2023

Unveiling the Commuting Experience of an Urban University Community

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UNVEILING THE COMMUTING EXPERIENCE OF AN URBAN UNIVERSITY COMMUNITY

by

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A THESIS

Submitted to the graduate faculty of the University of Alabama at Birmingham,
in partial fulfillment of the requirements for the degree of
Master of Science

BIRMINGHAM, ALABAMA

2023

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ABSTRACT

Conducting a comprehensive commuter survey is a prevalent task that can help to guide traffic operations, planning, designing, and infrastructure development decision. It is one of the best approaches to comprehending commuters' attitudes and preferences and the present commuting practices. The commuting behavior of the commuters at and around a university campus varies from that of residential or commercial areas as the university often serves a diverse community of transportation users such as students, faculty, and staff who serve the university or receive services from the university in a variety of ways.

The University of Alabama at Birmingham (UAB) is an emerging university that attracts thousands of students, faculty, staff, and visitors every day. As part of its commitment to serve the transportation needs of its constituents, UAB conducted its first commuter survey back in 2016 to understand the travel behavior and mode preference of the UAB community. That survey was regarded as the benchmark survey for the UAB, and the findings were used to set goals for the future improvement of traffic demand management at the UAB campus. In the following years, UAB Sustainability and UAB Transportation undertook some initiatives to reduce employee-alone and student-alone commuting, improve parking management, provide more accessible and sustainable transportation options including e-scooters and e-bikes,

upgrade the infrastructure to include marked bike lanes, improved bus stops, and promote ride-sharing and telecommuting initiatives.

Following the COVID pandemic, the university felt an urgency to conduct a similar survey to observe whether the past set goals were achieved and to understand the current commuting practices, preferences, and future travel demands of the commuters. The 2023 UAB commuter survey was conducted online using the Qualtrics Research Core platform and was open to all UAB employees and students. Proper announcements were made through GreenMail, UAB e-Reporter, and other social media to encourage participation. A total of 5052 participants willingly responded to the survey and provided valuable information about their commuting preferences and choices, factors that affect such choices, and their demographics. They also provided comments and suggestions for improving transportation services on and around the UAB campus and the commuting experience of UAB employees and students in the future.

This thesis was intended to accomplish this survey and analyze survey responses using Microsoft Excel and statistical software SPSS. The purpose of the analysis was to document survey responses and identify the statistically significant demographic and travel pattern attributes that influence UAB commuters to choose their mode of transportation. This report depicts the research objectives, discusses the appropriate research methodology, presents and interprets the results of the data analysis, and offers a summary of the study conclusions and future recommendations. It is expected that UAB Transportation, UAB Sustainability, the City of Birmingham, and other local transportation agencies can utilize the study as a valuable resource while creating plans for the improvement of the existing transportation system at and around

the UAB campus. The methods used in this study are anticipated to be of value to transportation researchers interested in studying the commuting patterns of university students and employees in other university settings. Moreover, the findings and results of this work can assist decision-makers, urban planners and engineers, and transportation service providers to understand the needs and priorities of commuters at urban university settings and help them to plan for transportation services that address such needs.

Keywords: UAB commuter survey, traffic and parking demand management, commuting patterns, mode choices, alternative mode preferences, demographics, travel behavior.

DEDICATION

This thesis is dedicated to my parents and siblings for their prayers, love, and mental support throughout the entirety of my life, my better half Dr. Md. Kalimur Rahman for his inspiration and immense support during my graduate study, my son Zohair Afraz Anas for his sacrifice and intense love which motivated me to pursue my degree and finally to my thesis advisor Dr. Virginia P. Sisiopiku for her continuous guidance throughout my research work to complete thesis report.

ACKNOWLEDGMENTS

First and foremost, I would like to express my deepest gratitude and appreciation to my supervisor, Dr. Virginia P. Sisiopiku, for her thoughtful assistance, ongoing direction, and the priceless time she invested during the course of my graduate studies and insightful feedback throughout the research process. I want to sincerely thank Dr. Muhammad M. Sherif and Mr. Andrew Sullivan for serving on my thesis committee. I also would like to express my gratitude to the officials of the Graduate School as well as Dr. Nasim Uddin, Graduate Program Director, Department of Civil, Construction, and Environmental Engineering for assisting me from the beginning of my graduate study.

I would like to thank the professors in the Civil Engineering program, Department of Civil, Construction, and Environmental Engineering at the University of Alabama at Birmingham for creating a climate of intellectual curiosity and promoting a dynamic academic environment. I am thankful for the knowledge and abilities that the institution has delivered to me. I also express my heartfelt gratitude to Dr. Wencui Yang for his continuous guidance during the analysis of the research project.

Finally, I'd like to show appreciation to Mr. Brian Atkinson, Executive Director of UAB Transportation, Mr. Nick Ciancio, UAB Sustainability Coordinator, and Ms. Bambi Ingram, Manager of UAB Sustainability for their immense support from the beginning of this project, and Ms. Natalie Merrill, UAB Communication Manager of the Facilities Division for her assistance with the mass dissemination of the survey link.

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LIST OF ABBREVIATIONS

AIC	Akaike Information Criterion
BIC	Bayesian Information Criterion
BJCTA	Birmingham Jefferson County Transit Authority
EVs	Electric Vehicles
FSM	Four Step Method
GPS	Global Positioning System
IPET	Individual Persuasive Eco-Travel Technology
MNL	Multinomial Logistic Regression
NCSU	North Carolina State University
ODU	Old Dominion University
TAZ	Traffic Analysis Zone
TDM	Travel Demand Management
UAB	University of Alabama at Birmingham
UVA	University of Virginia
VCU	Virginia Commonwealth University
VDOT	Virginia Department of Transportation
VT	Virginia Technology
VTBC	Voluntary Travel Behavior Change

CHAPTER 1

INTRODUCTION

Background of the Study

The advancement of transportation infrastructure and facilities is one of the accomplishments of modern civilization. At present, the development of transportation systems has made everyday life easier by ensuring the movement of goods as well as people from one place to another at the fastest possible time. People use different modes of transportation to reach their destinations for educational, business, work, health services, social interaction, and recreational purposes. Every community has diverse nature of travel demand behavior depending on the demographic and socio-economic characteristics. Different types of commercial development have been established to serve the needs of every community.

Communities located in the vicinity of institutions of higher education consist of students, employees, and staff along with those supporting the university operation and serve community needs. Due to the various demographic and socio-economic groups, the university campus zone has unique travel pattern than other residential or commercial zones.

The University of Alabama at Birmingham (UAB) is an emerging research-based university renowned for its research and clinical operation as well as its innovative and

interdisciplinary educational approach at the undergraduate, graduate, and professional degree levels. According to the UAB's Office of Enrollment Management, approximately 22,000 students have been enrolled in 2022. The total workforce of UAB in 2022, including the university and hospital, was nearly 28,000. Besides, Tripp Umbach reported in 'The Economic and Community Impacts of the University of Alabama at Birmingham' study that, in 2022, UAB had approximately $12.1 billion of economic impact, created 107,600 job opportunities, and made a $371 million revenue impact for the state and local government that made it the most significant single contributor to the state of Alabama's economy and the largest employer in this region. Additionally, in Birmingham alone, UAB contributed $8.3 billion in economic impact, created 73,595 jobs, and paid more than $256 million in local taxes. As an economic and educational hub, UAB generates and attracts a large number of trips every single day and requires appropriate traffic management actions on the university campus in order to address the transportation needs of its constituents in an effective manner while promoting other core university values including sustainability, accessibility and equity.

For the proper management of the transportation needs of the UAB community, it is necessary to examine the daily travel practices of the community in the vicinity of the university campus and identify needs and opportunities for transportation-related improvements. A comprehensive UAB commuter survey can help the University administrators to understand the commuting patterns and mode choice preferences of UAB's community as well as make effective decisions regarding land use, operation of sustainable transportation systems, and infrastructure investments to manage the current and future traffic demand.

Prior to this study, another UAB commuter survey was conducted in 2015-16 under the supervision of Dr. Sisiopiku to get a comprehensive idea of the commuting patterns of the community surrounding UAB. The study was the first ever survey to document commuting patterns and preferences of UAB employees and students and was based on an anonymous questionnaire survey consisting of questions on demographic, commuting characteristics, and mode choice preferences (Sisiopiku et al., 2016). The questionnaires were disseminated among UAB employees and students and the gathered data sets were then analyzed for understanding the travel patterns, mode preferences, and mode choice determinants of the UAB community. More than 10,000 participants responded to that 2015-16 survey and most of them (88.4% of employees and 82.5% of students) reported that they drove solo using their own vehicle to/from the UAB campus (Sisiopiku et al., 2016). Solo driving practice is partially responsible for the increased demand for parking spaces as well as congestion and emissions related to vehicle use. Following the release of the survey findings, the university authority, the City of Birmingham, and the local transportation agencies took actions to address the increasing traffic and parking demand on campus including improvement of on-campus traffic circulation as well as providing infrastructure provisions for non-motorized users, addressing parking issues, educating the UAB's community regarding sustainable transportation system, expanding shuttle services, introducing micro-mobility options on campus, and promoting ridesharing. Now, seven years since the last study and after the withdrawal of COVID-19 related restrictions, a new commuter study on the UAB campus was deemed necessary to examine the current commuting patterns and identify areas that require additional improvements.

Problem Statement

Being an economic, medical, and educational hub that continues to grow year after year, the primary problems that UAB has been facing in the transportation sector are the increased demand for transportation for the UAB community and associated traffic management issues surrounding the campus setting. Common traffic-related issues at UAB are traffic congestion, lack of parking spaces, pollution from vehicle emissions, and traffic safety. Sustainable mobility management is needed to address such problems and meet the current as well as future travel demands of the community.

The UAB's Sustainability Program has already proposed some sustainable transportation solutions and worked with UAB Transportation and local transportation agencies to develop initiatives and infrastructure that accommodates options other than the private automobile including shared rides, e-bikes, e-scooters, shuttle services, etc. So, it is important to (a) document the current commuting mode choices of the UAB community, and (b) identify the behavioral, economical, and social factors that influence commuters to one mode of transportation over the other modes. An extensive study on commuting patterns and travel mode preferences of the UAB community will help to understand the current travel patterns and preferences of UAB commuters and inform decision makers about their needs and priorities. This, in turn, will help UAB to better plan for transportation services that address such needs in the future.

Objective and Scope of the Study

The motivation behind this study is to identify needs and opportunities to improve the current commuting experience of the UAB community. UAB has already developed a

2019-2025 strategic plan to meet the current and future transportation demand as well as mitigate traffic congestion, parking concerns, and emissions. The goals of this plan were to reduce employee and student solo commuting by 5% during the 6-year period, decrease the overall vehicular traffic on the UAB campus, and reduce emissions from all the modes of transportation (Sustainability-Strategic-Plan, 2019-2025). One of the strategies for achieving these goals was to conduct a biennial commuter survey on the UAB campus to help understand how travel practices evolve over time, document areas where progress was achieved, and identify opportunities for future traffic management improvements.

To serve the above-mentioned priorities, the main objective of this study is to:

- Document commuting patterns and preferences of UAB commuters.
- Identify determinants that influence travel behavior and mode choices, and
- Propose initiatives that could reduce traffic impacts on the UAB campus and improve user satisfaction.

In order to meet the above-mentioned goal and objectives the following tasks need to be performed:

- Use an anonymous questionnaire survey to collect 2023 demographic data, commuting characteristics, commuting mode choices, and feedback on needs and priorities associated with transportation services from UAB employees and students.
- Analyze the UAB commuter survey responses to understand commuting patterns as well as observe the effects of COVID-19 pandemic on mode choices and daily traveling habits of UAB employees and students and document the findings.

- Perform a comparative analysis with the findings from the benchmarking study conducted in 2015-16 to observe areas where progress was achieved and recommend prospects for future enhancements.
- Identify influencing factors that push commuters to choose a certain mode and shape their travel behavior.

CHAPTER 2

LITERATURE REVIEW

Transportation demand management is a challenging job for both urban and rural universities. Usually, communities around the university are distinctive in nature as they consist of diverse socio-economic groups and have different travel patterns and needs which are not easily compared with other communities (Khattak et al., 2011). Besides, students living on campus are physically more active and often use walking or biking or using other non-motorized transport to reach their short-distanced destinations inside the university campus. As vehicle ownership is typically lower for student populations, compared to the general public, students that live on campus that do not have a vehicle often use transit or Uber/Lyft for trips outside of the campus. Students living outside the campus may rideshare or be dropped off by someone. Employees of the university mostly drive alone to their offices. Due to this various sub-population and different travel behavior, the commuting pattern of the communities surrounding the university is not considered uniform. As a result, the standard four-step travel demand forecasting method (FSM) may not establish a correct forecasting model for trip generation (Ma, 2015). In the four-step method of travel demand modeling, each traffic analysis zone (TAZ) is considered to have a community with the same socio-economic structure and uniform commuting pattern. But to understand the travel behavior of communities around a university setting and to meet the travel demand of students as well as the employees of the university, a comprehensive study is required.

This study focuses on the travel behavior of the UAB community that is located in downtown Birmingham City. So, the literature review of this study centers around commuter surveys conducted based on both urban as well as suburban university campuses. More specifically, the literature review focusses on three themes. The first theme summarizes recent commuting trends on various university campuses. The second theme recaps previous commuter surveys conducted on university campuses in the United States. Finally, the third part reviews the comprehensive commuter survey conducted on the UAB in the year 2015-16, which provides the foundation for the current study.

Recent Global Commute Trends in Urban University Campuses

In recent years, universities located in the city center or downtown areas face tremendous challenges in meeting the increased travel needs of the student and staff community. To find effective solutions to this situation, researchers as well as policymakers are nowadays paying attention to commuter surveys to understand the travel behavior of the community surrounding the university. Tuveri et. el. (2020) performed an in-depth tour-based survey to examine the commuting behavior of students at Roma Tre University, Italy using panel data from a sample of 50 engineering students. The survey data were collected in 2016-17 using the GPS-based mobile application Individual Persuasive Eco-Travel Technology (IPET). The survey results indicated that, despite the Voluntary Travel Behavior Change (VTBC) campaign program, just 26% of the sample students preferred public transit whereas the rest used personalized vehicles. While the researchers were optimistic that the VTBC program can help the mobility manager to encourage students about using more sustainable

modes of transport, the campaign program may not be sufficient to result in modal shift, if the alternative sustainable options had the level of service same or better than the private vehicle (Tuveri et al., 2020).

A biennial commuter survey was conducted by Logan et. al. (2020) at the University of Aberdeen, Scotland over a 10-year period to observe the influence of travel demand management (TDM) initiatives on the traveling habits of the university community. TDM initiatives included free inter-campus shuttle buses, charged parking permits and restrictions, infrastructure to promote sustainable modes (i.e., cycling), and campaigns to discourage solo driving. The research team identified age and distance traveled as significant variables in commuting trends for both employees and students at the university. They opined that social factors must be considered when encouraging the community to use sustainable modes. It was further revealed that female staff used to choose drive-alone options more than the male ones, may be due to family composition, economic condition, living costs, or health issues. Students preferred to commute by foot for short-distance trips and used public transport as a second option. During the semester time, 8,000-10,000 transportation users used inter-campus shuttle buses whereas the numbers lowered to 3,000 during the semester break. The usage of buses remained constant for the staff throughout the year. However, some students preferred to use electric vehicles (EVs) as a sustainable transportation mode. The research team recommended converting the existing buses to electric or hydrogen alternatives to reduce fuel emissions as well as consider them as sustainable modes of transportation ((Logan et al., 2020).

Crotti et. al. (2022) organized a survey to understand the commuting behaviors of staff and students at a university located on Varese, a suburban location in Italy that was far away from the facilities of mass transit. The research team conducted an online

survey at Uninsubria in late 2017 where approximately 7800 students and 450 faculty and administrative staff received the survey through e-mail. The survey was considered representative as the response rate was 22.5%, accounting for 1854 responses. After error checking and cleaning of the data, 1577 responses are considered for analysis. The data analysis revealed that 51% of students resided on campus and 83% of employees lived in the nearest province to the university campus and their overall commuting time was 31 to 60 minutes. The multinomial logit model was used to understand the mode preferences of the users for medium-short distance trips as well as long-distance trips. The research team found that the community was a car-dependent one and affirmed that car dependency and solo driving were predominant for older users when parking restrictions were relaxed. For medium-short distance trips, 50.6% and for long-distance trips, 60% of respondents prefer to drive alone. There were direct local bus services available for 16.2% of the respondents for traveling to their own neighborhood but only 33.3% of them use them. Besides, 57.1% had railway station access to use the rail but only 33.5% used it for long-distance traveling. The researchers also noted that the free parking facilities increased the proximity of solo driving tendency for the older users in peripheral universities. In addition to these observations, significant percentages of commuters stated that they would have preferred carpooling, if good transit services were available for medium-short distance trips (Crotti et al., 2022).

Although some recent studies show that young adults in developed countries are choosing alternatives to cars, the scenarios are different for developing countries. In developing countries, young adults are fascinated by technology and sport-oriented lifestyle. A comprehensive study was conducted by R. Etminani-Ghasrodasti et. al., (2018) regarding this matter to understand the current and preferred mode choice along with the travel pattern of the university students of age 18-30 years old at the 12

universities in metropolitan Shiraz, Iran. The researchers reported that, although public transport was available during the study, the majority (68.8%) of the respondents preferred private cars due to cultural and educational influences. They revealed that young adults in Iran believed in using the private car as a symbol of status rather than considering it for transportation purposes and being less aware of the negative environmental impacts of car usage. They found that poor infrastructure for walking and cycling could be another strong reason for attraction towards car use. Another interesting finding of this study was a positive relationship between streetscaping and walking rate. The lack of quality, technology-supported public transit was another reason for young travelers to choose personal cars over public transit. Finally, the researchers concluded that technology-oriented respondents are more likely to select private cars and are less likely to use public transit, compared to less technology-savvy transportation users (Etminani-Ghasrodashti et al., 2018).

Previous Studies on University Commuter Surveys in the USA

The United States is a country where the residents are highly car-dependent, especially in states located in the south. According to the American Community Survey Report, in 2019, more than three-quarters of USA workers drove alone to work and spent an average of 26.4 minutes of travel time to commute, a travel time that was even higher than commuting by walking or bicycle (Burd et al., 2021). However, the commuting behavior of a university community is expected to be somewhat different from the general community due to the presence of different types of sub-populations surrounding the university campus areas. Although most of the staff and students living off campus prefer the drive-alone option, the scenario has been changing over time as

the university authorities along with the local transportation departments have started taking sustainable measures to accommodate the travel demand while also reduce the likelihood of solo driving. But before implementing any transportation measures and realizing their consequences, it is a must to understand the commuting behavior of the concerned community people and the determinants of their travel mode choices.

Several commuter surveys have already been conducted to examine the travel practices of various university communities across the United States. In 2001, a research team from North Carolina State University (NCSU) conducted a survey where the travel data were collected by observing students' travel activity diaries for one school day. Through this study, it was found that 79.9% of on-campus students preferred walking whereas 68.9% of off-campus students used primarily private automobiles for their trips (Eom et al., 2009) .

A comprehensive statewide commuter survey was organized by the Virginia Department of Transportation (VDOT) in 2009 among the four major universities of the state of Virginia (Khattak et al., 2011). The study established that the internet-based survey methodology was feasible, efficient, and appropriate to understand the travel behavior of university students. The researchers found that the commuting patterns and socio-demographics of university students are different from the general population. Similar to the NCSU findings, on-campus students of all four universities surveyed in VA, utilized more active modes and made more trips on weekdays than off-campus students. Students from urban campuses (Old Dominion University and Virginia Commonwealth University) made approximately 40% of trips using single-occupancy vehicles. Among the four universities surveyed, the highest percentages (44%) of off-campus students at the University of Virginia (UVA) preferred walking as trip mode. Due to the presence of school shuttles and regional transit, bus trips were higher at

UVA, VT (Virginia Technology), and VCU (Khattak et al., 2011). A follow up study considering travel patterns at ODU and VT revealed that students living on- and near the campus were more likely to prefer walking or biking rather than driving (Wang et. al., 2012). Ma (2015) studied the travel behavior of six universities in North Carolina and found that the on-campus students mostly made trips around the university campus. Students having parking permits tended to drive alone and without parking permits, they were most likely to walk (Ma, 2015).

The first-ever commuter survey at the University of Alabama, Birmingham (UAB) was conducted in 2015-16 to observe the travel pattern of the UAB community, document travel preferences, choices, and behaviors, and to propose solution to meet the current as well as future transportation demand of the growing UAB community (Sisiopiku et al., 2016). Through this study, it was found that more than 82.5% of students liked solo driving and off-campus students felt shy about choosing biking or walking mode for their trips due distance, travel time and discomfort (Sisiopiku et al., 2016). The details of this study are discussed in the following section.

Associated Students' Transportation Solution at San Jose State University Conducted its annual commuter survey- one for university employee and another for university students in fall 2022. According to the survey results, 50% of on-campus employees and 67.03% of off-campus employees used personal cars to get into the university (AS TS Employee Survey, 2022). Whereas on-campus housing students mainly preferred walking (30.34%) and public transit (25%) to get around the campus. However off-campus students used public transportation (42.77%) and single occupancy car (27.39%) while commuting to the university (AS TS Student Survey, 2022).

UAB 2015-16 Commuter Survey

In 2015-16 Dr. Sisiopiku led the first ever UAB commuter study to collect information on daily travelling habits of UAB employees and students. The study documented responses from over 10,000 participants and served as a benchmark of commuting practices and preferences. The UAB 2015-16 commuter study used an online questionnaire survey that solicited information related to demographics as well as commuting characteristics and mode preferences. A total of 10,113 respondents completed the survey among which valid responses of students and employees were 3617 and 5675 respectively (Sisiopiku et al., 2016) . Analysis of the survey responses revealed that most of the respondents commuted to the UAB campus from Hoover and Vestavia Hills City. The survey responses further revealed that most of the UAB employees and students were highly dependent on automobiles for their commutes. Among them, 88.4% of employees and 82.5% of students used their personal vehicles and drove solo to UAB. Only 14% of students walked to school whereas 7% of employees were dropped off by relatives or friends. Some shuttle services such as Blazer Express, and BJCTA bus services operated around the campus, however, 88% of faculty and 94% of students did not take these modes while roaming around the campus, as they were likely not fully aware of the benefits of using these services to serve their transportation needs within the campus setting.

Even though the overwhelming majority of students and employees drove alone to UAB at the time of the 2015-16 UAB commuter survey, UAB commuters appeared receptive of the idea of shifting to more sustainable transportation modes such as carpools, vanpools, and transit, should such modes provide good levels of availability, convenience and potential incentives. In fact, while only a 5% percentage of UAB commuters were involved in organized ridesharing at the time of the survey,

approximately 20% of solo drivers expressed an interest and desire to consider ridesharing alternatives, should an opportunity and incentive is presented to them. Moreover, an additional 15% of employees and 13% of students were willing to share a ride to the UAB campus with a relative or friend. The study recommended that UAB and CommuteSmart work together and target these populations with marketing plans and incentives to encourage mode switching.

Besides, the study emphasized the need to educate the UAB commuters regarding the advantages of using sustainable transportation modes as well as providing appropriate transit stops to attract users and the improvements of the infrastructure to encourage them for walking, and bicycle. Moreover, creating a comprehensive parking management strategy along with providing incentives to students to use sustainable transportation modes i.e., bikes, e-scooters, transit, etc. were recommended as initiatives with a potential to reduce the parking demand, solo driving, as well as congestion at and around the UAB campus. Additional recommendations including considering flexible work schedules as well as encouraging telecommuting options for employees and distance learning options for students. (Sisiopiku et al., 2016).

