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13. Abstract

Access management is a form of traffic engineering utilized by transportation agencies to improve the safety and efficiency of traffic flow on, off, and between roadways. Access management applies a variety of construction interventions that manipulate how vehicles enter and exit roadways and access the driveways or parking lots of homes and businesses. These roadway interventions have been proven to reduce crashes involving vehicles, cyclists, and pedestrians. However, there is often concern about, or resistance to, these treatments from businesses located near the installation site. In most cases, these concerns are due to risk aversion. Businesses fear the roadway change will inconvenience their patrons, increasing travel distance and time to and from the business. This, in turn, may cause customers to opt for more accessible locations, negatively impacting the sales of businesses located closer to the access

management treatment sites. This report focuses primarily on investigating and analyzing whether these concerns over economic impact are legitimate. To do so, the sales data of 230 Louisiana businesses affected by access management treatments were collected from 8 different sites. The final analysis of the aggregated sales trends shows no significant change in sales before and after the installation of access management treatments. In addition, a linear regression model was used to compare sales differences between businesses directly impacted by access management treatments and those in the same approximate location that did not have their accessibility affected by the treatment. The model found no significant differences between the two groups when controlling for regional economic factors. To supplement these findings, 334 surveys of businesses and patrons were conducted across 9 sites. Results from these surveys provide insight into the perceptions of access management treatments along with other factors that influence attitudes toward roadways and access points. On average, the surveys reveal an increase in favorability toward access management treatments for both businesses and patrons. Findings from both the sales tax analysis and perception surveys provide evidence that the installation of access management treatments neither had a negative economic impact on businesses nor created a lasting negative attitude toward access management treatments from businesses and their patrons.

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Abstract

Access management is a form of traffic engineering utilized by transportation agencies to improve the safety and efficiency of traffic flow on, off, and between roadways. Access management applies a variety of construction interventions that manipulate how vehicles enter and exit roadways and access the driveways or parking lots of homes and businesses. These roadway interventions have been proven to reduce crashes involving vehicles, cyclists, and pedestrians. However, there is often concern about, or resistance to, these treatments from businesses located near the installation site. In most cases, these concerns are due to risk aversion. Businesses fear the roadway change will inconvenience their patrons, increasing travel distance and time to and from the business. This, in turn, may cause customers to opt for more accessible locations, negatively impacting the sales of businesses located closer to the access management treatment sites. This report focuses primarily on investigating and analyzing whether these concerns over economic impact are legitimate. To do so, the sales data of 230 Louisiana businesses affected by access management treatments were collected across 8 different sites. The final analysis of the aggregated sales trends shows no significant change in sales before and after the installation of access management treatments. In addition, a linear regression model was used to compare sales differences between businesses directly impacted by access management treatments and those in the same approximate location that did not have their accessibility affected by the treatment. The model found no significant differences between the two groups when controlling for regional economic factors. To supplement these findings, 334 surveys of businesses and patrons were conducted across 9 sites. Results from these surveys provide insight into the perceptions of access management treatments along with other factors that influence attitudes toward roadways and access points. On average, the surveys reveal an increase in favorability toward access management treatments for both businesses and patrons. Findings from both the sales tax analysis and perception surveys provide evidence that the installation of access management treatments neither had a negative economic impact on businesses nor created a lasting negative attitude toward access management treatments from businesses and their patrons.

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Implementation Statement

The study collected and analyzed several sources of data to assess the economic impact of access management treatments on nearby businesses. The first source of information was the sales tax data of 230 businesses from 8 different locations in Louisiana. The analysis determined the aggregated monthly trends in sales across all sites, identified if there were significant changes in both individual and aggregate sales before and after an access management treatment was installed, as well as determined if there was any significant difference between the sales trends of businesses directly affected by access management treatments and those that were not directly affected. In addition, perception surveys were administered to both businesses and patrons across 9 different access management sites in Louisiana, with a final analysis conducted on 334 perception surveys. The analysis assessed the retrospective attitudes businesses and patrons experienced toward access management treatments before, during, and after their installation on the roadway, as well as investigated if there were any underlying operational or market characteristics that influenced perception toward the installation of access management treatments at each site. The results of both sales tax and perception analysis were used as evidence for any determination of economic impact, either real or perceived. This determination can inform the public, as well as government and private organizations, about common concerns associated with these roadway changes and any potential economic risks (or lack thereof) a business near these access management treatments may experience.

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Introduction

State Departments of Transportation (DOT) are entrusted with ensuring the safe and efficient passage of its citizens through their states' transportation infrastructure. Within this immense and intricate infrastructure system, one key objective is to engineer the smooth flow of traffic while ensuring safe and convenient access on, off, and between roadways. This manipulation of roadway sections to facilitate the use of entrances, exits, and convergence points is termed access management. The Louisiana Department of Transportation and Development (DOTD) defines access management as a technique aimed at enhancing roadway efficiency and safety by strategically managing entrances, intersections, median openings, and traffic signals [1]. Access management treatments are acknowledged to stimulate economic development by fostering the efficient movement of goods and services while also improving safety.

A comprehensive 2010 study conducted by the National Cooperative Highway Research Program (NCHRP) revealed that nearly two-thirds of U.S. states have established standardized access management programs and policies, with the remainder incorporating access management informally into their routine operations [2]. Extensive research has consistently demonstrated a correlation between crash rates and the frequency, density, and spacing of access points and signals, with higher numbers of intersections and driveways generally corresponding to increased crash rates [3]. Louisiana DOTD has made strides in enhancing safety and increasing capacity along key highway corridors across the state by constructing a variety of access management treatments, including consolidated driveways, J-turns, roundabouts, traffic signal spacing, Raised Medians, Right-in-Right-out driveways, raised curb channelization, and the addition of roadway lanes. A key strategy for DOTD has been the implementation of access management in areas identified for significant potential reductions in overall crashes, as well as targeted decreases in fatal and serious injury crashes.

While existing academic research predominantly focuses on the safety and efficiency of access management treatments, there has been comparatively less exploration into their economic impacts on nearby businesses. Challenges in accounting for broader macroeconomic factors, as well as obtaining reliable data on business income, property values, and competitive dynamics, have hindered previous investigations [4]. Despite these challenges, studies have endeavored to leverage sales data, as well as business owner and customer perspectives, to demonstrate how access management treatments influence traffic patterns, accessibility, and sales.

This study aimed to further assess the economic ramifications of access management treatments in Louisiana, specifically focusing on J-Turns, Right-in-Right-out driveways, Raised Medians,

raised curb channelization, and center turn lanes, thus making significant contributions to existing knowledge in the field of transportation economics. Additionally, it filled a crucial research gap by specifically examining the economic impacts of access management treatments in the unique context of Louisiana. This localized approach provides valuable insights that can help policymakers, transportation planners, and researchers better understand attitudes toward access management strategies in Louisiana and their potential economic impacts, thus enabling more comprehensive planning and informed outreach regarding the implementation of roadway changes.

Literature Review

Overview

As mentioned in the Introduction, the research conducted across the United States on access management treatments primarily concentrates on their safety and efficiency, while there has been far less attention given to the potential economic impacts that these treatments may have on nearby businesses. This is partially due to the difficulty of accounting for wider macroeconomic conditions, unreliable business income and property value data, business conditions, traffic volume, population shifts, shifts in purchasing power, and developing sites of business competition [4]. For example, several studies conducted in the late 2000s coincided with the global economic recession, making it difficult to determine the precise impacts from access management on business sales [5]. Regardless, these studies have attempted to use both sales data and the perception of business owners on access management treatments to illuminate how businesses may be affected by changes in traffic flow, the types of access vehicles and pedestrians have to their premises, and the period of construction for the treatment of the adjacent roadway. Select statewide studies and their findings are highlighted in the following pages, along with the methodologies they utilize to investigate the economic impact of access management treatments on nearby businesses.

Historical Study Methodology

Based on the available literature, the primary forms of data collection for studying the economic impact of access management treatments are “empirical, survey-based before-after, and perception-based surveys” [6]. Both quantitative and qualitative methods of collection and analysis were used; however, quantitative data collection was often limited by the availability of accurate and reliable sources. Retroactive collection of sales data from taxable receipts is often unavailable to researchers and can also be unreliable, as information may be missing or contain reporting errors. To supplement this type of data, perception surveys have been conducted before, during, and after project construction. Researchers questioned both business owners and patrons about the effects of the treatment. These surveys can reveal trends in how people perceived the access management treatment’s impact on their businesses. Retroactive perception surveys have been common because they are the most feasible to conduct. Before and after surveys of owners and patrons are considered another valuable way to collect direct information

on economic impact. However, they are rarely conducted because most studies occur only after access management treatments have been completed.

Studies on Perception of Access Management Treatments

The literature on business owners' perception of access management treatments varies in terms of which perceptions are most prevalent and why. Overall, it seems that the perception a business owner has of an access management treatment depends on their specific business, as well as a variety of other factors ranging from location and type to property values and marketing strategy. For example, a 1998 report by Weisbrod and Neuwirth detailed the impact of access management treatments that restricted left-turn traffic. They found that business owners at locations in the middle of a block had a more negative perception of these projects compared to business owners at roadway intersections. However, the study found that customers surveyed at these sites did not indicate that the left-turn restrictions impacted the frequency of their patronage [7]. For each state in which a study on the perception of access management treatments was conducted, similar results were observed. While access management treatments are generally viewed as negative before project implementation, surveys conducted during and after implementation show that the perceptions become more positive over time. This movement of perception from negative to positive is likely due to the initial perceived risk that precedes a possible change to business operations; if, over time, it becomes apparent that the risk has not been realized, the view becomes more positive.

Texas

In Texas, Eisle and Frawley [8] conducted and summarized a four-year research study on raised medians. They used a perception survey to gather information on how business owners responded to raised medians before, during, and after project implementation. For this study, the researchers found that before the construction of raised medians, the perception of business owners on their installation was generally negative; however, during and after the projects were completed, they expressed more favorable views of the treatment. Another notable consideration is that business owners present before, during, and after construction perceived that property values would decrease because of the decreased access caused by raised medians. Contrary to that perception, property values increased by 6.7% in the measured years after construction was completed.

Washington

A 2002 study by Patrick Vu in Washington State included an in-depth analysis of the perception of business owners regarding access management treatments. Vu found that roadway treatments may elicit different reactions from business owners based on business type, whether it be a restaurant, retail store, convenience store, doctors' office, etc. Vu also finds that operational characteristics such as hours of operation, the amount of labor, and how the business advertises may influence an owner's reaction to the access management treatment. The study also considers the willingness-to-pay (WTP) theory. In the context of access management, the theory states that a business owner who can afford to move their business to a different location along the roadway will likely have a more negative attitude toward the access management treatment because they see relocation as an inevitability, and therefore a significant cost to them. Business owners who cannot afford the cost of relocation have no choice but to take on the potential negative impacts of the roadway change [9]. Overall, this study does not prove or disprove any real economic impact on businesses from access management treatments, but using more advanced statistical models, it does highlight various correlations between the attributes of businesses surveyed and their perceptions of access management.

Louisiana

A 2019 Louisiana Transportation Research Center study detailed the economic impact of access management treatments on businesses at different sites across the state, as well as the perception of business owners towards the respective construction projects. As with the previous studies, the reaction of business owners to access management projects varied depending on certain factors. A survey of businesses along US 90 in Broussard/Lafayette found that negative perceptions of the access management treatments in the area stemmed from the amount of time the roadway had been under construction. This caused consistent traffic congestion in the area during construction and was seen as negatively impacting business operations. This pattern of perception had little to do with access to the business itself and more to do with the congestion the construction was causing in the area, as well as the length of time the roadway had been under construction. The report concluded that "while the purpose of conducting the survey of businesses and their patrons was to gather insight into the perceived impact of access changes (i.e., J-turns) on business activity in areas where they have been previously installed, the access-related difficulties reported in the open-ended comments ultimately describe the impact of traffic, congestion, and/or traffic-impacting factors such as rush hour times, road work, driving behavior, etc." [10]. The findings of this study reveal that changes to the accessibility of the business through roadway treatments were not viewed particularly negatively, nor did access to the business rank

high in importance on both business owner and patron surveys. The travel inconveniences caused by the construction of access management treatments were qualitatively found to garner the most negative feedback, as opposed to the treatments themselves.

South Carolina

A 2018 study in South Carolina conducted economic impact and perception surveys similar to the previously mentioned statewide studies. The perception surveys included both business owners and patrons, with a focus on the impact of raised medians. Of those surveyed, 27% of patrons judged raised medians negatively, while 69% of business owners thought raised medians would lead to a negative impact on the customer experience. Additionally, 60% of business owners surveyed thought that raised medians would negatively impact sales, as well as the daily frequency of customers. Finally, the study found that the type of business surveyed had a significant effect on how the installation of raised medians was perceived. For example, destination businesses were less likely to believe that raised medians would negatively impact sales than businesses whose patrons stopped more impulsively [11]. These findings highlight the importance of collecting a broad range of descriptive data when surveying businesses, so statistical analysis can be used to uncover and predict patterns in how certain businesses may perceive the construction of access management techniques.

Studies on Economic Impact on Businesses

Access management techniques influence traffic flow through commercial areas, affecting how vehicles enter and exit roads as well as the driveways and parking lots of roadside businesses. Proposed treatments to the roadways are often met with concern from business owners who worry that the changes will alter the frequency and volume of customer visits, and potentially impact business sales. Studies conducted in several states seek to quantify and analyze the impact of access management treatments to address these concerns.

The primary way to assess economic impacts across all studies is through analyzing changes in taxable sales receipts before and after implementing access management treatments. Generally, businesses close to these treatments experience positive or negligible changes in sales, suggesting a positive correlation between access management and business sales, in addition to enhanced roadway safety. However, attributing direct economic benefits to access management is challenging. A primary confounding factor is the variety of the businesses sampled. Findings across all studies indicate that the effects of access management treatments can vary based on factors such as business type, size, location relative to the treatment, and advertising strategies.

Another major confounding factor is the broad economic character of the region in which the access management treatment is installed. Economic development, fluctuating business revenues, property values, unique business circumstances, traffic volumes, demographic shifts, evolving consumer preferences, and increased competition all interplay to influence business outcomes. These factors complicate the identification of specific correlations between access management treatments and economic impacts on businesses.

The following studies attempt to clarify these correlations by controlling for various business and economic factors. While there are documented exceptions, all studies found that the majority of businesses in proximity to access management treatments saw either positive or insignificant changes in sales when comparing aggregate sales before and after a treatment was installed. These findings suggest a positive correlation between time and sales, indicating that over time, sales increase in sampled businesses close to access management treatments. Coupled with the well-documented improvements in roadway safety that access management treatments provide, there is little evidence to suggest that the installation of these treatments has a net negative effect on an area's economic viability.

Louisiana

The 2019 LTRC project studying the economic impact of J-Turns (RCUT) collected sales data from 10 J-turn intersection locations in Louisiana and a limited survey of businesses and their patrons at these 10 locations. The study spanned two years before and two years after the completion of the access management treatments. Findings indicate that across sites, there was an aggregate increase in sales after the project was completed. All of the areas surveyed showed a general pattern of economic growth. The study did find a few exceptions where sales went down for specific businesses, but this decrease in sales was attributed to increased competition from similar businesses in the area and not clearly linked to the access management treatments themselves [10].

Texas

A Texas study conducted in the greater Houston area studied [12] the effects of access management projects on operations, safety, and the economic performance of businesses. The economic assessment was derived from an analysis of taxable sales data before, during, and after completion of access management treatments with a focus on trends for different types of business along three corridor study areas. All three corridors consisted of roads and streets that serve through traffic, and all contained retail and residential urban development. Businesses were

classified according to the North American Industry Classification System (NAICS) as “pass-by, destination, or combination (i.e., 50% pass-by/50% destination)” [5]. Aggregate data on tax collections were taken from each corridor and business category, then analyzed by zip code. The sales receipts were adjusted for inflation so they could be more directly compared across time.

The results of the analysis indicate mostly positive findings across the three corridors. Two corridors in particular saw taxable sales increase for all three business types after access management improvements were completed. The results for the third corridor were mixed, with some sections of the corridor showing significant decreases and others showing large increases. For this study, an increase in sales was seen in the control groups, but greater growth was observed in zones where access management treatments were implemented. The researchers note that two major hurricanes and the 2008 economic recession were likely to be confounding factors; however, it was difficult to ascertain their precise impacts with the limited data that the study used.

South Carolina

Researchers conducted a 2018 post-facto economic analysis in South Carolina which studied both the perceived and actual economic effects of installing raised medians near businesses. The study assessed economic impact with historical sales data to capture the post-facto trends in areas with and without access management projects. The study found a three-year decrease in sales across all sites, affecting both the businesses in proximity to access management treatments and the businesses in the control group. The analysis concluded that with comparable sales trends in the treatment group and the control group, the access management projects likely did not have an economic impact, with the probable cause being macroeconomic conditions instead. Once again, this was contrary to perception, with 52% of businesses indicating that raised medians negatively impacted aggregate sales and 60% indicating that raised medians negatively affected customer frequency per day [11]. This study concluded that the installation of raised medians had an insignificant effect on business sales, but the perception of those access management treatments remained negative.

Limitations of Existing Literature

One notable limitation of the existing literature is the range of access management treatments considered. A more robust survey to understand how business owners perceive different access management treatments (e.g., constructing roundabouts, redesigning medians, constructing frontage roads, and removing driveways) on their livelihoods would allow DOTD to foster better

communications at public meetings and address these concerns. The study would benefit from a survey that considers the variety of factors that influence perception as expressed in the literature. Measuring ranked factors of importance for patronage, types of businesses, proximity of similar types of businesses, number of employees, frequency of patronage, hours of operation, advertisement techniques, and willingness to relocate would all serve to predict how a business owner may perceive an access management treatment, regardless of the location within the state, depending on climate and terrain. Similarly, quantitative analysis of trends in economic data (e.g., tax revenues or sales) should be careful to control for the characteristics of businesses and economic trends, as well as the type of access management treatments in question, to further build on the existing literature.

Objective

This study's purpose was to determine if access management treatments in Louisiana have an economic impact on roadside businesses. The specific access management treatments observed in this study were J-Turns, Right-in-Right-out entrances, Raised Medians, raised curb channelization systems and center turn lanes. The research focused on business sales and the perceptions of both business owners and customers on access management treatments before, during, and after their construction. The findings from this study can inform communication strategies and outreach efforts directed at the public and stakeholders to better address concerns related to the economic effect of access management projects on nearby businesses.

Scope

The project's scope included two parts. The first was an analysis of the monthly sales data of Louisiana businesses located near access management treatments. This analysis covered three different time periods of monthly business sales: two years before construction, the years during which construction was ongoing, and two years following the completion of the access management treatment. The second portion of this study was a perception analysis of business owners and patrons at sites where an access management treatment was installed. Over-the-phone business perception surveys and in-person customer perception surveys were collected and analyzed to identify broad trends in attitudes toward the treatments.

Methodology

This section describes the data sources, collection, processes, methodologies, and access management treatments used in analysis for this project.

Economic Impact Analysis

The analysis of impacts to economic activity scrutinizes the economic effects of different access management treatments on individual businesses, utilizing primary data sourced from the Louisiana Department of Revenue. The dataset spans from 2010 to 2022, encompassing both pre- and post-intervention periods for each site. Business categorizations based on location and operational characteristics were added using the available observational data, and regional economic indicators (e.g., unemployment rates and population estimates) were integrated from government sources using R programming software [13].

The analysis primarily focuses on total monthly sales derived from the transformation of sales tax series using corresponding tax rates for each period under scrutiny. Spanning the years 2010 to 2022, this study encapsulates different periods in Louisiana's fiscal landscape, marked notably by shifts in statewide sales tax rates. Specifically, the tax rate increased from 4% to 5% in 2016, followed by a reduction to 4.45% in 2018.

To ensure a consistent evaluation of economic activity across the study period, sales tax collections for each timeframe were adjusted by dividing them by the applicable sales tax rate. This adjustment yields a more accurate view of taxable sales for each of the time periods, enabling a more accurate examination of sales trends before, during, and after the installation of the access management treatments across all study locations.

Data Collection Using APIs

In this study, APIs (Application Programming Interfaces) were utilized as a primary method for data collection, enabling direct and structured data retrieval from several authoritative sources. For sales tax analysis, the study accessed demographic, economic, and labor statistics through APIs offered by the Census Bureau [14], the Bureau of Economic Analysis [15], and the Bureau of Labor Statistics [16]. These APIs allowed for the efficient extraction of current and historical economic data relevant to the study's aims.

Data Handling and Statistical Analysis Using R Programming

R is a free software environment for statistical computing and graphics, supported by the R Foundation for Statistical Computing. It is widely used among statisticians and data scientists for developing statistical software and data analysis.

In this study, R programming was used to gather, clean, transform, and analyze data. The tidycensus [17], bea.R [18], and blsAPI [19] packages enabled API requests to retrieve publicly available data from public and private sources. Data was cleaned using the tidyverse [20] package, which filtered out inconsistencies and reshaped the data as needed.

For the statistical analysis, R provides the necessary environment for both descriptive and inferential statistics. The ggplot2 [21] package is utilized for data visualization, offering a graphical representation of trends and patterns. Statistical tests and models were applied to the processed data for hypothesis testing, allowing for comprehensive analysis of the data's underlying patterns and insights.

Hypothesis Testing and Regression Analysis

In our study, a student's t-test was used to assess the significance of changes in sales for individual businesses before and after the implementation of access management treatments. A Wilcox Signed Rank Test was used to analyze the average aggregate sales data by site location and determine if there was any significant change between the before and after periods. Finally, a linear regression model was used to measure sales differences between businesses over time while controlling for economic variables. All tests and models were conducted using the stats package [22] in the statistical programming software R. The following paragraphs elaborate on the process of these statistical methods.

