blue, and themes that correlate to not supportive comments in yellow, with the themes that go both ways in green.
When respondents’ comments fit into Theme A and Theme F they almost always select that they are supportive of the proposal with bike lanes. If people are supportive and comment on proposed bike lanes, there is a high likelihood that they mention the increased access, or comfort and safety benefits they see to people biking or walking along that street. If someone does not see the value or benefits of adding bike lanes, they may not understand or agree with the topics laid out in Themes A and F, including Themes AB, AF and EF.
When comments fit into Theme C and Theme D, the vast majority of respondents select that they are not supportive of the proposal. Theme D contains comments and topics that are essentially counter arguments to Theme A. Table 5 shows that there is some overlap between Theme A and Theme D (seven comments). These comments recognize that people do ride bikes on streets, but argue that they do not need to, or do not need bike lanes to do so. Some respondents said that people can ride bikes in the park or on the Shelby Farms Greenline, so those who do ride on the road should stay off it. This argument assumes that people ride bikes purely for recreation and do not or should not use bikes for transportation on streets.

Other respondents comment that they ride bikes in the lane with cars, and that adding bike lanes delegitimizes their right to “take the lane” and ride in the same lane as motor vehicles. These people would be considered to be in the strong and fearless category, which is a small percentage of the population. They can still ride to the same places, even if there are bike lanes, and providing the bike lanes creates opportunities for more people. Theme C included comments that the roadway is for cars, with some suggesting it is exclusively for cars. These respondents argued that because there are a lot of people in cars traveling on the road, they should have as much space as is possible. Some respondents also expressed that cars do and should be able to travel fast down the roads, and rightly note that this is dangerous, especially to people who do not have thousands of pounds of steel around them protecting them. If people do not support the proposed bike lanes they likely are considering the topics in Themes C and D, including Themes BC, CD, and DE. They assess that a particular street needs all the space currently provided for cars to stay available for people in cars, or that it is not worth taking money or space from people in cars and using it for people on bikes or people walking on that street.
If people support proposals with bike lanes, they likely judge that there is enough space for people in cars, people on bikes, and people walking. Most people who walk and bike along roads also drive or ride in cars at some point, and none of the comments argued that cars do not belong on the roads, or should be prohibited from these streets.

Most of the comments in Theme E are from respondents that select not supportive, but about one in four respondents with these comments select that they do support. Logically, most comments in Theme E that intersect with Theme F and Theme A would be supportive, and most of those in Theme D and Theme C would be not supportive. Inspecting Table 5 and Table 7 supports this grouping. This shows that if people are considering how much money is being spent on a project, they are probably not supportive. However, if they are talking about money that may be spent in capital investment or at businesses after the bike lanes are installed, they are likely supportive.

Comments in Theme B are evenly split between supportive and not supportive. Because many respondents suggested that streets are currently dangerous, the mention that a street is dangerous is typically does not indicate supportiveness. If people express that bike lanes will make the road safer, or if they acknowledge the danger, but argue that people on bikes still deserve a space on the road they are likely supportive. If they suggest that it is not safer, or that the proposal makes the road less safe, then they are likely not supportive. Many respondents expressed that they prefer protected bike lanes, demonstrating that they think people on bikes should have a space on the road, but that a white line does not do enough to protect them. Some said that they would be in favor of removing vehicle lanes to get them, but others requested protected bike lanes if possible, or only if space is available.
Protected bike lanes are recommended because they are safer, they invite people of all ages and abilities to ride in them, and importantly, they are what people want (Monsere et al., 2014). If protected bike lanes are proposed, then danger and safety is only a reason to support. With protected bike lanes, all other themes become amplified. The safety significantly increase, as does the benefit to the area including potential for economic benefits. Protected bike lanes also cost more financially and in terms of space required. If people perceived that the bike lanes will not be used, investing in protected bike lanes would seem like a larger waste.

It is also possible that someone sees the merit of all the themes and decides themes C and D outweigh themes A and E, and therefore are not supportive of proposed bike lanes on a given street. In the case of Getwell Rd., and many other streets around the city, the City Engineering department agrees with that assessment. If bike lanes do not fit in the context of one street, then there should be a facility on street nearby that bikes can use, so people are not required to go exceedingly far out of their way. The regional master plan lays out the streets designated for bike lanes to provide a connected network.

Case Study of Three Streets

The three streets that were coded for the thematic analysis: Airways Blvd., Cooper St., and Hickory Hill Rd. are each explored and compared.