The findings of the 'UAB 2015-16 Commuter Survey' revealed foundational information about UAB commuters' preferences and practices that serve as benchmark for future studies, including the one described in this document. The recommendations of the inaugural UAB commuter survey were used by the UAB Sustainability Transportation Working group to draft goals as part of UAB's 5-year strategic development plan that aimed at improving the UAB community travel experience to/from/and within the UAB campus (Sustainability-Strategic-Plan, 2019-2025). The study also became a valuable reference for other urban growing urban universities that face similar transportation-related problems and want to understand the travel pattern

of the campus community as well as find some sustainable transportation solutions as part of their plans for land-use planning, designing, and infrastructure development.

CHAPTER 3

METHODOLOGY

Study Area

The University of Alabama at Birmingham is a public research-based university located just south of downtown Birmingham, AL and in between interstate I-65 and US-280 HWY as shown in Figure 1. The UAB campus stretches between 4th Ave S and 12th Ave S in the north-to-south direction and 8th St and 22nd St east to west occupying over 100 city blocks. In recent years, the university has grown in both academic, clinical, and economic impact and expanded in land use as well. The continuous growth of the campus and its activities has created an ever-increasing demand for transportation services as well.

Figure 1: Location of UAB campus

According to the Economic and Community Impacts of the University of Alabama, Birmingham January 2023 report, UAB currently hosts around 22,000

students, and that number is expected to increase in the future. The existing six residence halls have 100% occupancy with sufficient resident assistant. Around 28,000 employees from the university side and UAB hospital work on this campus which makes it the single largest employer in the state of Alabama. These growing number of students and employees along with lots of visitors are creating huge traffic and parking demand at the UAB campus.

As an urban university, UAB Master Plan, 2020 focuses on redeveloping its underutilized areas by removing smaller, inefficient, non-contributing structures as well as historic structures that have outlived their usefulness. These sites will be redesigned for new facilities or held for future on demand facilities aligning with the UAB Strategic Plan to promote innovative research and creative activities or remained as open spaces (St John et al., 2020).

Existing Transportation Services at UAB

UAB offers a variety of transportation services for students and staff who wish to get from one place to another inside the UAB campus. These include Blazer Express and BJCTA bus services, Blazer Ride, and UAB Blazer Express Safety Escort. The Blazer Express Transit service provides mobility services to UAB students, staff, and authorized visitors along with six designated routes across the UAB campus and medical districts (Figure 2). Users can get this service free of charge, just by showing their valid ID badge and can track the bus by following the 'Bus Tracker Map' in the link https://www.uab.edu/transportation/blazer-express. Besides, any two students (full-time, part-time, or enrolled that semester) or three full-time employees can apply

for the carpooling service with an incentive of purchasing reserved parking space near the academic buildings.

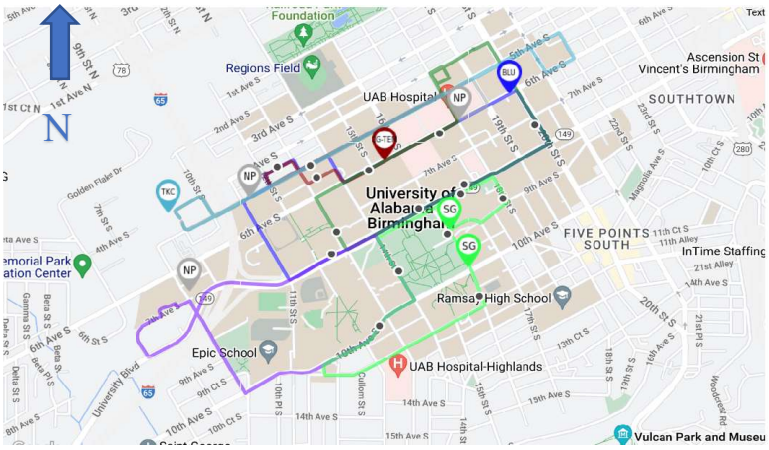

Figure 2: Blazer Express Transit Route

To ensure safety, UAB Blazer Express Safety Escort provides late-night services to the students, staff, and visitors accompanied by UAB card-carrying students or employees from 9:00 pm to 5:30 am every day. The safety escort coverage areas are shown in Figure 3. Blazer Ride provides services to disabled students or employees from 7:30 am to 7:30 pm following the same coverage areas as Blazer Express Safety Escort.

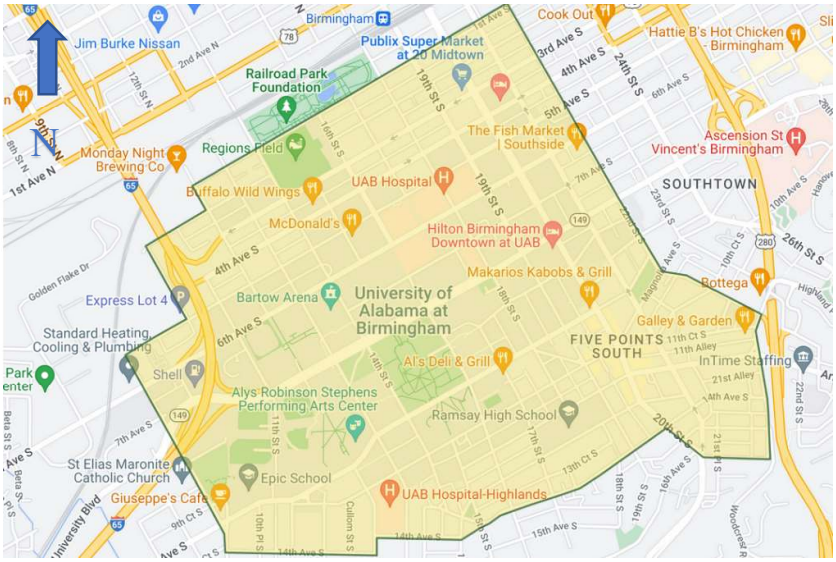

Figure 3: Coverage Area for Blazer Express Safety Escort and Blazer Ride

Data Collection

Data collection for this study was performed using a questionnaire survey designed to capture the daily commuting preferences and patterns of the community surrounding the UAB campus. The 2023 questionnaire survey tool is built upon the survey tool used in the UAB 2015-16 Commuter Survey study. While modifications were made to expand the survey and include questions related recent topics of interest (such as impact of COVID-19 on mode choices; or use of micro-mobility options), the core of the two surveys remained the same in order to facilitate comparisons. Such comparisons help understand the changes in the commuting pattern of the UAB campus community over a 7-year long period and impacts of transportation policies and initiatives over time.

The voluntary questionnaire survey was developed in Qualtrics and was shared with the current staff and students of the UAB. The survey was disseminated electronically on 21 March 2023, using the email addresses of all UAB employees and students. To ensure equitable participation, paper copies of the survey were also available for UAB employees and staff that wished to participate but might have not been able/willing to complete the survey online. The responses from the paper surveys were collected with the help of UAB Facilities and UAB Sustainability offices and manually entered into the database by members of the research team.

The 2023 UAB Commuter Survey not only gathered the data of the commuters through some specific questions but also provide a platform for the participants to provide their own feedback and comments pertaining to the existing transportation system of the UAB and future directions, in a free-form manner. The following three tasks have been performed to get the survey data.

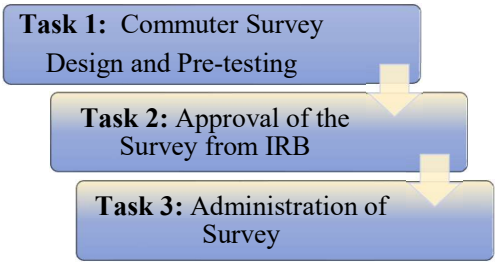

Figure 4: Conceptual Structure of Process Used for Data Collection

In Task 1, survey questions were designed following the guidelines recommended by the Institute of Transportation Engineers Manual on Transportation Engineering (ITE) Studies (Institute of Transportation Engineers, 2011) and the previous survey questionnaire. Then, the questions were adjusted to better fit the target populations as well as be more relevant to the current urban university campus setting. Two types of questionnaire surveys (one for the UAB employees and the other for the UAB students) were prepared as the commuting pattern of these two groups is distinct and important for understanding the complete travel behavior of the community. The survey instrument for employees contained 22 questions whereas the students' questionnaire had 24 questions including both qualitative and quantitative questions. A copy of the 2023 UAB Employee Commuter Survey is available in APPENDIX A, followed by a copy of the 2023 UAB Student Commuter Survey (APPENDIX B).

The survey questionnaire included a cover page that illustrated the purpose of the survey, completion time, participant's rights, and consent information. The survey questions mainly centered around the following:

a) Demographic characteristics (age, gender, auto ownership, income, employment type etc.).

b) Traveling behaviors (trip origin, home-to-school distance, travel time, commute time of the day, etc.); and

c) Commuting mode preferences (drive alone, ride share, bicycle, e-scooter, etc.).

The survey also included open-ended questions that gave participants the opportunity to express their sincere opinion on specific questions and share comments and feedback.

As noted earlier, the 2023 UAB Commuter Survey questions were largely similar to the previous UAB Commuter Survey except for the inclusion of COVID-19 effects on commuters' travel patterns. The questionnaires set for the student survey were alike to the employee surveys except that students were not asked about income but were asked about their educational year classifications, student type, employment status, as well as if they were residents in Alabama. All survey questions were designed in such a manner that the demographic characteristics and their influences on mode choices can be easily understood.

Before conducting any survey related to humans, it is required to get the approval of the Institutional Review Board (IRB) for Human Use from UAB. Task 2 involved getting such approval from IRB. The 2023 UAB Commuter Survey instruments were submitted, and IRB granted approval. The survey was conducted in the Spring 2023 and the University Relations' communication team helped in sending a mass e-mail inviting the UAB community to provide their feedback to the survey. The e-mail link directed the students and employees to the online survey portal to complete the survey. A reminder e-mail was sent one week after the first e-mail in order to increase participation rates. At the same time, a message containing the link to the survey was sent to the students through Blazer Net. The UAB Sustainability and the UAB Transportation also helped promote the survey via posts on social media channels

linking directly to this survey. Besides, the e-Reporter and GreenMail published announcements and links to this survey so that the readers can have easy access to complete the survey.

The online 2023 UAB Commuter Survey was live for two weeks from the date of its launch (3/21/23) and mass data were gathered within this timeline and accounted for the vast majority of responses obtained. The paper-based questionnaire surveys were limited and were entered into the online survey portal manually. The entire database was checked for any kind of errors and inconsistencies prior to data analysis.

Data Analysis Process

Responses from UAB employees and UAB students were analyzed and documented separately. Analysis techniques involved basic statistical analysis, graphical representation of survey responses, cross-tabulation of survey results, and spatial analysis. Industry-standard software was employed (SPSS, Microsoft Excel, and ArcGIS) to assist with the data analysis and reporting of findings. Comparisons of findings from the 2023 survey to those obtained in 2015-16 was performed to examine changes in response trends and identify areas of progress and opportunities for improvement.

Data obtained from the surveys were also used to identify factors that affect the regular mode choice through a conceptual framework depicted in Figure 5. This conceptual framework helps to identify the contributing factor for preferring certain modes as well as establish relationships among i) demographic attributes and mode choice, ii) commuting patterns and mode choices, and iii) demographic attributes and commuting pattern.

In order to establish the above relationships, four hypotheses were investigated in this study, as follows:

1) **Model 1 (M1)** will identify the significant effects of demographic attributes (gender, age, occupation type, household annual income before taxes, etc.) on regular mode choice of employees and establish the following hypothesis:

   H1: Employee demographic attributes have significant influences on mode choice (drive alone)

2) **Model 2 (M2)** will determine the effects of commuting behavior attributes (one-way commute distance from home to UAB, average commute time to get to UAB, and commute frequency in a week) on mode choice.

   H2: Employee commuting behavior attributes have significant impacts on mode choice.

3) **Model 3 (M3)** will identify the significant effects of demographic attributes (gender, age, occupation type, household annual income before taxes, etc.) on regular mode choice of students and establish the following hypothesis:

   H3: Student demographic attributes have significant influences on mode choice (drive alone)

4) **Model 4 (M4)** will determine the effects of commuting behavior attributes (one-way commute distance from home to UAB, average commute time to get to UAB, and commute frequency in a week) on mode choice of UAB students.

H4: Student commuting behavior attributes have significant impacts on mode choice.

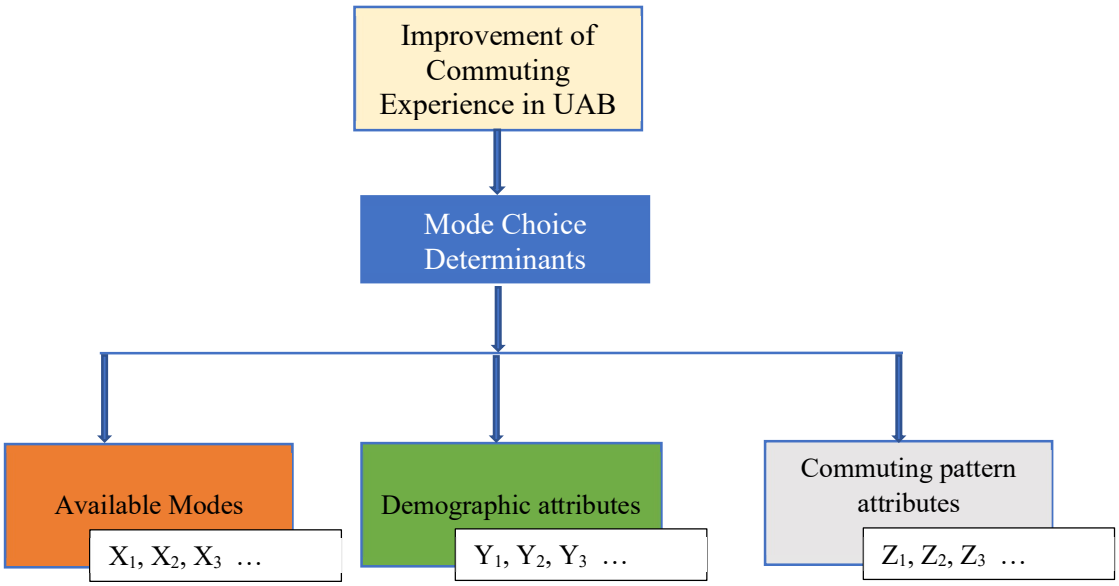

Figure 5: Conceptual Framework for the Commuter Survey Analysis

Model Formulation

The multinomial logistic regression (MNL) model has been performed using IBM-SPSS version 29 to test the above two hypotheses. This statistical regression model explores circumstances when there are more than two discrete outcomes(Pothina et al., 2022). Thus, it is a widely used model choice model when an individual traveler has the opportunity to select transportation modes from more than two options. To investigate the mode choice behavior through MNL, a utility function is used. It is a measure of the mode preferences of a traveler. The utility maximization rule asserts that an individual will choose the alternative from the collection of accessible alternatives that maximize his or her utility. In general, this factor may be determined from the

features of alternatives. According to the utility function, an alternative is selected if its utility exceeds the utility of every other alternative in the person's decision set. If and only if the utility of alternative (i), which is picked from a group of alternatives (j), is higher than or equal to the utility of all the alternatives (j) in the choice set (C), then this can be expressed as in Equation (1).

$$U_{it} = V_{it} + \in_{it} \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (1)$$

Where,

U_{it} = is the utility function of alternative (i) to the mode choice (t)

V_{it} = is the deterministic or observable portion of the utility

$\in_{it}$ = is the error or the unknown portion of the utility

The purpose of travel mode choice modeling is to analyze the commuter's behavior to select the mode from a set of available alternatives ensuring the achievement of maximum utility (Al-Salih & Esztergár-Kiss, 2021). The utility component alternatives include the modes that an individual chooses for his/ her regular travel purposes which are known as dependent variables (e.g., drive alone, dropped off by relative/friend, rideshare-organized carpool/vanpool, rideshare uber/lyft, BJCTA bus, Blazer Express, motorcycle, bicycle, E-scooter/E-bike, walk, telecommute). The independent variables are the demographic attributes (e.g., gender, age bracket, occupation type, and household annual income range) and commuting patterns (commute distances, travel time, frequency of traveling in a week) attributes which affect the utility of each mode choice by the commuter. The generalized utility function for Model 1 (M1) and Model 2 (M2) can be expressed as shown in Equations (2) and (3) respectively.

$$V_{X1i} = \alpha_{x1i} + \beta_{y1} \times Y_{i1} + \beta_{y2} \times Y_{i2} + \cdots + \beta_{yK} \times Y_{iK} \ldots\ldots\ldots\ldots\ldots\ldots\ldots (2)$$

$$V_{X2i} = \alpha_{x2i} + \beta_{z1} \times Z_{i1} + \beta_{z2} \times Z_{i2} + \cdots + \beta_{zK} \times Z_{iK} \ldots\ldots\ldots\ldots\ldots\ldots\ldots (3)$$

Where,

Vxi = the value of the utility function of the travel mode preferences by travelers

α_{xi} = the intercept of the equation

$\beta_{y\text{-}k}$ = the regression coefficients of the independent variables for Model 1

$\beta_{y\text{-}k}$ = the regression coefficients of the independent variables for Model 2

$Y_{i\text{-}k}$ = the independent variables referring to demographic attributes

$Z_{i\text{-}k}$ = the independent variables referring to commuting pattern attributes.

Equations (2) and (3) establish the linear utility function of travel mode choice and are used to estimate the utility values of each alternative mode choice depending on the values of demographic attributes as well as commuting behavior attributes, respectively. In this study, MNL is used to observe the effects of these independent attributes on mode choice where the utility functions are used to identify the choice probability. The mathematical expression of the MNL providing the choice probabilities of each alternative as a function of the systematic portion of the utility of all the alternatives are as follows (Equation (4)).

$$P_r = \frac{\exp(V_{in})}{\sum_{i=1}^{j} \exp(V_{in})} \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (4)$$

Where,

P_r = is the probability of utility for a mode choice (n) by the commuter choosing alternative i

V_{in} = is the utility systematic component for a mode choice (n) by the commuter choosing alternative i, and

V_j = is the utility systematic component for the set of alternative j.

The MNL treats all the variables equally and identifies the relationship between the dependent variables and independent variables in terms of utility.

The "Goodness of Fit" test indicates how well a model performs. For this study, we expect to get a highly significant value (the sig. value should be less than 0.05). Several other statistical criteria are also checked through MNL such as Loglikelihood, Pearson chi-square, Pseudo R square (Cox and Snell, Nagelkerke and McFadden) (Pallant, 2016).

The Loglikelihood test indicates how well all of the independent variables affect the outcome variable. This can be measured by comparing the fit of null model or reduced model and the final model. The null model indicates that there is no influence of the predictor variables on outcome variables. The AIC and BIC of reduced model refer to Akaike Information Criteria and Schwarz's Bayesian Information Criteria and both are used in model fitting criteria as well as to penalize the likelihood information criteria. AIC is a measure of the goodness of fit of any estimated statistical model whereas BIC selects model among a class of parametric models having parameters with different numbers. BIC penalizes free parameters more strongly than AIC (Fabozzi et al., 2014).

The likelihood of the final model is the likelihood of obtaining the observations considering the effects of all predictor variables incorporated in the final model. The difference between these two models provides the value of chi-square with degree of freedom K and the significance value below 0.05 indicates the model is a good fit (Pallant, 2016).

The Cox and Snell R square and Nagelkerke R square indicate the amount of variation in the outcome variable explained by the model. The range of value of these two parameters is 0 to 1.

The Logit or Log odds in MNL indicate how much more likely for an observation is to be a member of the target group rather the other group and can be expressed as by Equation (5),

$$odds = \frac{P}{1-P} \dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots (5)$$

Odds values can range from 0 to infinity. The odds ratio represents the change in the odds of membership in the target group for a one unit increase in the predictor. It is estimated as exponent or exp of the regression coefficient of the predictor.

The Wald test indicates how much impact the predictor variables have on the outcome or dependent variable. The B values obtained in the multiple regression model are used in Equations (2) and (3) to calculate the probability of a case falling into a specific category. Signs of B values are important as they indicate the direction of relationship between the predictor variables and outcome variables, i.e., which factors increase or decrease the likelihood of a choice. A negative B value indicates that an increase in the independent variable score will decrease the probability of choosing the option in the dependent variable.

Comparison of 2023 UAB Commuting Behavior with 2015-16 Commuting Behavior

Following the 2015-16 UAB Commuter Survey, some sustainable transportation options such as micro-mobility options (e-bike/e-scooter) have been

incorporated at or near the UAB campus. To assess whether the mode choice of the commuters has been changed due to the incorporation of these new travel modes, a Chi-square test was performed. Through this test, the distribution of recent categorical variables (i.e., mode choice from the current survey) was compared with the distribution of previous categorical variables (i.e., mode choice from the previous survey). The null and research hypothesis, in this case, can be as follows:

Null Hypothesis: There is no significant difference between the current and previous mode choice patterns of UAB commuters.

Research Hypothesis: There are significant differences between the current and previous mode choice patterns of UAB commuters.

The Chi-square test is performed only when the sample contains the actual number of occurrences, not on percentages, proportions, or means of sample observations or other derived statistics. The Chi-square look up table provides critical chi-square values for the sets for specific degrees of freedom and respective probability. If the obtained Chi-square value is less than the critical Chi-square value, the null hypothesis cannot be rejected. The following steps were performed to get the obtained Chi-square value in this study.

Step 1: Calculate the expected frequency (E) using the observed frequency (O) for each class of the variable.

Step 2: Subtract each expected frequency from the corresponding observed frequency.

Step 3: Square the subtracted value and then divide it by the corresponding expected frequency.

Step 4: Determine the Chi-square value using the Equation (6),

$$X^2 = \sum \frac{(O-E)^2}{E} \ldots\ldots\ldots\ldots\ldots\ldots (6)$$

Step 5: Calculate the degrees of freedom and set the value of α

Step 6: Identify the critical Chi-square value based on the degrees of freedom and select α value using the standard statistical lookup table for Chi-square values.

Step 7: Check whether the obtained Chi-square value is less or greater as compared to the critical Chi-Square value.

Step 8: State the conclusion from the comparison.

CHAPTER 4

RESULTS AND DISCUSSION

The responses from the 2023 UAB Commuter Survey were analyzed to:

1. Understand the existing commuting pattern of the UAB.
2. Identify the factors that influence the users to choose a certain mode.
3. Compare the results with the baseline commuter survey conducted in 2015-2016.

At the end of the survey, a total of 5118 responses were recorded among them 5052 (98.43%) participants willingly responded to the survey and 66 (1.3%) participants did not consent to participate in the survey. Considering the type of survey participants, 85.49% (4319) self-identified as UAB employees (UAB University and UAB Hospital combined) and 14.23% (719) as UAB students. While the number of employees responding to the 2023 survey was comparable to that from the 2015-16 benchmark survey, the number of students responders was unexpectedly much lower. This may be attributed to survey timing, survey overload, or apathy and is an issue that deserves attention in follow up surveys.

Organization of the Response Results

The analyses results are organized and presented in 9 sections as follows:

- Section 1: Brief sample description

- Section 2: Locations of trip origins and working schedule
- Section 3: Demographic and employment status of the sample
- Section 4: Mode preference contributing factors
- Section 5: Motivations and barriers to use alternative modes.
- Section 6: Parking facilities and parking preferences
- Section 7: Options for improvement of the campus environment
- Section 8: Demographic and employment status of the sample
- Section 9: Suggestions to improve the existing transportation system of the campus

Questions related to commuters' travel behavior, regular mode choice, alternative mode preference, trip origin locations, trip frequency, awareness of using sustainable modes, and positive attitudes to improve the campus were similar for both employees and students and are discussed in sections 1 to 7. Participants were asked about their age bracket, gender, household size, vehicle ownership, income and employment status, and years of education to create some specific sub-groups for the purpose of analysis which are discussed in section 8. In section 9, suggestions of the survey participants are summarized on ways to improve the existing commuting experience as well as transportation facilities and services on the UAB campus. As the commuting behaviors of employees and students may be different from each other, they will be discussed separately in the following chapters.