Student's T-Test

For each individual business, monthly sales numbers were separated into two distinct periods—two years before and two years after the implementation of the access management treatment. The sales data for every individual business was then averaged by month for the two years before and two years after to create a 12-month series of mean monthly values for the 'before' period and another for the 'after' period. A logarithmic transformation was applied to normalize the final sets of average monthly data to meet the normal condition required by a paired student's t-test. The t-test was conducted for each business using R software to compare each set of monthly mean sales in the before and after periods. This statistical test was intended to determine whether

the mean difference between the two sets of monthly data within each period was statistically significant.

Wilcox Signed Rank Test

The Wilcox Signed Rank Test is a non-parametric statistical test used to compare two related samples, or repeated measurements on a single sample, to assess whether their population mean ranks differ. It is used when the data does not meet the normality assumption required by the paired t-test. This makes it ideal for scenarios where the data may be skewed or more ordinal in nature. This method was used to analyze the sampled businesses sales in aggregate as one site. To do so, average annual sales were calculated for each business within a site in both the before and after periods, resulting in paired data. Unlike the student's t-tests performed on the average monthly data of individual businesses, this data was not transformed to meet normal distribution requirements because the Wilcox Signed Rank Test is suitable for analyzing non-parametric data. The test was performed on each site using the paired data of the before and after periods per individual business. This test was similarly intended to assess whether the overall change in sales at the site level was significant.

By employing both tests, the analysis distinctly quantifies the significance of sales changes from the before period to the after period by both individual businesses within each site and each site as a whole. The resulting statistics provide evidence that can point to the impact or lack thereof that roadway interventions have on business performance.

Fixed Effects Linear Regression Model

The fixed effects linear regression model serves as a robust analytical tool to examine how access management treatments can influence business sales over time. By utilizing this model, researchers can effectively control for both observable and unobservable variables that might affect sales outcomes across different sites and years. This method allows the team to isolate the effect of various management treatments by accounting for inherent differences between sites and any site-specific trends over time, ensuring that the observed effects on sales are attributed specifically to the treatments rather than to external or unrelated factors. The use of fixed effects regression is particularly advantageous for this study because it aids in analyzing data that is multi-dimensional, involving multiple measurement points for each business across various times and locations, thereby providing a clearer, more accurate assessment on the impact of access management. The analysis was conducted by utilizing the stats package in R with the lm() function used to designate the model as a linear regression model.

Survey Methods

Surveys were conducted to understand how access management treatments were perceived before, during, and after their installation by both business owners and patrons. Business location and contact information were originally retrieved using the statistical programming software R and the Google Places API [12] service. Two distinct questionnaires were constructed using the data collection software Qualtrics: one tailored for phone surveys targeting business employees, managers, and owners, and the other designed for in-person interviews and conducted on-site at the various study locations.

The primary aim of these surveys was to determine the perceptions businesses and patrons had towards the access management treatments before, during, and after their installation. Because of the length of time that had passed since some treatments were installed, researchers assumed that participants may face challenges in recalling conditions before or after construction. Moreover, current employees or managers may not have been present during those periods and may therefore lack firsthand recollection. A similar scenario applies to patrons. To minimize memory or recall bias, the questionnaires were designed to focus on identifying any ongoing access-related issues experienced by businesses and their customers in the area, with specific questions targeting the access management treatments delivered at the end of each respective survey.

Both sets of questionnaires were exempted from institutional oversight by The University of Louisiana at Lafayette Institutional Review Board (IRB).

Qualtrics

Qualtrics [23] is an online comprehensive survey software and experience management platform that allows users to create, distribute, and analyze surveys. It provides advanced tools for survey design, sample selection, data collection, and analytics.

Google Places API

The Google Places API [12] is a service that allows developers to access detailed information about geographical locations and points of interest. Through the API, applications like R can retrieve data such as the names, locations, and types of establishments.

Business Survey

To ensure a targeted approach in data collection, businesses selected for the phone survey were first identified using a combination of the Google Places API service and R programming software. This initial selection process yielded a very large sample of businesses across all nine DOTD selected sites. The list was subsequently filtered based on a set of filtering criteria that targeted businesses most relevant to the study objectives. These criteria included whether the business location and the access management treatment were separated by a major highway, if the business was located on another major road, and if the business operated within a residential area or from a home. Next, observations of the businesses' physical structures were made to determine whether multiple businesses were located under the same roof, such as a shopping mall or major retailer like Walmart. If this was the case, the primary retailer was chosen; if a primary retailer could not be determined, one business was randomly selected while the others were filtered out. Similarly, all businesses that functioned as a component of a larger entity with a distinct role (e.g., a CVS Pharmacy within a CVS store) were filtered out in favor of the larger store. Finally, any business that was not at least partially affected by the access management treatment was filtered out. The application of these criteria ensured that the final sample of businesses surveyed was likely to provide responses that reflected accurate insights regarding the impacts of access management treatments.

Following this filtering process, the researchers conducted telephone interviews with the selected businesses to gather data on the treatments' effects. The business survey was administered by phone and included an explanation of the study, participation rights, and a verbal request to perform the survey. Once consent was obtained, an invitation to participate was extended to the employee present at the time of request, provided they were at least 18 years old and had been employed at the location or within the same area for a minimum of one month.

The questionnaire was comprised of several sections, including inquiries regarding the business and its day-to-day operations, such as staff numbers and average daily customer or client footfall. Additionally, participants were asked to provide insights into their customers' perceptions and their own observations regarding traffic congestion, the ranking of specific business factors that customers find most important, and the general attitude of the business toward the access management treatments affecting them.

The survey was conducted by phone, and data collection was performed by researchers, who entered participants' answers using the online Qualtrics platform. The research team conducting phone calls received specialized training in survey interviewing techniques tailored to the needs of this study. Research staff supervisors, experienced in overseeing such efforts, managed the

team throughout the phone call process. They were responsible for monitoring the data collection process, ensuring an even distribution of interviewers among businesses, and addressing any questions that arose. Participant confidentiality was a priority, with all participants being reassured that their responses would remain anonymous and could not be linked back to them, neither statistically nor by any other means.

Patron Survey

The in-person patron survey was carried out at 7 out of 9 DOTD-selected sites. Exclusions included Ruth Street in Sulphur, Louisiana, and a truck stop on LA 383 in Iowa, Louisiana. The omission of Ruth Street was due to the raised median indirectly affecting fewer than 5 businesses. A gas station that was constructed simultaneously with the median extension was directly affected but would not have experienced any differences in access before or during the extension of the raised median. At the truck stop on LA 383, the introduction of a center turn lane effectively enhanced access by improving traffic flow, rather than restricting it. Given the travel logistics and the minor impact of the access management treatments at these locations, they were deemed non-essential for the survey, allowing researchers to allocate more time and resources to the remaining sites.

At these sites, surveyors identified businesses directly impacted by the access management treatments and sought permission from each business to conduct surveys with patrons in their parking lots. The patron survey mirrored the format of the business survey, with the key difference being its in-person execution. Participants were approached, informed about the study and their rights as a participant through a verbal consent script, and surveyed upon agreement. Eligibility for participation was extended to individuals at least 18 years old who had been residents of the area for a minimum of one month.

The survey inquired about patrons' intended frequency of visitation to the business or others nearby, along with their preferences and concerns about the roadways and access to the business they were visiting. To avoid bias, participants were not asked to evaluate the access management treatment directly; instead, they were questioned about their recollection of the roadway changes and of their views before, during, and after the installation. The survey also included open-ended questions, allowing participants to express their overall perspectives on traffic, safety, and the dynamics of the affected roadways.

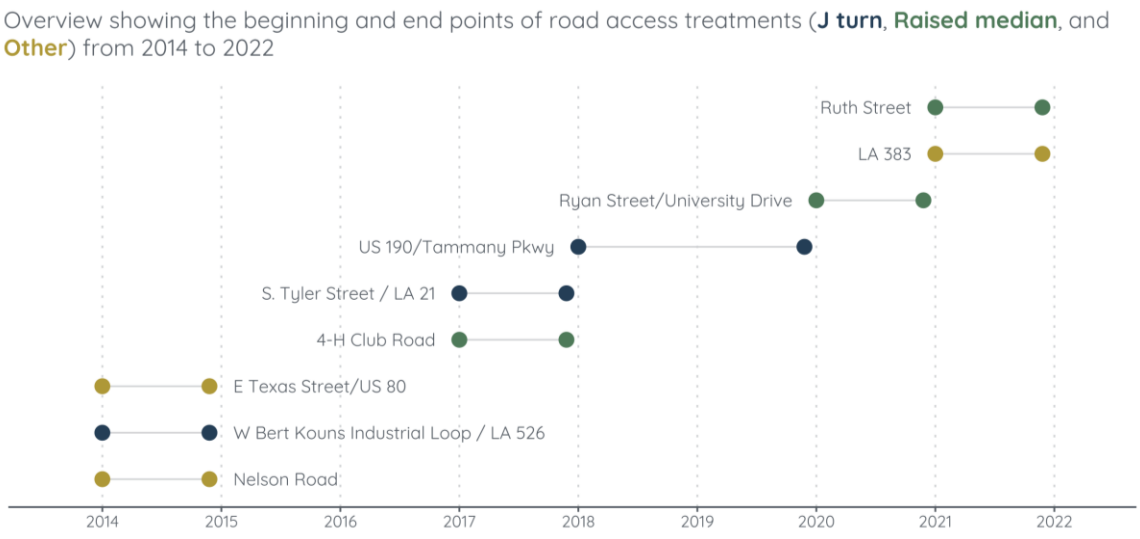
The recruitment process for this study was conducted on-site, with the research team visiting each of the 7 designated locations for a single day to gather data. Data was collected electronically on iPads and uploaded to the Qualtrics platform. The research team received

specialized training in survey interviewing techniques tailored to the needs of this study. Field supervisors, experienced in overseeing such efforts, accompanied the interviewers. They were responsible for monitoring the data collection process, ensuring an even distribution of interviewers among businesses, and addressing any questions that arose throughout the day. Participant confidentiality was a priority, with all participants being reassured that their responses would remain anonymous and could not be linked back to them, neither statistically nor by any other means.

Site Locations and Access Management Treatments

Survey Sites

Figure 1. Construction Timeline for Selected Access Management Projects



The chart above shows the timelines for treatment installation periods at each site. The treatments at the Nelson Road, West Bert Kouns Industrial Loop, and East Texas Street/US 80 sites were installed between 2014 and 2015. The treatments at the 4-H Club Road and S. Tyler Street/LA 21 sites were installed between 2017 and 2018. The treatment at the US 190/Tammany Pkwy site was installed between 2018 to 2020. The Ryan Street/University Drive site treatments were installed between 2020 and 2021. Finally, the installation of the LA 383 and Ruth Street site treatments took place between 2021 and 2022. The location of each project is mapped in Figures 2 through 5.

Figure 2. Location of all Treatments across Louisiana by Treatment Type

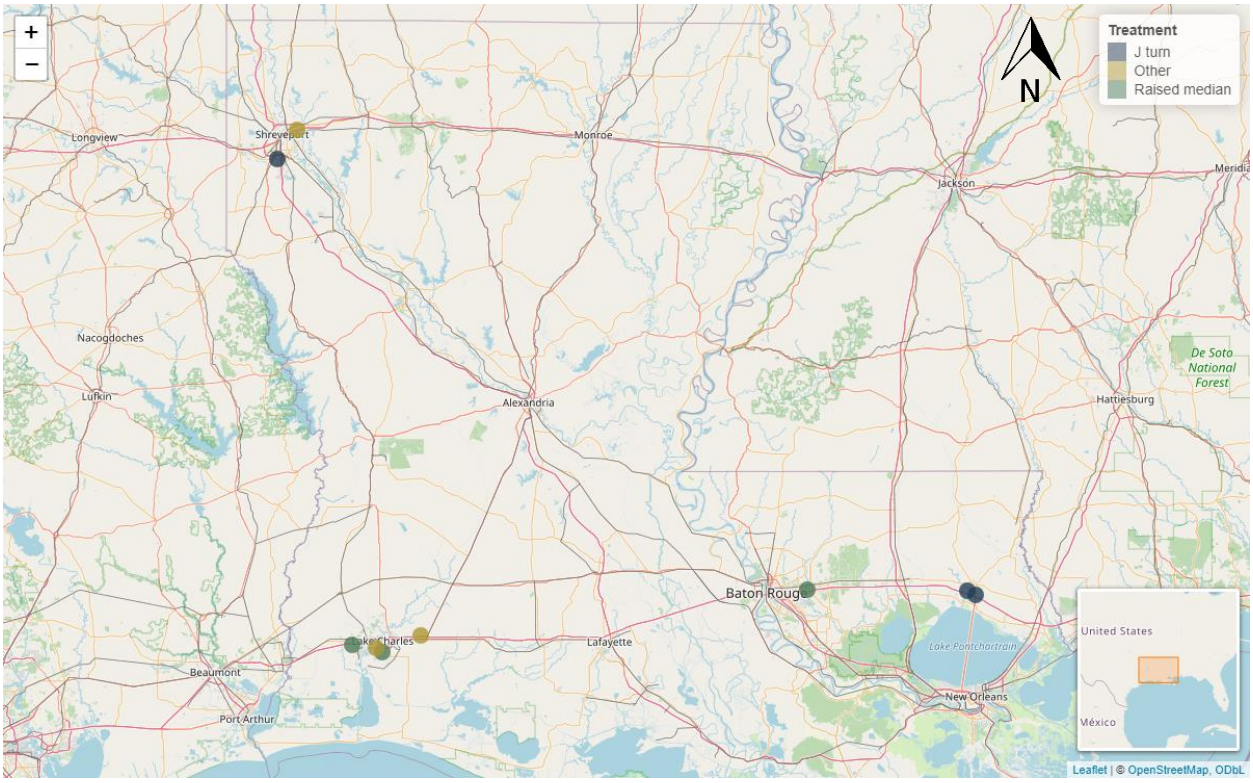


Figure 2 displays all access management treatment site locations on a simple highway map of Louisiana. The West Bert Kouns and East Texas Street sites are in DOTD District 04, Shreveport, in the northwest corner of the state. The Ruth Street, Ryan Street, Nelson Road and LA 383 sites are in DOTD District 07, Lake Charles, in the state's southwest corner. The 4-H Club Road, LA 21 and US 190 sites are in DOTD District 62, Hammond, in the state's southeast corner.

Figure 3. Location of Treatments near 4-H Club Road, S. Tyler Street/LA 21, and US 190/Tammany Pkwy

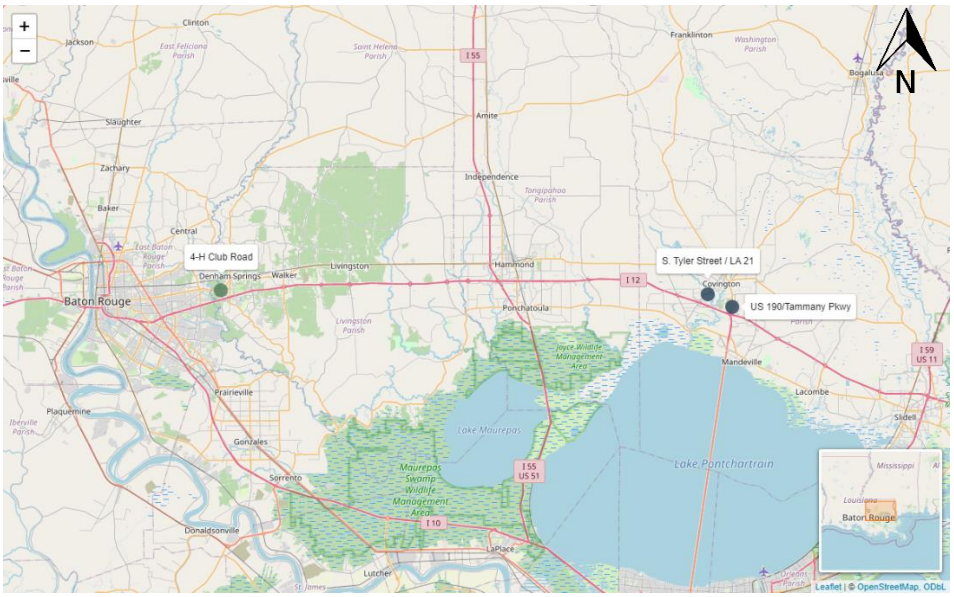


Figure 4. Location of Treatments near Ruth Street, Nelson Road, Ryan Street/University Drive, and LA 383

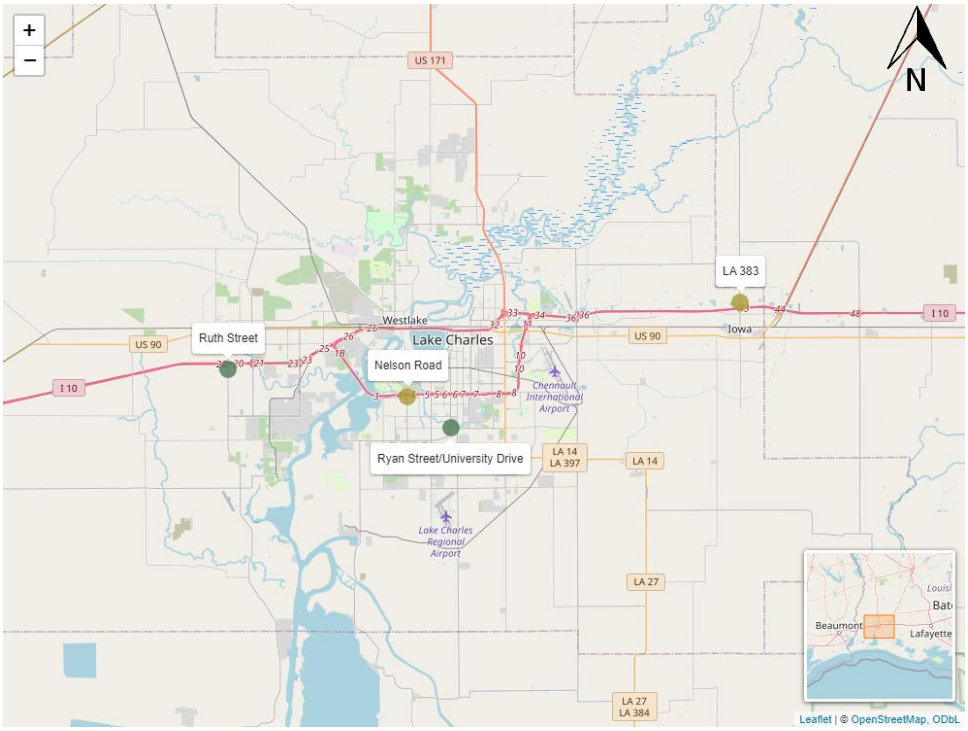
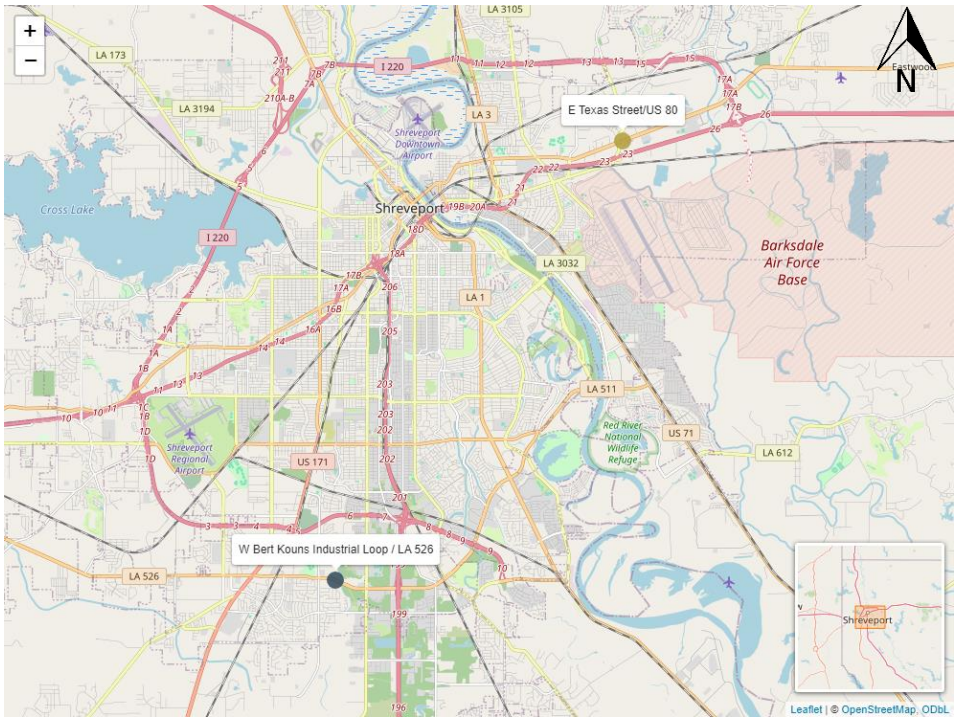


Figure 5. Location of Treatments near West Bert Kouns Industrial Loop/LA 526 and East Texas Street/US 80



Access Management Treatments

J-Turns

The J-Turn intersection, also known as the RCUT, Superstreet, or Reduced Conflict Intersection, is an innovative traffic management solution designed to reduce collisions by eliminating the need for direct left turns from side roads, driveways, or parking lots onto busy main roads across multiple lanes of traffic. Instead, from the side road, driveway, or parking lot, drivers turn right onto the main road in the same direction as traffic and use a designated J-turn a short distance away to transition to the opposing lane of traffic and change direction. This configuration improves traffic flow and reduces the risk of vehicle collisions associated with directly crossing lanes with oncoming traffic. In some cases, the J-Turn intersection is used to increase access by creating openings in the raised or grass medians that separate opposing lanes of traffic.

Figure 6. J Turn Installation (US 190/Tammany Pkwy - 30.447358, -90.082012) Pre-Treatment

[24]

Figure 6 shows the pre-treatment image of a J-Turn installation location at the US 190 site. Prior to the installation of the treatment, the opposing lanes of traffic were divided by a grass median, with no option for vehicles to turn around until they reached the next intersection.