The section of Airways Blvd. for this proposal extends south from the Shelby Drive to the Tennessee Mississippi State. As shown on the map at the beginning of the survey, there are existing bike lanes on Airways Blvd. extending down to Shelby Drive which is the southern boundary of the Memphis International Airport. The existing conditions of the street includes three vehicle lanes in each direction and a center turn lane for a total of seven lanes, each 12 feet wide. This section of road is approximately 1.8 miles long, and the adjacent properties include
apartment complexes, warehouses, a couple gas stations with convince stores, and vacant land. There is sidewalk for a portion of the apartment complexes, but much of the road has no sidewalks. The proposal showed narrowing the lanes by one or two feet and adding bike lanes.

Cooper Street is in an area that is commercial adjacent to residential neighborhoods with both single family homes and apartments. The section included in this proposal extends from Washington Ave (just south of Overton Park) one mile to Central Avenue. This stretch of road includes two typical sections. One is for the quarter mile section north of Lasalle Pl, which is a small street near Madison Ave, and the other extends three quarters of a mile south. The current section is one 16-foot lane in each direction with on street parking on the sides north of Lasalle Pl and two 10- or 11-foot lanes in each direction with parking on the sides south of Lasalle Pl. The city map presented with the survey shows several bike lanes on streets that intersect this section of Cooper Street. There are also existing bike lanes on Cooper Street that extend south form Central Avenue.

The area once was a street car suburb. Cooper St. connects two commercial districts that have many shops and restaurants, Cooper Young and Overton Square, and provides access to Overton Park, a 342 acre park in the city with the city zoo, outdoor music venue, playgrounds, and an old growth forest with trails for people on bikes and people walking. And is an access point to other neighborhoods and other bike trails including the Hampline which connects to the Greenline, a well-used shared use path that cuts across the city to Shelby Farms Park.

Hickory Hill Road from Mt. Moriah to Winchester Rd. cuts between residential neighborhoods with a both of single-family residences and apartment complexes. The land to the west of Hickory Hill was annexed into the City of Memphis in the 1960’s, and the area to the east was annexed in the 1990’s (Mercuro, 2015). At the intersection of Hickory Hill and
Winchester is Hickory Ridge Mall. The mall was popular in the 1990’s but is now vacant. There are several out parcels that have shops including auto parts stores, and multiple fast-food restaurants in the area. Hickory Hill Rd. connects to existing bike lanes at Winchester Rd. and both existing and proposed bike lanes at Knight Arnold.

It is remarkable how similar the distribution of themes is across the streets, though there are a couple of noteworthy differences between Cooper St. and the others, as is shown in Figure 4. This again demonstrates that some people consider the context of the street and respond differently to proposed bike lanes given the street. Table 7 shows this for the six major themes. Even though Airways Blvd. has nearly twice as many total comments as Hickory Hill, they have nearly identical percentages for each theme. All participants were given the opportunity to respond to each question, so this could reflect the fact that some people responded with identical comments for multiple streets, and some people commented on some streets, but not others. Hickory Hill and Airways likely are perceived as being in similar contexts and have similar existing and proposed configurations. Compared to these two streets, Cooper Street has very similar percentages for Theme B, Theme C, Theme E, and Theme F. Theme A, People on Bikes and pedestrians deserve space on the roadway is 10-15% higher for Cooper, and Theme D, No real need for bike lanes, is 12% lower. While people may have viewed the streets as having different levels of safety, approximately the same number of people per street commented on the level of safety, as recorded in Theme B Danger and Safety.

Clearly people see Cooper Street as being in a different context, one where more people see that people on bikes should have a space on the road, and fewer people say that space should not be taken from cars. Remarkably the total levels of supportiveness, as shown in Table 1, are 75%, plus or minus 1%, for each of these three streets. Table 7 shows that the comments on
Cooper street had about 10% more support than the other streets. With these two tables taken together, it appears that the same percentage of people selected supportive, or not supportive. However, on Cooper Street more people saw a reason to comment about the usefulness of bike lanes and fewer people said they would not be used or would be a waste of space.

This is likely because, as some people noted in their comments, people already ride bikes along that section of roadway and there are clear destinations for trips on a bike in Overton Park’s trails and Overton Square’s and Cooper Young’s shops, restaurants and bars. More people said they would ride there, or had seen other people riding there. Because of the context of Cooper Street, there were twice the rate of comments (30% compared to 16%) in theme A *People on bikes deserve a space on the road*, and half the rate of comments (7% compared to 19%) in theme D *No real need for bike lanes*. Figure 4 presented these rates of themed comments per street. If the public was familiar with the value of a connected bike network and could see how proposed bike lanes on a street fit into that context, the conversation may shift away from Theme D *No real need for bike lanes*.