Commuting Pattern of the Employees (UAB University and Hospital)

Section 1: Brief Sample Description

The total workforce of UAB including the UAB hospital in 2022 is approximately 28,000. Among them 4319 employees participated in the 2023 UAB Commuter Survey which indicates that one in every 7 employees responded to this survey. As mentioned earlier, employ responses comprised over 85% of the total responses received from the 2023 survey (Figure 6).

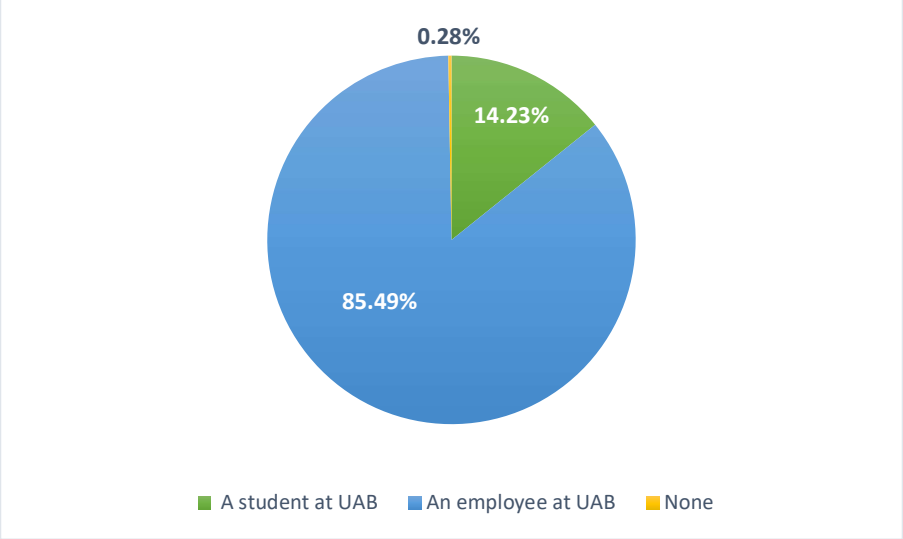

Figure 6: Employee and Student Responses

Section 2: Location of Trip Origins and Working Schedule

Employees were asked about the location of their residence to identify the locations from where most of the trips originated. Respondents had the option to provide their city name, nearest intersections, and zip code. This question and zip code option were set as mandatory to fill in for the respondents to know trip origin locations.

After summarizing the responses, it was found that 3740 employees (86.66% of total employee respondents) provided the zip code information among them 3725 (86.25% of total employee respondents) had valid responses.

It was found that UAB employees commute to the UAB campus from 205 different zip codes. Among these, the top ten zip codes that generated the most trips to the UAB campus were 35124, 35173, 35205, 35209, 35210, 35216, 35226, 35242, 35243, and 35244 accounting for more than 40% of trips by total employees combined. Close inspection of the data reveals that most of the employees reside in the cities of Hoover, Vestavia, and Birmingham. Figure 7 depicts the trips generated by UAB employees by 5 aggregated categories classified by natural breaks distribution based on trip frequency.

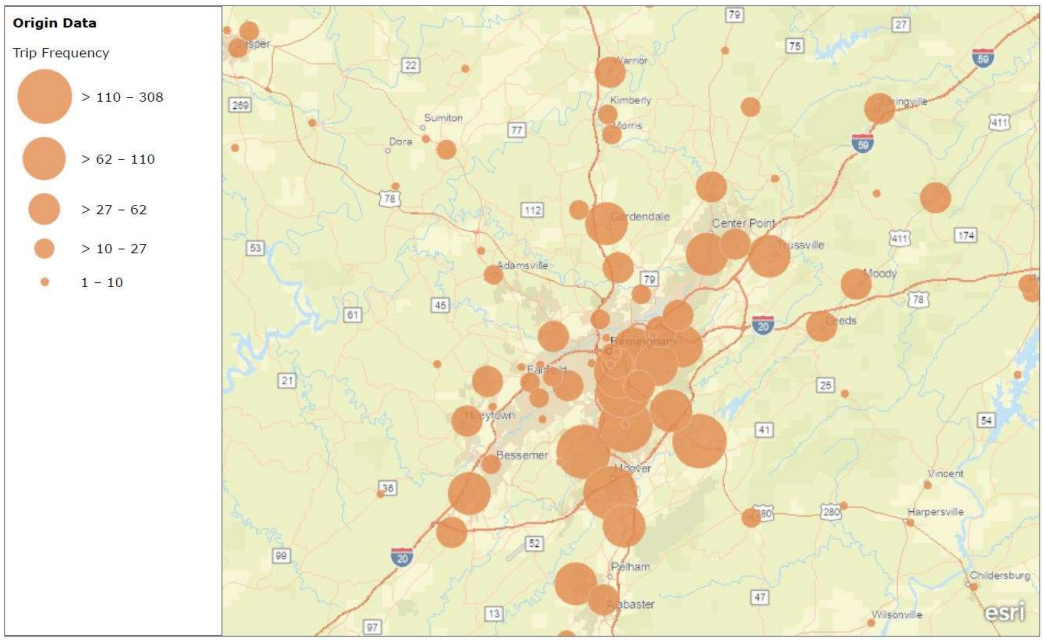

Figure 7: Employee Trip Origins

To understand the impact of commuting distance and commute time on mode choice employees were asked to provide information regarding travel time and distance

from their home to their work along with which route they prefer to use to reach their destination.

The survey results indicate that 31% of the employees travel 21 miles or more one-way distance to reach their workplace, and another 16% travel 16-20 miles each way (Figure 8). Approximately 10% of the employees reported living 3 miles or less from the UAB campus. The high percentile of employees (90%) that report commuting distances above 3 miles indicates the low likelihood of these users to utilize non-motorized modes such us walking, bicycle, or micro-mobility options such as e-bikes, and e-scooters for their commute.

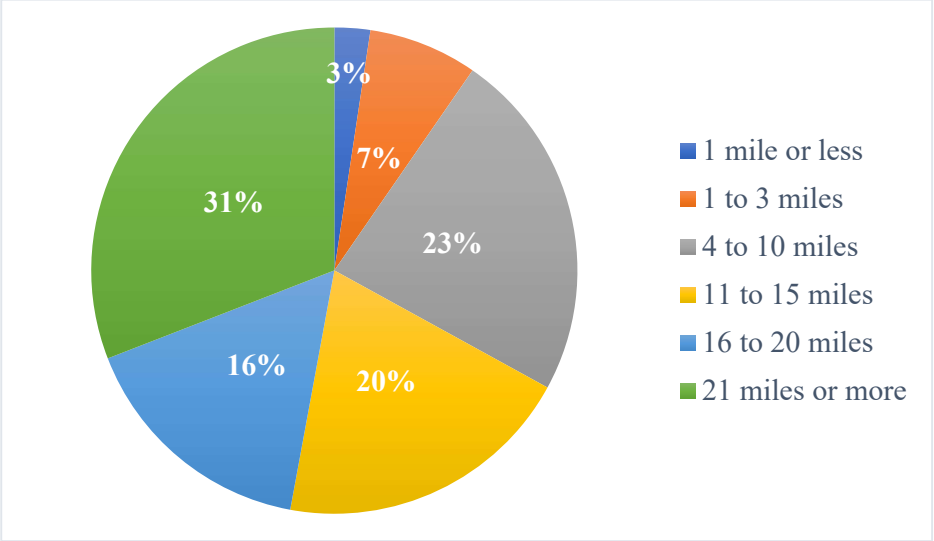

Figure 8: Employee Commuting Distance to UAB and UAB Hospital

Survey participants were asked to report their average commute time (one-way) to campus, the results of which are shown in Figure 9. The largest percentile of employee respondents reported that they commuted for 21-30 minutes one way (27%), and 24% reported spending 11 to 20 minutes to get to UAB.

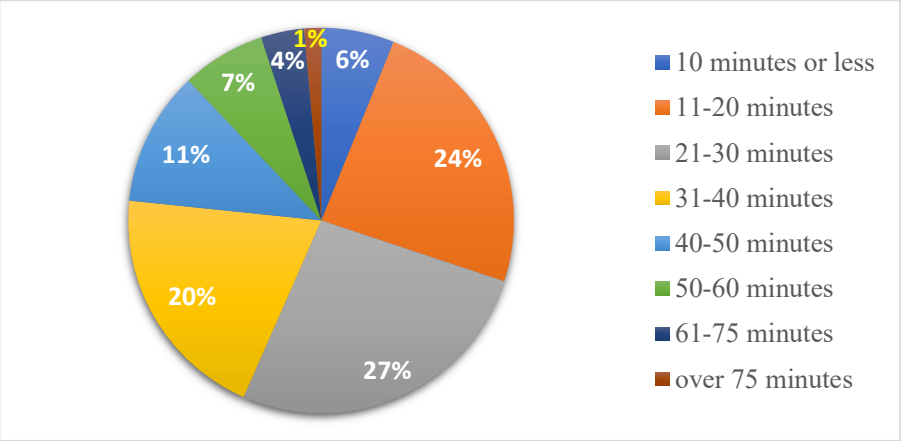

Figure 9: Employee Commute Time to UAB and UAB Hospital

It is worth noting that nearly a quarter of respondents (23%) spend over 40 minutes one way to get to UAB. This includes a small number of employees (approximately 1%) that commute to UAB from the nearby states of Georgia and Mississippi, who report one way commuting time to UAB of over 75 minutes.

Employees were also asked to report their preferred route to enter the UAB campus. As most of them live in either Hoover, Vestavia, or Birmingham, over 50% of respondents reported that they entered UAB either from I-65 Northbound -traveling from the south (29%) or from I-65 Southbound- traveling from the North (23%) (Figure 10). A significant percentage of employees (21%) use arterial streets while commuting to and from the UAB campus. Around 12% of participants use other routes, especially I-59 / I-20 / Highway-31/ Greenspring Highway and less than 1% of employees reported living on campus.

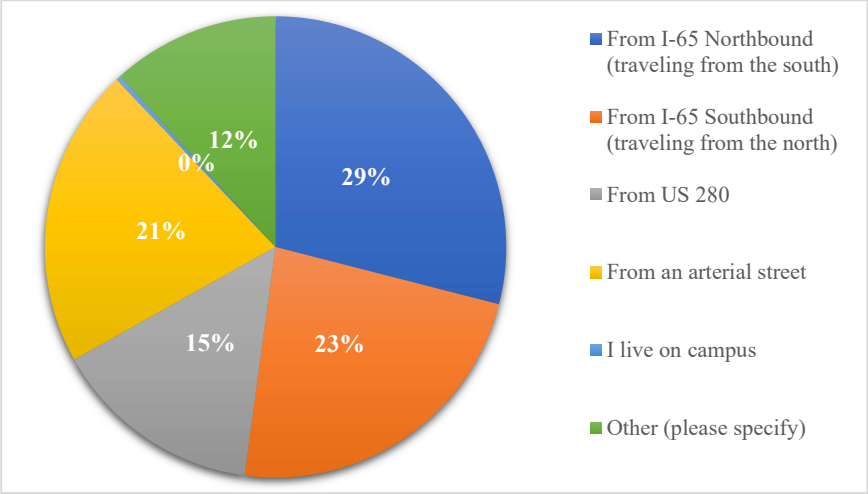

Figure 10: Employee Commute Route to UAB and UAB Hospital

Participants were also asked to report how often they commute to UAB in a typical week and when (day or night). Figure 11 summarizes their responses.

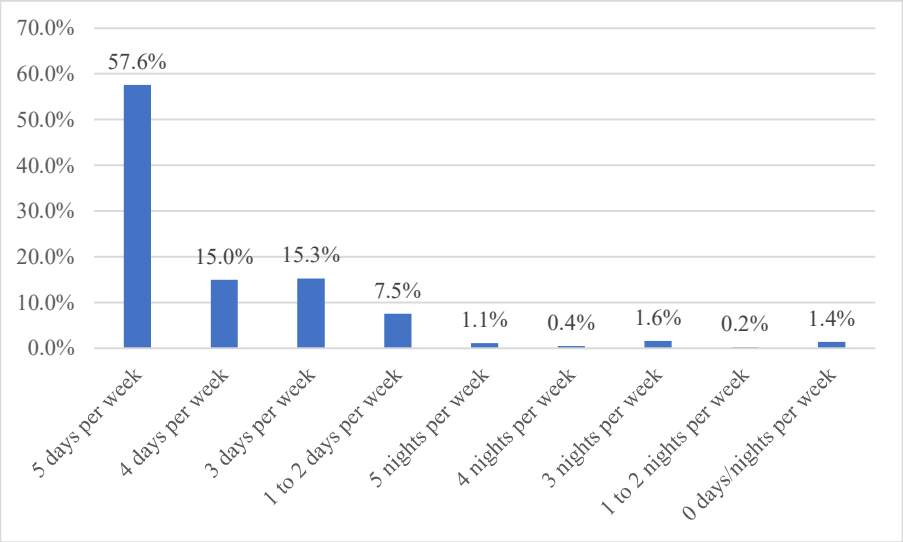

Figure 11: Commuting Frequency of UAB Employees in a Week

As seen in Figure 11, approximately 58% of employees travel to UAB 5 days a week and another 15% commute to UAB 4 days a week. The vast majority of employees

report commuting during the day (between 7:00 am to 4:00 pm) with only 4% of employees reporting commuting to UAB at nighttime.

Section 3: Current Commute Patterns and Recent Commute Changes

Employees were asked to report their household size and auto ownership information. The responses are depicted in Figure 12(a) and Figure 12(b) respectively and showed that 58% of respondents lived in households that had a total of 2 adults (including themselves) and 60% of households had no children during the survey.

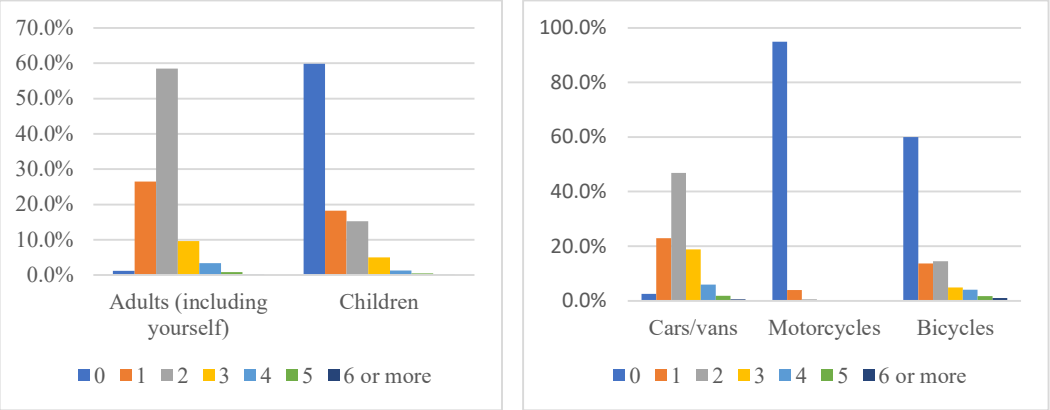

Figure 12: (a): Employee Household Size Data, (b): Employee Auto Ownership Data

With respect to vehicle ownership, around 47% of households had 2 cars/vans and 23% of households reported having a single car. Less than 3% of respondents reported that they did not own a car and less than 1% of employees responded that they had 6 or more autos in their household. Participants reported very low ownership of motorcycles and bicycles with 4% and 14% respectively indicating that they have one of these vehicles. Besides, a high percentage of respondents replied that they have no motorcycle (95%) and bicycle (60%). The auto-ownership characteristics of employees

indicate that employees show a preference for and dependency on private car use rather than alternative modes of transportation i.e., bicycles, motorcycles, scooters, etc.

To document the travel modes of employees while commuting to and from UAB, they were asked to report their typical mode of travel. The responses are shown in Figure 13 indicating that 90.4% of employees choose to drive alone to UAB, 2.8% are dropped off by relatives or friends, 1.6% walk, and just 1.1% use organized carpool/van pool services. Besides, very low percentages of respondents reported using bicycles (0.3%), motorcycles (0.2%), transit (0.2%), Uber/Lyft services (0.1%) and e-scooters/e-bikes (0.1%). Overall, the responses show that the overwhelming majority of UAB commuters choose to drive solo to work and confirms the UAB employee commuters continue to embrace the automobile-dependent commuting culture.

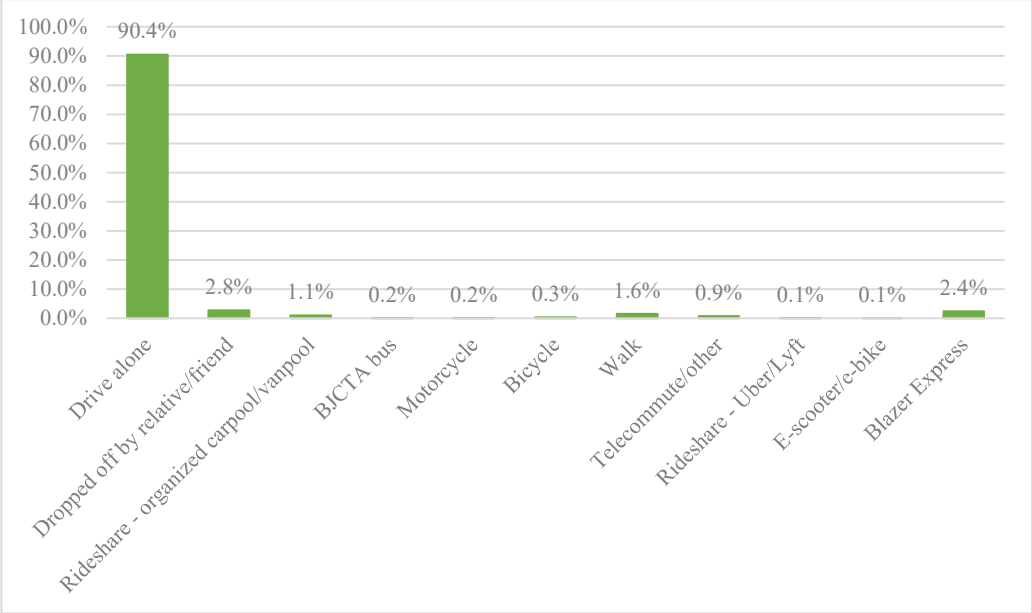

Figure 13: Employee Regular Mode Choice

Employees were also asked to provide information on whether they use Uber/Lyft, E-scooters/ E-bikes, Blazer Express, etc., in a typical day while at UAB.

Approximately 21% reported using Blazer Express whereas over 75% of respondents reported that they did not use any of those modes.

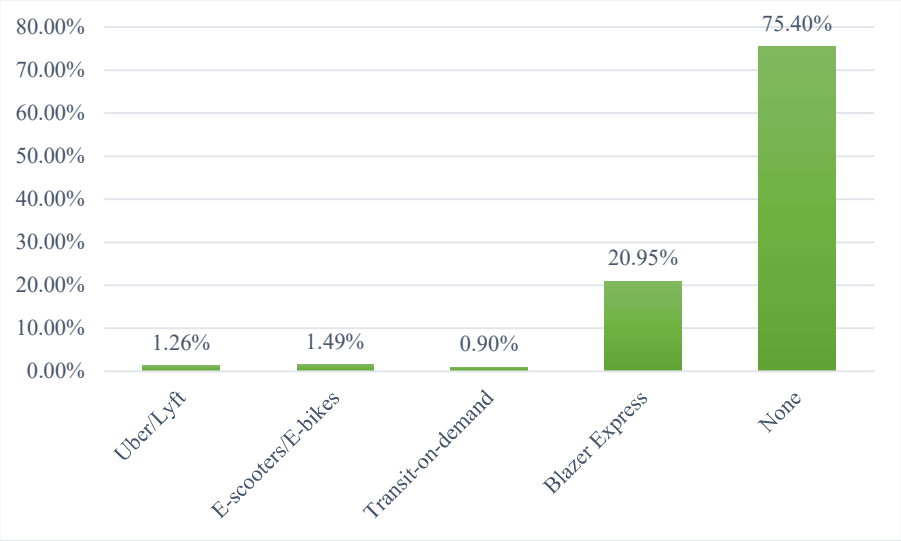

Figure 14: Employee Alternative Mode Use in UAB on a Typical Day

The recent Covid-19 pandemic has changed the working environment all over the world. Working from home, the usage of online platforms to conduct meetings and online classes in educational institutions reduces the necessity of travel for office and school purposes. In this study, employees were asked to notify of any changes in their commuting patterns as a result of the COVID-19 pandemic in order to document current telecommuting patterns following the COVID-19 pandemic.

Figure 15 shows the survey responses indicating that around 77% of respondents continued a similar commuting pattern as before the pandemic, whereas 21% reported telecommuting 1 to 3 days/week and 2% working fully remotely.

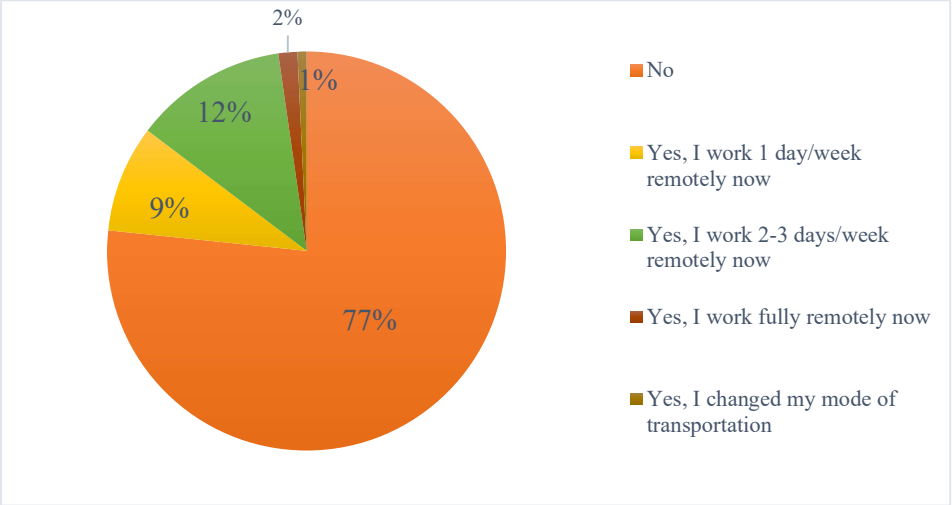

Figure 15: Changes in the Commuting Behavior of UAB Employees due to the Covid-19 Pandemic

When asked if they changed their mode of transportation following the COVID-19 pandemic only 1% of survey participants reported doing so.

Section 4: Mode Preference Contributing Factors

Employees were also requested to provide information about their mode of preference while commuting to and from UAB should alternative options were easily available to them. The majority of them (62.9%) reported that they would prefer to drive their own vehicle rather than use other modes (see Figure 16).