Figure 7. J Turn Installation (US 190/Tammany Pkwy - 30.447358, 90.082012) Post-Treatment

[25]

Figure 7 shows the completed J-Turn, post-treatment. The grass median shown in Figure 6 is now replaced with a J-Turn intersection, with new left turn lanes and traffic lights, allowing vehicles to change direction safely and securely while through traffic can continue uninterrupted.

Raised Medians

Raised Medians are physical barriers between the directions of traffic on busy roads. They help manage left-turn movements and reduce the potential for head-on collisions. By controlling access points and reducing the number of direct left turns, raised medians enhance safety for both vehicles and pedestrians while maintaining orderly traffic flow.

Figure 8. Raised Median (Ryan Street - 30.176669, -93.218558) Pre-Treatment

[26]

Figure 8 shows a pre-treatment image of a section of roadway along Ryan Street. The image shows no barrier preventing vehicles from making left turns across the double yellow line from either side of the road.

Figure 9. Raised Median (Ryan Street - 30.176669, -93.218558) Post-Treatment

[26]

Figure 9 shows the post-treatment image of the raised median installed at the Ryan Street site. The raised yellow curb now prevents vehicles from making left hand turns from either side of the road.

Right-in Right-out (RIRO)

Right-in Right-out access restricts vehicle movements to right turns only, both into and out of driveways or streets. This access management technique is used to prevent left-turn movements and crossing traffic, significantly reducing the potential for side-impact or head-on collisions while improving traffic safety and flow.

Figure 10. Right-in-Right-out Installation (East Texas Street / US 80 - 32.533706, -93.671444) Pre-Treatment

[26]

Figure 10 shows the pre-treatment image of the roadway at the intersection of East Texas Street and Industrial Drive. The image shows the original three-way intersection, as opposed to the Right-in-Right-out intersection in Figure 11.

Figure 11. Right-in-Right-out Installation (East Texas Street / US 80 - 32.533706, -93.671444) Post-Treatment

[27]

Figure 11 shows the post-treatment image of the completed Right-in-Right-Out treatment at the intersection of East Texas Street and Industrial Drive. A raised curb now prevents cars from

crossing lanes of traffic and instead requires vehicles to turn right off of East Texas Street to access Industrial Drive, or turn right out of Industrial Drive to access East Texas Street.

Center Turn Lanes

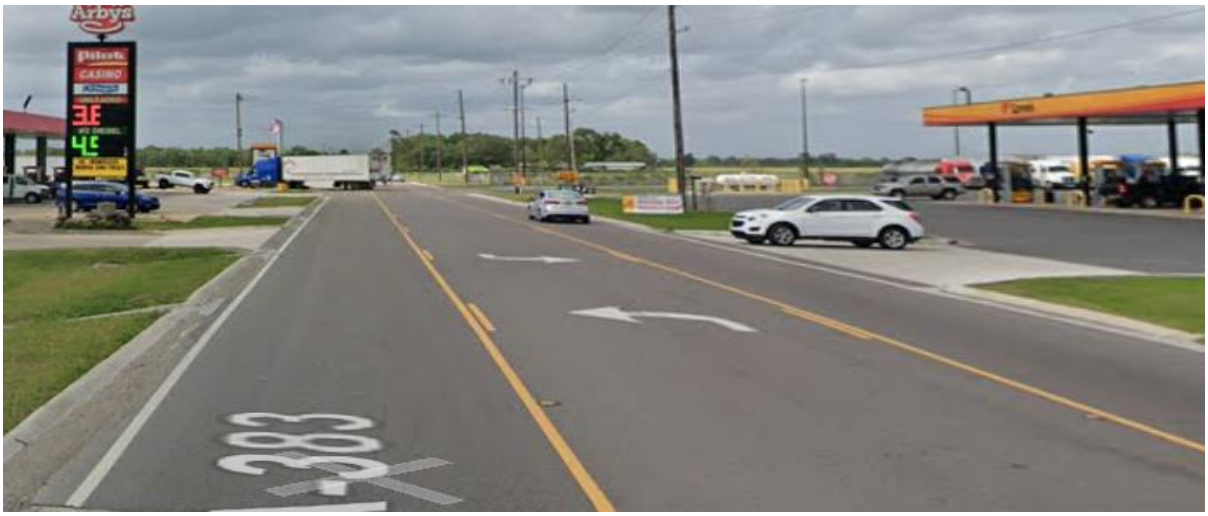
Center turn lanes are dedicated lanes situated in the middle of a roadway, allowing drivers from both directions to make left turns without impeding the flow of traffic. This system helps to manage left-turn traffic, reducing congestion and minimizing the risk of accidents associated with turning across one or more lanes.

Figure 12. Center Turn Lane Installation (LA 383 / Lowe-Grout Road 30.252688, -93.013809) Pre-Treatment

[28]

Figure 12 shows the pre-treatment image of a section of roadway along Lowe-Grout Road at the LA 383 site. The image shows two total lanes of traffic, each going in opposite directions.

Figure 13. Center Turn Lane Installation (LA 383 / Lowe-Grout Road 30.252688, -93.013809) Post-Treatment



[29]

Figure 13 shows the post-treatment image of Lowe-Grout Road, with the addition of a center turn lane. Now, vehicles can move into the center turn lane to access driveways on either side of the road, while allowing traffic flow to continue as they wait for a safe opportunity to make their turn.

Raised Curb Channelization Systems

Raised curb channelization systems are typically modular panels or posts that create physical delineations for various traffic lanes and turning paths. They can be installed quickly and offer a flexible solution to guide traffic and manage access without making permanent alterations to road infrastructure.

Figure 14. Raised Curb Channelization (Nelson Road - 30.195263, -93.249429) Pre-Treatment

[30]

Figure 14 shows a pre-treatment image of a section of Nelson Road. The image shows that the roadway contains the painted indicators for turn lanes, but there are no raised delineators to guide traffic or prevent vehicles from making left-hand turns across oncoming traffic.

Figure 15. Raised Curb Channelization (Nelson Road - 30.195263, -93.249429) Post-Treatment

[30]

Figure 15 shows the post-treatment image of the section of Nelson Road. The turn lanes now have a raised curb channelization system to guide vehicles into lanes designated for left turns and prevent them from crossing lanes with oncoming traffic.

Discussion of Results

Sales Tax Data

Overview

The analysis of the economic effects of access management techniques utilizes a comprehensive approach, beginning with an examination of sales changes for individual businesses grouped by their treatments and extending to trends over time across different sites and treatments. Initially, data was sourced from 337 businesses provided by the Louisiana Department of Revenue spanning 8 different site locations in Louisiana, with each site associated with 1 of 5 different access management treatments. After applying stringent filtering criteria to ensure the accuracy and relevance of the sales data, the analysis was conducted on a refined sample of 230 businesses.

The analysis commenced by categorizing businesses based on their surrounding access management treatments, performing t-tests on each individual business comparing the average monthly sales from the pre-treatment period to those from the post-treatment period. The resulting data was utilized to sum up the number of businesses that demonstrated a statistically significant increase or decrease in their sales for each of the 5 access management treatments.

In the study of business performance at various sites, the Wilcox Signed Rank Test was applied to analyze changes in business sales before and after implementing access management treatments. For each business within a site, average annual sales were calculated for both the before and after periods, resulting in paired data. The test was performed on the paired data for each site to determine if there were statistically significant changes in sales at the site level.

Further analysis focused on examining aggregated sales trends over time for each site, without grouping by specific access management treatments, thereby avoiding potential biases linked to the unique economic characteristics of each site. Sales data of businesses were separated by site location, aggregated monthly, and visualized to provide a clearer view of trends.

The final phase entailed a fixed effects linear regression analysis across all sites and access management treatments. Given the limited sample size from some sites and further reduction of those samples when categorizing businesses as directly affected by treatments vs. unaffected, a comprehensive regression analysis on individual sites using treatment and control groups would have yielded unreliable results. However, by considering the entire dataset when distinguishing

between treatment and control groups, the team was able to conduct a regression analysis using a two-way fixed effects linear model. This model assessed the economic impact of access management treatments on the logarithmically transformed aggregated annual sales, incorporating variables such as annual unemployment rates by parish, annual number of business establishments by zip code, and average household income by zip code.

This multifaceted approach to data analysis was not only tailored to accommodate the diverse sample sizes from each site, but also aimed to provide a thorough perspective on the different ways economic impact can be assessed through sales tax data.

Significance Testing for Individual Businesses by Treatment Type

Figure 16. Change in Sales (Before to After) by Treatment Type

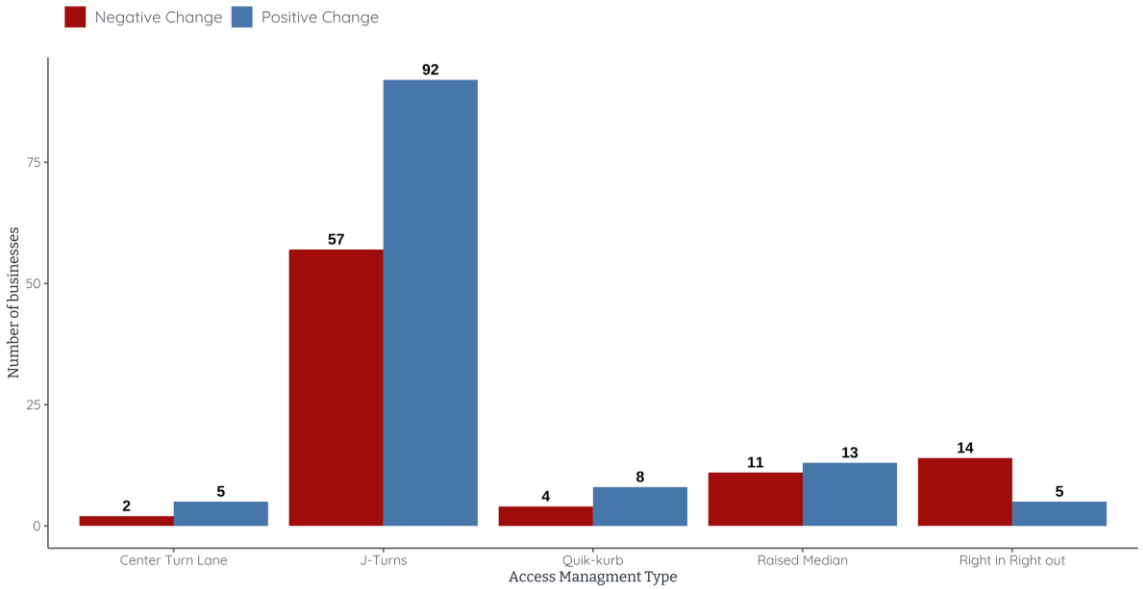
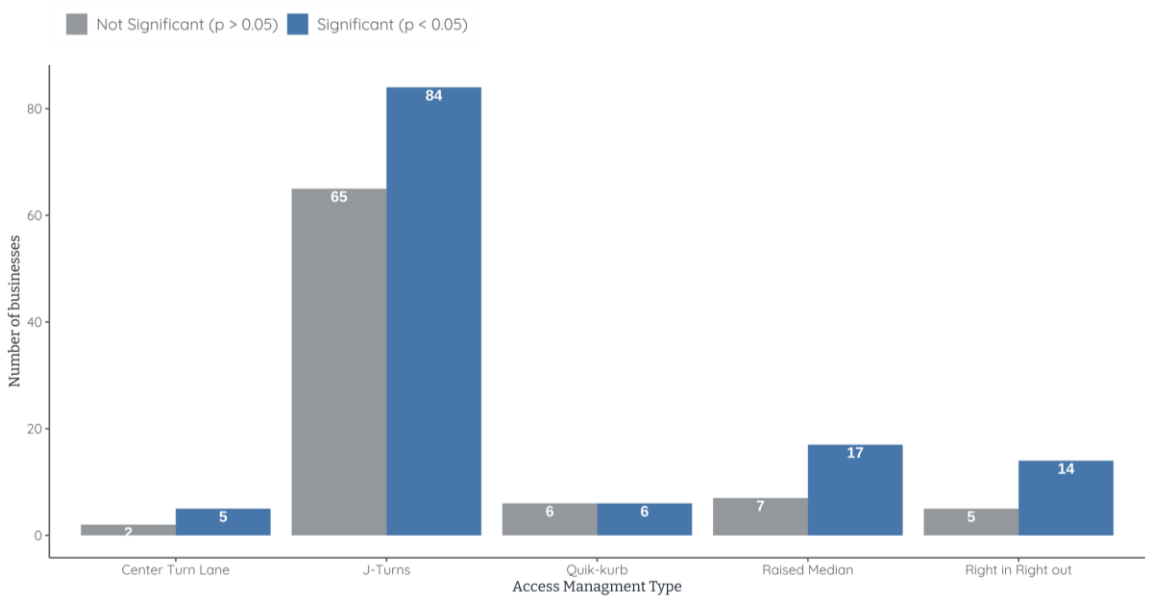


Figure 16 groups individual businesses by access management treatment type and identifies whether the change of average yearly sales was positive or negative by subtracting the mean sales of the before period from the mean sales of the after period. The majority of businesses experienced positive changes in sales for each access management treatment, with the sole exception being businesses in half-mile proximity to the Right-in-Right-out treatment located at the East Texas Street site in Bossier City, Louisiana.

Figure 17. T-Test Results by Individual Business (Significant vs. Not Significant) Grouped by Treatment Type



A paired t-test was administered to a logarithmically transformed monthly average of sales in before and after periods for each individual business. The null hypothesis for these tests assumes that no significant change occurred from the average monthly sales in the before period to the average monthly sales in the after period. If a significant change was found ($p < 0.05$), the alternative hypothesis for that business would be accepted, indicating a less than 5% chance that sales had increased or decreased by chance, with no contributing factor. Whether those changes were due to the access management treatments is unclear; however, the results do tell us that there are significant changes in sales, and they occurred over the period in which the access management treatment was installed. Figure 17 compiles results for each business by access management treatment, showing an equal or greater number of businesses that experienced significant changes in sales after the treatments were installed. Figure 18 elaborates further on these results.

Figure 18. Significant T-Test Results by Individual Business (Before to After) Grouped by Treatment Type

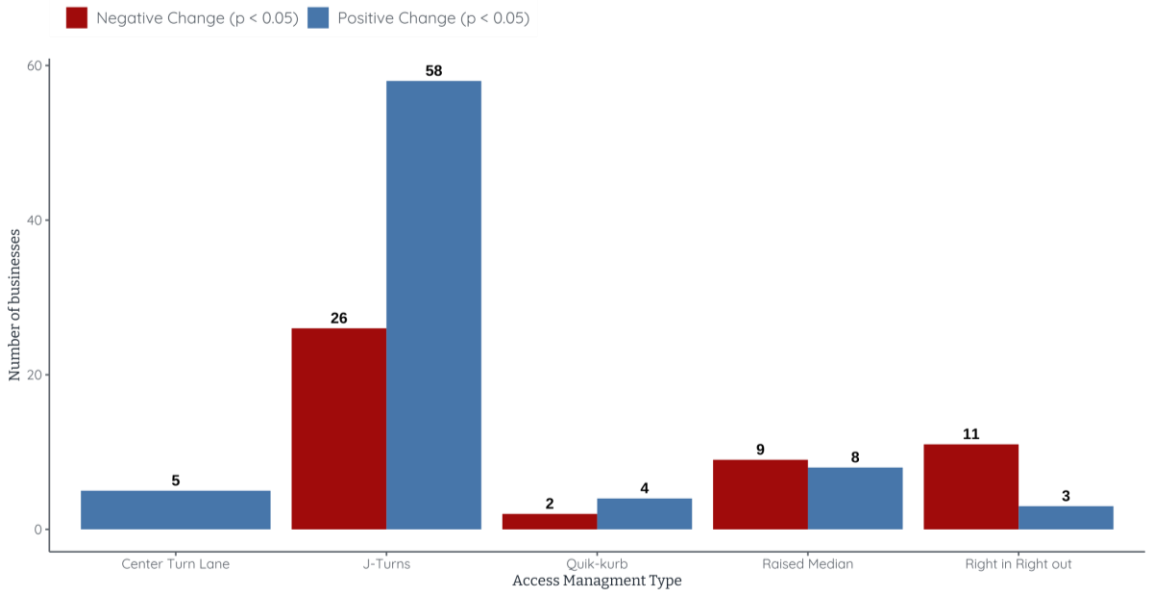


Figure 18 takes the results from Figure 17 and filters out all businesses that did not experience a significant change in sales from the periods before and after access management installation. Significant changes were then categorized as either positive or negative based on the difference in average yearly sales between the before and after periods for each business. The findings indicate that most businesses located at sites where center turn lanes, J-Turns, and raised curb channelization interventions were introduced experienced a significant rise in sales. The counts of businesses located at sites where raised medians were installed were almost equal in terms of the positive or negative changes in sales with 8 businesses showing an increase in sales and 9 businesses showing a decrease. The majority of businesses located within a half mile of the Right-in-Right-Out treatment at the East Texas Street site experienced a significant decrease in sales.

J-Turn Sites

Figure 19. Average Annual Sales of Sampled Businesses Before, During, and After Treatment Installation- J-Turn Sites

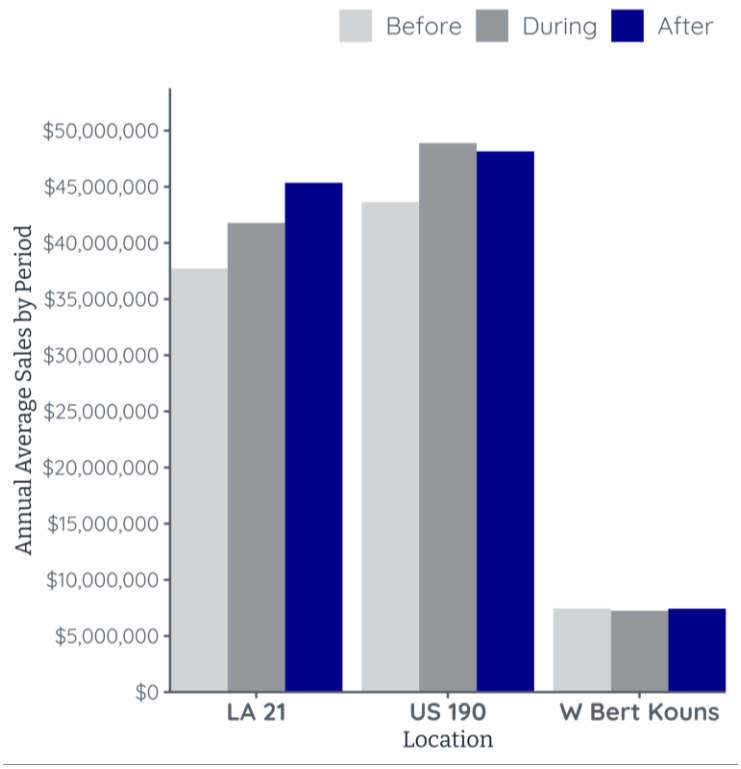


Figure 19 shows the average annual sales at businesses located near J-Turn treatment sites before, during, and after construction. The access management treatments on LA 21 and US 190 were both located in Covington, Louisiana, but they were installed several years apart from one another. The businesses near the LA 21 site saw an incremental increase in sales from before, to during, to after installation. Sales for businesses near the US 190 treatment sites also experienced a small jump in sales from the before period to the during and after periods. Businesses near the West Bert Kouns treatment sites saw a very slight decrease during construction, then a slight increase in the after period, maintaining approximately the same level of sales throughout all periods. Figures 2 through 5 display the geographic locations of these treatments.

Table 1. Wilcox Signed Rank Results for LA 21, US 190, and West Bert Kouns Sites

Access Type	Site	t Statistic	p Value	Median Difference	Median Change	Interpretation
J-Turns	LA 21	1039	0.247	23737	Increased	Moderate increase, not statistically significant
J-Turns	US 190	1022	0.585	14265	Increased	Slight increase, not statistically significant
J-Turns	West Bert Kouns	26	0.722	6975	Increased	Minimal increase, not statistically significant

Table 1 further analyzes data for sites with J-Turns by conducting a Wilcox Signed Rank Test on the average yearly sales of individual businesses two years before treatment and two years after treatment for each site. The null hypothesis assumes there are no significant changes in average yearly sales from the before period to the after period for each site. The results indicate an increase in sales for the LA 21 site post-treatment, but the results were not statistically significant. This result suggests that while sales improved at that site, there is not enough evidence to indicate that the change in average yearly sales was not due to chance alone. In other words, there is no indication that the installation of J-Turns had a positive or negative effect on sales for aggregated sales of businesses at the LA 21 site. Similarly, results for West Bert Kouns and US 190 sites showed that sales did increase but that those increases were not statistically significant, giving no indication that J-Turns affected the aggregated performance of the sampled businesses in each site location.