**Topic Modeling**

The topic models, while not a perfect fit, demonstrate that the 12 themes developed through thematic analysis are well represented in the data for all 10 streets. The process of doing the thematic analysis lends guidance for understanding the words in the topic models in the context of the comments. Likewise, the results of the topic models lend credence to the results of the thematic analysis. There are, however, some words that do not fit well with the name given to a topic. If the topic analysis was done independently of the thematic analysis, it is possible that a different number of topics would have been chosen or different names given to them.
Getwell Road was included in the topic model because, even though bike lanes were not proposed, many of the comments mentioned bike lanes. The page for responses on Getwell did not explicitly say no bike lanes would be added. Some people commented that they did not see the difference between the existing and proposed and asked if they were missing something. Others commented in favor of adding bike lanes for example: “Would it be possible to fit a bike lane?” and “I bike on Getwell weekly.” Other respondents seemed to assume bike lanes were being added, commented as if they were.

The topic model is done at the semantic level, because it works with the words that were explicitly said. The comments were initially coded, with the many different codes on the semantic level. But this level of meaning is different than the themes which were developed on a latent level. Therefore, interpretation is required to go from the surface group of words to any underlying idea that may be connecting them. The author read all of the comments and performed the thematic analysis, thereby gaining insight as to the contexts in which words were used, helping with the interpretations.

The order of the words in the model’s topics are not reflective of the order they are used in the comments, so each word should be considered individually, or possibly paired with another word in that topic, though not necessarily with the following word. For example, in Topic 2: Transportation and Recreation, the final two words are “big” and “improvement”. From reading the comments, it is likely that “big” is associated with “river”, as in the “Big River Crossing”, a bridge for pedestrians and people on bikes to cross over the Mississippi River, and not simply “big improvement”, though this sentiment may be in some comments as well. One additional note, the word “don” refers to “don’t” however the topic modeling program does not include apostrophes as part of words.
Without having read all of the comments, it may not be clear what some of the words in the topics, shown in Table 10, are referring to, or why they are on the comments about bike lanes. For example, Topic 8: Money and Funding, includes “police”, “south”, “Cordova”, “services”, “crime”, “entire”, and “level” in addition to “money”, “spend”, and “spending”. There were many comments saying that money should be spent on police to fight crime instead of signing and striping the proposed bike lanes. There were other comments stating that the proposals did not benefit South Cordova. Others said they wanted more police and have services brought up to a better level for the entire city before money was spent on bike lanes. So, all of these words frequently occurred together in comments, which is why they were grouped into a topic, and they all relate to money and funding. Thus, a deep understanding of and familiarity with the comments is essential for understanding the topic model results.

There are some words that genuinely do not seem to fit the topics, but there are surprisingly few of these, given that the topic names were developed without the words in the model. Topic 3: Economic growth, includes the word “stop”. There may be a way that this fits in, given particular comments and contexts, but it likely is an example of how the topic modeling and thematic analysis themes are not a perfect match, which is to be expected.

Topic 4, may be another example of how the topic model does not perfectly align with the themes developed in the thematic analysis. However, Roadway is for cars was chosen because best aligns with the words in the topic. There were multiple comments that north south routes we needed for cars, and there are not enough bike riders on similar streets, like Cleveland, to justify taking space from cars and drivers.

Having an unbiased method like topic modeling so closely align with the themes developed in the thematic analysis reinforces the results. The topic model is unbiased in that,
provided the same stop words were used, the same number of topics are generated, and the number of words per topic remain consistent, the results will be the same regardless of when it was run, or who ran it. Conversely, the thematic analysis is heavily dependent on the author’s understanding of respondents comments, and if a different person did the analysis, it could look quite different. The topic models are particularly similar to the initial codes that were generated, which demonstrates that those initial codes are indeed grounded in the data. Even the five themes, which did not fit the data as well, still included the themes developed here. The topic models were run on all 2,473 comments from all 10 streets, and the main ideas that came from them are similar to the themes developed in the thematic analysis based on the 852 comments from three streets. This demonstrates that the themes are not limited to these three streets but are applicable to the whole dataset. Therefore, the themes are likely relevant to future proposals on other streets in Memphis and beyond.
Conclusion

“Everyone has peace on the road when everyone has a piece of the road.” succinctly addresses many of the themes identified in this research (People for Bikes, 2018). In a roadway context, there is space for people in cars and space for people on bikes and space for people walking. Connected networks of bike lanes create opportunities for health and economic benefits to cities and communities. Protected bike lanes provide a safe space where people of all ages and abilities feel comfortable riding and everyone including drivers have decreased stress on the road. Adding bike lanes is an investment and does have a cost, both monetarily as well as in terms of decreased space for cars. Many roads have sufficient space to accommodate car traffic and provide space for bikes, but some roads do not, and may be better left without bike lanes. A city does not need bike lanes on every street to have a connected network that allows multiple options of routes for people to get from one point to another safely and comfortably on a bike, or walking, or in a car, or using transit. There are safety benefits for everyone, whether they regularly travel by bike or would never get on a bike. A city and community is more livable when it has a transportation system that works for everyone regardless of how they choose to travel. People should not expect to see as many bikes on a road as cars on a road. However, they can expect to see the number of people biking grow as the network of bike lanes and protected bike lanes and bike paths grows.