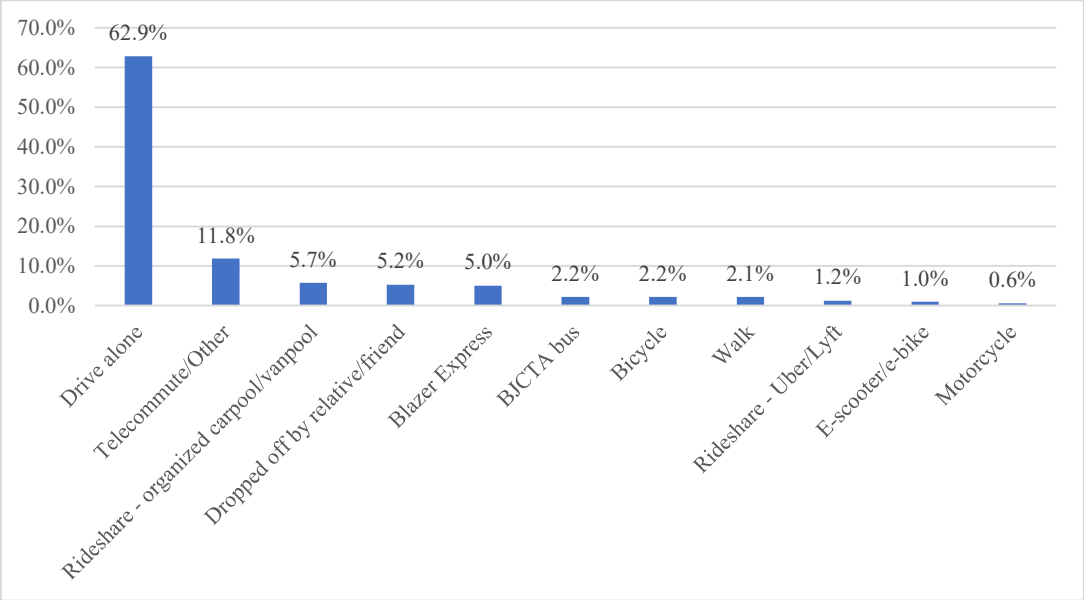

Figure 16: Employee Alternative Mode Preferences

Intrestingly, 11.8% of the respondents answered that they would like to telecommute or work remotely if this option was available whereas, in the current situation, only 0.9% of them telecommute (see Figure 13). Also, 7.2% of employee respondents said that they would feel interested in using transit (Blazer Express and BJCTA bus) while at present only 2.6% of them were using these modes. Regarding, micro-mobility options (bicycle and e-scooter, or e-bike), 3.2% of employee respondents expressed an interest in using them, if these options were available, a percentage far higher than the 0.4% of the respondents are currently using micro-mobility options. With respect to ride sharing, 5.7% percent of responders would prefer to take organized carpools/vanpools if convenient, while just 1.1% reported currently using this option. The survey responses to the question about mode choice preference show that more than a quarter of employees responded to the survey are open to the idea of using alternative modes of transportation and work schedules for improving

their commute to UAB, which lead to reduction of traffic congestion and parking demand significantly at the UAB campus.

To better understand the influencing factors for commuting mode selection of UAB employees, survey participants were asked to report which factors most affected them while choosing their typical travel mode to work (car, bus, walk, etc.). The influencing factors set for this question were cost (in dollars), time, convenience, reliability, safety, and environmental impacts. Each respondent was requested to rate these specific factors from 'Not at all important' to 'very important' where 'Not at all important' was coded as 1 and 'Very important' was coded as 5 and employee survey responses are summarized in Figure 17.

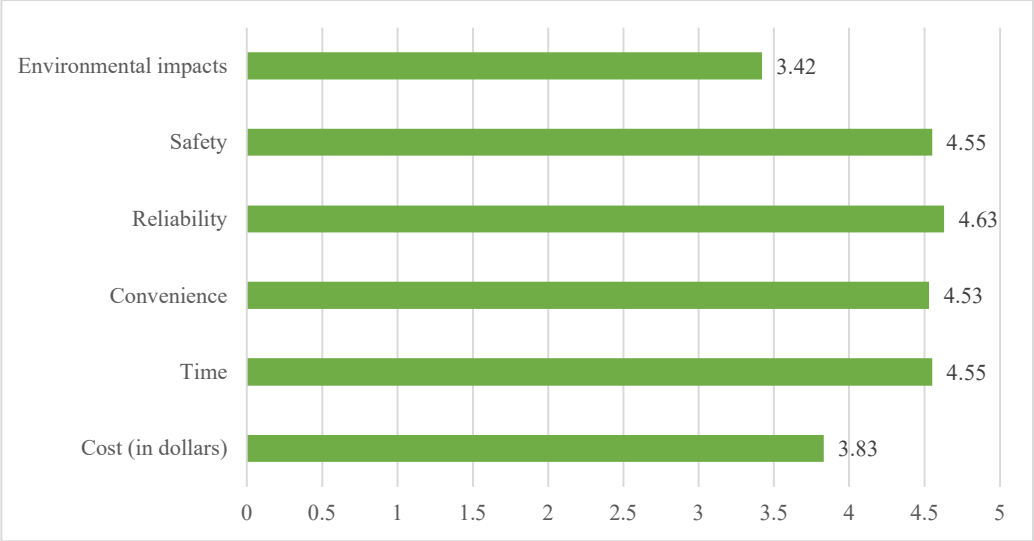

Figure 17: UAB Employee Mode Choice Contributing Factors.

As seen in Figure 17, travel mode reliability got the highest attention as an influencing factor, closely followed by safety, convenience, and time. Cost (in dollars) and environmental impacts were regarded as the least important factors in community mode selection by UAB employees. These findings indicated that employees showed

limited consideration for environmental impacts while selecting their regular commuting mode to work.

Section 5: Motivations and Barriers to Use Alternative Modes

Part of the goal of this survey was to understand what factors would motivate employees to switch to alternative modes rather than driving alone. The employee survey responses to this question are summarized in Figure 18.

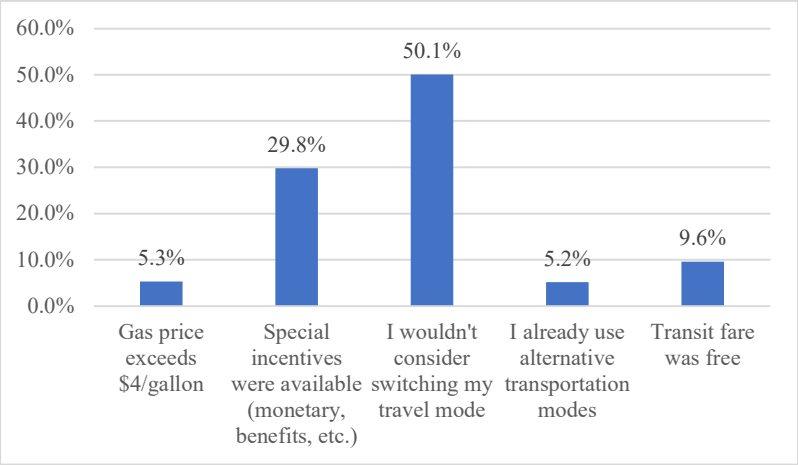

Figure 18: Incentives that Motivated Employees to Use Alternative Modes.

Around half of the employee respondents would not consider switching their travel mode for any incentives. However, a significant percentage of respondents (29.8%) said that they would consider changing their primary mode of transportation if they received proper monetary and other incentives. Cost of fuel and transit fare was a mode choice determinant for a small percentage of employees surveyed (5.3% and 9.6% respectively).

To identify existing barriers toward using alternative modes of transportation such as transit, walking, or micro-mobility options, employee participants were

requested to provide the primary reasons among 3 options provided, namely safety, convenience, and availability. The responses are displayed in Figure 19.

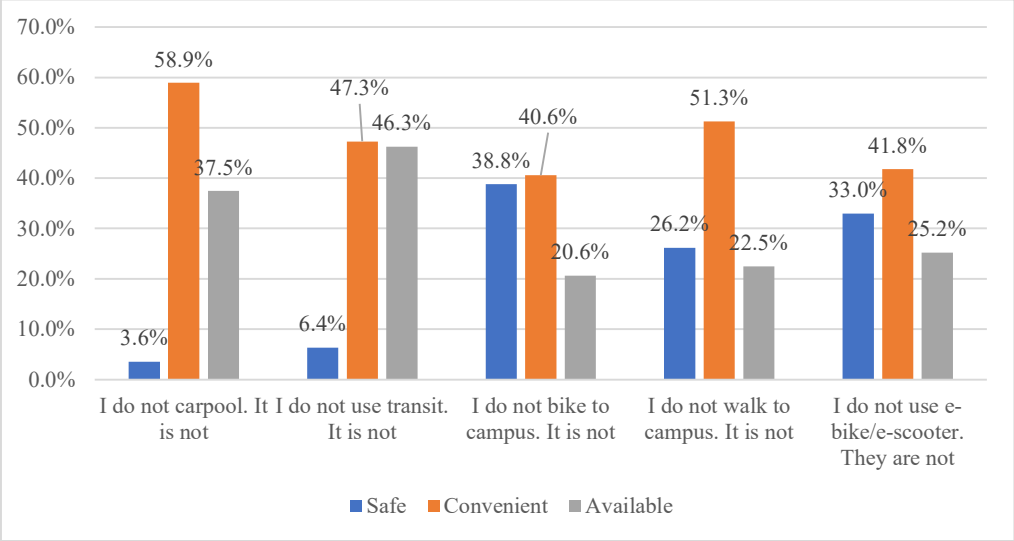

Figure 19: Employee Non-alternative Mode Choice Reasoning

The majority of the respondents said that alternative modes were not convenient to use. Availability was another concern raised, especially for carpooling and transit. Safety was cited by survey respondents as the second most important reason (after convenience) for not selecting biking, e-bikes/e-scooters, and walking to meet their travel needs.

Section 6: Parking Facilities and Parking Preferences

UAB employees were asked about parking facilities, parking preferences, and preferred mode choice while moving around the campus and their responses are shown in Figure 20.

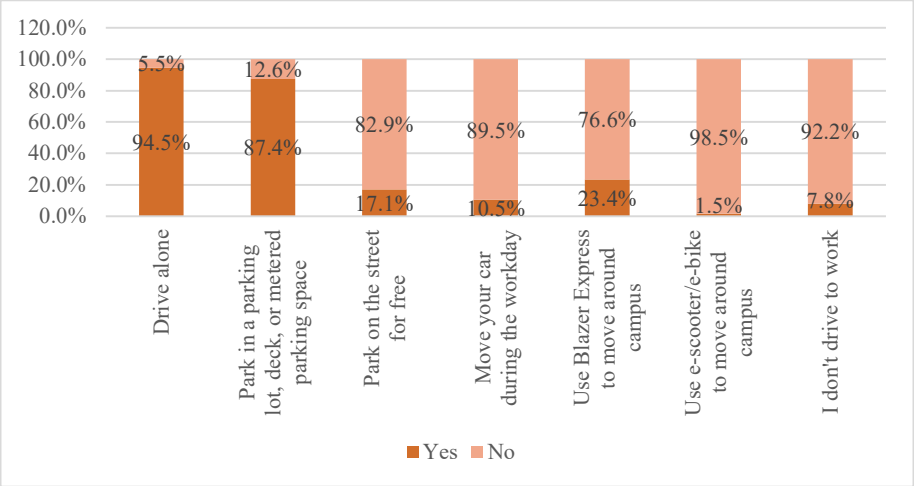

Figure 20: Employee Driving and Parking Data

The survey responses are reported in Figure 20 and show that around 95% of the respondents replied that they use their own vehicles and drive alone while moving around the campus. 87% of them park their autos in a parking lot, deck, or metered space whereas 17% of respondents park their cars on the street for free. A higher percentage of respondents (89%) reported that they do not move their car during the workday. To move around the campus 23% of the UAB employee respondents use Blazer Express services and a small percentage of survey participants (2%) use e-scooters or e-bikes.

Section 7: Options for Improvement of the Campus Environment

To document the users' perspectives on improving transportation services at the UAB campus, survey participants were given twelve selected choices of potential improvements and asked to select their preferences. Participants had the opportunity to select as many options as applied and their choices were summarized in Figure 21.

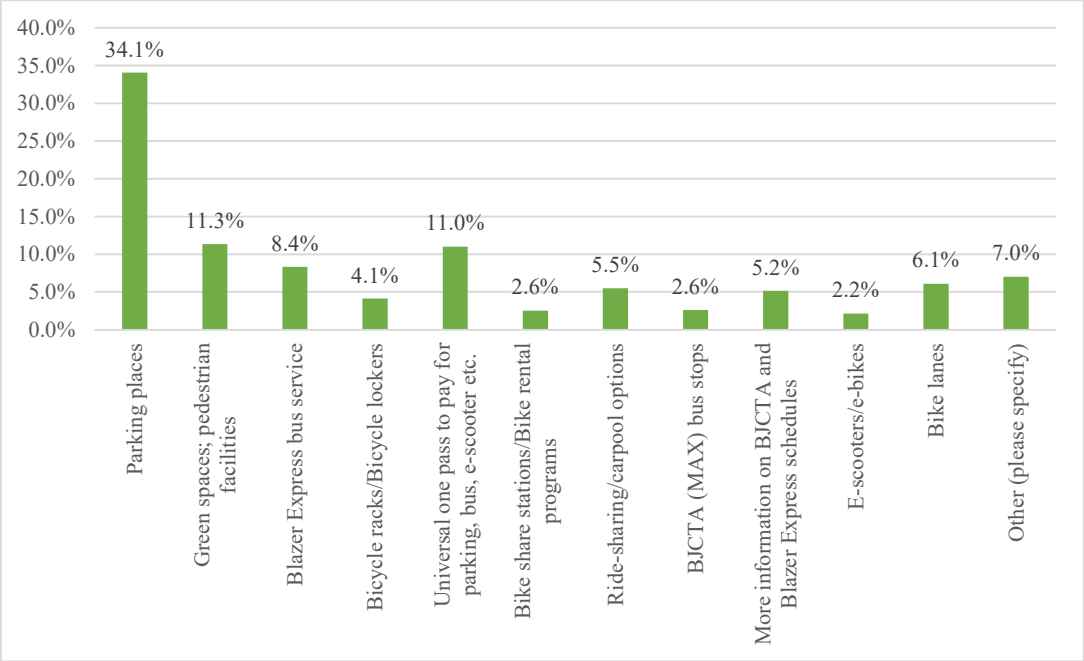

Figure 21: Employee Ideas for Improvements on Campus

Analysis of the responses revealed that one-third of the employee respondents would like to have more parking places on campus, and around 11% of respondents expressed an interest in using universal one pass to pay for parking, bus, e-scooters, and other services. Some employees (11.3%) revealed their desire to see more green spaces and facilities for pedestrians, whereas. As far as bicycling on campus is concerned, 6.1% of employee respondents said there should be separate lanes for those who ride bikes and 2.6% of the participants felt the necessity of bike share stations or bike rental programs. In addition, 8.4% of the respondents requested expansion of the Blazer Express bus services and 7.8% wished to see BJCTA bus stops as well as more information on BJCTA and Blazer Express schedules. In addition, 5.5% of the respondents expressed interest in ridesharing or carpool options, and 2.2% recommended expansion of micro-mobility options.

Although the demand for building parking places on the campus is still high, these responses indicate that employees are inclined to use other sustainable modes which will help to improve the existing transportation services as well as the environment of the university campus.

Section 8: Demographic and Employment Status of Employee Survey Participants

Demographic information of the survey participants and employment status are important factors that may affect mode choice. According to UAB Human Resource Management the male to female employee ratio is 1:2. After analyzing the survey data, it was found that more female employees participated in the survey than male employees. Around 72.5% of female employees and 24.2% of male employees in UAB provided their commute-related data along with their demographic information.

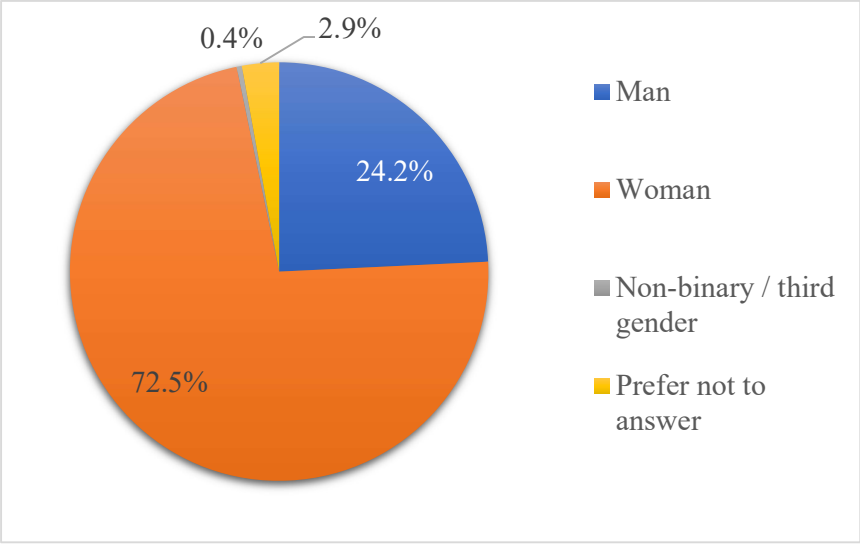

Figure 22: Employee Gender Data

Employee mode choice often varies with respect to the nature of gender and are shown in Table 1. As more female employee participated in the survey, they reported

higher percentage in all the mode options except rideshare by Uber/Lyft, motorcycle and walk. The reason behind not choosing these modes might be they feel unsafe to use these modes as compared to other modes.

Table 1: Employee Gender and Mode Choice (%)

Gender	Drive alone	Dropped off by relative/friend	Rideshare - organized carpool/vanpool	Rideshare - Uber/Lyft	BJCTA bus	Blazer Express	Motorcycle	Bicycle	E-scooter/e-bike	Walk	Telecommute/other
Male	24.1	14.4	31.0	66.7	14.3	11.1	66.7	42.9	25.0	52.9	33.3
Female	72.6	84.6	66.7	33.3	71.4	88.9	33.3	50.0	75.0	43.1	63.0
Non-binary / third gender	0.4	1.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2.0	0.0
Prefer not to answer	3.0	0.0	2.4	0.0	14.3	0.0	0.0	7.1	0.0	2.0	3.7
Total	100	100	100	100	100	100	100	100	100	100	100

Responses from the age bracket question of employees are presented in Figure 23 and show a good distribution of responses by age group. As expected, the majority of the employee participants were between 25 to 64 years of age. Besides the cross relationship of employee age bracket and mode choice are shown in Table 2 where more than 90% of employees who belong to the age range 25-64 years drive alone while commuting to UAB.

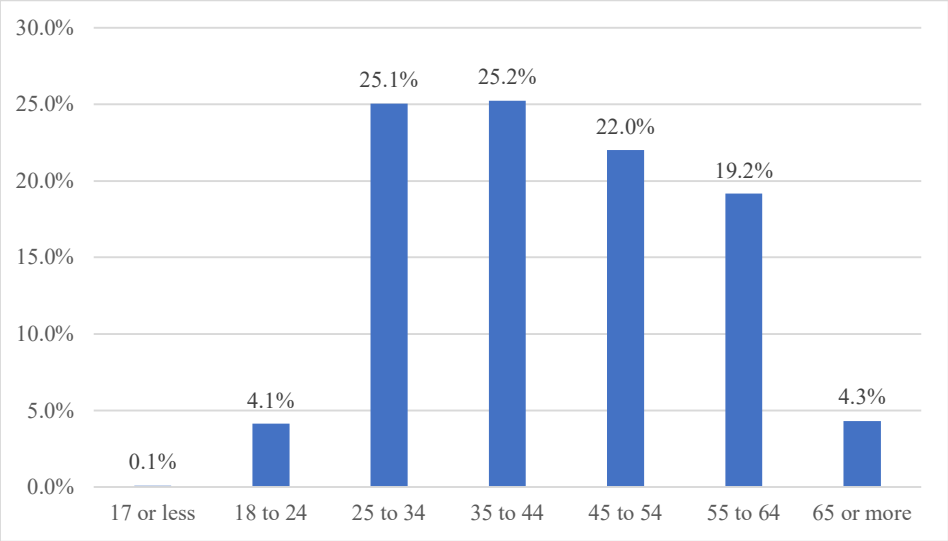

Figure 23: Employee Age Bracket Data

Table 2: Employee Age Bracket and Mode Choice

Age bracket	Drive alone	Dropped off by relative/friend	Rideshare - organized carpool/vanpool	Rideshare - Uber/Lyft	BJCTA bus	Blazer Express	Motorcycle	Bicycle	E-scooter/e-bike	Walk	Telecommute/other	**Total**
17 or less	100%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	100%
18 to 24	82%	5%	1%	0%	0%	8%	0%	0%	0%	4%	0%	100%
25 to 34	90%	2%	1%	0%	0%	4%	0%	1%	0%	2%	1%	100%
35 to 44	92%	2%	0%	0%	0%	2%	0%	0%	0%	1%	1%	100%
45 to 54	92%	3%	1%	0%	0%	1%	0%	1%	0%	1%	1%	100%
55 to 64	91%	3%	2%	0%	0%	1%	1%	0%	0%	1%	0%	100%
65 or more	88%	3%	3%	0%	0%	1%	1%	0%	0%	3%	1%	100%

Employees were also asked to report their employment status, and specifically whether they work at UAB or UAB Hospital as part-time or full-time employees. Over 94% of the survey participants worked as full-time employees either in the UAB Hospital (48.1%) or at the University (46.1%).

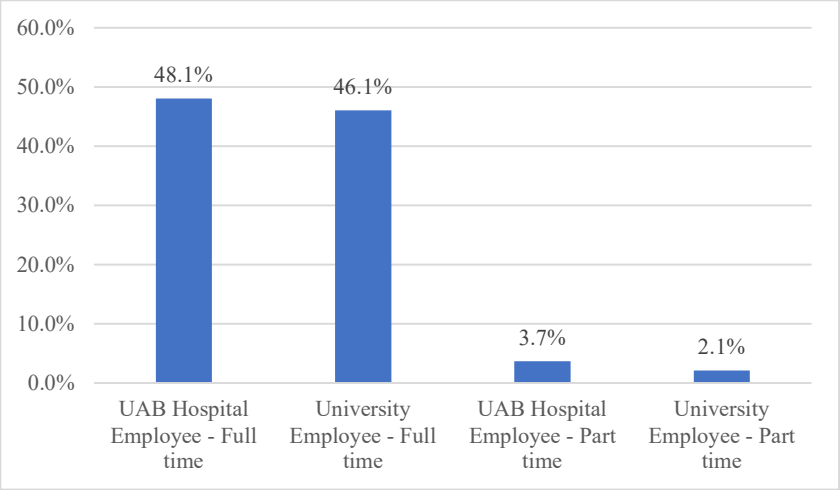

Figure 24: Employee Type Data

The type of employees who are willing to telecommute and switch to sustainable modes are presented in Table 3. UAB employees prefer to telecommute more than UAB hospital employees. On the other hand, more UAB hospital employees are ready to switch mode than UAB employees.

Table 3: Employment Type and Mode Switch Criteria

Employment Type	Criteria	Count	Percentage
UAB Hospital Employee - Full time	Willing to Telecommute	173	10%
	Willing to switch mode	910.0	51%
	Total	1772	
University Employee - Full time	Willing to Telecommute	262	15%
	Willing to switch mode	823.0	48%
	Total	1698	
UAB Hospital Employee - Part time	Willing to Telecommute	4	3%
	Willing to switch mode	67.0	49%
	Total	136	
University Employee - Part time	Willing to Telecommute	8	10%
	Willing to switch mode	30.0	38%
	Total	79	

Besides, it is important to know commute distance for the targeted employee who wants to consider mode switching for certain incentives. Table 4 below shows cross a comparison between commute distance and percent of employee wish to mode switching.

Table 4: Employee Commute Distance Compared with Mode Switching

Commute distance	Mode switch incentives				
	Gas price exceeds $4/gallon	Special incentives were available (monetary, benefits, etc.)	Transit fare was free	I wouldn't consider switching my travel mode	I already use alternative transportation modes
1 mile or less	2.9%	1.7%	3.4%	1.1%	12.7%
1 to 3 miles	6.2%	7.2%	10.5%	5.4%	21.6%
4 to 10 miles	14.4%	24.7%	25.0%	23.6%	22.1%
11 to 15 miles	14.4%	18.6%	20.8%	21.8%	13.7%
16 to 20 miles	20.6%	15.7%	13.9%	16.7%	11.3%
21 miles or more	41.6%	32.0%	26.3%	31.3%	18.6%

The self-reported total annual household income range of UAB employees (before income taxes) is shown in Figure 25. Responses from the employee income question were close to normally distributed between $12,000 per year and more than $200,000. This indicates that the sample of respondents is representative of employees' income types. The largest percentile of employees reported making between $100,000 and $130,000 per year, and around 10% of respondents had an income level of $40,000 or below per year.