LA 21 - Covington, LA 70433

Figure 20. Average Monthly Sales Trend for Sampled Businesses - LA 21 / South Tyler Street

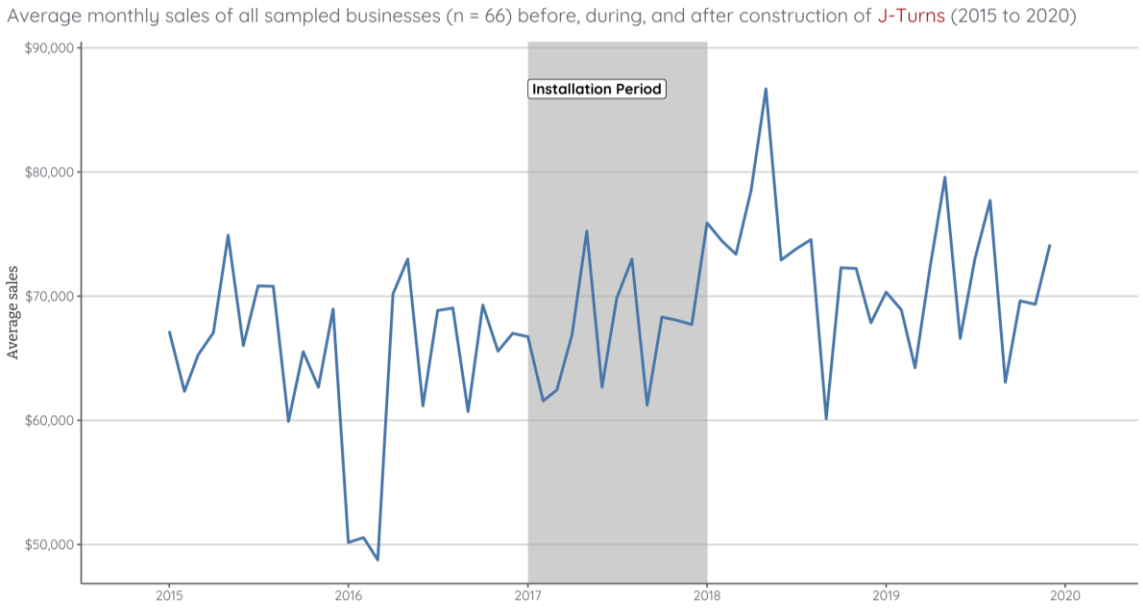


Figure 20 shows the average monthly sales trend of sampled businesses located within the LA 21 treatment site before, during, and after construction. The consistent monthly volatility of average sales, along with an overall increase in sales during and after the installation of J-Turns in 2017, does not provide any substantial evidence that the access management treatment negatively impacted the aggregated sales of the sampled businesses. Figure 3 demonstrates the location of this treatment site.

US 190 – Covington, LA 70433

Figure 21. Average Monthly Sales for Sampled Businesses - US 190 / Tammany Parkway

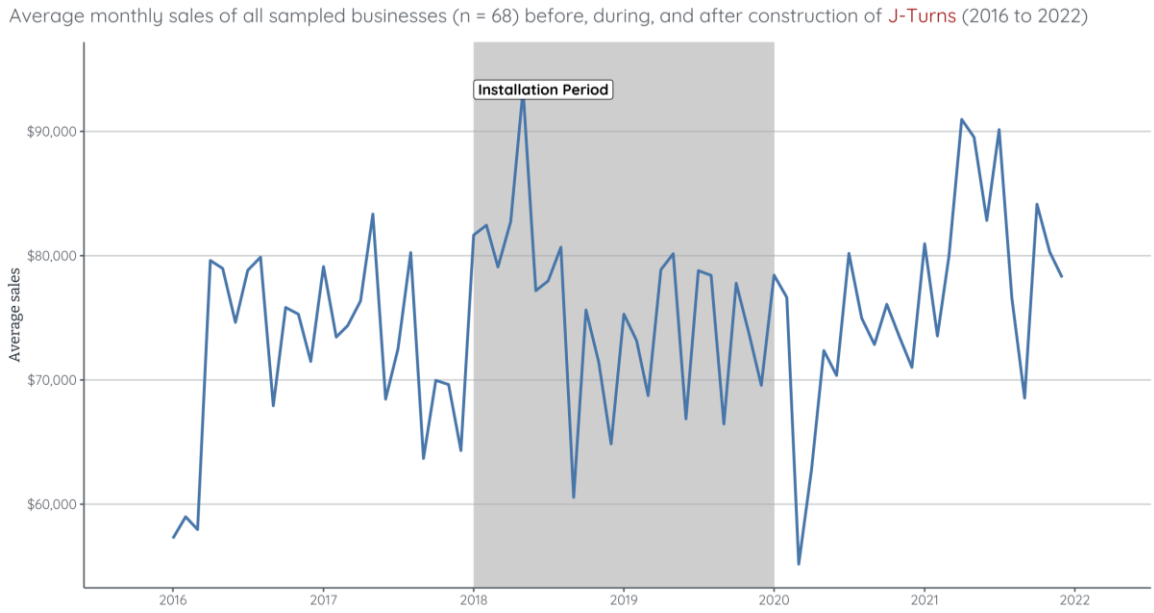


Figure 21 shows the average monthly sales trend of sampled businesses near the US 190 treatment site before, during, and after construction. Excluding outlying monthly trends (i.e. the large dip in early 2020, possibly due to the COVID-19 pandemic), the data indicates that sales during and after the construction project experienced a slight overall increase. There is no clear evidence that the installation of J-Turns impacted the aggregated sales of sampled businesses. Figure 3 demonstrates the location of this treatment site.

West Bert Kouns Industrial Loop - Shreveport, LA 71106-71118

Figure 22. Average Monthly Sales Trend for Sampled Businesses - West Bert Kouns Industrial Loop

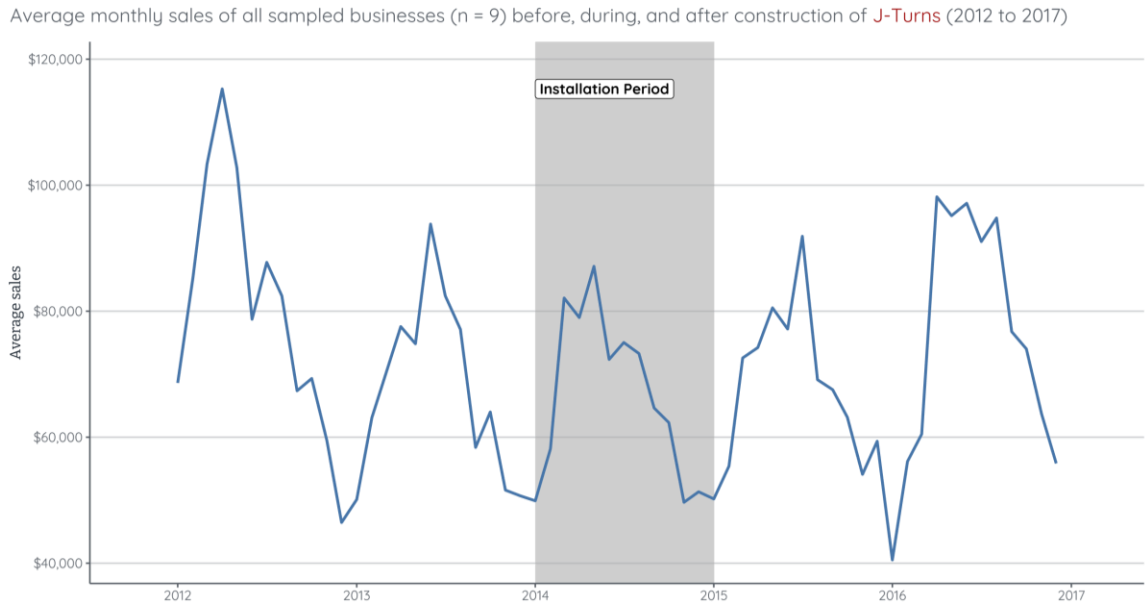


Figure 22 shows the average monthly sales trend for sampled businesses located near the West Bert Kouns treatment site. The high sales of the spring and summer months, and the low sales at the beginning of each year, imply a potentially strong and consistent influencing factor, whether that be the seasonal trends of a larger business, or another unknown economic factor present at this specific site. Considering the consistency of the sales trend before, during, and after the periods of access management installation, there is no clear evidence suggesting J-Turns installed at this site are responsible for any of the fluctuations in aggregate sales. It is also worth noting that at this particular site, J-Turns served to increase access to businesses in the area by changing a grass median to a J-Turn, allowing an opportunity for a quicker turnaround from east to west or west to east than was previously possible. Figure 5 demonstrates the location of this treatment site.

Raised Median Sites

Figure 23. Average Annual Sales of Sampled Businesses Before, During, and After Treatment Installation – Raised Median Sites

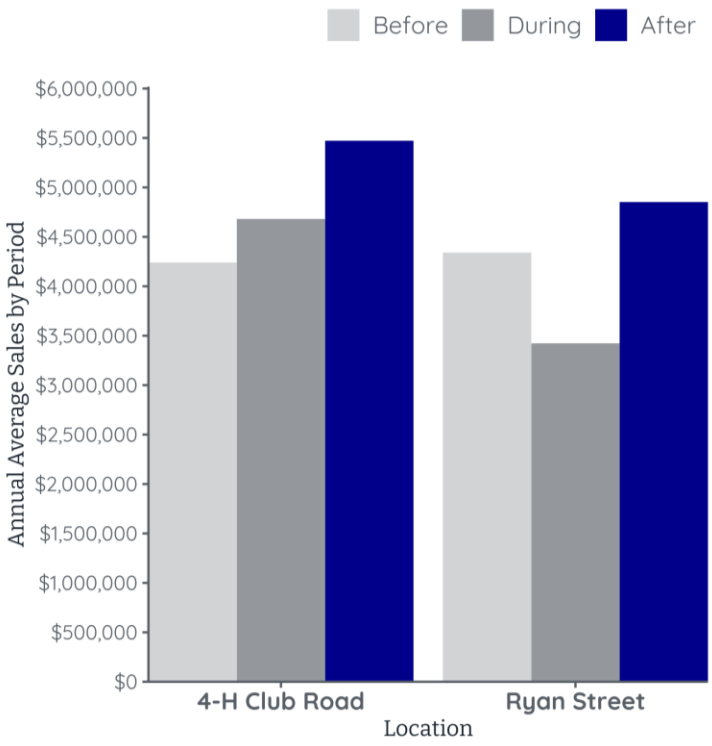


Figure 23 shows the average aggregated sales of sampled businesses located near raised median treatment sites before, during, and after construction. A raised median was installed on Ryan Street, and a dedicated left turn lane was installed along its continuation, University Drive. Both treatments restrict access in a similar manner by preventing left turns from one side of the road into the available driveways where businesses and their parking lots are located. Since these treatments were built within the same time frame and have similar effects on access, this study evaluates both treatments as raised medians. The 4-H Club Road site is in Denham Springs, Louisiana. The raised median treatment runs approximately 500 feet down 4-H Club Road from its intersection with Florida Avenue. Sampled businesses near 4-H Club Road experienced an incremental increase in sales for each period. Sampled businesses near Ryan Street experienced a decrease in sales during the installation year but rebounded in the after period with the highest yearly average across all three periods.

Table 2. Wilcox Signed Rank Test Results for 4-H Club Road and Ryan Street Sites

Access Type	Site	t Statistic	p Value	Median Difference	Median Change	Interpretation
Raised Medians	4-H Club Road	41	0.0330	119121	Increased	Significant increase, statistically valid
Raised Medians	Ryan Street	54	0.576	72562	Increased	Increase observed, not statistically significant

Table 2 shows the results of Wilcox Signed Rank T-Test on average yearly sales between the before and after periods of sampled businesses located at the 4-H Club Road and Ryan Street sites. The test investigates the difference between sales data from two years before and two years after the implementation of access management treatments for each business. The null hypothesis assumes no significant difference between the before period sales and the after period of all sampled businesses within their respective sites. Test results show a significant increase in sales at the 4-H Club Road site following the installation of the raised median. The significance of the test provides strong evidence that the change in sales was not due to chance alone, implying an influencing factor. The raised median could be a possible contributing factor because it was a change that occurred between the before and after periods of sales. While it is not clear that the raised median influenced an increase in sales for sampled businesses at the 4-H Club Road site, the statistical significance of the increase does provide evidence that at the very least, the raised median did not negatively impact the aggregate sales of sampled businesses within the site location. Sampled businesses at the Ryan Street site also show an increase in median sales, but these results are not statistically significant, providing no evidence that the roadway changes had a positive or negative effect on sales at that site.

4-H Club Road - Denham Springs, LA 70726

Figure 24. Average Monthly Sales Trend of Sampled Businesses Before, During, and After Installation – 4-H Club Road

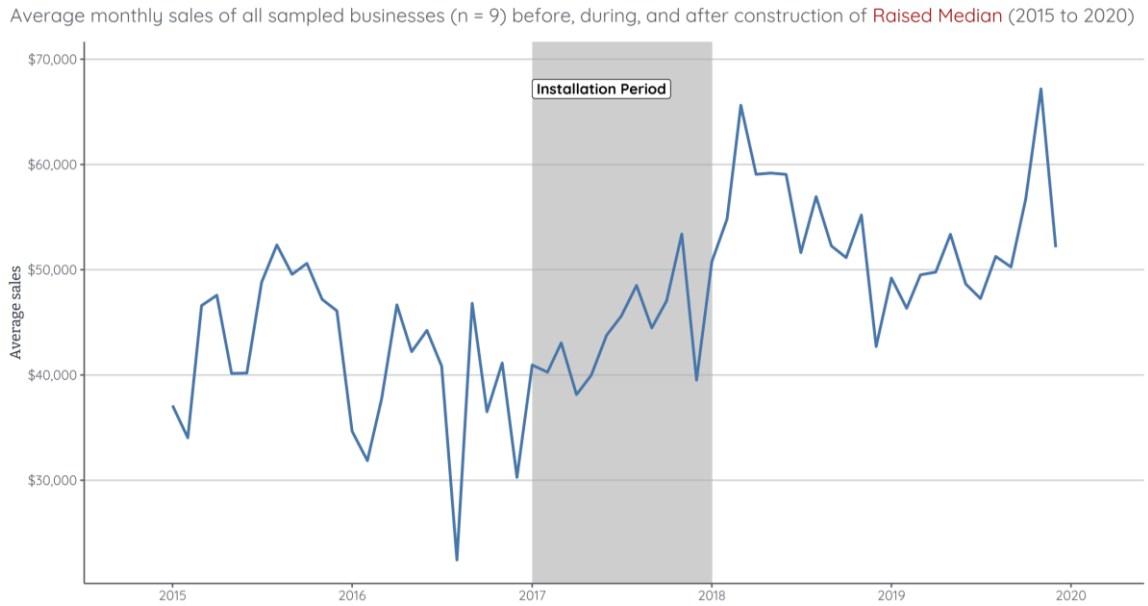
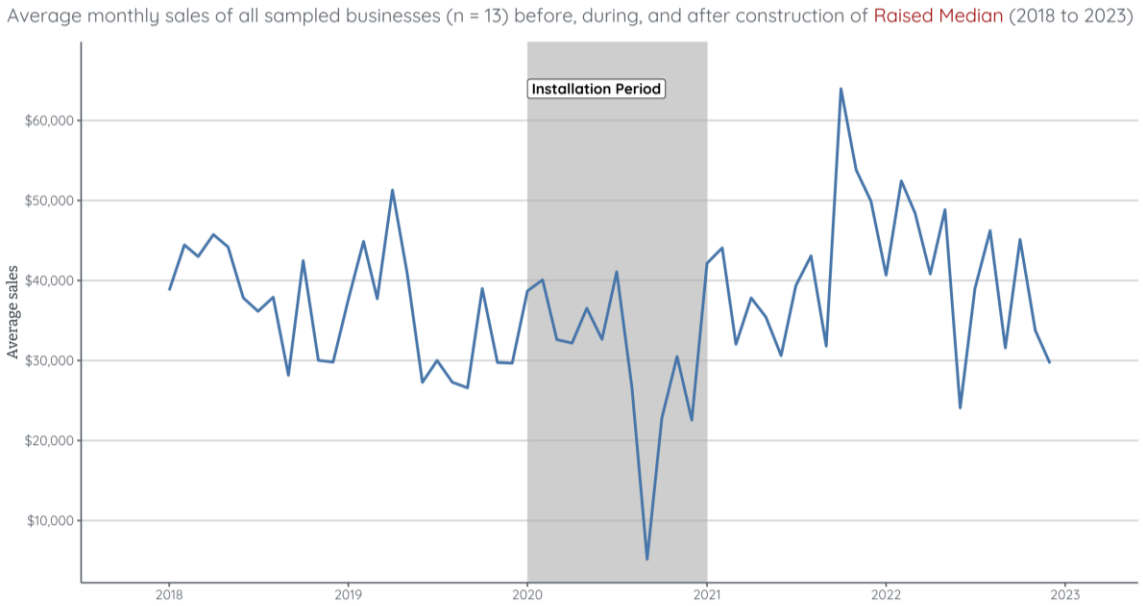


Figure 24 illustrates the average monthly sales trend of all sampled businesses at the 4-H Club Road site before, during, and after the construction of a raised median. The sales trend line shows a general increase in sales over time through the installation and after periods. There is some variability in sales numbers from month to month; however, the general upward trend of average sales at this site provides evidence that the installation of the raised median did not have a negative impact on the aggregated sales of sampled businesses in the area. Figure 3 demonstrates the location of this treatment site.

Ryan Street – Lake Charles, LA 70605-70607

Figure 25. Average Monthly Sales Trend of Sampled Businesses Before, During, and After Installation – Ryan Street / University Drive



As shown in Figure 25, averaged monthly sales of sampled businesses near the Ryan Street site are steady into the beginning months of the installation period, followed by a sharp drop in average sales and a rebound to higher average sales by the end of 2020. After the installation year, the monthly sales trend shows an overall increase compared to the two years before construction began. The drop during the installation year is likely attributable to extreme weather events. Both Hurricanes Laura and Delta struck the Lake Charles area within months of each other, precisely at the dip in sales during the installation period. Overall sales appear to have an upward trend, suggesting the access management treatment did not have any obvious negative economic impact. Figure 4 demonstrates the location of this treatment site.

Other Treatment Sites

Figure 26. Average Annual Sales of Sampled Businesses Before, During, and After Treatment Installation – RIRO, Center Turn Lane, Raised Curb Channelization

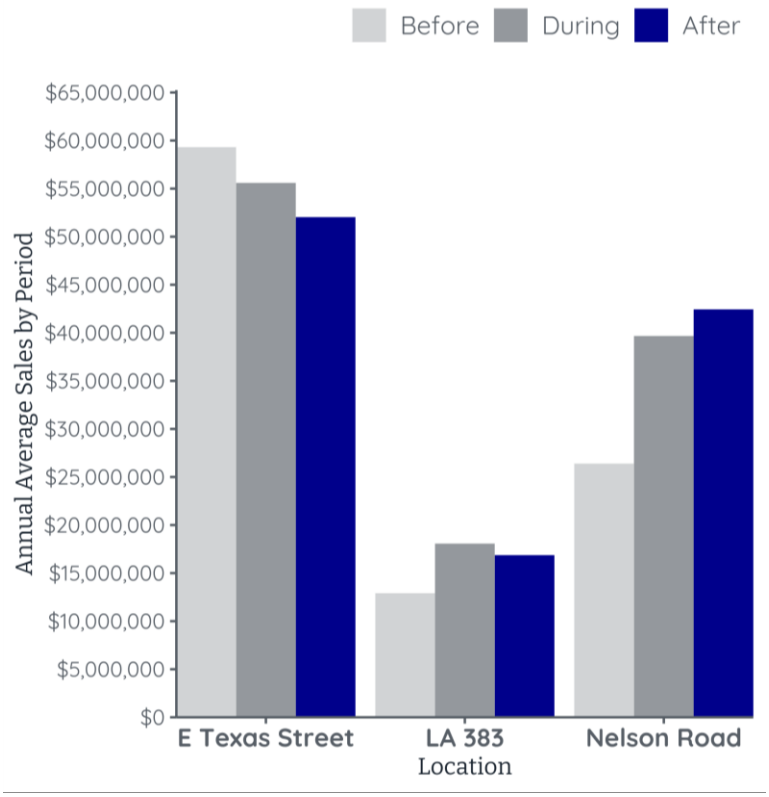


Figure 26 shows the average annual sales of sampled businesses located near all other access treatment sites before, during, and after construction. The East Texas Street site treatment was a RIRO installation at the intersection of East Texas Street and Industrial Drive. A full intersection with traffic lights was changed to a Right-in-Right-out intersection, at which vehicles could enter and exit Industrial Drive from or onto East Texas Street with a right turn. Observation of average sales from sampled businesses at this site experienced an incremental decrease from before to after construction. The LA 383 site treatment was an addition of a center turn lane along Lowe-Grout Rd next to a travel center and several other businesses. Average sales of businesses sampled near this site show an increase from the before to after periods. Finally, the Nelson Road site treatment was a raised curb channelization installation along Nelson Road in front of driveway leading to the Walmart Supercenter and various other businesses. The raised curb channelization treatment involved the use of plastic delineators that more clearly defined a left turn lane into the shopping center and prevented illegal left turns out of that same driveway and

onto Nelson Road. Average sales for sampled businesses near Nelson Road show an overall increase from the before period to the after period.

Table 3. Wilcox Signed Rank Test Results for East Texas Street, LA-383, and Nelson Road

Access Type	Site	t Statistic	p Value	Median Difference	Median Change	Interpretation
Right in Right Out	East Texas St.	53	0.163	-79020	Decreased	Decrease observed, not statistically significant
Center Turn Lane	LA 383	21	0.272	14685	Increased	Minor increase, not statistically significant
Raised Curb Channelization	Nelson Road	59	0.126	33630	Increased	Noticeable increase, not statistically significant

Table 3 focuses on the impact of remaining access management treatments at the East Texas Street, LA 383, and Nelson Road sites. The analysis compared average monthly sales data from two years before and two years after the implementation of the treatments with the null hypothesis assuming no significant change from the before period to the after period for each site. The t-tests reveal non-significant changes in sales results across all remaining sites. Sales at Nelson Road and LA 383 sites show an upward trend following the installation of their respective treatments, while East Texas Street experienced a decrease in average sales from before to after; however, considering no site experienced a significant change in sales, there is no substantial evidence to suggest that the access management treatments in these areas affected the sales of nearby businesses.