Often in conversations about bike lanes, people consider different pieces of information which lead them to different conclusions. If city staff and all members of the public had a shared understanding of facts along with a shared knowledge of different perspectives, then conversations could be more productive and both sides can feel heard and better understand the reasons others come to different conclusions. Many people recognize that a street’s context
influences whether bike lanes would be beneficial and appropriate on a particular street. So, people presenting or advocating for a proposal with bike lanes should focus on describing how the street fits into the bike network and provides opportunity for transportation or recreation, improves safety, and can benefit the community. Local agencies should be clear on the funding source designated for a project and the limitations in alternative uses of the money. This can avoid unproductive discussions about using the money for unrelated issues such as education or fighting crime, or allow discussions to ensue about how investing in bike lanes may address other externalities. Agencies will likely benefit from emphasizing that cars will still have space to travel the road and will not need to find alternate routes. If concerns are raised that no one will use the bike lanes since no one rides on the street currently (or that no one rides on another street with bike lanes), local agencies can explain that the goal is to provide access so more people feel safe traveling by bicycle, similar to providing sidewalks rather than providing an additional lane for vehicles to meet a high demand.

If people oppose the addition of a bike lane on a particular street, they too should focus on the context of the street and explain to those proposing it why that street is not an appropriate place for bike lanes. It would be beneficial for stakeholders to look at maps and the proposed bike network and suggest alternatives. This approach would allow stakeholders to consider if a person on a bike would be required to cross a major road at a non-signalized intersection, or return to a major road to cross a river or freeway with the alternate suggestion. If citizens are concerned about safety and think that the proposed bike lanes would decrease safety, they should voice this. Agencies can engage with them and explain how decreasing motor vehicle speeds increases safety for all road users. To have productive conversations with people opposing
government spending on bike lanes, agencies need to acknowledge that bike lanes’ benefits extend beyond people who bike.

There are many people in Memphis, and every city, that care passionately about how their roads are used. When people express what is important to them and listen to one another to understand factors that are important to their neighbors a city can move forward and improve experiences for all its residents and visitors. People may still differ on conclusions for the layout of a particular street. However, once there is a shared understanding of important factors to consider for proposed bike lanes, there will be less frustration, because there is respect for people and recognition of each other’s goals. This research provides insight that can be used to better shape productive conversations between local governments and their citizens so that more effective progress toward community livability goals can be achieved.
Recommendations for Future Research

There are several opportunities for future research into the economic impact of bike lanes and bike paths, specifically in Memphis since this has not been established locally. These include:

- Examining the Shelby Farms Greenline’s impact on property values for homes and apartments adjacent to it or with access to it.
- Compare the return on investment (ROI) for projects including bike lanes relative to ROI of infrastructure projects that focus primarily on improving conditions for drivers.
- Studying the impact of bike lanes on commercial districts for existing or planned bike lanes. Businesses and business investment on Madison Avenue and Broad Avenue could be considered for existing bike lanes. Or as Arancibia et al. (2019) suggested, pre and post surveys could be conducted for a street that does not currently have bike lanes but will have them added.

At a local and national level, additional research into changes in safety along corridors that had bike lanes added is important to discern. If this only looked at safety for people on bikes, his may be difficult to control for potential changes in volume of bike traffic if there are no counts for before bike lanes were installed. However, safety could be examined for all road users, to see to further establish the extent that the frequency or severity of crashes decreases for roads with bike lanes. This could be compared to the same road before the bike lanes were installed, and use similar streets with no bike lanes installed as a control group.
Finally, case study research focused on how some cities have made the shift from having very limited bike lanes to having extensive bike networks and lessons learned to help others on that journey are important to aid communities across the country in addressing livability goals.
References


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From the information provided on your determination review request for “Reasons for bike lanes”, the IRB has determined that your activity does not meet the Office of Human Subjects Research Protections definition of human subjects research and 45 CFR part 46 does not apply.

This study does not require IRB approval nor review. Your determination will be administratively withdrawn from Cayuse IRB and you will receive an email similar to this correspondence from irb@memphis.edu. This submission will be archived in Cayuse IRB.