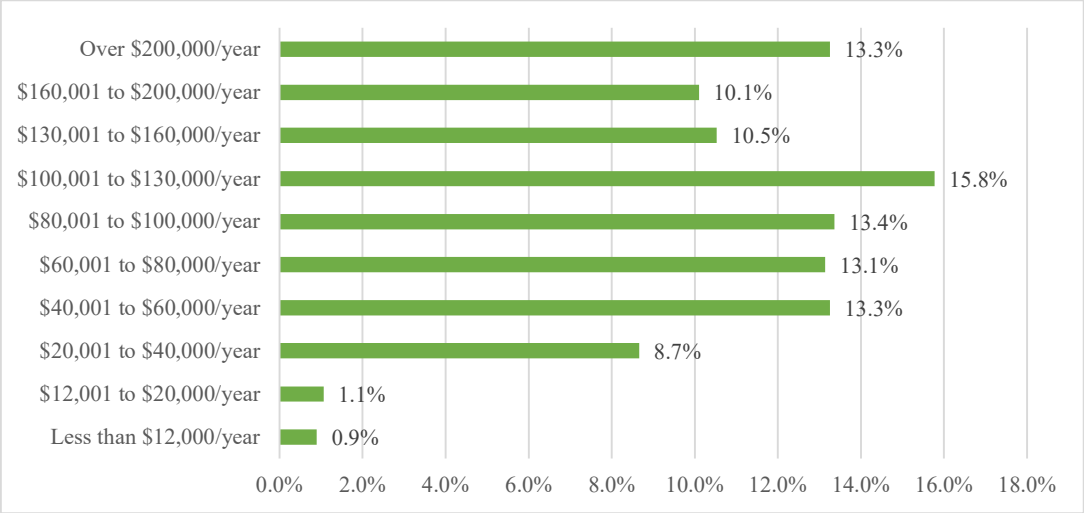

Figure 25: Employee Annual Income (before taxes)

As income is one of the influencing factors for mode choice, how their annual income affects mode choice is shown in Table 5. Employees with higher income ranges, specially who earns more than $200,000 prefer solo driving most. Whereas low-income (income less than $12,000 to $40,000) employees prefer other alternative modes along with solo driving. Surprisingly low-income employees want to use Blazer Express and BJCTA bus, carpool, walk and telecommute more than the employee of other income ranges. They also prefer to be dropped off by their relatives/friends more than the higher income ranges.

Table 5: Employee Mode Choice by Average Annual Income

Average annual income	Employee mode choice											
	Drive alone	Dropped off by relative/friend	Rideshare - organized carpool/vanpool	Rideshare - Uber/Lyft	BJCTA bus	Blazer Express	Motorcycle	Bicycle	E-scooter/e-bike	Walk	Telecommute/other	Total
Less than $12,000	69.7%	12.1%	3.0%	0.0%	3.0%	6.1%	0.0%	0.0%	0.0%	3.0%	3.0%	100%
$12,001 - $20,000	82.1%	7.7%	2.6%	2.6%	0.0%	5.1%	0.0%	0.0%	0.0%	0.0%	0.0%	100%
$20,001 - $40,000	83.1%	4.1%	2.5%	0.0%	1.6%	4.7%	0.0%	0.0%	0.0%	3.8%	0.3%	100%
$40,001 - $60,000	89.4%	2.9%	0.4%	0.2%	0.0%	2.9%	0.4%	0.6%	0.2%	2.7%	0.4%	100%
$60,001 - $80,000	91.8%	2.3%	0.2%	0.0%	0.0%	2.5%	0.0%	0.8%	0.0%	1.6%	0.8%	100%
$80,001 - $100,000	89.4%	2.4%	2.2%	0.0%	0.0%	2.8%	0.4%	0.4%	0.2%	1.0%	1.0%	100%
$100,001 - $130,000	92.8%	2.7%	1.2%	0.0%	0.2%	1.7%	0.2%	0.0%	0.2%	0.3%	0.7%	100%
$130,001 - $160,000	93.6%	3.1%	1.0%	0.0%	0.0%	1.3%	0.0%	0.3%	0.0%	0.8%	0.0%	100%
$160,001 - $200,000	92.8%	2.9%	0.5%	0.0%	0.0%	1.1%	0.0%	0.8%	0.0%	0.5%	1.3%	100%
Over $200,000	93.9%	1.6%	1.0%	0.2%	0.0%	0.6%	0.2%	0.2%	0.2%	1.0%	1.0%	100%

Section 9: Suggestions to Improve the Existing Transportation System of the Campus

Survey participants were requested to put their suggestions in the open-ended question section of the questionnaire which was the last question of this survey. In the employee survey, 2028 (47%) respondents provided their suggestions regarding potential improvements of transportation facilities to/from the UAB campus. Around 1138 respondents (or nearly 56% of the total comments provided) focused on parking-related issues. The majority of them were concerned about parking management on the UAB campus and recommended constructing more parking decks, providing free or lower fare parking facilities for staff, as well as locating parking facilities at or near

their work locations. Approximately 10% of among respondents concerned about parking issues requested free parking facilities for UAB employees. Low-income employees commented on their inability to cover the high costs of parking at UAB and some employees requested reduction of parking costs at remote parking lots to offset the inconvenience and time spent on bus transfers (often exceeding 20 minutes) by employees that are using such lots when they commute to work. Many hospital employees urged for designated parking spaces for them at or near the building where they work because remote parking needed extra time to commute, and they often did not feel safe to walk through the campus to get their car after work. Some employee survey participants who were not assigned parking spaces reported the need to park their cars on the street at parking metered spaces and had to move their cars throughout the day in order to avoid getting tickets.

Another significant suggestion was about the need for improvement of public transit, bus system, and light train system. Around 480 surveyed employees (approximately 24% of those provided comments) brought up the transit issue and stressed the need to establish safe, reliable, and flexible transit option to serve the UAB community. Some employee survey participants commented that as the largest employer in the state of Alabama, UAB should leverage its influence to increase public transit options in the Birmingham Metro Area. Participants who commuted from distant places like Moody, Hoover, and places near the US 280 Highway corridor noted that they would love to use efficient public transit options while commuting to/from UAB, rather than driving to campus. Some participants requested BJCTA (Max bus) stops at the nearest intersection to their homes. Regarding bus shuttle service on campus, some respondents commented that the app of Blazer Express tracker did not work properly and provided incorrect information frequently. Some of them identified existing bus

services as insufficient, and identified long waiting time, unreliable service, and inappropriate rain cover, or shades at the bus stops as deficiencies that needed attention.

Few employees commented on ridesharing or carpooling options for commuting to/from UAB and some suggested that Internal Uber services would benefit greatly medical trainees (residents) to commute from UAB Highlands, Callahan, UAB Children's etc., They also requested that UAB should subsidize or manage some sorts of incentive to reward employees who share their rides or carpool. Some employee survey participants commented on the safe bike or e-scooter option. Employees were also interested in telecommuting and requested for the University promote this option, if physical presence on campus is not required. Besides they commented that telecommuting option will reduce the resource consumption of UAB, add flexibility, as well as help manage traffic congestion and parking demand at the UAB campus.

Employee Mode Choice Model Results and Interpretation

From the above data analysis, it is clear that demographic attributes and commuting behavior attributes have some impacts on mode choice. In Model 1 (M1), the multinomial logistic regression (MNL) model was used to see the relationship between demographic attributes and regular mode choice of UAB employees. Similarly, Model 2 (M2) used MNL regression to demonstrate the relationship between commuting behavior and mode choice.

Model 1 (M1) -Impact of Demographic Attributes on Mode Choice of UAB Employees

Model M1 investigated whether employee demographic attributes have significant impact on mode choice. Demographic attributes considered included gender, age bracket, current occupation, auto ownership, and total household income. These factors have categorical data and Table 6 displays the case processing summary for all valid responses provided by UAB employees (N=3684).

Table 6: Case Processing Summary (Model 1)

		N	Marginal Percentage
Q6. In a typical weekday, how do you travel to UAB?	Drive alone	3345	90.8%
	Dropped off by relative/friend	104	2.8%
	Rideshare - organized carpool/vanpool	42	1.1%
	BJCTA bus	7	0.2%
	Motorcycle	6	0.2%
	Bicycle	14	0.4%
	Walk	51	1.4%
	Telecommute/other	27	0.7%
	Rideshare - Uber/Lyft	3	0.1%
	E-scooter/e-bike	4	0.1%
	Blazer Express	81	2.2%
Valid		3684	100.0%
Missing		1432	
Total		5116	
Subpopulation		951[a]	

[a] *The dependent variable has only one value observed in 762 (80.1%) subpopulations.*

The MNL analysis has been performed using IBM-SPSS version 29.0 to determine whether the demographic attributes of UAB employees have impacts on the dependent variable that was the choice of private vehicle to drive alone to work. The answer “No” is coded as 0 and “Yes” is coded as 1. Table 7 indicates that the employee demographic attributes significantly encourage them to drive alone rather than using

other modes. This is the case with a 95% confidence level. The standard indicating 95% confidence level is obtaining a p value (aka significance value) of less than 0.05. Such p value indicates that the predictor variables have statistically significant impacts on outcome variables.

Table 7: Likelihood Ratio Tests (Model 1)

	Model Fitting Criteria			Likelihood Ratio Tests		
Effect	AIC of Reduced Model	BIC of Reduced Model	-2 Log Likelihood of Reduced Model	Chi-Square	df	Sig.
Intercept	32061.657	32372.245	31961.657[a]	29847.710	10	<.001
Gender	2241.050	2551.638	2141.050	27.103	10	.003
Age bracket	2249.011	2559.599	2149.011	35.063	10	<.001
Current occupation	2239.991	2550.579	2139.991	26.044	10	.004
Auto ownership	2324.469	2635.057	2224.469	110.522	10	<.001
Total annual income of household (before taxes)	2241.234	2551.822	2141.234	27.287	10	.002

Note: *The chi-square statistic is the difference in -2 log-likelihoods between the final model and a reduced model. The reduced model is formed by omitting an effect from the final model. The null hypothesis is that all parameters of that effect are 0.*

[a]. *The log-likelihood value cannot be further increased after a maximum number of step-halving.*

Table 8 and Table 9 show the model fitting and "Goodness of Fit" results. The final model incorporates the combined effects of all predictor variables. "Goodness of fit" indicates how well the Model M1 performs. Table 8 indicates the chi-square value 275.859 and degrees of freedom 50 for the final model and it fits significantly better than the null model. For a good fit, the model needs to have high significant value (significance value < 0.001) (Pallant, n.d.). The large Chi-square value in Pearson statistics indicates a poor fit for the model and a statistically significant value confirms

that the model is not well fitted to the data. However, the non-significance value for the Deviance statistics indicates that the model fits the data well. It is possible that these two goodness-of-fit measures do not always provide the same result (laerd Statistics, 2018). Besides, the suitability of model M1 is measured, respectively, by the goodness of fit indicators: −2 log-likelihood, Pearson chi-square, Cox and Snell R square, and Nagelkerke R square. The reliability of the model is assessed by these R square values, where a greater R square value indicates a good correlation between the data (Chowdhury, 2019). However, some researchers argued about these and commented that low R Square values in logistic regression are the norm and thus this indicator is not recommended as a measure of model goodness (McCullagh, 1980), (Eboli et al., 2020). Nevertheless, the Cox and Snell R square values and Nagelkerke R square values indicate that model M1 has been reliably fit to the given data.

Table 8: Model Fitting Information (Model 1)

	Model Fitting Criteria			Likelihood Ratio Tests		
Model	AIC	BIC	-2 Log Likelihood	Chi-Square	df	Sig.
Intercept Only	2409.806	2471.924	2389.806			
Final	2233.947	2606.653	2113.947	275.859	50	<.001

Table 9: Goodness of Fit (Model 1)

	Chi-Square	df	Sig.
Pearson	13846.543	9450	<.001
Deviance	1669.727	9450	1.000

Moreover, the Cox and Snell R square values and Nagelkerke R square (Table 10) stipulate an indication of the amount of variation in the outcome variables by the

model. The pseudo-R square values for this model are 0.072 and 0.118 denoting that between 7.2% and 11.8%, this variability is explained by the set of variables.

Table 10: Pseudo R-Square (Model 1)

	Pseudo R-Square
Cox and Snell	0.072
Nagelkerke	0.118
McFadden	0.079

Parameter estimates of model M1 are presented in Table 11. During the MNL analysis in SPSS, the option that has the highest frequency is considered as a reference category or base case. The reference category in our analysis is “Drive Alone”. The significance level below 0.05 indicates that the outcome variables (mode choice options) are significantly influenced by the predictor variables (respective demographic attributes). B and exp(B) values denote odds and odds ratios respectively. Statistically significant variables are highlighted in green.

Table 11: Parameter Estimates (Model 1)

In a typical weekday, how do you travel to UAB?[a]		B	Std. Error	Wald	df	Sig.	Exp(B)	95% Confidence Interval for Exp(B)	
								Lower Bound	Upper Bound
Dropped off by relative/friend	Intercept	-2.995	0.642	21.748	1	0.000			
	Gender	0.083	0.170	0.237	1	0.627	1.086	0.778	1.516
	Age bracket	0.104	0.078	1.801	1	0.180	1.110	0.953	1.292
	Current Occupation	0.127	0.144	0.772	1	0.380	1.135	0.855	1.507
	Auto ownership	-0.217	0.113	3.700	1	0.054	0.805	0.645	1.004
	The total annual income of the household (before taxes)?	-0.089	0.047	3.586	1	0.058	0.915	0.834	1.003
Rideshare - organized carpool/vanpool	Intercept	-4.393	1.048	17.552	1	0.000			
	Gender	-0.287	0.286	1.006	1	0.316	0.750	0.428	1.315
	Age bracket	0.293	0.122	5.770	1	0.016	1.341	1.055	1.703
	Current Occupation	0.142	0.219	0.421	1	0.516	1.153	0.750	1.770
	Auto ownership	-0.095	0.166	0.330	1	0.566	0.909	0.656	1.259
	The total annual income of the household (before taxes)?	-0.106	0.072	2.166	1	0.141	0.899	0.781	1.036
BJCTA bus	Intercept	1.587	2.838	0.313	1	0.576			
	Gender	0.313	0.537	0.340	1	0.560	1.368	0.478	3.917
	Age bracket	0.128	0.298	0.185	1	0.668	1.136	0.634	2.037
	Current Occupation	0.091	0.536	0.029	1	0.865	1.095	0.383	3.130
	Auto ownership	-3.170	0.826	14.744	1	0.000	0.042	0.008	0.212
	The total annual income of the household (before taxes)?	-0.471	0.256	3.385	1	0.066	0.625	0.378	1.031
Motorcycle	Intercept	-5.848	3.110	3.536	1	0.060			
	Gender	-1.715	0.883	3.771	1	0.052	0.180	0.032	1.016
	Age bracket	0.876	0.389	5.058	1	0.025	2.401	1.119	5.151
	Current occupation	0.300	0.487	0.380	1	0.538	1.350	0.520	3.505
	Auto ownership	-0.900	0.527	2.914	1	0.088	0.407	0.145	1.143
	The total annual income of the household (before taxes)?	-0.038	0.190	0.041	1	0.839	0.962	0.664	1.395
Bicycle	Intercept	-1.501	1.762	0.726	1	0.394			
	Gender	-0.366	0.501	0.535	1	0.465	0.693	0.260	1.850
	Age bracket	-0.157	0.230	0.463	1	0.496	0.855	0.545	1.342
	Current Occupation	-0.009	0.439	0.000	1	0.983	0.991	0.419	2.342
	Auto ownership	-1.428	0.363	15.498	1	0.000	0.240	0.118	0.488
	The total annual income of the household (before taxes)?	0.151	0.128	1.407	1	0.236	1.163	0.906	1.494
Walk	Intercept	1.893	0.928	4.160	1	0.041			
	Gender	-1.147	0.283	16.428	1	0.000	0.318	0.183	0.553
	Age bracket	-0.146	0.117	1.559	1	0.212	0.864	0.687	1.087
	Current occupation	0.513	0.203	6.413	1	0.011	1.671	1.123	2.486
	Auto ownership	-1.500	0.210	51.118	1	0.000	0.223	0.148	0.337
	The total annual income of the household (before taxes)	-0.088	0.075	1.363	1	0.243	0.916	0.791	1.061

Telecommute/other	Intercept	-5.163	1.297	15.851	1	0.000			
	Gender	-0.237	0.358	0.439	1	0.508	0.789	0.391	1.592
	Age bracket	-0.015	0.160	0.009	1	0.925	0.985	0.721	1.347
	Current occupation	-0.012	0.298	0.002	1	0.968	0.988	0.551	1.771
	Auto ownership	0.183	0.186	0.975	1	0.323	1.201	0.835	1.728
	The total annual income of the household (before taxes)	0.033	0.091	0.134	1	0.715	1.034	0.865	1.235
Rideshare - Uber/Lyft	Intercept	-1.140	3.598	0.100	1	0.751			
	Gender	-1.858	1.238	2.251	1	0.134	0.156	0.014	1.767
	Age bracket	0.118	0.446	0.070	1	0.792	1.125	0.469	2.697
	Current occupation	0.587	0.751	0.612	1	0.434	1.799	0.413	7.841
	Auto ownership	-1.559	0.810	3.701	1	0.054	0.210	0.043	1.030
	the total annual income of the household (before taxes)	-0.082	0.286	0.083	1	0.774	0.921	0.526	1.614
E-scooter/e-bike	Intercept	-2.658	3.520	0.570	1	0.450			
	Gender	-0.399	1.020	0.153	1	0.696	0.671	0.091	4.960
	Age bracket	-0.998	0.587	2.895	1	0.089	0.369	0.117	1.164
	Current Occupation	-0.878	1.087	0.653	1	0.419	0.415	0.049	3.496
	Auto ownership	0.131	0.515	0.065	1	0.799	1.140	0.416	3.128
	The total annual income of the household (before taxes)?	0.156	0.249	0.394	1	0.530	1.169	0.718	1.905
Blazer Express	Intercept	0.374	0.749	0.249	1	0.618			
	Gender	0.042	0.212	0.039	1	0.843	1.043	0.688	1.581
	Age bracket	-0.360	0.099	13.106	1	0.000	0.698	0.575	0.848
	Current occupation	-0.855	0.232	13.610	1	0.000	0.425	0.270	0.670
	Auto ownership	-0.014	0.116	0.015	1	0.902	0.986	0.786	1.237
	The total annual income of the household (before taxes)?	-0.212	0.057	14.035	1	0.000	0.809	0.724	0.904

a. The reference category is: Drive alone.

The negative odds value indicates that there is less influence of predictor variables (demographic attributes) on outcome variables (mode choice). The age bracket has significant positive impact while choosing 'ridesharing by organized carpool/vanpool' option whereas negative impact on Blazer Express. Gender, current occupation, and auto ownership are significant factors on an employee's choice to walk. Both 'current occupation' and 'the total household income' negatively affect the choice of mode- 'Blazer Express' while commuting to/from UAB.

Model 2-Impact of Commuting Behavior Attributes on Mode Choice

Model M2 explores whether employee commuting behavior attributes have any significant impact on mode choice where the contributing factors are commuting distance, average commuting time, and commute frequency per week. These factors contain categorical data and MNL analysis has been performed using IBM-SPSS version 29.0. Table 12 represents the model case summary where 4126 responses were valid responses.

Table 12: Case Processing Summary (Model 2)

		N	Marginal Percentage
In a typical weekday, how do you travel to UAB?	Drive alone	3731	90.4%
	Dropped off by relative/friend	117	2.8%
	Rideshare - organized carpool/vanpool	45	1.1%
	BJCTA bus	7	0.2%
	Motorcycle	6	0.1%
	Bicycle	14	0.3%
	Walk	64	1.6%
	Telecommute/other	35	0.8%
	Rideshare - Uber/Lyft	5	0.1%
	E-scooter/e-bike	4	0.1%
	Blazer Express	98	2.4%
Valid		4126	100.0%
Missing		990	
Total		5116	
Subpopulation		199[a]	

[a] *The dependent variable has only one value observed in 106 (53.3%) subpopulations.*

Similar to model M1, the IBM-SPSS has also dealt with the dependent variables (mode choice) to observe whether the employee commuting pattern attributes have any impact on choosing any specific mode. The answer "No" is coded as 0 whereas "Yes" is coded as 1 (Pallant). Table 13 demonstrates the likelihood ratio test of employee travel behavior on specific mode choice (drive alone) with 95% confidence level. As all the employee commuting behavior attributes considered have significant level below .05, these attributes are found to significantly affect the employee mode choice. Table 14 shows model fitting information of model M2 with Pearson Chi-square value 583.41 and degrees of freedom 30; and Table 15 summarizes results from the 'Goodness of Fit' test that represents how well the model M2 performs. As the significance level is within the 95% confidence interval in Table 13 and Table 14, it can be said that M2 is better fit than the null model.

Table 13: Likelihood Ratio Tests (Model 2)

	Model Fitting Criteria			Likelihood Ratio Tests		
Effect	AIC of Reduced Model	BIC of Reduced Model	-2 Log Likelihood of Reduced Model	Chi-Square	df	Sig.
Intercept	1515.560	1705.312	1455.560	365.314	10	<.001
Commute distance	1483.397	1673.149	1423.397	333.151	10	<.001
Commute time	1210.163	1399.915	1150.163	59.917	10	<.001
Commute frequency	1275.313	1465.065	1215.313	125.067	10	<.001

The large Chi-square value in Pearson statistics in Table 15 indicates a poor fit for the model and a statistically significant value confirms that the model is not well fitted to the data. However, the non-significance value for the Deviance statistics indicates that the model fits the data well. It is possible that these two goodness-of-fit measures do not always provide the same result (laerd Statistics, 2018).

Table 14: Model Fitting Information (Model 2)

Model	Model Fitting Criteria			Likelihood Ratio Tests		
	AIC	BIC	-2 Log Likelihood	Chi-Square	df	Sig.
Intercept Only	1693.651	1756.901	1673.651			
Final	1170.246	1423.249	1090.246	583.405	30	<.001

Table 15: Goodness of Fit (Model 2)

	Chi-Square	df	Sig.
Pearson	21350.189	1950	<.001
Deviance	667.886	1950	1.000

The suitability of the model is tested by pseudo-R square values, Likelihood test ratios and Pearson Chi-square values. Pseudo R-square values for model M2 are shown in Table 16. The test values imply that Model 2 is reliably fit to the employee commuter survey data regarding mode choice and commuting pattern (Cheng Hua et al., 2021).

Table 16: Pseudo R-Square (Model 2)

	Pseudo R-Square
Cox and Snell	.132
Nagelkerke	.211
McFadden	.144

Parameter estimates of model M2 are presented in Table 17 where the reference category is Drive alone. A significance level below 0.05 indicates that the outcome variables (mode choice options) are significantly influenced by the predictor variables (respective commuting pattern attributes). B and exp(B) values denote odds and odds ratios.