East Texas Street – Bossier, LA 71111-71112

Figure 27. Average Monthly Sales Trend of Sampled Businesses Before, During, and After Treatment Installation – East Texas Street

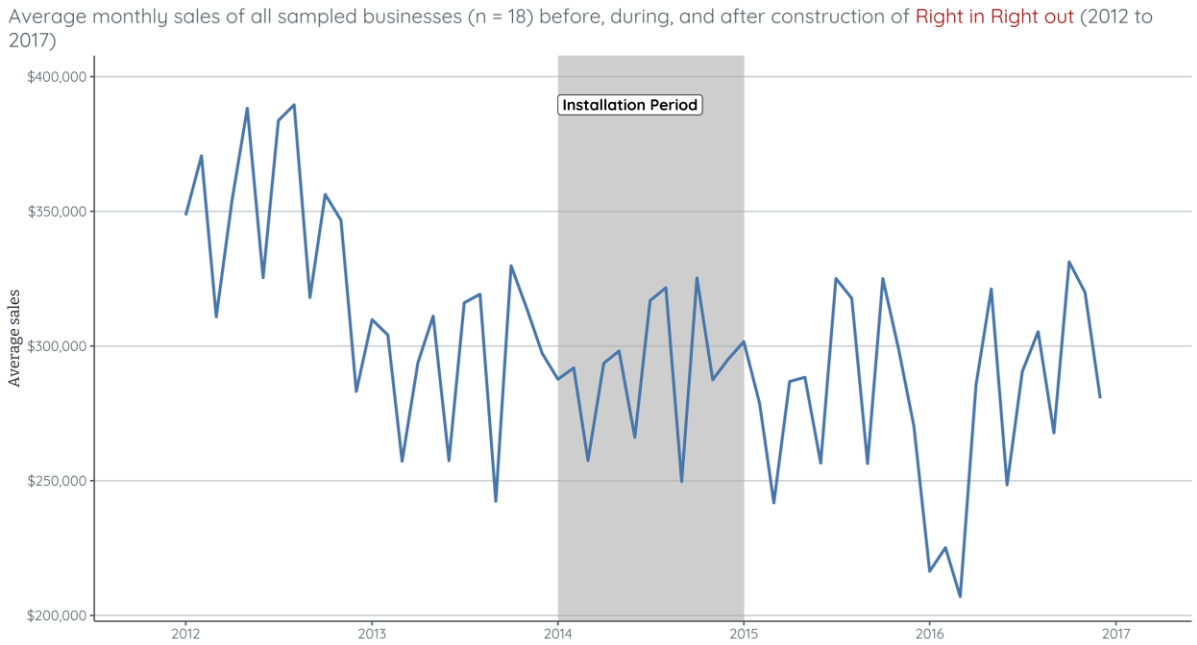


Figure 27 illustrates the average monthly sales of all sampled businesses on East Texas Street before, during, and after the construction of a Right-in-Right-out treatment. The monthly sales trend line shows a decrease from 2012 to 2013 followed by a steady fluctuation of monthly sales through the installation until the beginning of 2016, where aggregate sales experience a sharp decrease. This large decrease in sales overlaps with historic flooding in the area, which may explain the dip in sales around that time. Considering weather events and the steady sales trend from 2013 through the construction of the project to 2016, there is little evidence to suggest that the installation of the access management negatively impacted the aggregate sales of sampled businesses. Figure 5 demonstrates the location of this treatment site.

LA 383 – Iowa, LA 70647

Figure 28. Average Monthly Sales Trend of Sampled Businesses Before, During, and After Treatment Installation – LA 383

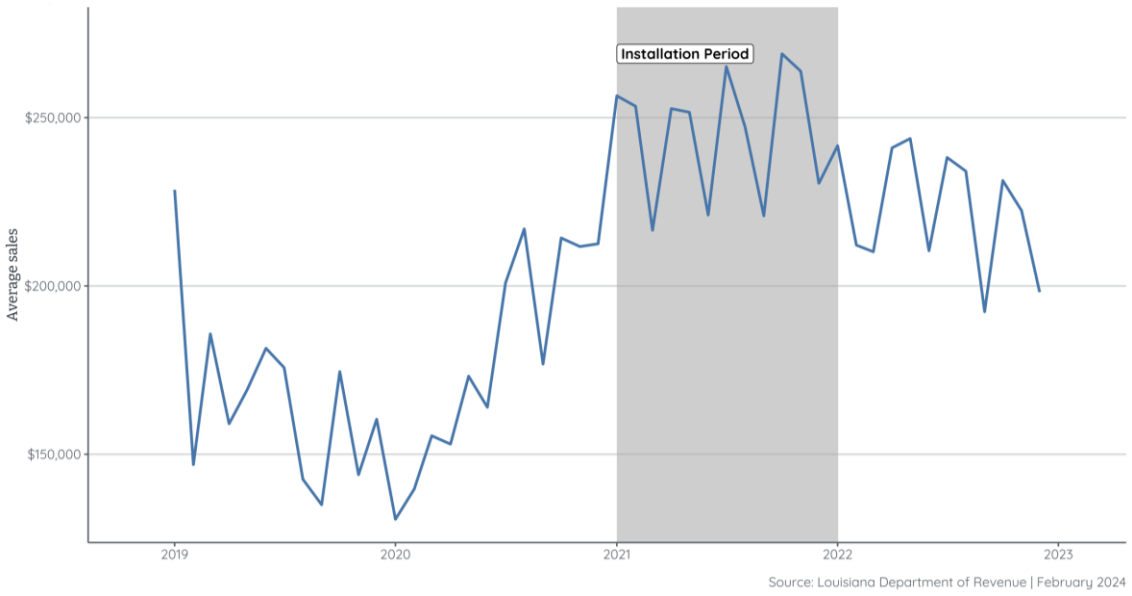


Figure 28 illustrates the average monthly sales of all sampled businesses (n = 7) at the LA 383 site before, during, and after the construction of a raised median. The monthly sales trend line shows a marked increase in sales over time, which holds through the installation period, with a slight downturn in the after period. The increasing sales trend over time and the stability through the installation period gives no indication that the installation of a center turn lane on LA 383 had a negative impact on sales in the site area. It is also of note that the center turn lane did not decrease or change access to businesses at this particular site after construction was completed. It is unlikely that any change in aggregate sales was due to the access management treatment.

Nelson Road – Lake Charles, LA 70601

Figure 29. Average Monthly Sales Trend of Sampled Businesses Before, During, and After Treatment Installation – Nelson Road

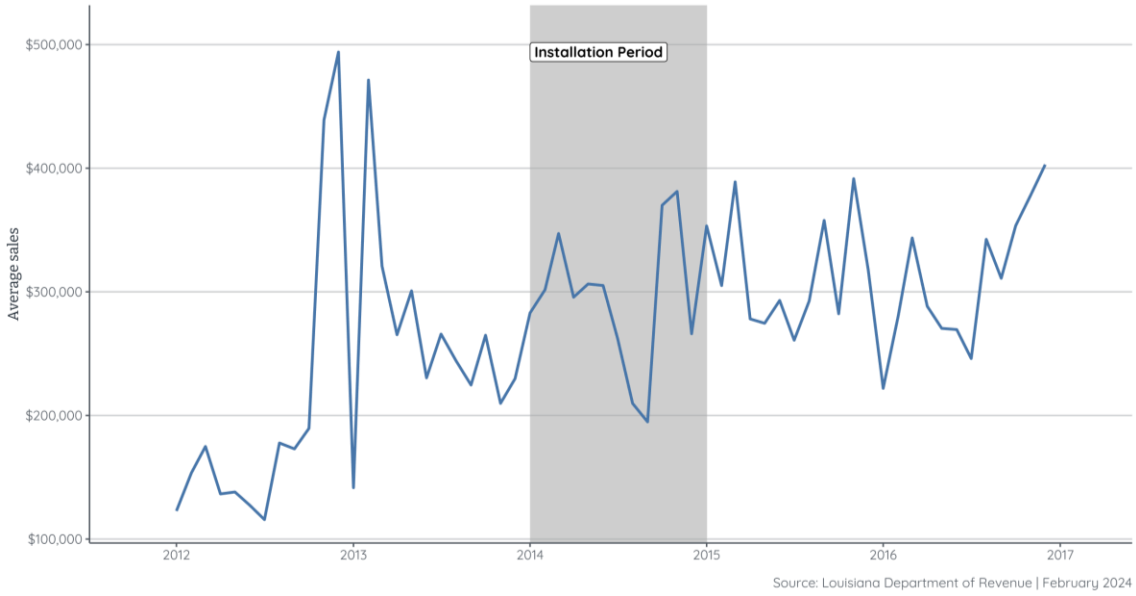


Figure 29 illustrates the average monthly sales of all sampled businesses (n =12) at the Nelson Road site before, during, and after the construction of a raised median. The trend line shows a marked increase in aggregated sales over time. While there are several large dips from month to month, the overall trend does not seem to be affected by any single monthly decrease in sales. As such, there is little evidence that the raised curb channelization installations on Nelson Road negatively impacted the sales of nearby businesses.

Linear (OLS) Model Analysis

A linear model regression analysis was used to examine the economic impact of access management treatments on roadside businesses' annual sales. The study analyzed all available sales data from the different sites. The analysis aimed to quantify any statistically significant differences between the change in sales of businesses directly affected by access management treatments (treatment group) and the change in sales of businesses not directly impacted by the treatments (control group) over their respective before and after periods of construction. Additionally, researchers controlled for various economic and demographic variables across all years and site-specific locations. Notable exclusions from the data include the Nelson Road site, which did not include sales data from businesses directly affected by access management treatments (treatment group).

Table 4. Linear Regression Results for Change in Sales

Variable	Estimate	Std. Error	t value	p value	Significance
4-H Club Road	12.06	3.079	3.916	0.0001	***
East Texas Street	12.20	5.565	2.192	0.0287	*
LA 21	12.17	4.297	2.833	0.0048	**
LA 383	13.03	2.280	5.716	<0.0001	***
Ryan Street	11.05	5.556	1.989	0.0471	*
US 190	12.37	4.406	2.807	0.0051	**
West Bert Kouns	13.13	5.571	2.356	0.0187	*
Treatment	-0.354	0.381	-0.930	0.3528	-
After	-0.0106	0.348	-0.030	0.9757	-
Average Household Income Inflation Adjusted by Zip Code	0.000004165	0.0000272	0.153	0.8783	-
Average Unemployment Rate by Parish	-0.0661	0.0818	-0.808	0.4192	-
Establishments by Zip Code	0.0002226	0.00123	0.181	0.8565	-
Interaction Treatment/After	**0.01213**	**0.3566**	**0.034**	**0.9729**	**-**

Summary Statistics

- Residual Standard Error: 1.939 (df = 706)
- Multiple R-squared: 0.9767
- Adjusted R-squared: 0.9763
- F-statistic: 2276 on 13 and 706 DF
- p-value: < 2.2e-16

Significance Codes

- *** p < 0.001
- ** p < 0.01
- * p < 0.05
- - p > 0.05

Table 4 and the following statistics present the statistical outputs of the regression model. It includes coefficients, indicating the effect size of each variable; standard errors, which provide an estimate of the variability of the coefficient; t-values, which are the ratios of the coefficient to its standard error; and p-values, which indicate the probability of observing any effect equal to or larger than what would be observed if the null hypothesis (of no effect) were true.

Variables

Dependent Variable

- The logarithm of annual sales by business. The logarithm of annual sales was used to reduce the effects of outliers in the data and induce linearity. The coefficient can be interpreted as the percentage change in the dependent variable for a one-unit change in the independent variable, holding other variables constant.

Independent Variables

- Sites: Each site has its own coefficient; therefore, the results are not in reference to another site. The significance levels informed by the p-value show that each site's sales are significantly greater than 0, which is meaningless in this context. However, it was necessary to give each site its own coefficient to control for the specific time and location factors of each site, which inform the other results.
- Treatment: Businesses directly affected by the access management treatment were assigned to the treatment group, and businesses that were in the same approximate area,

but not directly affected by the treatment, were assigned to the control group. The control group is used as the model reference, and its statistical results on sales can be interpreted as the treatment group compared to the control group.

- After: Sales data from years after an access management treatment was installed were assigned to the after group, and sales data from years before the access management treatment was installed were assigned to the before group. Sales data in the before group were used as the reference point in the model, and statistical results should be interpreted as the after group compared to the before group.
- Interaction Term / After: Interaction between the treatment/control group and before/after group testing the differential effect of the treatment from before to after. The control group and the before period were used as reference data for the model. Results should be interpreted as sales of the control group from before to after compared to the sales data of the treatment group from before to after.

Economic and Demographic Control Variables

- Annual unemployment rate of each parish where a site is located.
- Estimated number of establishments by zip code in which each site is located.
- Average household income adjusted for inflation by zip code in which each site is located.

The Model

The model controls for unobserved heterogeneity by focusing on changes within sites over time. The regression model helps to eliminate biases in parameter estimation that could result from omitted time-invariant characteristics of each site.

Model Fitness

- Residual Standard Error: 1.939, indicating average deviations of observed values from model predictions.
- Multiple R-squared: 0.9767, suggesting that nearly 97.67% of the variability in sales is explained by the model.
- Adjusted R-squared: 0.9763, confirming the model's effectiveness after adjusting for the number of predictors.
- F-statistic: 2276 on 13 and 706 degrees of freedom, with a p-value of less than 2.2e-16, indicating the model and its predictors significantly affect the sales outcomes.

These results indicate a highly effective model with strong explanatory power and statistical significance.

Key Findings

The intention of statistical analysis was to determine whether there were significant sales differences between treatment and control groups before and after the implementation of the treatments. Utilizing a linear regression model, the analysis included a specific focus on separating each site due to their unique regional and temporal characteristics, which was achieved by treating each site as its own factor within the model.

The results from the regression analysis indicated that there were no statistically significant differences in the sales changes between the treatment and control groups across the before and after periods of the access management treatment. This suggests that the treatments did not have a uniform impact on sales across different sites. The model's inclusion of site-specific factors highlighted varying economic performances, which were significantly influenced by the unique conditions at each location. Despite these variations, the overall analysis across all sites demonstrated that there is no strong evidence that access management treatments significantly altered sales outcomes for the roadside businesses involved in the study.

Business Survey

Overview

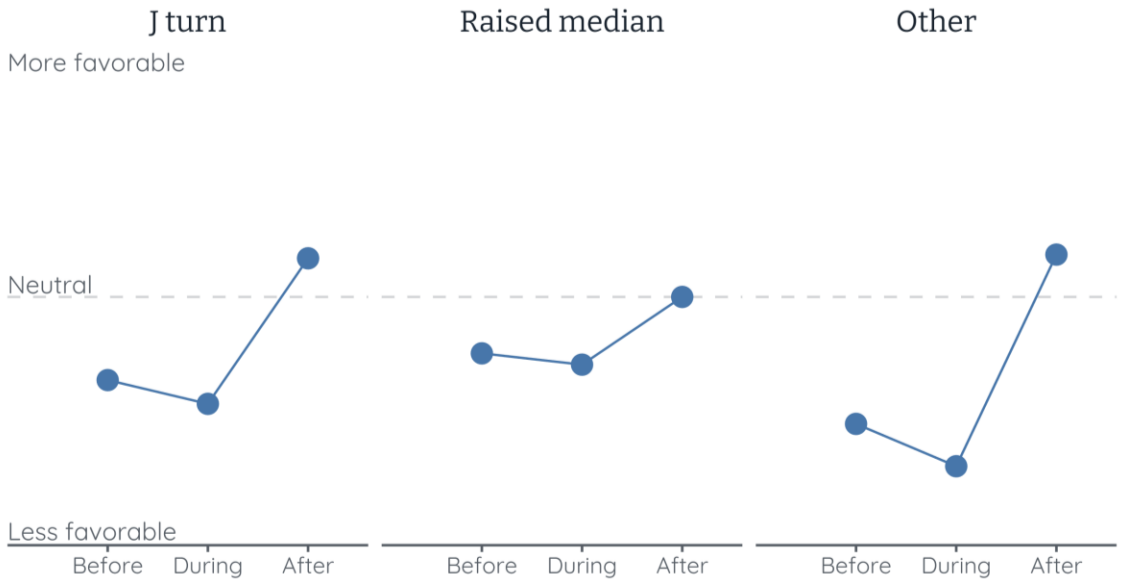
From October 2023 to May 2024, a business telephone survey was conducted to assess attitudes toward access management treatments on roadways. The survey collected 98 completed responses across 9 different sites in Louisiana.

Interestingly, less than 30 percent of businesses and their feedback from customers indicated any issues with the current operation of roadways. This provides some evidence that access management treatments are not perceived as particularly detrimental to affected businesses. However, it is relevant to note that these responses could also suggest a degree of adaptation to the existing conditions, especially since some of the treatments discussed date back as far as 2014. This acclimatization may have skewed perceptions of the roadway's functionality.

Regarding the factors deemed most important by businesses for their customers, product price, quality, and customer service were ranked highest. In contrast, travel distance and ease of access were considered less critical. This ranking suggests that, generally, businesses prioritize internal management and product-related factors over logistical concerns related to roadway configurations. However, this perspective may also be influenced by the prevailing economic conditions; if roadway issues were causing significant disruptions, these priorities might shift.

The most important finding from the analysis of survey results is that attitudes towards all access management treatments improved across sampled businesses. This overall positive shift indicates a potential acceptance or satisfaction with the changes made to manage access and traffic flow around these businesses.

Figure 30. Attitudes Toward Different Access Management Treatments by Treatment Group – Business Survey



As shown in Figure 30, the attitudes expressed by businesses towards projects in each of the three intervention groups broadly shared the same pattern. Business owners and operators expressed less favorable opinions prior to and during construction, with a move towards even less favorable attitudes during construction. However, they expressed moderately favorable opinions after the project's completion. Completion of the access management treatment marked a substantial improvement in favorability across all treatment types. While attitudes for raised medians showed the least improvement, attitudes toward this type of construction began at a more neutral level.

Figure 31. Attitudes Toward All Access Management Projects Before, During, and After Installation by Consumer Engagement Type – Business Survey

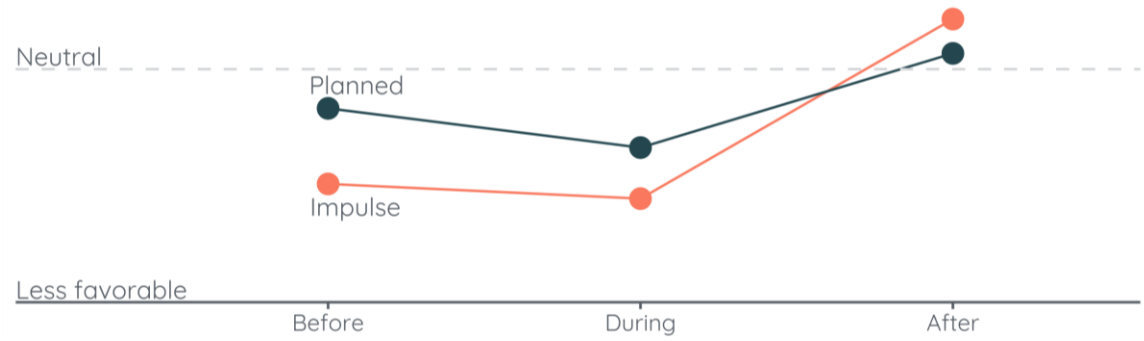
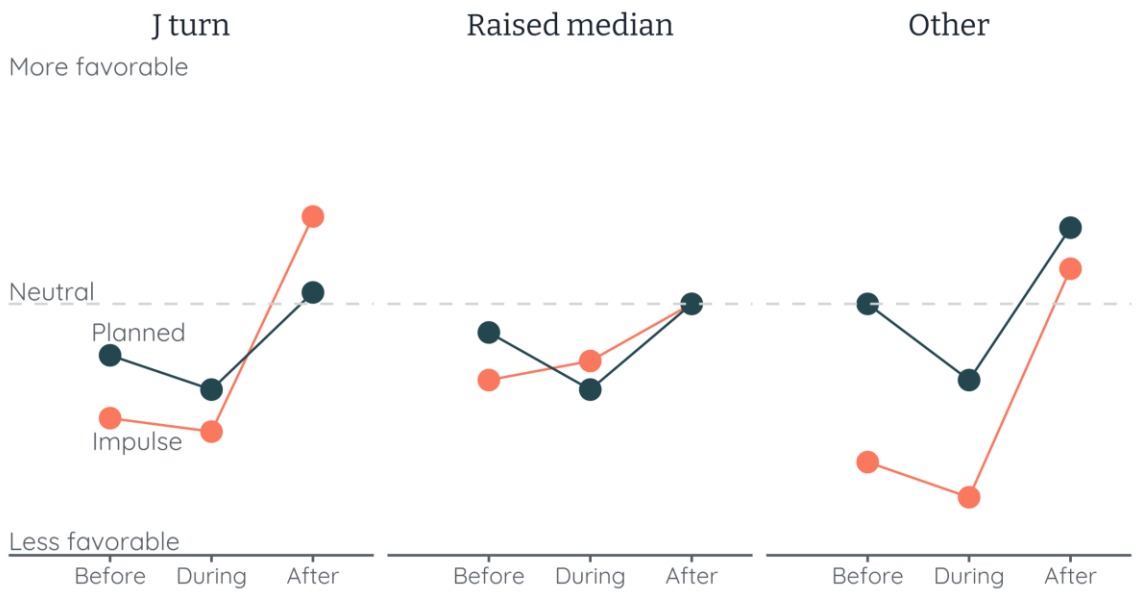


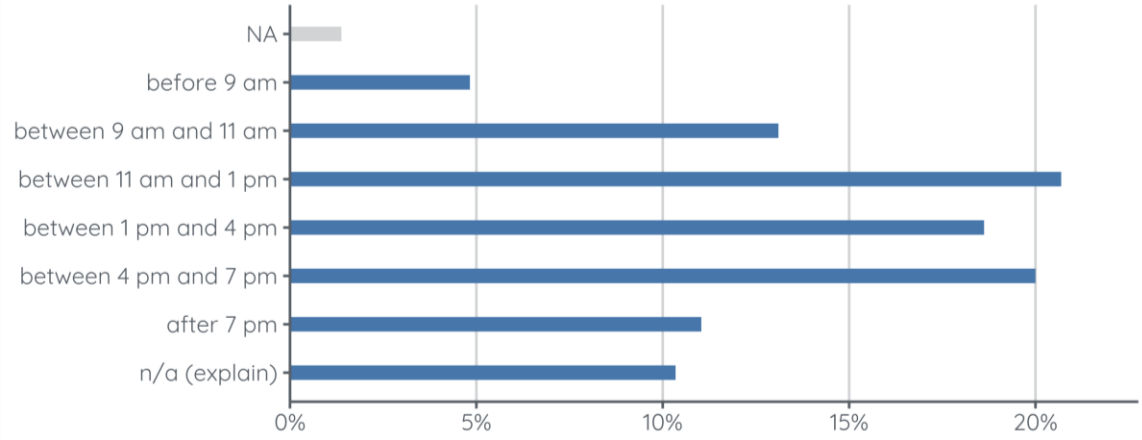
Figure 31 shows the overall attitudes toward access treatments before, during, and after installation, with responses grouped by businesses who said most of their customers plan to visit their premises versus businesses whose patronage is based more on impulse stops. Businesses who viewed their customer base as more intentional (i.e. they planned to go to their business before leaving their homes) were more neutral on the whole, whereas businesses who view their customer base as more impulsive (i.e. they visited because they saw their business as they drove by) were less favorable before and during construction, but reported being much more favorable after construction was complete. This survey question was based on the theory that if most business sales were due to patrons who impulsively visited, the construction of an access management treatment that decreased the ease of access to the business would also decrease the number of impulse shoppers. If this were indeed the case, those businesses would likely view the treatments more negatively than businesses where customers were intentional about their visit and would not be deterred by any potential travel inconvenience an access management treatment might cause. The results shown in Figure 31 support this theory. Businesses with a majority customer base that stopped impulsively viewed the planned roadway change and the construction period more negatively than their counterparts. After construction was completed, most impulse patronage based businesses viewed the treatment as more favorable than their counterparts. This could be due to a more efficient flow of traffic by their business, or the discovery that the expected negative impact on patronage did not occur. Overall, the increase in favorability for both groups towards the treatment from before to after construction indicates that the treatment did not cause any lasting economic impact or travel inconveniences.