Table 17: Parameter Estimates (Model 2)

In a typical weekday, how do you travel to UAB?[a]		B	Std. Error	Wald	df	Sig.	Exp(B)	95% Confidence Interval for Exp(B)	
								Lower Bound	Upper Bound
Dropped off by relative/friend	Intercept	-2.242	.314	50.868	1	<.001			
	Commute distance	-.048	.099	.239	1	.625	.953	.784	1.157
	Commute time	-.245	.102	5.831	1	.016	.783	.641	.955
	Commute frequency in a week	-.124	.079	2.485	1	.115	.883	.757	1.031
Rideshare - organized carpool/vanpool	Intercept	-3.832	.525	53.310	1	<.001			
	Commute distance	-.021	.156	.018	1	.894	.979	.722	1.329
	Commute time	-.059	.144	.168	1	.682	.943	.711	1.250
	Commute frequency in a week	-.162	.130	1.546	1	.214	.850	.659	1.098
BJCTA bus	Intercept	12.925	1.084	142.179	1	<.001			
	Commute distance	-1.394	.364	14.641	1	<.001	.248	.122	.507
	Commute time	1.074	.258	17.305	1	<.001	2.926	1.764	4.853
	Commute frequency in a week	-17.362	.000	.	1	.	2.882E-8	2.882E-8	2.882E-8
Motorcycle	Intercept	-3.340	1.252	7.114	1	.008			
	Commute distance	-.504	.502	1.007	1	.316	.604	.226	1.617
	Commute time	-.609	.612	.988	1	.320	.544	.164	1.806
	Commute frequency in a week	.153	.217	.497	1	.481	1.165	.762	1.781
Bicycle	Intercept	-.098	.840	.014	1	.907			
	Commute distance	-1.882	.349	29.090	1	<.001	.152	.077	.302
	Commute time	.313	.296	1.113	1	.291	1.367	.765	2.444
	Commute frequency in a week	-.375	.305	1.513	1	.219	.687	.378	1.249
Walk	Intercept	2.028	.455	19.897	1	<.001			
	Commute distance	-2.887	.235	151.458	1	<.001	.056	.035	.088
	Commute time	.747	.149	24.973	1	<.001	2.110	1.574	2.828
	Commute frequency in a week	-.231	.129	3.203	1	.073	.794	.616	1.022
Telecommute/other	Intercept	-5.761	.585	96.971	1	<.001			
	Commute distance	-.383	.183	4.406	1	.036	.682	.477	.975
	Commute time	.155	.145	1.144	1	.285	1.168	.879	1.553
	Commute frequency in a week	.631	.060	109.075	1	<.001	1.879	1.669	2.115
Rideshare - Uber/Lyft	Intercept	-4.544	1.428	10.123	1	.001			
	Commute distance	-1.071	.433	6.109	1	.013	.343	.147	.801

	Commute time	.791	.325	5.902	1	.015	2.205	1.165	4.173
	Commute frequency in a week	-.454	.547	.689	1	.407	.635	.217	1.855
E-scooter/e-bike	Intercept	-1.384	1.754	.623	1	.430			
	Commute distance	-.720	.660	1.189	1	.276	.487	.134	1.775
	Commute time	-.816	.834	.958	1	.328	.442	.086	2.266
	Commute frequency in a week	-.722	.800	.814	1	.367	.486	.101	2.332
Blazer Express	Intercept	-2.666	.348	58.861	1	<.001			
	Commute distance	.041	.108	.145	1	.704	1.042	.843	1.287
	Commute time	-.295	.111	7.051	1	.008	.745	.599	.926
	Commute frequency in a week	-.103	.083	1.534	1	.215	.902	.766	1.062

a. The reference category is Drive alone.

From Table 17 it can be said that both Blazer Express and BJCTA buses are positively affected by the commute time. But the negative effects of commuting distances on BJCTA bus illustrates that this mode would not be a suitable mode for employees who live far away from the UAB. Similarly, options such as biking, walking, telecommuting, being dropped off by relatives or friends and ride sharing- Uber/Lyft are also negatively affected by typical commute distances (one way) which means the employees that live far away from UAB are less likely to use such options. But when the commute duration is low there is likelihood that walk and rideshare by Uber/Lyft would be suitable mode choice for the employee. 'Telecommute/other' mode option is only positively affected by commuting frequency per week which implies that as commuting frequency in a week increases, there is a higher chance that employees choose to telecommute.

Comparison of the Present Commuting Behavior of Employees with Previous Commuting Behavior (2015-16)

One of the goals of this study is to observe whether the commuting behavior of the UAB employees changes due to the changes in physical infrastructure, incorporation of micro-mobility options around the UAB campus, and improvement of transit services. A chi-square test was performed and it was found that there are significant positive differences in mode choices such as 'Drive alone' and 'Transit' as compared to the previous survey (see Appendix C). This indicates that UAB employees in 2023 were more likely to choose solo driving and transit options as compared to the 2015-16 commuter survey.

Figure 26 shows the employee mode choice of the previous UAB commuter survey as well as current survey (Sisiopiku et al., 2016). When compared to the current mode choice of employees, still higher portion of employees prefer to drive alone in 2023 than before (90.4% in 2023 versus 88.4% in 2015-2016). Employee use of organized carpool/vanpool, motorcycles, bicycles, and walking for the commutes to UAB saw significant declines in 2023, as compared to the baseline. While the increase in solo driving and decrease in use of non-motorized transportation modes are not an encouraging trend, some improvement was observed in the reported usage of transit services which has increased significantly, from 1.2% in 2015-16 to 2.6% in 2023 (BJCTA and Blazer Express combined). The 'Telecommuting/other' option has seen a minor increase and around 0.9% of the employee respondents are currently telecommuting as compared to 0.7% in the previous survey.

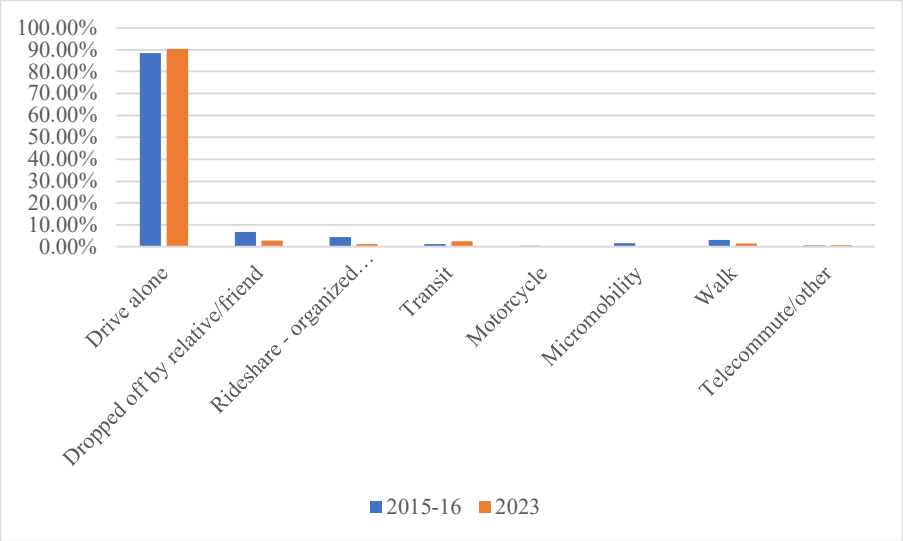

Figure 26: Comparison of Employee Mode Choice Pattern between 2015 and 2023 UAB Commuter Surveys.

In both surveys, UAB employees were asked to identify the types of transportation they would choose, if that option was easily available to them. (Sisiopiku et al., 2016). When comparing the perspectives of employees in the 2023 survey with those expressed in 2015-16 as shown in Figure 27 (Sisiopiku et al., 2016), it is clear that more UAB employees prefer to drive alone now than seven years ago and fewer express any interest in switching to more sustainable modes of transportation. Surprisingly, fewer employees also said that they would prefer telecommuting as an alternative to driving to work in 2023 (11.8% versus 14.1% in 2015-16).

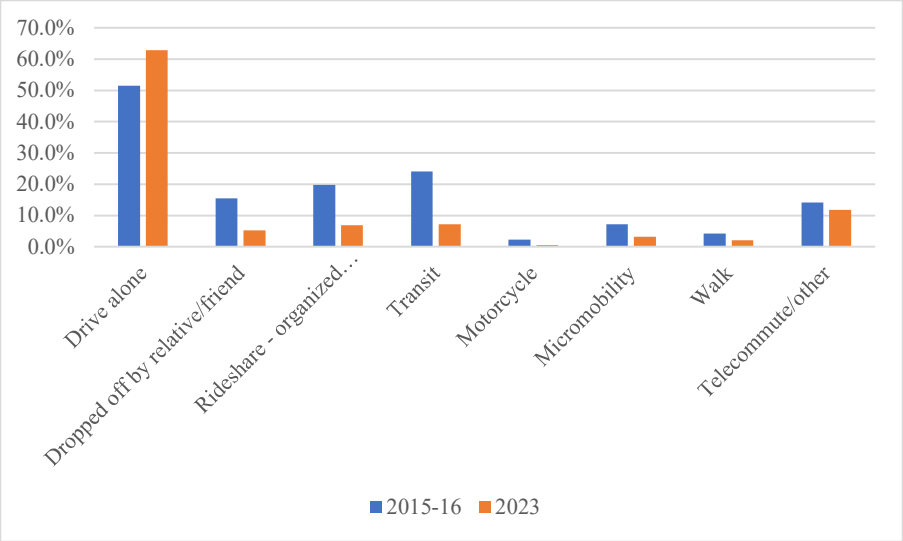

Figure 27: Comparison of Employee Mode Preference between the 2015-16 and 2023 Study if Alternative Modes were Available.

In both the current and previous surveys, employees were asked under what circumstances they would consider switching to carpooling or transit from driving alone. The response from the previous survey is shown in Figure 28 (Sisiopiku et al., 2016). In the recent survey, the percentages of employees that would not consider switching their travel mode and remained committed to driving solo was 50.1%, significantly higher than that reported in the 2015-26 UAB Commuter survey (39.4%). Furthermore, only 5.3% of UAB employees in the current survey would consider switching to carpool or transit if the gas price exceeded $4 per gallon, far less than 28.7% that considered doing so in the previous survey. This is another indication of the strong dependence of UAB employees on their private automobile, which apparently strengthened over the past 7-year period.

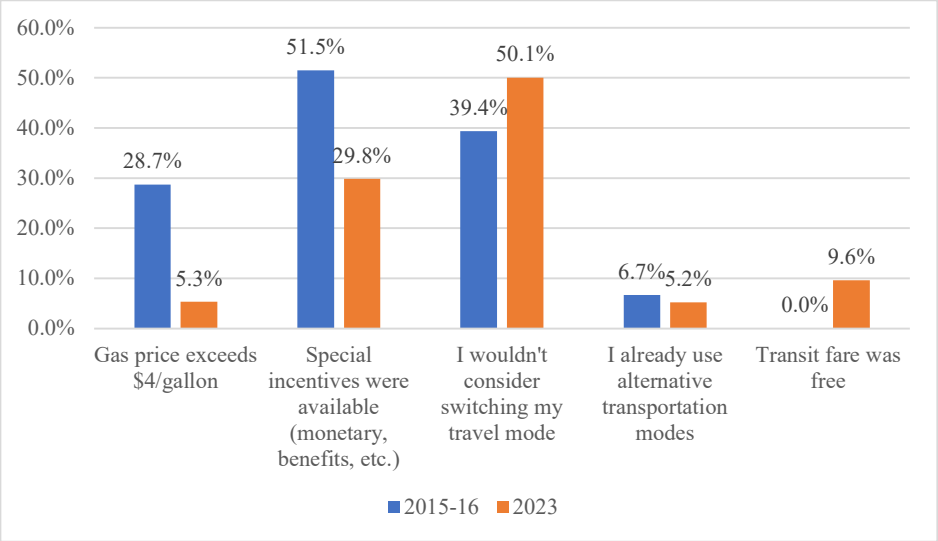

Figure 28: Comparison of Employee Incentive for Mode Switching between Previous (2015-16) and Recent (2023) UAB Commuter Survey

Employees in both surveys were also requested to report on their driving and parking preferences. Results from the previous and recent surveys are shown in Figure 29 (Sisiopiku et al., 2016). In both surveys, responses regarding driving, parking in a parking lot, deck or metered parking space, street parking, moving their car during workday are quite similar. In the previous survey, more employees (81%) used Blazer Express service to move around the campus in comparison to the recent survey (76%). Besides, only 1.5% of employees reported in the 2023 survey that they are using micro-mobility options to move around the campus.

In both surveys, employees were also asked about what they would like to see more on the UAB campus. Their responses from the previous survey and recent one is presented in Figure 30 and Figure 20 respectively.

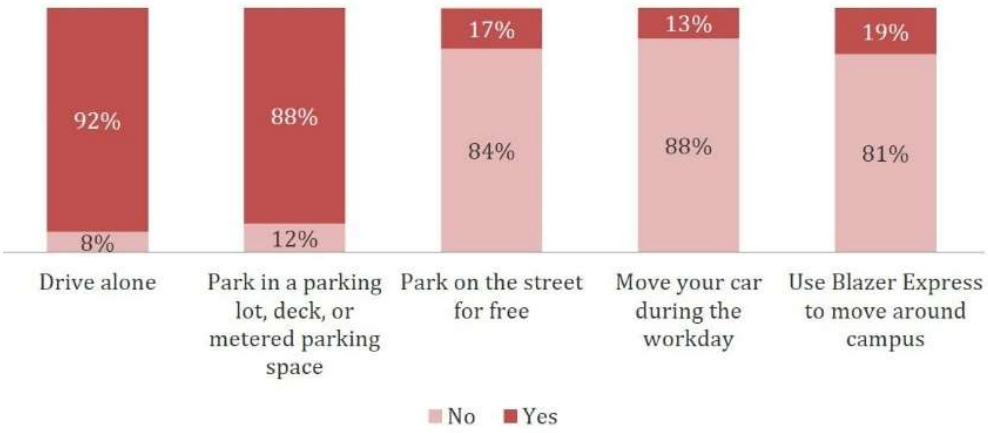

Figure 29: Employee Driving and Parking Data During Previous UAB Commuter Survey (Sisiopiku et al., 2016)

In both surveys, employees put emphasis firstly on building more parking places and then creating green spaces and pedestrian facilities. In the recent survey, employees also favored having a universal one pass to pay for parking, bus fares, and e-scooters. Besides, 2.2% of employees countered for expansion of e-scooter service and 6.1% of employees requested separate bike lanes which were not presented in the previous UAB Commuter Survey.

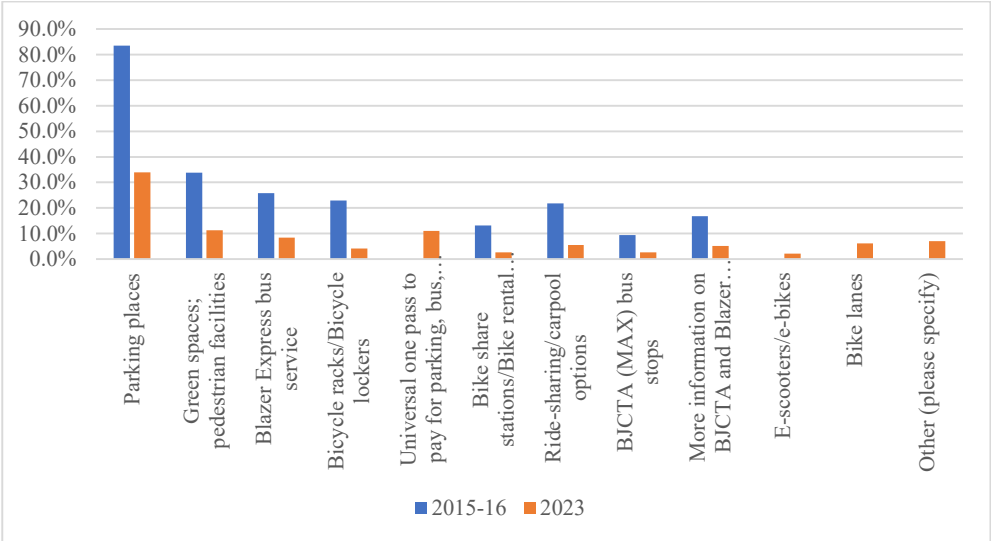

Figure 30: Employee Ideas for UAB Campus Improvements (2015-16 and 2023 Surveys)

Comparison of results from both surveys further show that employees put the highest emphasis on reliability, convenience, time, and safety and placed comparatively low emphasis on costs and environmental impacts while choosing their regular travel mode. Moreover, similarities in the main themes of employee comments were observed with parking management issues and the need to improve and expand transit options topping the list in both the 2015-16 and 2023 surveys.

Commuting Patterns of UAB Students

As the students at any university have different socio-demographic characteristics, their mode choice as well as commuting behavior is expected to be different from that of the employees. In this survey, students were not asked about their income, household information and whether they would change their travel mode if incentives were given. Rather they were asked some specific questions to define their status, student type, job status, living status in Alabama.

Section 1: Brief Sample Description

According to the Economic and Community Impacts report of UAB, the total enrollment in fall 2022 semester was nearly 22,000 (Tripp Umbach, 2023). Among them, only 720 students (14.24% of total respondents) participated in the 2023 survey. This shows that one in every 30 students responded to this survey. Compared to the employee responses and previous UAB commuter surveys for students, this number is unexpectedly low. Reasons behind the low response rate might be that students were not contacted through proper communication channels, students might not have noticed the e-mail that contained the survey link, or students were busy in doing their academic activities and ignored this survey.

Section 2: Locations of Trip Origins and Class Schedule

Students were asked about where they live in Alabama to spot the locations from where most of the trips originated. Respondents were requested to write their city name, nearest intersections, and zip code. This question and zip code option were set as mandatory. After accumulating the results, it was found that 480 nos. of students

(66.67% of total student respondents) put the zip code information. Among them 477 (66.25% of total student respondents) had valid responses. There are 69 different zip codes among these; only three zip codes- 35205, 35209, and 35233 have generated more than 30 nos. of student trips. The majority of the students reside in the cities adjacent to the campus, i.e., Birmingham, Homewood, and Vestavia Hills areas. Figure 31 illustrates the trips generated by the UAB students.

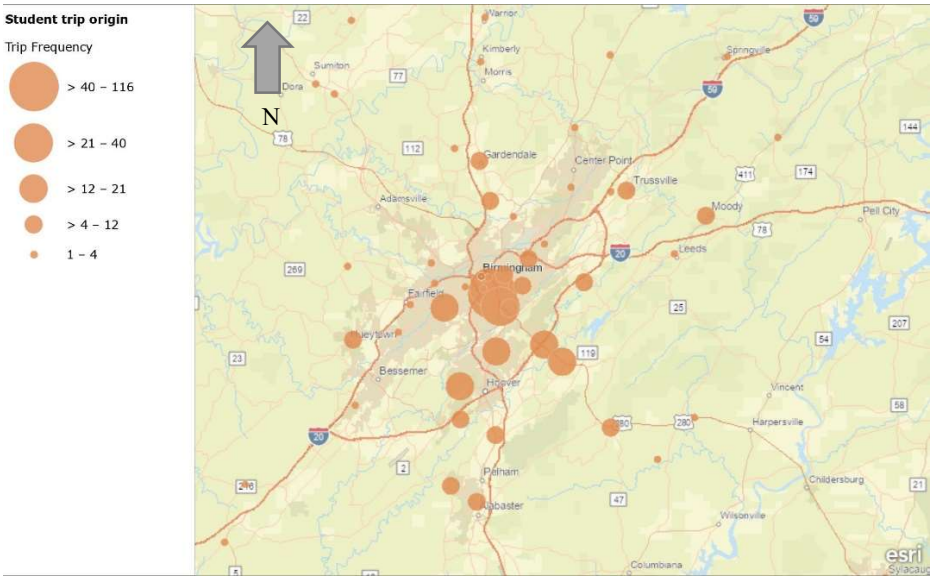

Figure 31: Student Trip Origin Map in the Current Survey.

To identify the impact of distance traveled by the students to get to UAB and required time on mode choice, they were asked to provide information regarding travel time and distance from their home to school along with which route they prefer to reach the destination. The survey results indicate that most of the students (47.7%) live very close to the UAB campus traveling less than one mile to 5 miles (one-way) to reach the school.

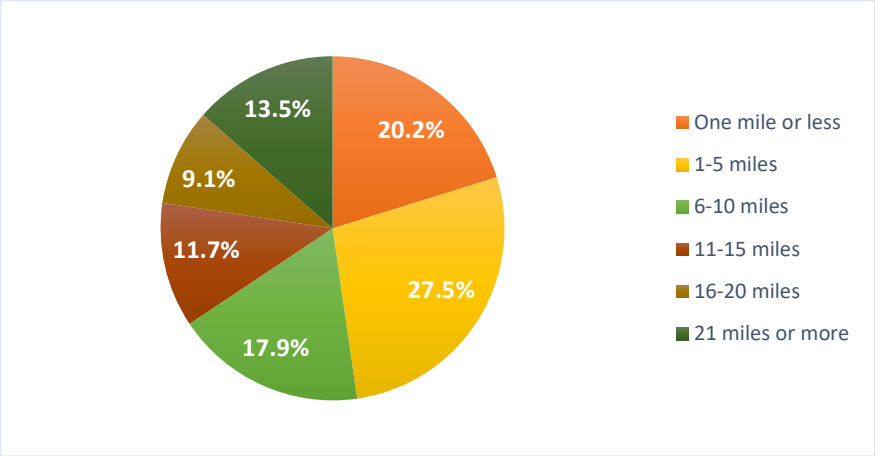

Figure 32: Student Commuting Distance to UAB

A significant portion of employees reported that they usually travel from neighboring cities of the UAB campus and cross 6 to 10 miles (17.9%). Surprisingly, 13.5% of students travelled from the distant cities of UAB like Alabaster, Moody, Pelham, Gardendale, Warrior, Kimberly etc., and crossed 21 miles or more to reach UAB (see Figure 32).

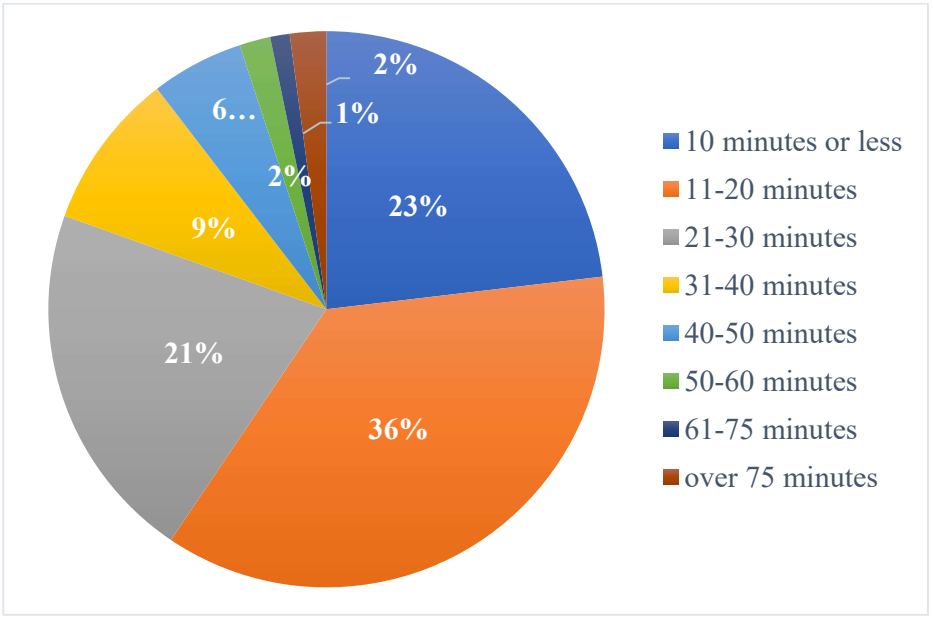

Figure 33: Student Commute Time to UAB

As the majority of the students live at or very close to UAB, it is likely that the average commuting time will not be so high. Around 23.1% and 36.3% of students need on average 10 minutes or less and 11 to 20 minutes (one way) time respectively to reach UAB (see Figure 33). Besides, students living in neighboring cities of UAB need 21 to 30 minutes of travel time and who live the distant cities need more time to get to UAB.

Students who live outside the campus were asked to report which route they prefer to follow to enter the UAB. Students who live on campus (11.1%) and others (10.8%) did not use the specified major road. As they live at or near the campus, they prefer to walk to reach their school. A significant portion of the students who come to school from the neighboring cities of UAB use nearby arterial street, I-65 Northbound (travelling from the south), I-65 Southbound (travelling from the north) and US 280 (Figure 34).

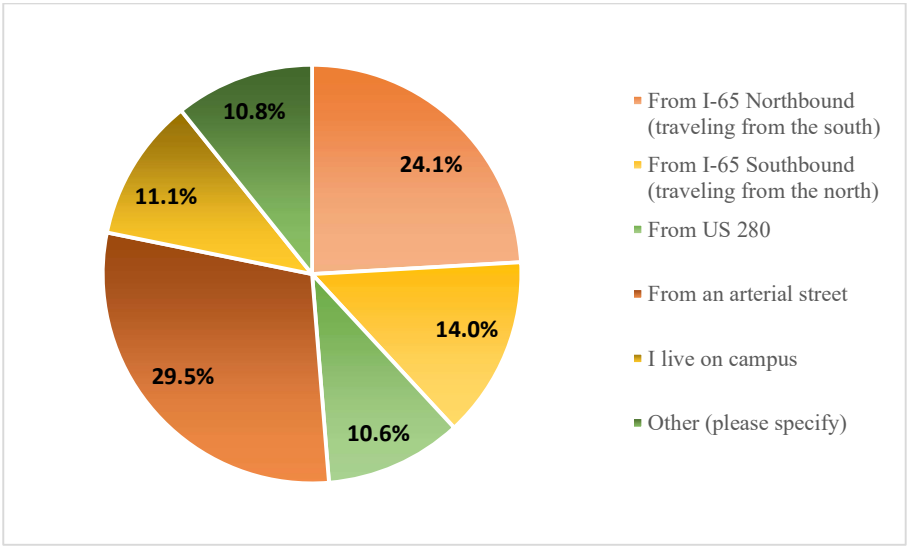

Figure 34: Student Commute Routes to UAB

To know the impact of traffic volume in creating congestion at or near the UAB campus and increased parking demand, participants were asked to report about how often they commute to UAB in a typical week.

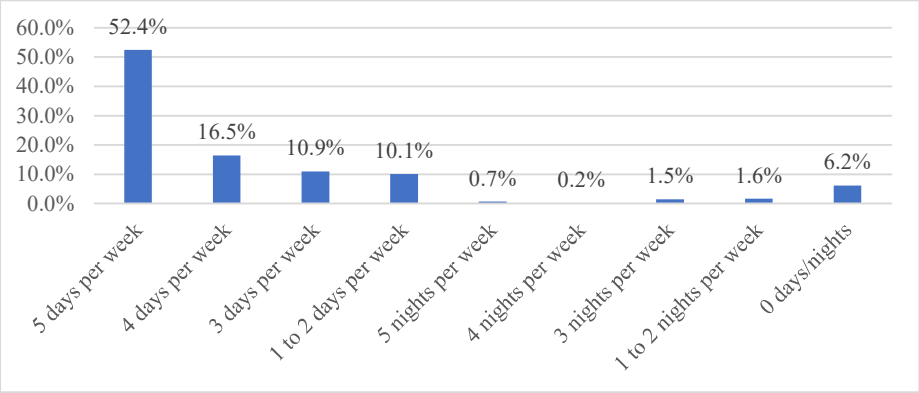

Figure 35: Student Number of Commutes to UAB in a Week

From Figure 35, it was found that approximately 52.4% of students usually travel to UAB 5 days a week and very few students (4% in total) commute to UAB at nighttime. Around 6.2% of students travel 0 days/night per week because they may attend their course remotely or do online classes. The majority of the students leave home for UAB between 7:00 am to 9:00 am and leave UAB for home between 3:00 pm to 7:00 pm.

Section 3: Current Commute Patterns and Recent Commute Changes

Students were asked to report whether they own any automobiles and e-scooters/bikes or bicycles in question no. 22 of 'Student Survey Questionnaire'. The responses were portrayed in Figure 36 and showed that around 76%, 8% and 3% of student respondents owned 1 car, 2 cars and 3 or more cars/vans respectively. Students rarely had e-scooters/e-bikes (3.8%) or motorcycles (1.7%). On the other hand, 23.5% of student respondents had one or more bicycles. This also indicates that like the employees, the majority of the students prefer to solo driving rather than using micro-mobility options while commuting to/from UAB.

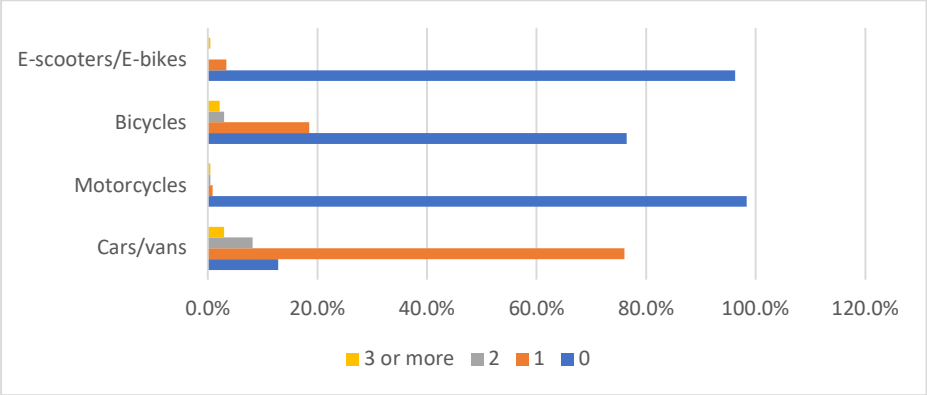

Figure 36: Student Auto Ownership Data

To know the regular modes of transportation that the students used to commute to and from UAB, they were asked to report their typical mode in question no. 6 of the student survey questionnaire. The results are shown in Figure 37 where 68.4% of students preferred to drive alone as 76% of students owned at least one car (Figure 36). Besides 21.3% of students usually walked to their school as 20.2% of students live 1 mile or less from UAB (Figure 32). This justifies that students who live within the comfortable zone for walking don't prefer solo driving. This also states that students' responses were fairly accurate and consistent, which increases confidence in the validity of the study findings.

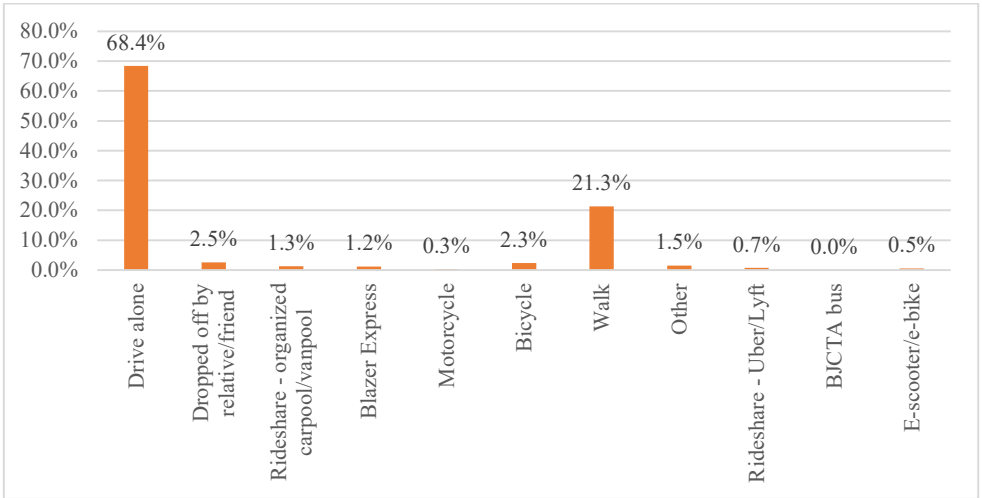

Figure 37: Student Regular Mode Choice

Very few students (2.5%) were dropped off by relatives/friends and only 1.2% of students used transit (Blazer Express). In total 2% of student respondents used to rideshare by organized carpool/vanpool and Uber/Lyft. Around 2.3% of participants used bicycles whereas only 0.5% of students preferred e-scooters/e-bike. BJCTA buses and motorcycles were the least popular mode of transportation for the students. However, 1.5% of students did not use the above specified modes as they might do their classes virtually.

Students were also asked to provide information on whether they use any of the alternative modes such as Uber/Lyft, E-scooters/ E-bikes, Blazer Express, etc., other than cars in a typical day. Around 75% of respondents reported that they did not use these modes. However, they used blazer express services (11.4%) than the micro-mobility options, Uber/Lyft, and transit on-demand. But the positive thing is that micro-mobility options are getting popular among the youngsters as 6.63% of the student respondents currently use this alternate mode to fulfill their travel needs.

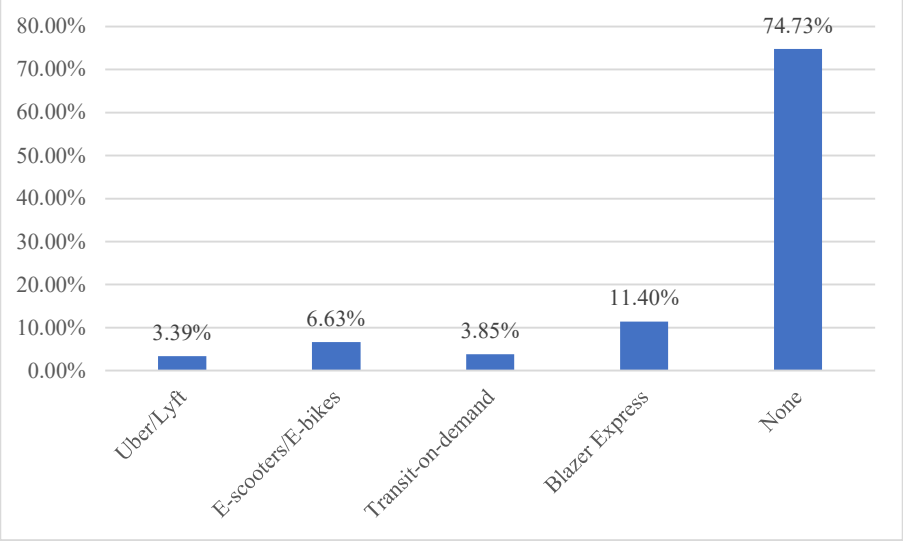

Figure 38: Student Alternative Mode Use in UAB on a Typical Day

The recent Covid-19 pandemic has brought dramatic changes in the educational system all over the world. The usage of online platforms to conduct meetings, online classes and exams in educational institutions reduces the necessity of travel for office and school purposes. In this new normalization, students were asked to report whether the Covid-19 has changed their travel patterns. Figure 39 showed the survey responses that around 77% of students' respondents continued a similar commuting pattern as before the pandemic. Around 16% of them attend one or more courses remotely and 5% do their study remotely. Only very few students (1.98%) changed their transportation modes.

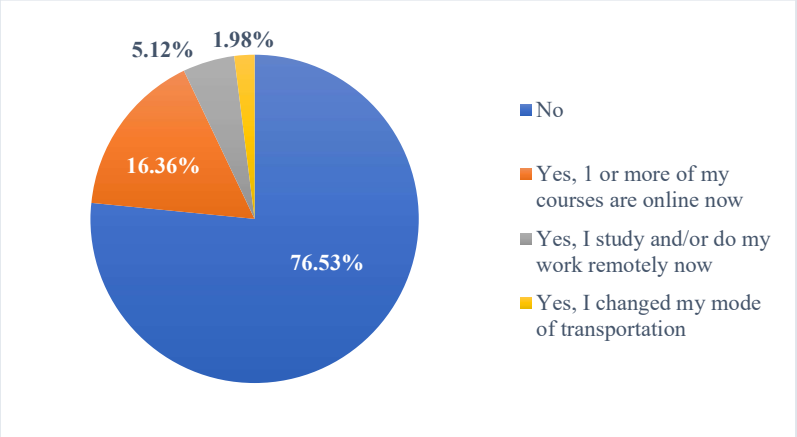

Figure 39: Changes in the Commuting Behavior of UAB Students due to the Covid-19 Pandemic

Section 4: Mode Preference Contributing Factors

To know whether students would prefer other alternative modes instead of solo driving, if alternative modes were available, they were requested to provide information about their choice of preference for commuting mode while traveling to and from UAB. The majority of the student respondents (41.7%), like the employees reported that they would prefer to drive their own vehicle rather than use other modes.

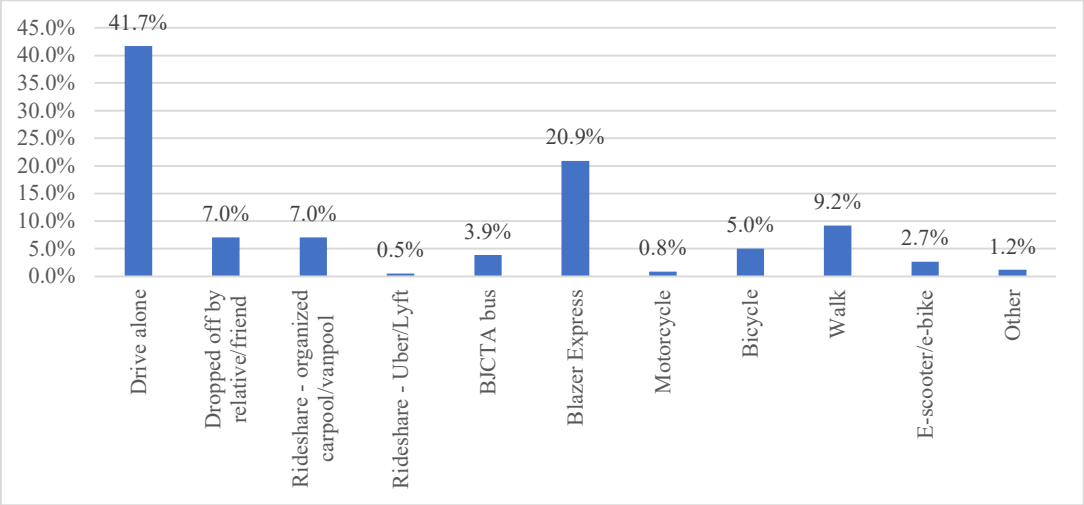

Figure 40: Student Alternative Mode Preferences

The second highest choice of travel mode to the students was Blazer express bus service. Around 20.9% of student respondents preferred to use blazer express service. Whereas, very few respondents (3.9%) liked BJCTA bus as their preferred travel mode. An equal portion of students also liked to be dropped off by friends/family or use rideshare by organized carpool/vanpool. Although significant portions of students live very close to the campus only 9.2% of student respondents preferred to walk to the campus. As a new addition of travel mode, micro-mobility option became familiar to the students and approximately 7.7% of the student survey participants preferred to use these new alternative modes. However, motorcycles and Uber/Lyft were not as a popular mode choice as only 0.8% and 0.5% of student respondents respectively used those modes.

To understand what factors, instigate students for choosing their regular modes (car, bus, walk, etc.,) while commuting to/from school, survey participants were asked to report in question no. 10. The influencing factors set for this question were cost (in dollars), time, convenience, reliability, safety, and environmental impacts.

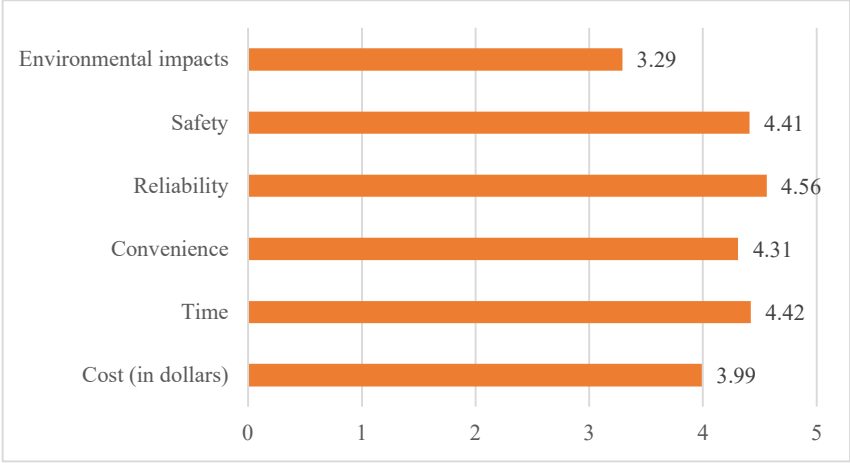

Figure 41: Contributing Factors for UAB Students in Choosing Regular Travel Mode to School (Average Rating per Factor)

Similar to the employee survey, each respondent was requested to rate these specific factors from 'Not at all important' to 'very important' where 'Not at all important' was coded as 1 and 'Very important' was coded as 5. The survey responses from students were summarized in Figure 41 where reliability got the highest attention as an influencing factor. After that, time, and safety factors got nearly equal importance for selecting certain modes. Convenience is the third factor that the participants consider while choosing their regular mode. Cost (in dollars) and environmental impacts were regarded as the least important factors. These trends of prioritizing the factors while choosing the current mode for commuting to school indicated that students rarely think about the environmental impacts.

Section 5: Motivations and Barriers to Use Alternative Modes

One of the important goals of this survey was to know the barriers of using alternative modes such as carpooling, bus, bike walk or e-scooter/e-bike. Students were asked to report in question no. 11 in the student survey what reasons pushed them for

not switch to carpooling or transit or micro-mobility options from solo driving tendency. The survey responses were summarized in Figure 42.

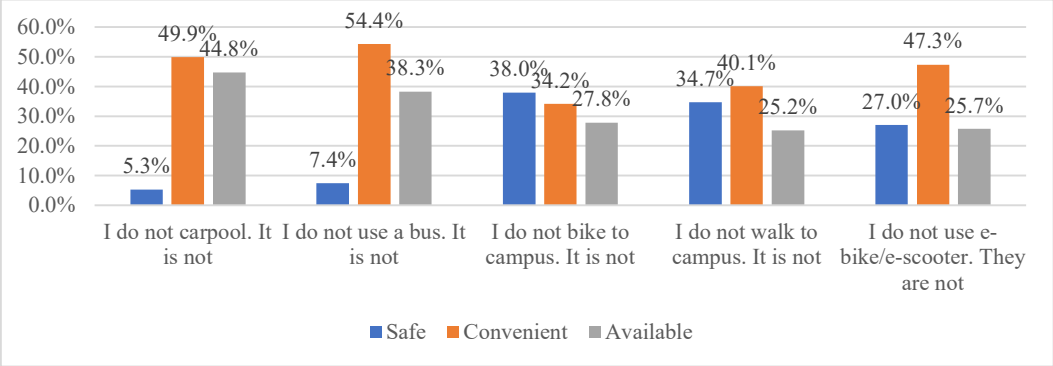

Figure 42: Student Non-alternative Mode Choice Reasoning.

The majority of the respondents said that both the bus and carpool were not convenient to use and not available to them. Students did not like to ride bikes as they considered this mode as an unsafe, unavailable, and inconvenient one. Besides they reported walking was not a safe and convenient mode. Most of the students also did not want to use the micro-mobility options (e-bike/ e-scooter, bike) for inconvenience reasons.

Section 6: Parking Facilities and Parking Preferences

UAB students were asked to report on parking facilities, parking preferences, and preferred mode while moving around the campus in question no. 12 on the student survey. The results were shown in Figure 43 where around 85% of the respondents replied that they use their own vehicles and drive alone while moving around the campus.

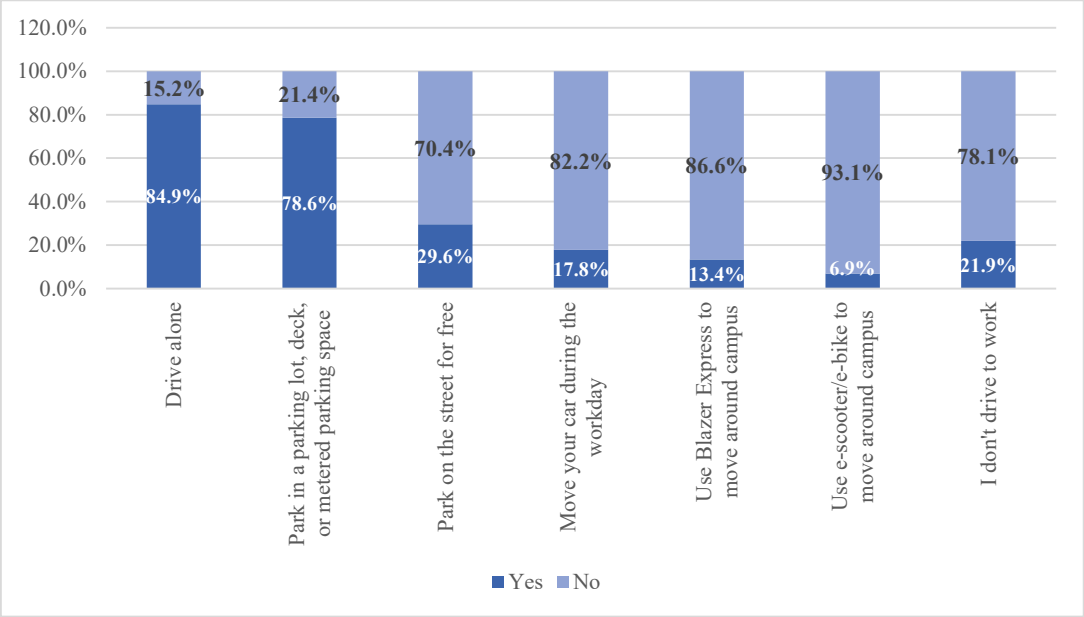

Figure 43: Student Driving and Parking Data

Around 79% of them parked their autos in a parking lot, deck, or metered space whereas approximately 30% of respondents parked their cars on the street for free. Only 18% of respondents moved their car during the workday. Approximately 22% of the participants did not drive to work and might use other modes to reach their workstations. To move around the campus 13.4% of the respondents use blazer express services and very few survey participants (7%) use e-scooters or e-bikes.

Section 7: Ideas for Improvement of the Campus Environment

To understand what the students thought about improving transportation services as well as the overall environment of the UAB campus, they were asked to report from the twelve selected choices about what they would like to see more in this area. Respondents had the opportunity to select as many options as applied and their choices were summarized in Figure 44.

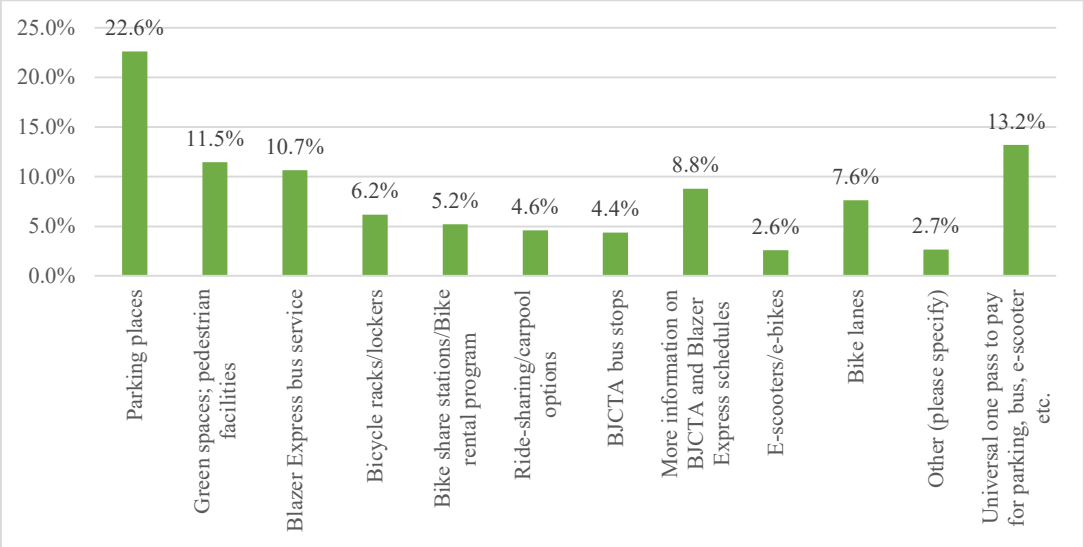

Figure 44: Student Ideas for Improvements on Campus

From Figure 44 it can be seen that 22.6% of the student respondents would like to have more parking places on the campus and around 13.2% of respondents chose universal one pass to pay parking, bus, e-scooters, etc. Some students (11.5%) revealed their desire to see more green spaces and build facilities for pedestrians. Around 7.6% of UAB student respondents said there should be separate lanes for those who ride bikes and 5.2% of the participants felt the necessity of bike share stations or bike rental programs. Approximately 1.07% of the respondents wanted more Blazer Express bus services and in total 12.2% wished to see BJCTA bus stops along with more information on BJCTA and Blazer Express schedules. In addition, 4.6% of the respondents suggested ridesharing or carpool options, and in total 8.8% of them recommended improving micro-mobility facilities.