Figure 32. Attitudes Toward Different Access Management Projects Before, During, and After Installation by Consumer Engagement Type – Business Survey



Similar to Figure 31, Figure 32 shows the attitudes toward access management projects before, during, and after construction by consumer type and access management treatment type. Broadly, a business that considers its customer base more impulsive became much more favorable after access management treatments were completed. Businesses that view their customer base as more intentional also reported increased favorability after the completion of installation. Apart from businesses who have a more impulsive customer base and are located near raised medians, perception trends show decreased favorability during construction, indicating that the conditions of the road during construction may have had a negative impact on patronage compared to roadway conditions in the absence of construction.

Figure 33. Busiest Hours of Operation as reported by All Business Owners and Operators



Business owners and operators were asked what times of day tended to be busiest for their businesses. Figure 33 shows the aggregated survey responses for hours of operation, indicating that busiest times for most businesses ranged between 11 a.m. and 7 p.m., in line with normal business hours.

J-Turn Sites

Figure 34. Busiest Hours of Operation reported by Business Owners and Operators located near the West Bert Kouns Site

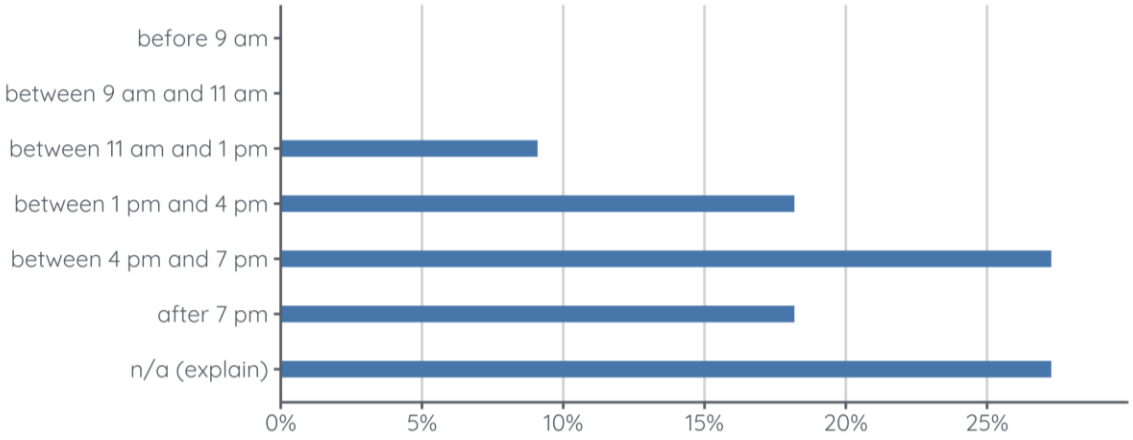


Figure 34 shows what times most business owners near the West Bert Kouns access management treatment project perceive as the busiest in terms of patronage. This site had a significant amount of variance, and no clear majority emerges. Over 25% of businesses reported that either the times between 4:00 p.m. and 7:00 p.m. were their busiest or that the question did not apply to them. The times between 1:00 p.m. and 4:00 p.m. and after 7:00 p.m. garnered over 15% each. Slightly less than 10% of businesses reported that the times between 11:00 a.m. and 1 p.m. were the busiest times for them. As seen in Figure 5, this treatment site and the surrounding businesses are near a residential part of Shreveport. As such, it makes sense that more economic activity occurs later in the day as patrons return home from work.

Figure 35. Busiest Hours of Operation as reported by Business Owners and Operators located at the LA 21 Site

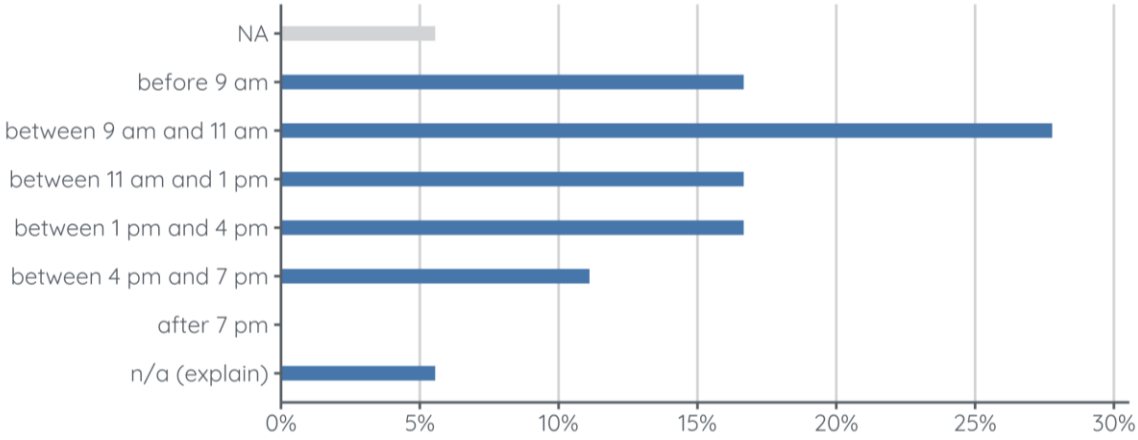


Figure 35 shows the times business owners near the LA 21 site consider busiest in terms of patronage. This site had a significant amount of variance, and no clear majority emerges. Over 25% of businesses reported that the times between 9:00 a.m. and 11:00 a.m. were their busiest times. Times before 9:00 a.m., between 11:00 a.m. and 1:00 p.m., and between 1:00 p.m. and 4:00 p.m. garnered over 15% each. Slightly more than 10% of businesses reported that the times between 4:00 p.m. and 7:00 p.m. were the busiest times for them. Slightly over 5% of businesses stated that the question was not applicable to them. Figure 3 demonstrates that this treatment site is in Covington, Louisiana.

Figure 36. Busiest Hours of Operation as reported by Business Owners and Operators located at the US 190 Site

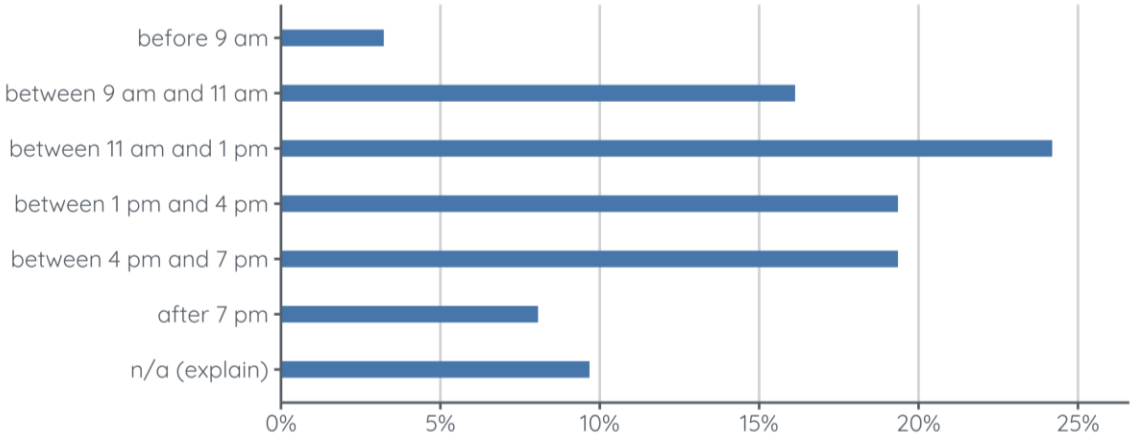


Figure 36 shows the times that business owners near the US 190/Tammany Parkway access management treatment projects perceive to be busiest in terms of patronage. This site had a significant amount of variance, and no clear majority emerges. Nearly 25% of businesses (a plurality) reported that either the times between 11:00 a.m. and 1:00 p.m. were their busiest times. The times between 1:00 p.m. and 4:00 p.m. and 4:00 p.m. and 7:00 p.m. garnered nearly 20% each. Slightly more than 15% of businesses reported that the times between 9:00 a.m. and 11:00 a.m. were the busiest times for them. Slightly over 5% of businesses reported that after 7:00 p.m. was their busiest time, and slightly less than 10% of businesses stated that the question was not applicable to them. Figure 3 demonstrates that this site is near Covington, Louisiana.

Figure 37. Business Perceptions on the Flow of Traffic at Peak Times near J-Turns

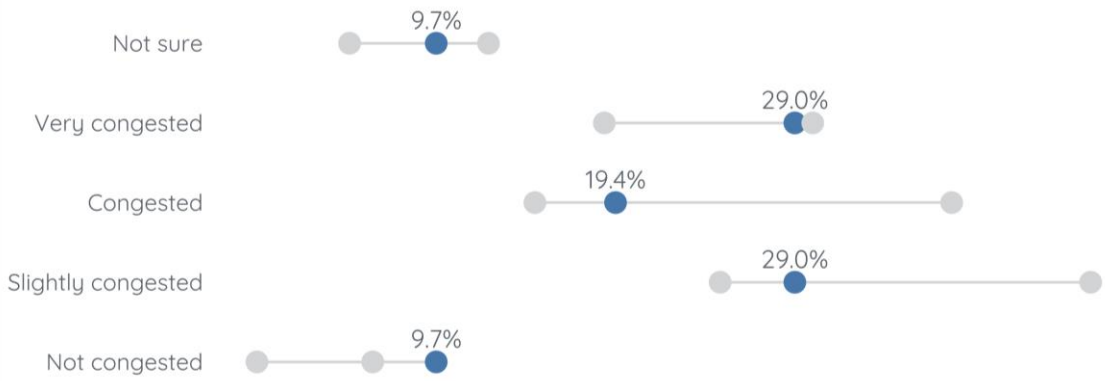
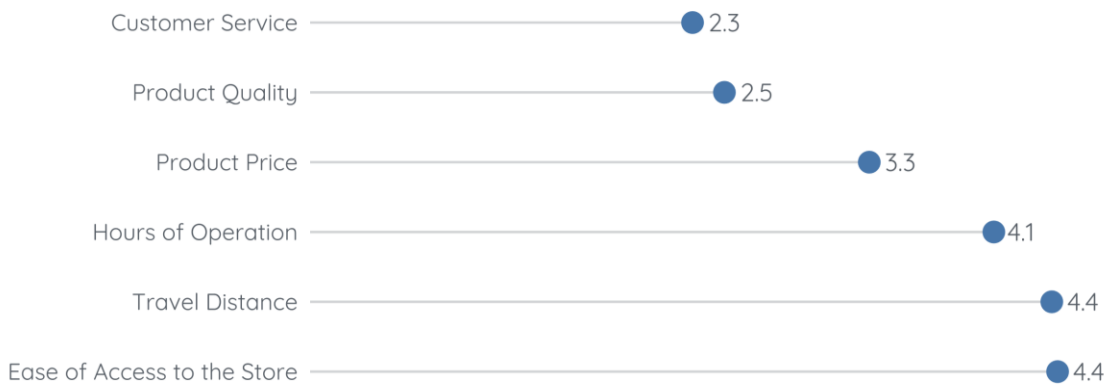


Figure 37 shows how business owners and operators located near J-Turns perceive traffic near their business at peak times. The dark shaded points represent the percentage of businesses near J-Turns with a specific perception as indicated by the level of congestion on the y axis. The light shaded points represent the alternative access management types (Raised Median and Other) for comparison. 77.4% reported perceiving the traffic as being slightly congested, congested, or very congested. Only 9.7% reported that it was not congested, and the same number of business owners reported being unsure of how to describe traffic near their business at peak times. With 77.4% of businesses reporting traffic congestion during their busiest times, we would expect to see more unfavorable attitudes toward access management projects (Figures 30, 33) if they were perceived to be the reason for traffic congestion, as well as more importance placed on ease of access and travel distance for their customers (Figure 38). Results show that this is not the case, indicating that the access management treatment itself is not, or is not known to be, the cause of poor traffic conditions, and perhaps by extension less patronage.

Figure 38. Business Owners' and Operators' Average Perceptions on the Importance of Selected Business Characteristics to Consumers – J-Turns



Business owners and operators located near J-turns were asked to rank business attributes in order of importance according to their customers' preferences, with one being the most important and six being the least important. Figure 38 shows that on average, business owners and operators reported customer service, product quality, and product price as more important than ease of access to the business, hours of operation, or travel distance. Notably, access and travel distance, two attributes that would typically be most impacted by access management treatments, were ranked last and second to last in terms of customer preferences by treatment affected businesses. These results, however, may carry a temporal bias, considering that many of these treatments were installed several years prior to the administration of the survey. Business owners may have given different answers immediately following the change in the roadway, but perhaps whatever negative feelings an access management treatment may initially produce for affected businesses does not last as both businesses and their patrons acclimate to the change.

Raised Median Sites

Figure 39. Busiest Hours of Operation reported by Business Owners and Operators located at the Ryan Street Site

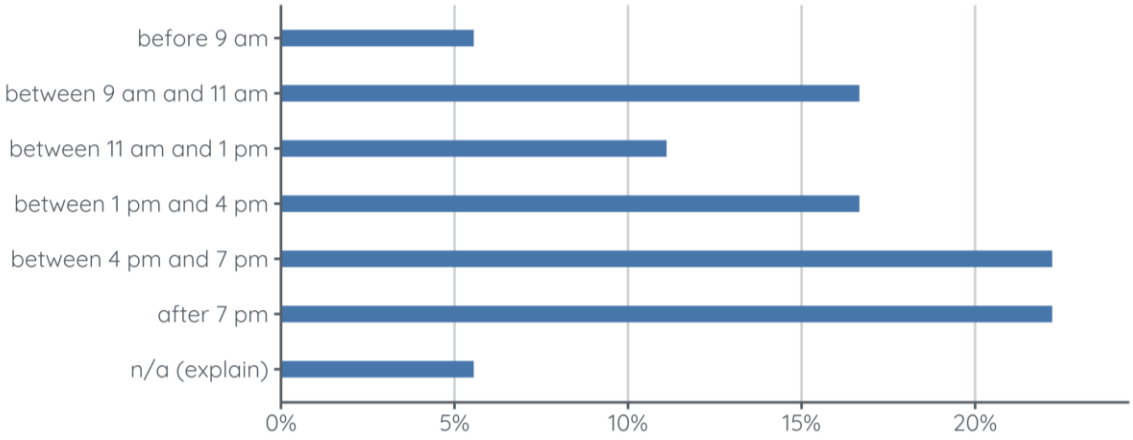


Figure 39 shows what times business owners near the Ryan Street/University Drive access management treatment project perceive to be their busiest. This site had a significant amount of variance, and no clear majority emerges. While over 20% each of businesses reported that either the times between 4:00 p.m. and 7:00 p.m. or after 7:00 p.m. were their busiest times, the times between 1:00 p.m. and 4:00 p.m. and 9:00 a.m. and 11:00 a.m. garnered over 15% each. Slightly more than 10% of businesses reported that the times between 11:00 a.m. and 1 p.m. were the busiest times for them. Slightly over 5% of businesses reported that before 9:00 a.m. was their busiest time, and slightly over 5% of businesses stated that the question was not applicable to them. Figure 4 reveals this treatment site's proximity to McNeese State University, which could explain the consistent activity and the trend towards later busy hours.

Figure 40. Busiest Hours of Operation reported by Business Owners and Operators located at the 4-H Club Road Site

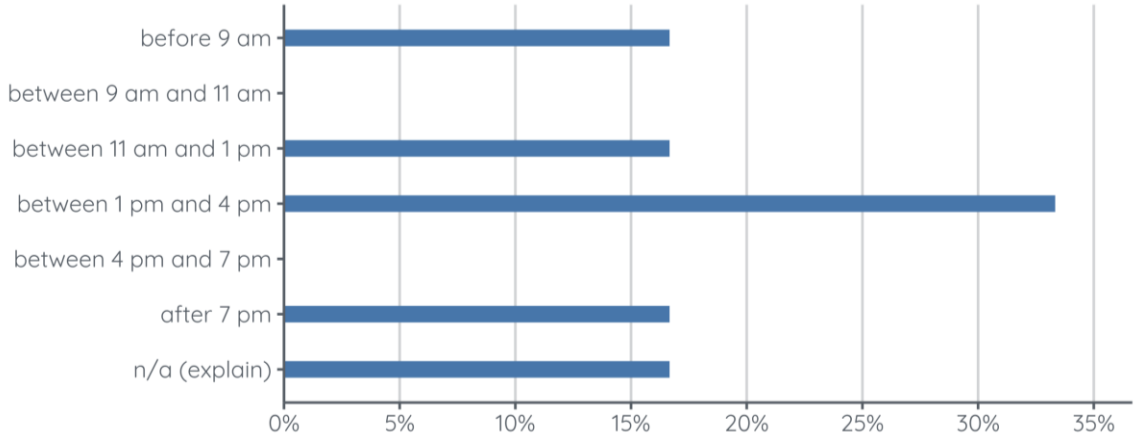


Figure 40 shows what times business owners near the 4-H Club Road access management treatment project perceive to be busiest in terms of patronage. This site had a significant amount of variance, with slightly over 15% reporting that times before 9:00 a.m., between 11:00 a.m. and 1:00 p.m., and after 7:00 p.m. were the busiest. Nearly 35% reported that the times between 1:00 p.m. and 4:00 p.m. were the busiest for them, and slightly over 15% stated that the question was not applicable to their business. Figure 3 demonstrates that this treatment site is in Denham Springs, Louisiana.

Figure 41. Busiest Hours of Operation reported by Business Owners and Operators located at the Ruth Street Site

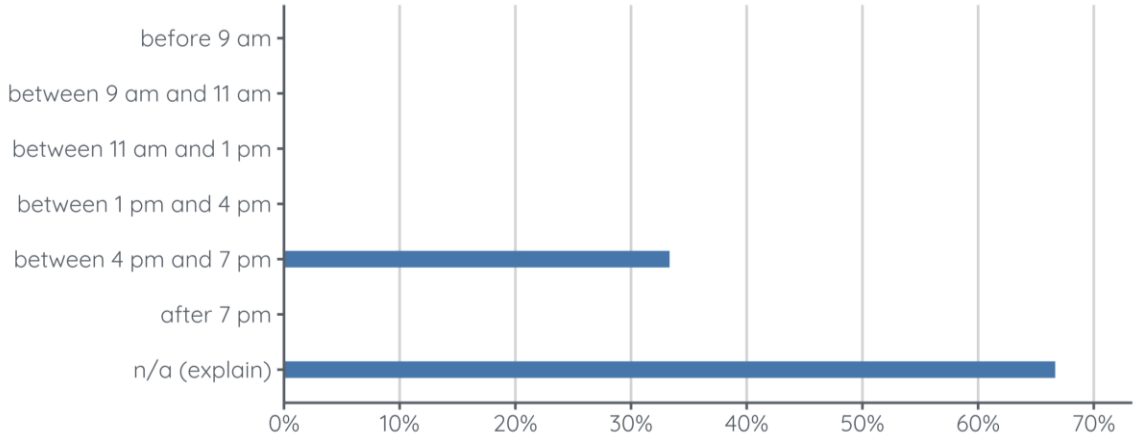


Figure 41 shows times that business owners near the raised median at the Ruth Street site perceive to be the busiest in terms of patronage. Two thirds of businesses reported that the question was not applicable, whereas one third described dinnertime hours (between 4:00 p.m. and 7:00 p.m.) as the busiest. Figure 4 demonstrates that this treatment site is on the western outskirts of Lake Charles, and experiences far less traffic than sites located in the Lake Charles city limits.

Figure 42. Business Perceptions on the Flow of Traffic at Peak Times near Raised Medians

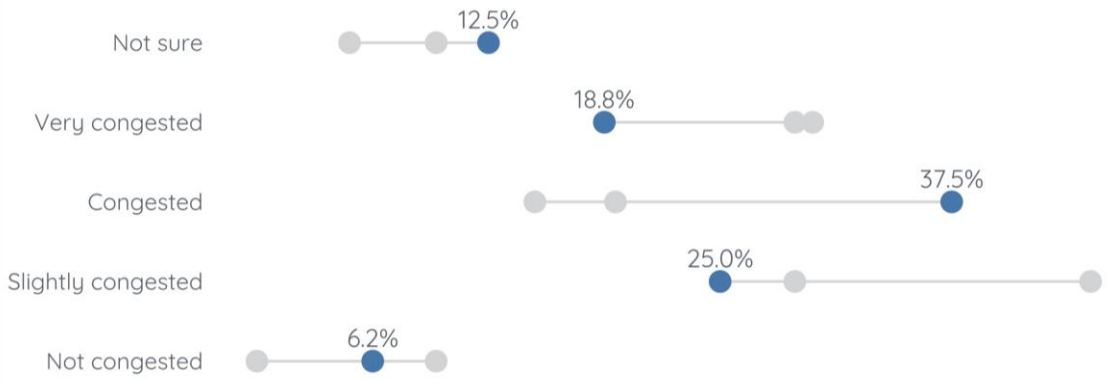
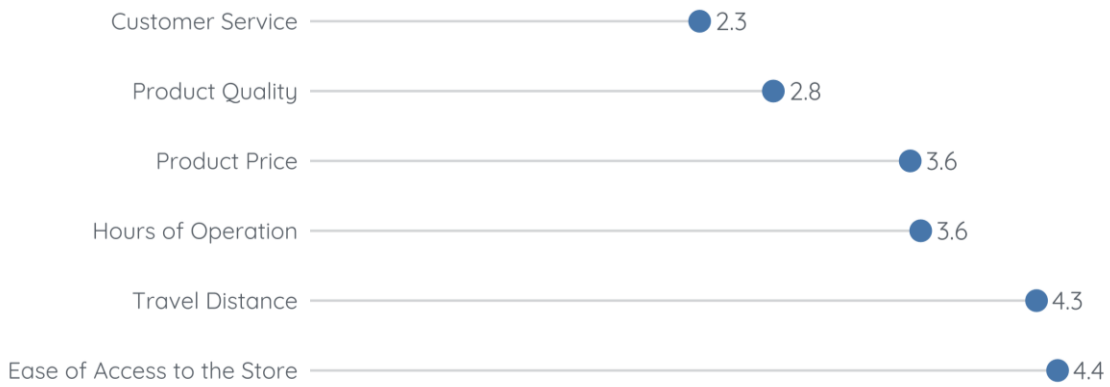


Figure 42 illustrates how business owners and operators located near raised medians perceive traffic near their businesses at peak times. The dark shaded points represent the percentage of businesses near raised medians, with the specific perception of traffic congestion indicated on the y axis. The light shaded points represent the alternative access management types (J-Turns and Other) for comparison. 81.3% reported perceiving the traffic as being slightly congested, congested, or very congested, and a plurality (37.5%) reported it just being congested (without any sort of qualifier). Only 6.2% reported that it was not congested. Some business owners (12.5%) reported being unsure of how to describe traffic near their business at peak times. With 81.3% of businesses reporting traffic congestion during their busiest times, we would expect to see more unfavorable attitudes toward access management projects (Figures 30, 33) if they were perceived to be the reason for traffic congestion, as well as more importance placed on ease of access and travel distance for their customers (Figure 43). Similar to J-Turn treatments, there is little evidence from perception survey results that indicate raised medians are the cause of poor traffic conditions or less patronage.

Figure 43. Business Owners' and Operators' Average Perceptions on the Importance of Selected Business Characteristics to Consumers – Raised Medians



Business owners and operators located near raised medians were asked to rank business attributes in order of importance according to their customer's preferences, with one being the most important and six being the least important. Figure 43 shows that on average, customer service, product quality, and product price ranked highest, while hours of operation, travel distance, and ease of access ranked lowest. Business owners near raised medians did not see ease of access or travel distance as having a strong influence on a customer's decision to choose their business. This could indicate that if the access management treatment did have a noticeably negative impact on patronage, or generate enough complaints, results may reveal factors directly related to the access management treatment ranked higher.

Other Treatment Sites

Figure 44. Busiest Hours of Operation reported by Business Owners and Operators located at the Nelson Road Site

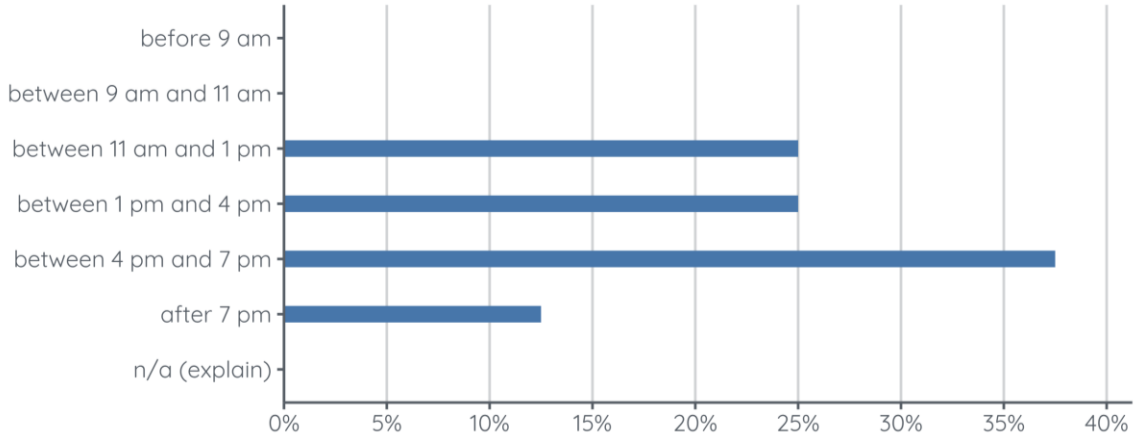


Figure 44 shows the times business owners near Nelson Road perceive to be their busiest in terms of patronage. Nearly 40% reported that evening hours between 4:00 p.m. and 7:00 p.m. were the busiest, whereas the times between 11:00 a.m. and 1:00 p.m. and 1:00 p.m. and 4:00 p.m. received 25% each; an additional 13% stated that the busiest time was after 7:00 p.m. Figure 4 demonstrates the area of Lake Charles where this site is located.

Figure 45. Busiest Hours of Operation reported by Business Owners and Operators located at the LA 383 Site

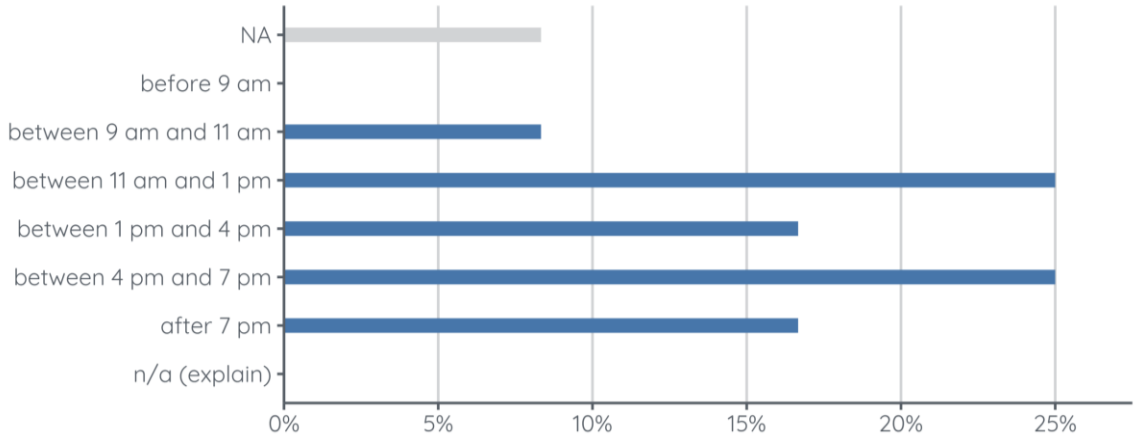


Figure 45 shows times that business owners located at the LA 383 site perceive to be the busiest in terms of patronage. Unlike businesses near other treatment sites, there is no clear majority. Less than 10% reported that between 9:00 a.m. and 11:00 a.m. was busiest, a quarter of businesses sampled reported times between 11:00 a.m. and 1:00 p.m. to be their busiest, and a quarter of businesses sampled reported 4:00 p.m. and 7:00 p.m. as their busiest. An additional 17% stated that the busiest time was between 1:00 p.m. and 4:00 p.m., and another 17% reported that their busiest time was after 7:00 p.m. Figure 3 demonstrates that this treatment site and the businesses sampled are in Iowa, Louisiana. Businesses sampled for this survey operate close to a truck stop on the outskirts of Iowa as vehicles enter or exit the town. The transitory nature of patrons in this area likely explains the more uniform distribution of customer activity for sampled businesses.

Figure 46. Busiest Hours of Operation reported by Business Owners and Operators located at the East Texas Street Site

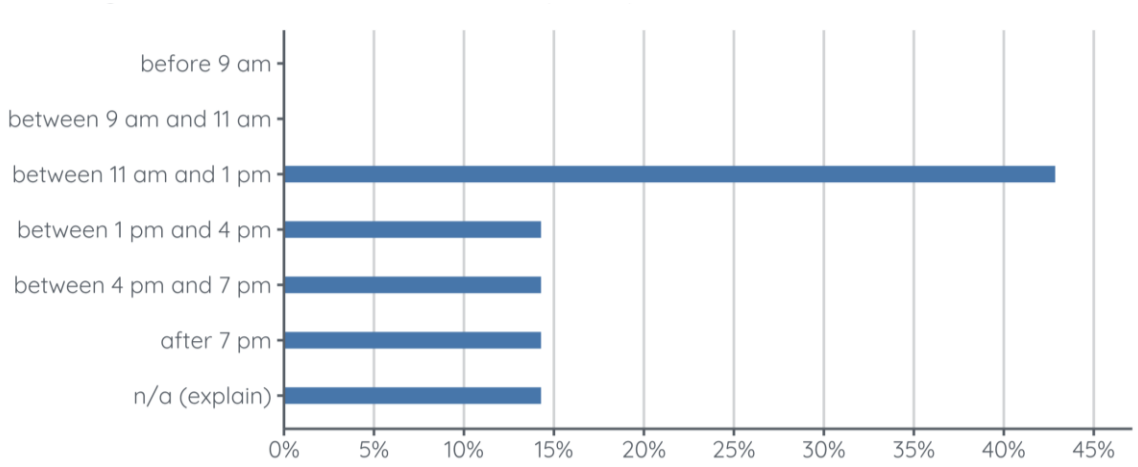


Figure 46 shows what times business owners near East Texas Street consider to be busiest in terms of patronage. Nearly 45% reported that lunchtime hours (between 11:00 a.m. and 1:00 p.m.) were the busiest, whereas the times between 1:00 p.m. and 4:00 p.m., 4:00 p.m. and 7:00 p.m., and after 7:00 p.m. received nearly 15% each; an additional 15% decline to answer or stated that it was not applicable. Figure 3 demonstrates that this treatment site and the surrounding businesses are near Barksdale Air Force Base, slightly east of Downtown Shreveport.

Figure 47. Business Perceptions on the Flow of Traffic at Peak Times near Other Treatments

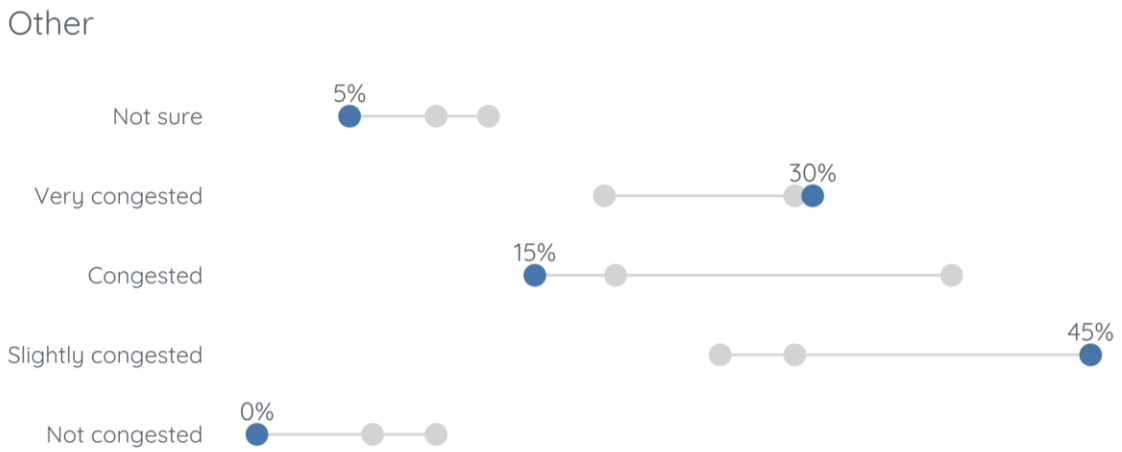
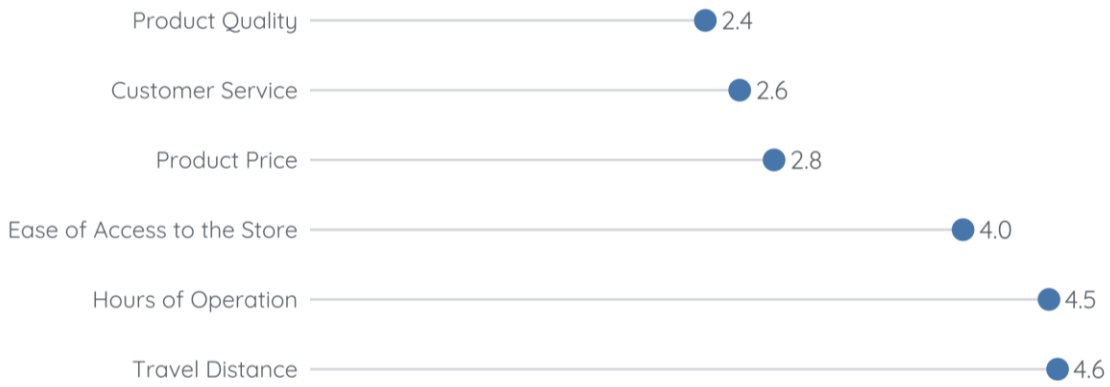


Figure 47 shows how business owners and operators located near all other types of access management treatments perceive traffic near their business at peak times. The dark shaded points represent the percentage of businesses near the RIRO, center turn lane, and raised curb channelization treatment types, with the specific perceptions of traffic indicated on the y axis. The light shaded points represent the alternative access management types (Raised Medians and J-Turns) for comparison. 90% reported perceiving the traffic as being slightly congested, congested, or very congested, though a plurality (45%) reported it being slightly congested. None reported the roadways as "not congested"; the only business owners or operators that reported anything other than congested were unsure of how to describe traffic near their business during peak hours. 90% of businesses reported traffic congestion across a variety of peak business hours, but as we see in Figures 30 and 33, the average attitudes of sampled businesses toward all treatments labeled "other" were found to be favorable after the treatments were installed. This indicates that while many businesses rate high levels of traffic congestion throughout the day, it does not seem to have an effect on how they view access to their business. Additionally, Figure 48 shows that on average, businesses at sites with treatments labeled as "other" rate ease of access and travel distance in the bottom 3 out of 6 important business attributes for customers, again implying that the access management treatments did not negatively impact their client base.

Figure 48. Business Owners' and Operators' Average Perceptions on the Importance of Selected Business Characteristics to Consumers – Other



Business owners and operators located near the access management treatments designated as "other" were asked to rank business attributes in order of importance according to their customers' preferences, with 1 being the most important and 6 being the least important. Much like results for J-Turns and raised medians, results highlighted in Figure 48 show that on average, customer service, product quality, and product price ranked highest, while hours of operation, travel distance, and ease of access ranked lowest. Again, if businesses perceived that factors like ease of access and travel distance were responsible for a decrease in patronage, we may see them ranked higher. However, this is not the case, providing the researchers with indirect evidence supporting the assumption that access management treatments are not responsible for decreases in patronage and sales in a significant way.

Patron Survey

Overview

During February 2024, 236 survey interviews were conducted with patrons at businesses near each access management site. Interviewees were asked about their consumer habits (i.e. were they visiting this business on a planned visit or on an impulse), the importance of a variety of factors on their decision to patronize a business, and their attitudes towards the access management projects before, during, and after construction efforts. Broadly, patron attitudes towards access management projects were neutral before construction, less favorable during construction, and more favorable after the project was completed, though there was some variation based on the consumer habits reported and the type of access management project. The data collected as part of these surveys seems to indicate that patrons have similar attitudes and patterns toward access management projects as business owners and operators. When it came to ranking the importance of business attributes, patrons ranked ease of access slightly higher than business owners, but overall, their selections show that access related factors like travel distance and ease of access were of lesser concern than customer service, product quality, and product price.

Figure 49. Attitudes Toward Different Access Management Treatments by Treatment Group – Patron Survey

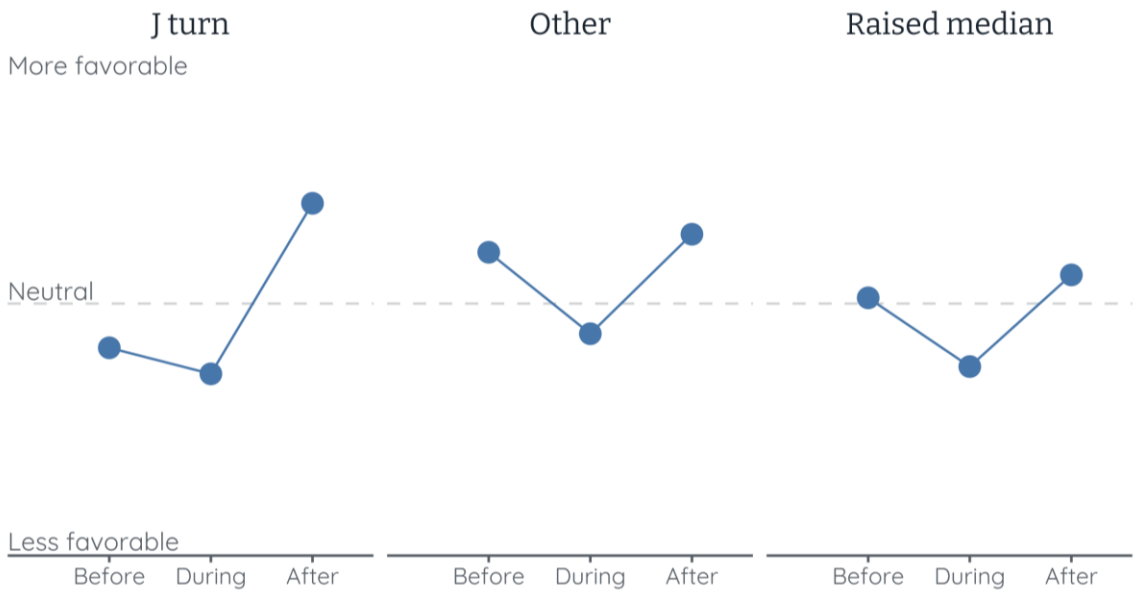


Figure 49 shows consumer attitudes towards J-turns, raised medians, and other access management treatments before, during, and after construction for all consumers. Attitudes before the treatments began were nearly neutral, declined during the construction project, then increased to a more favorable position once the installment was complete. This holds true across all treatment types.

Figure 50. Attitudes Toward All Access Management Projects Before, During, and After Installation by Consumer Engagement Type – Patron Survey

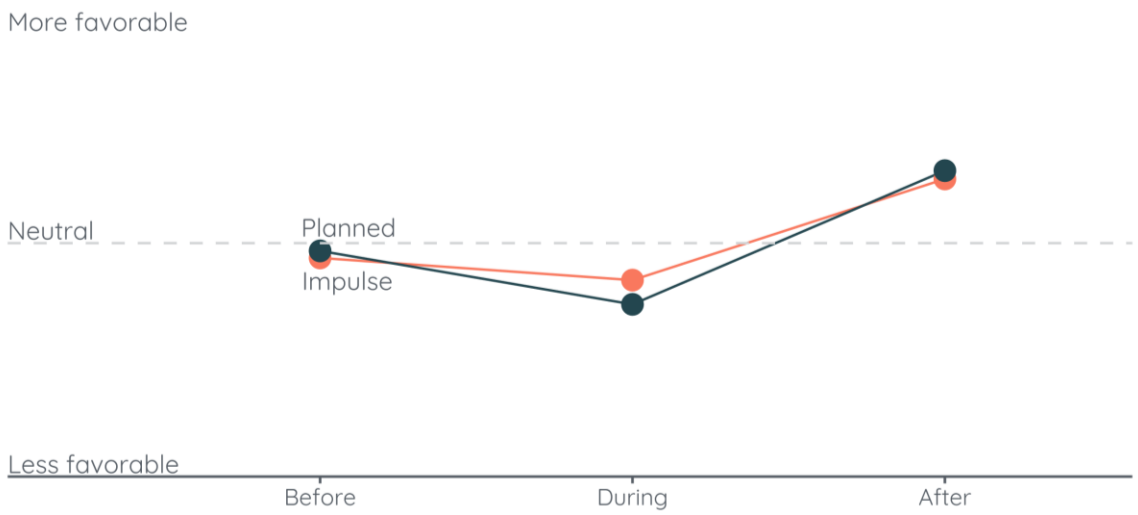


Figure 50 shows consumer attitudes towards access management treatments across all types before, during, and after constructions by consumer type. Attitudes toward treatments before are, on average, neutral. Although attitudes experience a slight decline in favorability during the installment period, attitudes reach peak favorability once the access management project is complete. This is true both for consumers who visited businesses based on impulse and consumers who planned their visits to businesses. The theory informing the question of impulsivity and the attitude distinction between the two groups is that a patron who makes an impulse stop at a business may have found that business easily accessible; as a result, they may have a more neutral attitude toward the roadway changes they were asked about because they did not have to change how they navigated the roadways to get there. A customer who planned to stop at a business may have a stronger opinion about business accesibility if the access management had increased the time and distance it took to reach that business. The overall similarity of results between the two groups suggests that this type of consumer behavior does not strongly influence attitudes toward access management treatments.

Figure 51. Attitudes Toward Access Management Projects Before, During, and After Installation by Consumer Engagement Type – Patron Survey

Figure 51 shows consumer attitudes towards J-turns, raised medians, and other access management treatments before, during, and after construction by consumer type. Attitudes before the treatment installation are generally neutral. Attitudes after treatment remain the same as before, or experience an increase in favorability toward the treatment. For J-turns and raised medians, both consumers that plan their trips to businesses and those that visit businesses on impulse became less favorable during construction, but reported much higher favorably once construction was complete. For all treatments designated as “other”, this trend holds for consumers that plan their trips to businesses. However, consumers visiting on impulse reported consistently increased favorability toward access management projects.

J-Turn Sites

Figure 52. Importance of Selected Business Characteristics to Consumers (near J-Turns) – Patron Survey

Figure 52 shows how consumers surveyed near J-Turns weigh the importance of selected factors when they decide which businesses to patronize. Consumers were asked to rank the importance of each factor relative to one another. Accessibility to stores and travel distance (the two factors most likely to be influenced by access management treatments) ranked above customer service and hours of operation but were broadly considered less important than product price and product quality. These results differ from the business survey, where ease of access and travel distance consistently ranked in the bottom three in terms of importance. The higher ranking of ease of access by patrons may signal difficulty navigating the roadway and indirectly implicate access management treatments as a contributing factor. Overall, product price and quality remain the most important factors for both businesses and consumers.

Raised Median Sites

Figure 53. Importance of Selected Business Characteristics to Consumers (near Raised Medians) – Patron Survey

Figure 53 shows how heavily consumers near raised medians weigh the importance of selected factors when they decide which businesses to visit. Consumers were asked to rank the importance of each factor relative to one another. Accessibility to stores and travel distance (the two factors most likely to be influenced by access management treatments) ranked above product quality and hours of operation but were broadly considered less important than product price and customer service.

Other Treatment Sites

Figure 54. Importance of Selected Business Characteristics to Consumers (near Other Treatment types) – Patron Survey

Figure 54 shows how heavily consumers at RIRO, center turn lane, and raised curb channelization treatment sites weigh the importance of selected factors when they decide which businesses to patronize. Consumers were asked to rank the importance of each factor relative to one another. Consumers at these sites ranked accessibility to stores second to last in terms of importance, while travel distance ranked second highest. Both factors can be influenced by an access management treatment, but it is difficult to say if the specific treatments in this study influence these rankings or other roadway conditions in the general area of these sites. Considering the more isolated nature of these access management treatments in terms of how access on and off the roadway is affected, the high ranking of travel distance and the low ranking of ease of access may indicate an influencing factor other than the specific treatments in this study.

Conclusions

The purpose of this study was to assess the economic impact of access management treatments on businesses in the corridors where they have previously been installed in Louisiana. This was accomplished by analyzing sales tax data from nearby businesses. A secondary objective was to provide insight into any access-related concerns among businesses and their patrons near the access management treatments. This was accomplished using several survey methods. This section summarizes the findings and conclusions, which have implications for the implementation of access management strategies in Louisiana.

Economic Impact Analysis

The study conducted a comprehensive examination of the economic impacts of various access management treatments on roadside businesses, utilizing observational analysis of trends in sales averages and significance testing through t-tests and regression analysis.

J-Turns

For sites with J-Turn installations, no significant increases or decreases in aggregate sales were observed at the LA 21, US 190, and West Bert Kouns sites, and the majority of individual businesses between these three sites experienced significant positive changes in average monthly sales from before to after treatment installation. The findings in this report provide no strong evidence that J-Turns negatively impacted the sales of sampled businesses.

Raised Medians

A Wilcox Ranked Test comparing the aggregate yearly sales of the 4-H Club Road and Ryan Street site businesses show a significant positive increase and an insignificant positive increase in average aggregate yearly sales, respectively. These results are slightly contrasted by t-test results that found between both sites, the log transformed monthly sales of nine individual businesses were significantly negatively impacted over time, while the sales of eight individual businesses were significantly positively impacted over time. Observational analysis shows that despite some volatility in aggregated monthly sales trends, these sites do not appear to experience any clear negative economic impact over the course of years before, during, and after the access management treatments were installed. Acknowledging that there were a number of individual businesses that experienced significant decreases in sales, the aggregated statistical

analysis and observation of trends show no clear evidence that raised medians were the cause of a change in sales, either positive or negative.

Other Treatments

Remaining treatments sites show similar results. Aggregate sales analysis of the East Texas Street site showed a non-significant decrease in sales after the implementation of the Right-in Right-out construction project; however, most individual businesses did experience a significant negative change in sales between before and after periods as evidenced by t-test results. Monthly trends appear to be stable throughout the installation period and after with a large dip in sales corresponding with historic flooding in the area in 2016. There is not a clear indication that the Right-in-Right-out treatment was a contributing factor, with the downturn in sales of sampled businesses more likely explained by economic factors and severe weather events in the area. By contrast, sampled businesses near the center turn lane addition at the LA 383 site and the raised curb channelization installation on Nelson Road both show non-significant aggregate increases in sales, with a majority of individual businesses experiencing positive significant changes from before to after treatment, discouraging any conclusion that the treatments had negative economic impact on sampled businesses.

Regression Analysis

The results of the regression analysis, examining the impact of access management treatments on business performance, showed no significant evidence of either a positive or negative effect when controlling for site-specific factors and broader economic conditions. The high adjusted R-squared value of 0.9763 indicates that the model fits the data well, capturing a significant portion of the variability in log-transformed total annual sales across various sites. The interaction between treatment and time was not statistically significant, suggesting that the treatments did not have a significant impact on sales performance across the study period.

This analysis underscores the complexity of attributing changes in business performance to specific interventions like access management treatments, particularly when such effects may be caused by more influential factors such as location, market dynamics, and economic conditions. The lack of a significant impact from these treatments could indicate that there is no measurable impact of this type of access management treatment on business activity, or that other factors play a dominant role in shaping business outcomes, making potential minor changes related to access management difficult to detect. Overall, the analysis finds no strong evidence of an economic impact from access management treatments on affected businesses.

Concluding Remarks

The business sales analysis indicated that there is little evidence of a correlation between access management treatments and changes in aggregated business sales. This does not mean that businesses cannot be negatively affected by these treatments, but rather that the statistical analysis and aggregated trends of the sample did not provide sufficient evidence that access management treatments influence either an increase or decrease in sales. Factors such as business size, business type, the measured increase or decrease of distance to a business an access management treatment causes, and the ability and willingness of a business to relocate could not be linked to sales tax data due to confidentiality restrictions, thereby presenting a potentially large research gap. Targeted research around a narrower number of sites with a large sample size of businesses could provide additional evidence in the future. Larger sample sizes enhance the statistical power of the analysis, enabling the detection of smaller effects that may otherwise be overlooked in smaller datasets. This is particularly critical in studies assessing the nuanced impacts of interventions such as access management treatments, where the effects may not be immediately obvious, or may be small relative to other factors that determine levels of the outcome variable (e.g. sales). However, considering the lack of statistical evidence of economic impact and the relative consistency of steady or increasing sales trends during the study periods of each site, this study suggests that the installation of access management treatments has no impact, or a negligible impact, on the economic success or decline of nearby businesses.

Perception Surveys

The findings from both the business owner and patron surveys conducted around different types of access management sites (J-turns, raised medians, and other treatments) revealed a consistent pattern regarding attitudes toward these projects. Both groups initially displayed neutral or slightly unfavorable attitudes towards these projects, with a noticeable dip during the construction phase. However, post-construction, there is a rebound to more favorable attitudes.

J-Turns

The average attitude toward J-turns among both businesses and patrons initially showed neutrality or slight unfavorability, which dipped further during construction due to disruptions. However, post-construction attitudes improved significantly, reflecting an adaptation to and acceptance of the new traffic configurations. Businesses emphasized that factors like service quality and product value remained more critical than ease of access, suggesting that the core business attributes outweigh the temporary inconveniences caused by construction.

Raised Medians

For businesses near raised medians, the average pattern in attitude towards access management treatments was similar, with the trend shifting from neutral to unfavorable during construction with a significant improvement afterward. Additionally, out of the six factors that customers find most important about a business, both patrons and businesses ranked access related factors in the bottom three. This indicates that, on average, raised medians are not causing enough disruption to alter consumer priorities.

Other Treatments

At locations with other types of access management treatments, attitudes followed a similar pattern. Despite varying busy times and local factors affecting traffic, the completion of these projects generally led to improved perceptions among patrons and businesses. Once again, the data highlights that while access management treatments can be temporarily perceived as negative, their manipulation of access, travel distance, and travel time to a business are not substantial enough to alter the top business and patron rankings of consumer priorities (i.e., customer service, product quality, and product price) determined at the time of the study.

Summary

These surveys indicated a level of resilience and adaptability among both business owners and patrons when it comes to navigating changes caused by access management projects. Despite initial and mid-project setbacks in attitudes, likely due to construction-related disruptions, there is a clear recovery and overall enhancement in perceptions once the projects are completed. Importantly, the fundamental drivers of consumer choice—product quality, price, and customer service—consistently ranked higher in importance than factors directly affected by access management, such as ease of access and travel distance.

These perception findings suggest that while the implementation of access management treatments is initially met with some concern, particularly during the construction phase, their perceived negative impacts are temporary, and eventually, attitudes become more positive.

Recommendations

Long term work to improve safety and efficiency in the movement of traffic has sometimes been met by opposition from the business community due to concerns about project impacts on economic activity. This study contributes to a growing body of evidence showing no pattern of negative impacts to businesses from the implementation of access management treatments. By examining a broader set of project types than had previously been studied in Louisiana, this study provides new evidence to reassure businesses about the typical impacts of access management treatments on economic activity.

The findings can be used by planners to engage the business community and the general public to create a more collaborative environment for advancing projects that can improve safety and efficiency in the movement of traffic. Taken in combination with prior research on J-turns in Louisiana, and findings from studies in other states, this information helps to reinforce a public benefit as well as address concerns about potential negative impacts to businesses before, during, and after their construction on the roadway.

To ensure ongoing effectiveness and address potential lingering concerns from the business community about access management, DOTD could implement comprehensive data collection strategies for future research and monitoring activities related to access management treatments. This could include the use of traffic flow sensors, business performance surveys, and periodic safety audits. Engaging with local businesses to gather qualitative data on their experiences before, during, and after project implementation will also be valuable and provide an opportunity to collect business data in real time, rather than relying on retrospective surveys. Additionally, leveraging modern data analytics and geographic information systems (GIS) can enhance the understanding of traffic patterns and economic impacts over time. This type of ongoing and proactive data collection and analysis will not only provide continuous feedback for improving access management strategies but also foster transparency and trust between DOTD and the business community. Finally, Louisiana has recently established a new state data center known as LA FIRST, which contains longitudinal wage record data on employers. This database may be a source of information in future studies to track changes in activity over time, providing greater visibility into industry-specific trends within an area than can be gleaned through de-identified sales tax data.

Acronyms, Abbreviations, and Symbols

Term	Description
API	Application Programming Interface
DOT	Department of Transportation
DOTD	Department of Transportation and Development
LTRC	Louisiana Transportation Research Center
NCHRP	National Cooperative Highway Research Program
RIRO	Right-in-Right-Out

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Appendix

2023 - 2024 Access Management Business Survey

- Survey Flow
- Block: Interviewer Information (2 Questions)
- Standard: Consent and Screening (5 Questions)
- Standard: Respondent Employment (1 Question)
- Standard: Business Operation (4 Questions)
- Standard: Customer Type (2 Questions)
- Standard: Roadway Safety and Access Management Treatment (11 Questions)

Page Break

Start of Block: Interviewer Information

Page Break

Q1 blanco_id

_____

Q1.1 interviewer_id

_____

End of Block: Interviewer Information

Start of Block: Consent and Screening

Q2

Hello this is _____ from the Kathleen Blanco Public Policy Center at the University of Louisiana at Lafayette. We are conducting a short survey on behalf of the Louisiana Transportation and Research Center to gain insight into roadway issues that businesses in the area are currently experiencing. Do you have 5 to 10 minutes for a brief survey?

If no:

Is there a more convenient time we can call back? (record answer on separate document and into excel spreadsheet)

If yes:

Thank you, your responses will remain anonymous, and more than 200 other businesses will be included in this study. Your business name will be attached to the survey responses only to assist with survey administration; however, no identifying information will be released to the public. If you have questions during this survey, please ask me. There are no anticipated risks or benefits for you to take our survey, however results from this study will be used to help inform policy and decision-makers at the Department of Transportation and Development. If you have any questions or concerns about this study or your rights as a research participant, please contact Stephen Barnes at the Kathleen Blanco Public Policy Center (337-482-5014) or the IRB Chair at the University of Louisiana at Lafayette (337-482-5811).

Q3 Do I have your permission to continue with the survey?

o Yes (1)

o No (2)

Skip To: End of Survey If Q3 = No

Q4 Are you at least 18 years old?

o Yes (1)

o No (2)

Skip To: End of Survey If Q4 = No

Q5 Have you worked at this location for at least two months?

o Yes (1)

o No (2)

Display This Question:

If Q5 = No

Q6 Prior to accepting your current position, was your former place of work located in the same general area?

o Yes (1)

o No (2)

Skip To: End of Survey If Q6 = No

End of Block: Consent and Screening

Start of Block: Respondent Employment

Q7 How long have you worked at this location?

o Years (1) _____

o Months (2) _____

End of Block: Respondent Employment

Start of Block: Business Operation

Q8 How long has this business been operating at this location?

o 0-5 years (1)

o More than 5 years, less than 10 (2)

o More than 10 years (3)

o Not sure (4)

Q9 About how many employees currently work at this location?

o Less than 10 (1)

o 11-25 (2)

o 26-40 (3)

o 41-60 (4)

o 61-74 (5)

o More than 75 (6)

o Not sure/ Other (7)

Q10 On average, about how many customers/clients per day does this business serve?

o Less than 50 (1)

o 50-99 (2)

o 100-200 (3)

o More than 200 (4)

Q11 What time(s) of the day is the busiest in terms of customers or clients coming in?

▢ Before 9 am (1)

▢ Between 9 am and 11 am (2)

▢ Between 11 am and 1 pm (3)

▢ Between 1 pm and 4 pm (4)

▢ Between 4 pm and 7 pm (5)

▢ After 7 pm (6)

▢ N/A (explain) (7) _____

End of Block: Business Operation

Start of Block: Customer Type

Q12 On average, what percentage of your customers do you think intentionally plan to come to your business, either as a final destination, or as a planned stop on the way to another destination? This is opposed to a customer who may see your business while driving (or walking) and decide to come in without any prior planning.

Enter percent of customers who plan to visit:

_____

Q13 Please rank the following factors in ascending order from “1" to “6" (with “1" being the most important) that customers use when selecting your business:

_____ Travel Distance (1)

_____ Hours of Operation (2)

_____ Customer Service (3)

_____ Product Quality (4)

_____ Product Price (5)

_____ Ease of Access to the Store (6)

End of Block: Customer Type

Start of Block: Roadway Safety and Access Management Treatment

Q14 During your busiest times, how would you describe the flow of traffic near your business?

o Not congested (1)

o Slightly congested (2)

o Congested (3)

o Very congested (4)

o Not sure (5)

Q15 When thinking about the roadways and entrances to access your business, do any challenges or barriers come to mind?

o Yes (1)

o No (2)

Display This Question:

If Q15 = Yes

Q16 Please explain your current access-related concerns.

_____

Q17 Have any of your customers reported any difficulty accessing your business (at any time)?

o Yes (1)

o No (2)

o Not sure / not aware (3)

Display This Question:

If Q17 = Yes

Q18 In general, what kinds of difficulties have they reported?

_____

Q19

Have the spreadsheet ready to read in information:

Are you aware of the roadway changes installed on (blanco_business_survey_identifier) between (start) and (end)?

o Yes (1)

o No (2)

Skip To: Q24 If Q19 = No

Q20 Did you or anyone related to business operations attend any publicly held meetings to discuss the changes to the roadway?

o Yes (1)

o No (2)

o Not sure (3)

Q21 What was the business's attitude about the project before construction began?

o Favorable (1)

o Slightly favorable (2)

o Slightly unfavorable (3)

o Unfavorable (4)

o It was not a concern (5)

o Not sure (6)

Q22 What was the business's attitude about the project during construction?

o Favorable (1)

o Slightly favorable (2)

o Slightly unfavorable (3)

o Unfavorable (4)

o It was not a concern (5)

o Not sure (6)

Q23 What was the business's attitude about the project after construction was completed?

o Favorable (1)

o Slightly favorable (2)

o Slightly unfavorable (3)

o Unfavorable (4)

o It was not a concern (5)

o Not sure (6)

Q24 Do you have any further comments or concerns about access management in the vicinity of your business that you would like to add?

_____

End of Block: Roadway Safety and Access Management Treatment

2024 Access Management Patron Intercept Survey

- Survey Flow
- Block: Interviewer Information (1 Question)
- Standard: Consent and Screening (3 Questions)
- Standard: Visit Today (7 Questions)
- Standard: Considerations (4 Questions)
- Standard: Concerns (6 Questions)

Page Break

Start of Block: Interviewer Information

Q1 Interviewer ID Number

_____

End of Block: Interviewer Information

Start of Block: Consent and Screening

Q2

Interviewer Script:

Hello, my name is _____ with the Kathleen Public Policy Center at the University of Louisiana at Lafayette.

We are conducting a short survey on behalf of the Louisiana Transportation Research Center to learn more about peoples' experience with accessing businesses in this area. Would you be willing to participate? The survey should only take about 5 minutes of your time.

If yes:

Thank you, your responses will remain anonymous, and more than 200 other individuals will be included in this study. The information you provide cannot be traced back to you statistically or otherwise. Findings from the study will be published, however, no personally-identifying information will be collected. Results from this study will be used to help inform policy and decision-makers at Department of Transportation and Development and other agencies at the state and local levels.

If you have any questions or concerns about this study or your rights as a research participant, please contact Stephen Barnes at the Kathleen Blanco Public Policy Center (337-482-5014) or the IRB Chair at the University of Louisiana at Lafayette (337-482-5811).

Q3 Do I have your permission to continue with some preliminary questions?

o Yes (1)

o No (2)

Skip To: End of Survey If Q3 = No

Q4 Are you at least 18 years of age or older?

o Yes (1)

o No (2)

Skip To: End of Survey If Q4 = No

End of Block: Consent and Screening

Start of Block: Visit Today

Q5 What business were you visiting today?

_____

Q6 How did you arrive at this location today?

o Driver (of motor vehicle) (1)

o Passenger (of motor vehicle) (2)

o Pedestrian (walking) (3)

o Bicycle (4)

o Ride Sharing (Uber, Lyft, Taxi) (5)

Q7 Thinking about your visit today, were you specifically planning to come to this business, or was your stop here on impulse?

o Yes, Planned to stop (1)

o No, Impulse or convenience stop (2)

Q8 How long have you been a patron of this business?

o First time was today (1)

o Less than one year (2)

o 1-3 years (3)

o 4-6 years (4)

o Over 6 years (5)

Q9 How often do you visit this business (on average)?

o Less than once per month (1)

o Once a month (2)

o A few times a month (3)

o Once a week (4)

o More than once a week (5)

o Other (Do not read unless given specific frequency) (6)

_____

Q10 How often do you visit other businesses in the area?

o Regularly (1)

o Sometimes/ On occasion but not regularly (2)

o Rarely (3)

o Never (4)

Q11 Please rank the following factors in ascending order from “1" to “6" (with “1" being the most important) that you typically consider when choosing to visit this type of business:

_____ Travel Distance (1)

_____ Hours of Operation (2)

_____ Customer Service (3)

_____ Product Quality (4)

_____ Product Price (5)

_____ Accessibility to Stores (6)

End of Block: Visit Today

Start of Block: Considerations

Q12 Have you ever experienced any difficulties accessing this business?

o Yes (1)

o No (2)

Display This Question:

If Q13 = Yes

Q13 What were the circumstances or could you describe those difficulties?

_____

Q14 Have you experienced any issues navigating streets or accessing other property in this area?

o Yes (1)

o No (2)

Display This Question:

If Q15 = Yes

Q15 What sorts of issues or specific problems have you encountered navigating streets or accessing other properties in the area?

_____

End of Block: Considerations

Start of Block: Concerns

Q16 Are you familiar with the roadway changes [treatments] made on the main road [blanco_business_survey_identifier] beginning in the year [begin]?

o Yes (1)

o No (2)

Skip To: Q25 If Q17 = No

Q17 Were you informed of roadway changes through any of these types of outreach?

▢ Paper Mail (1)

▢ E-Mail (2)

▢ Local News (Television, Online Platforms, Newspaper) (3)

▢ Social Media (4)

▢ Word of Mouth (5)

▢ I was not informed / not aware until construction began (6)

▢ Not sure (7)

▢ Other (8) _____

Q18 What was your general attitude toward the roadway changes before the construction project began?

o Favorable (1)

o Slightly favorable (2)

o Slightly unfavorable (3)

o Unfavorable (4)

o It was not a concern / no opinion (5)

o Not sure (6)

Q19 What was your general attitude toward the roadway changes during construction?

o Favorable (1)

o Slightly favorable (2)

o Slightly unfavorable (3)

o Unfavorable (4)

o It was not a concern / no opinion (5)

o Not sure (6)

Q20 What was your general attitude toward roadway changes after the construction project was completed?

o Favorable (1)

o Slightly favorable (2)

o Slightly unfavorable (3)

o Unfavorable (4)

o It was not a concern / no opinion (5)

o Not sure (6)

Q21 Do you have any comments or other traffic-related concerns in this area that you would like to share?

_____

End of Block: Concerns