The results of these responses indicated that UAB students were inclined to use other sustainable modes such as bus, bicycles, bikes, e-scooters/e-bikes etc., although the demand for building parking places on the campus was still higher. These will help

to improve the existing transportation services as well as the environment of the university campus.

Section 8: Demographic and Employment Status of the Sample

Demographic information of the participants, student type and status, employment type and status, resident information in Alabama are important factors that may affect mode choice. According to UAB Headcount Enrollment Report for Spring 2023 total student enrollment in spring 2023 semester is 20,205 and male-female ratio is 1:1.6. This ratio also affected in this survey as more female students responded to this survey than male students. Around 66.7% of female students and 28% of male students in UAB participated in this commuter survey and provided their home-to-school commute-related data along with their demographic information (see Figure 45).

In Table 18, how the mode choice of UAB students influenced by their gender is shown. As the more female students participated in the survey, they use more mode options than the male students except motorcycle and bicycle. However, both types of students equally like Uber/Lyft. While male students prefer to use motorcycle, female students like to use e-scooter/e-bike.

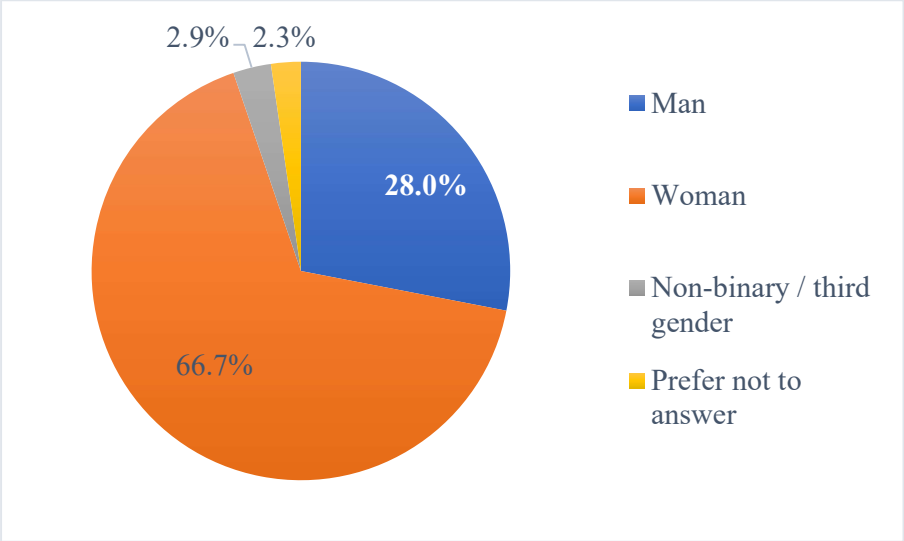

Figure 45: Student Gender Data

Table 18: UAB Student Mode Choice by Gender (%)

Gender	Drive alone	Dropped off by relative/friend	Rideshare - organized carpool/vanpool	Rideshare - Uber/Lyft	BJCTA bus	Blazer Express	Motorcycle	Bicycle	Walk	E-scooter/e-bike	Other
Male	26	9	17	50	0	17	100	46	38	0	20
Female	68	82	67	50	0	83	0	38	63	100	80
Non-binary / third gender	3	9	0	0	0	0	0	8	0	0	0
Prefer not to answer	3	0	17	0	0	0	0	8	0	0	0
Total	100	100	100	100	0	100	100	100	100	100	100

Responses for the age bracket question of students were shown in Figure 46. The majority of the student participants were undergraduate and graduate students and fell in the age group of 18 to 24 (63%) followed by 25 to 34 (30.1%).

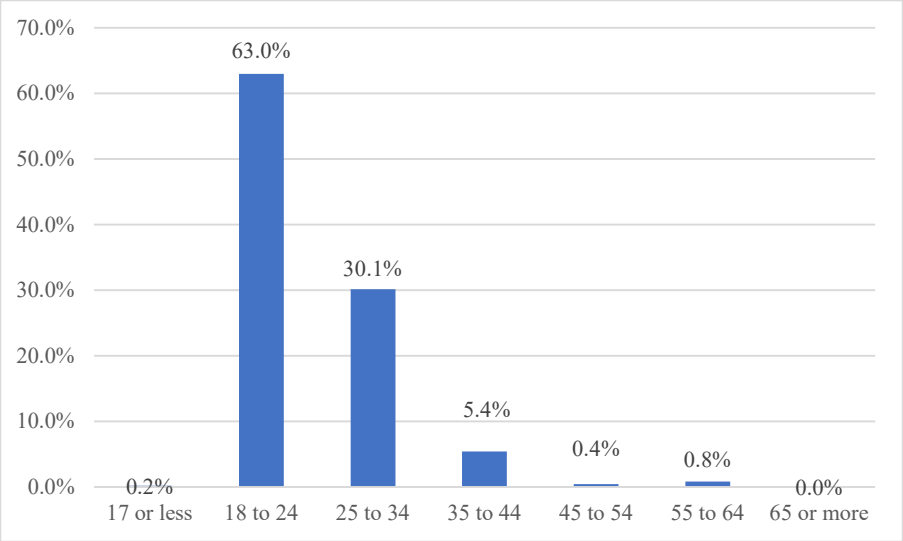

Figure 46: Student Age Bracket Data

Students were also asked to define their status as six classified levels such as Freshman, Sophomore, Junior, Senior, Graduate student, Professional student. According to UAB Headcount Enrollment Report for Spring 2023, the total number of enrollments of undergraduate, graduate, and doctoral students are 11996, 4983, and 3226 respectively in spring 2023. In this survey, responses from graduate and undergraduate students were 36.6% and 55.5% respectively. Besides, fewer Freshman (6.1%) and Professional students (8.0%) participated in the survey which might be skewed the survey results as their opinions were underrepresented in the survey.

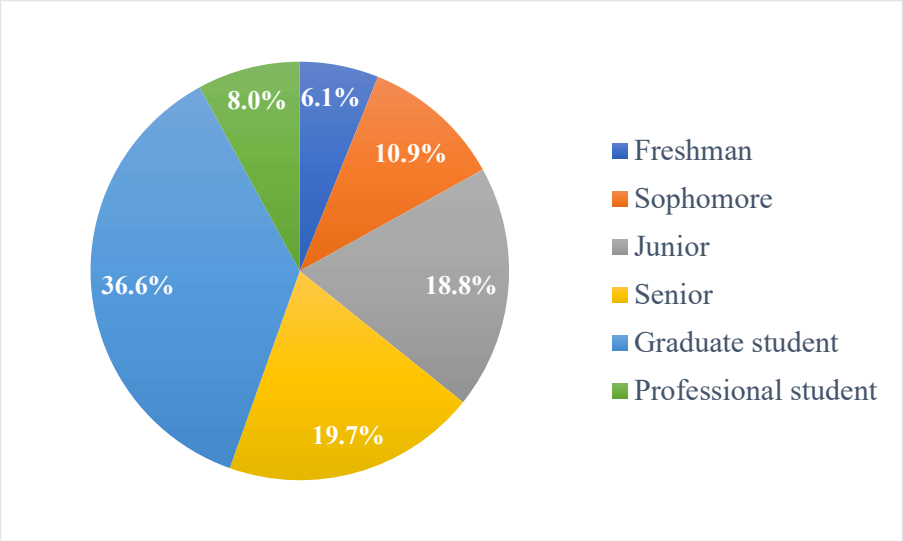

Figure 47: Student status classification

The relationship between mode choice and class of students is shown in Table 19. According to this table, junior students have the highest interest in solo driving than any other student class. Surprisingly, a good percentage of professional students prefer to walk or use bicycle while commuting to UAB.

Table 19: Mode Choice (percentages) by UAB Student Classification

Student type	Drive alone	Dropped off by relative/friend	Rideshare - organized carpool/vanpool	Rideshare - Uber/Lyft	BJCTA bus	Blazer Express	Motorcycle	Bicycle	Walk	E-scooter/e-bike	Other	**Total**
Freshman	72.4	3.4	0.0	0.0	0.0	0.0	0.0	3.4	20.7	0.0	0.0	100
Sophomore	65.4	5.8	0.0	0.0	0.0	0.0	0.0	3.8	25.0	0.0	0.0	100
Junior	82.2	3.3	0.0	0.0	0.0	1.1	0.0	0.0	12.2	1.1	0.0	100
Senior	78.7	1.1	1.1	0.0	0.0	0.0	0.0	2.1	14.9	1.1	1.1	100
Graduate student	63.4	1.7	2.9	1.1	0.0	2.9	0.6	3.4	21.1	0.6	2.3	100
Professional student	76.3	0.0	0.0	0.0	0.0	0.0	0.0	5.3	18.4	0.0	0.0	100

Similarly, student classification was compared with the commute frequency in a week both daytime commute and nighttime commute in Table 20. Most of the students went to UAB 5 days in a week and professional students scored the highest percentage in this case. Whereas a significant percentage of freshman and sophomore students reported that they hardly commute to UAB. This might be because these students attended their program remotely.

Table 20: Student Classification Compared to Commute Frequency in a Week

Student type	5 days per week	4 days per week	3 days per week	1 to 2 days per week	5 nights per week	4 nights per week	3 nights per week	1 to 2 nights per week	0 days/nights	**Total**
Freshman	45%	10%	14%	10%	0%	0%	0%	0%	21%	100%
Sophomore	44%	25%	6%	12%	0%	0%	0%	0%	13%	100%
Junior	50%	23%	14%	3%	1%	1%	1%	2%	3%	100%
Senior	45%	20%	13%	16%	1%	0%	1%	3%	1%	100%
Graduate	58%	13%	9%	12%	1%	0%	3%	2%	1%	100%
Professional	87%	8%	3%	0%	0%	0%	0%	0%	3%	100%

Students were asked to report their student type in UAB -full time student, part time and not currently enrolled. Around 94.3% of students were enrolled as full-time and only 5% students were enrolled as part time students during the commuter survey. Very few respondents (0.6%) reported that they were not currently enrolled in UAB.

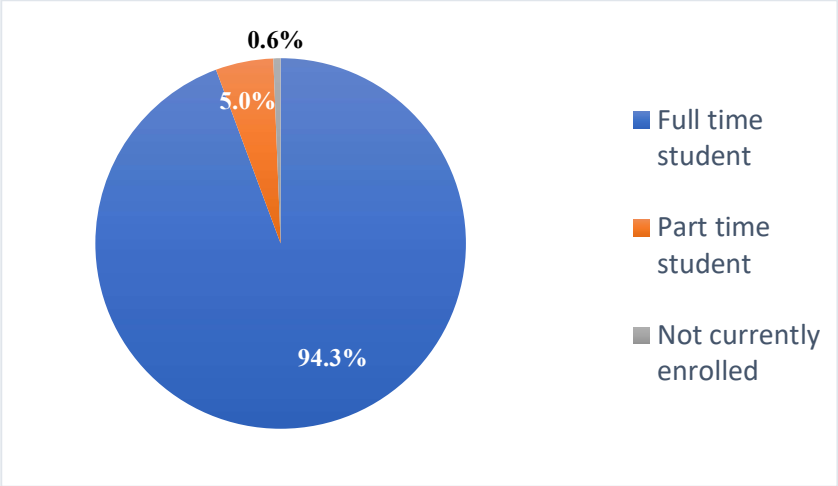

Figure 48: Student Type Classification

As the employment status of students may affect the travel demand, trip generation as well as parking demand they were asked whether they have any job during the survey. Around 57.9% of student respondents have a job whereas 42.1% of students do not work.

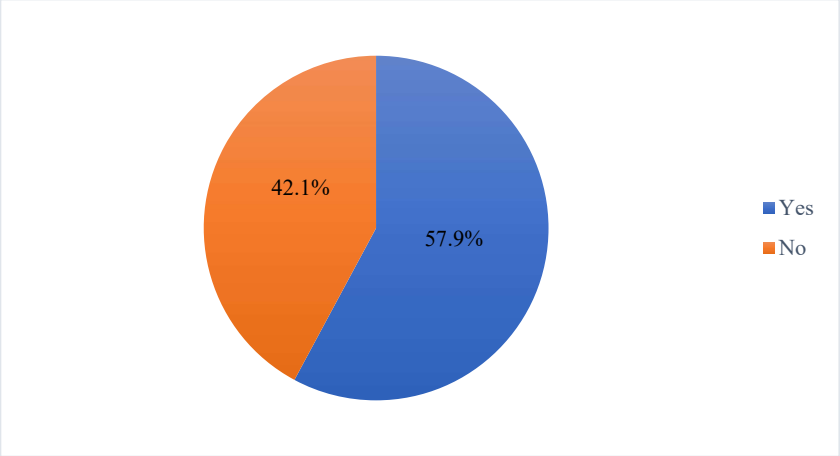

Figure 49: Job Statistics of UAB Students

Students were also asked what type of job they did during the commuter survey. They could choose an option from full-time off-campus, full-time on-campus, part-time off-campus, and part-time on-campus. Survey responses are summarized in Figure 50.

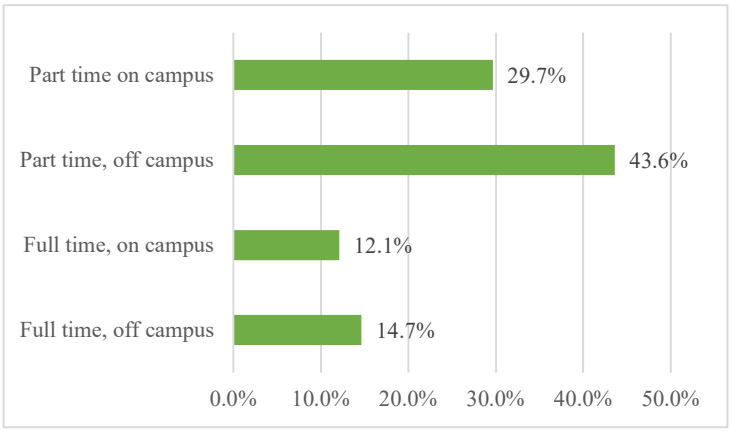

Figure 50: Job Status of UAB students

As the majority of students were enrolled as full-time students, it is hard for them to do a full-time job. Only 12.1% and 14.7% of student respondents had full-time on campus and off campus jobs respectively. However, students who did part-time jobs had off campus and on campus jobs 43.6% and 29.7% respectively.

Students were also asked to provide their living arrangements in Alabama as both out of state and international students were enrolled along with the instate students. Students were given a choice whether they lived alone, with roommate, with significant other/spouse or with parent. Responses are summarized in Figure 51.

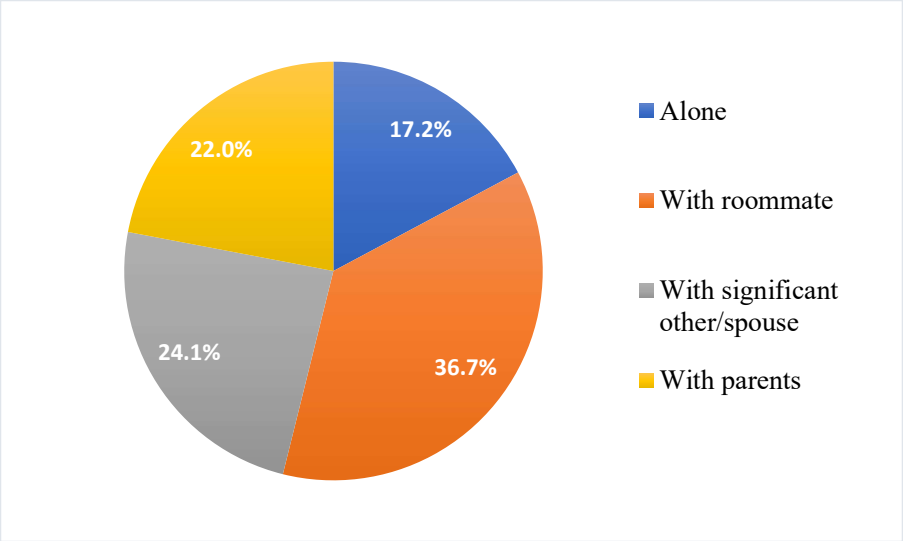

Figure 51: UAB Students Living Arrangements.

Around 36.7% of students lived with roommates and 17.2% of students lived alone. 22% of student respondents lived with their parents and 24.1% of the participants lived with significant other/spouse.

Section 9: Suggestions to Improve the Existing Transportation System of the Campus

Similar to the employee survey, students were also requested to put their suggestions in the open-ended question which was the last question of this survey. In the student survey, 406 (56.3%) respondents provided their suggestions regarding the improvement of transportation facilities to/from the UAB campus. The majority of the students commented on parking issues. Around 170 respondents nearly 42% of the total comment provided were suggested about the improvement of parking facilities and constructing more parking deck, free or less fare parking facilities for students, less parking ticket, location of car parking at or near their schools, alternate parking space during any maintenance or construction work of existing parking place. Students also complained against the mismanagement of parking by UAB Transportation (Facilities

Division) that students often got parking although they had valid parking passes. Besides they paid the same amount of parking fees as the employees and often did not get any parking spot although they already paid for the parking pass. They also demanded free parking for the students at or near their school from the university authority as they paid high tuition fees for their education. Besides, they also felt it unsafe to walk to school after parking their cars in a remote parking lot. Many of them faced harassment while walking to the parking lots from their school.

Some students put very positive thoughts regarding the improvement of transit services. They suggested both mass transit as well as bus transit and urged to set up a mass transit option from outside of downtown Birmingham to select suburb cities and provide transit service at nighttime. One student recommended reducing the crisis for transit services by taking a holistic approach in collaboration with the city, university, and federal government. Besides students commented that they felt the need for a concerted effort of express bus services with remote parking spots to reach their school.

Around 9% of the total comments provided expressed their feelings regarding the improvement and routes of blazer express bus services. Students demanded new bus stops along the route, the extension of the existing routes as well as the inclusion of some routes near the off-campus housing, reliable bus drivers, more frequent bus services, shorter waiting time for the bus and upgraded the Blazer Express Bus Service app. They also recommended arranging some carpooling or bus services for the new students as they were completely unaware about the new environment of the campus and people.

The next important topic that the participants emphasized was incorporation of a separated bike lane and 6% of total comment provided demanded for a safer and more

separated bike lanes, marked bike racks/storage areas, bike repair services, detailed information on bike services around the campus and installation of visible cameras to stop bike stolen. They also commented regarding e-scooter/bike payment plan instead of parking pass to reduce the demand for parking. Some students were interested to use e-scooter or e-bike if those were free, or the fare was less enough for the students. They put a request to UAB authority that UAB could purchase student right to use scooters for free from the companies using student one card. Thus, micro-mobility can be a good option for the students who are in comfortable distance to use these modes. This trend of accepting micro-mobility options will encourage students to use sustainable travel mode and to stop solo driving tendency which will reduce congestion, fuel emission, as well as lessen the demand for parking.

Student Mode Choice Model Results and Interpretation

Similar to the employee, student survey results were also analyzed to identify the most important factors that influence them to choose a certain mode while commuting to/from UAB. From the above chapter, it appears that student demographic and commuting behavior attributes have impacts on mode choice. In Model 3 (M3) and Model 4 (M4), the multinomial logistic (MNL) regression analysis was used to observe whether there are any significance relationships between mode choice and demographic attributes as well as mode choice and commuting behavior attributes. Model interpretations are as follows:

Model 3-Impact of Demographic Attributes on Mode Choice

Model M3 investigates whether students' demographic attributes have any significant impact on mode choice where the contributing factors are gender, age

bracket, current occupation, employment type, student classification and vehicle ownership. These factors have categorical data and MNL analysis has been performed using IBM-SPSS version 29.0. Table 21 illustrates the case processing summary where the valid responses are 273 among the total student responses 717. The model fitting results (Table 22) and goodness of fit (Table 23) derived from the analysis indicated that it was a good fit. The likelihood ratio tests (Table 24) indicated that the predictor variables did not significantly affect the outcome variables except the predictor variable that dealt with the auto ownership. This interprets that student's gender, age, student type, employment status and type did not have significant impact on their regular mode choice. Students who own vehicles were likely to prefer to drive alone. Previously, it was shown in Figure 34 and Figure 35 that 76.1% of student respondents own at least one car during the survey and 68% of the participants drive alone regularly while commuting to/from UAB.

Table 21: Case Processing Summary (Model 3)

		N	Marginal Percentage
Regular mode options	Drive alone	209	76.6%
	Dropped off by relative/friend	7	2.6%
	Rideshare - organized carpool/vanpool	1	0.4%
	Blazer Express	6	2.2%
	Motorcycle	1	0.4%
	Bicycle	4	1.5%
	Walk	39	14.3%
	Other	3	1.1%
	Rideshare - Uber/Lyft	1	0.4%
	E-scooter/e-bike	2	0.7%
Valid		273	100.0%
Missing		444	
Total		717	
Subpopulation		111[a]	

a. The dependent variable has only one value observed in 86 (77.5%) subpopulations.

Table 22: Model Fitting Information (Model 3)

Model	Model Fitting Criteria	Likelihood Ratio Tests		
	-2 Log Likelihood	Chi-Square	df	Sig.
Intercept Only	352.750			
Final	245.968	106.782	54	<.001

Table 23: Goodness of Fit (Model 3)

	Chi-Square	df	Sig.
Pearson	746.077	936	1.000
Deviance	193.637	936	1.000

Table 24: Likelihood Ratio Tests (Model 3)

Effect	Model Fitting Criteria	Likelihood Ratio Tests		
	-2 Log Likelihood of Reduced Model	Chi-Square	df	Sig.
Intercept	262.022	16.053	9	.066
Gender	249.482	3.513	9	.940
Age bracket	258.221	12.252	9	.199
Student class	262.349	16.381	9	.059
Student type	258.583	12.614	9	.181
Employment type	260.558	14.590	9	.103
Vehicle ownership	285.864	39.896	9	<.001

The chi-square statistic is the difference in -2 log-likelihoods between the final model and a reduced model. The reduced model is formed by omitting an effect from the final model. The null hypothesis is that all parameters of that effect are 0.

Table 25 indicated pseudo-R square values of the model and Table 18 presented parametric estimate of the predictor variables where the reference category was drive alone. The predictor variables obtaining significance level above 0.05 indicated that the outcome variables (mode choice options) were less likely influenced by the predictor variables (respective demographic attributes).

Table 25: Pseudo R-Square (Model 3)

	Pseudo R-Square
Cox and Snell	0.324
Nagelkerke	0.393
McFadden	0.225

Table 26: Parameter Estimates (Model 3)

Regular mode options		B	Std. Error	Wald	df	Sig.	Exp(B)	95% Confidence Interval for Exp(B)	
								Lower Bound	Upper Bound
Dropped off by relative/ friend	Intercept	-3.765	3.427	1.207	1	0.272			
	Gender	0.732	0.595	1.516	1	0.218	2.080	0.648	6.672
	Age bracket	0.743	0.504	2.169	1	0.141	2.102	0.782	5.649
	Student class	-0.116	0.343	0.115	1	0.735	0.890	0.455	1.744
	Student type	0.441	1.063	0.172	1	0.679	1.554	0.193	12.484
	Employment type	0.369	0.393	0.883	1	0.347	1.447	0.669	3.127
	Vehicle ownership	-2.301	0.921	6.241	1	0.012	0.100	0.016	0.609
Rideshare - organized carpool/ vanpool	Intercept	15.22	7824.9	0.000	1	0.998			
	Gender	-1.246	4.092	0.093	1	0.761	0.288	9.464E-05	874.408
	Age bracket	-4.831	6.468	0.558	1	0.455	0.008	2.490E-08	2555.010
	Student class	2.463	2.319	1.128	1	0.288	11.746	0.125	1106.605
	Student type	-13.78	7824.90	0.000	1	0.999	1.031E-06	0.000	.[b]
	Employment type	-0.950	0.945	1.012	1	0.314	0.387	0.061	2.462
	Vehicle ownership	-1.154	2.097	0.303	1	0.582	0.315	0.005	19.230
Blazer Express	Intercept	14.977	4.093	13.390	1	0.000			
	Gender	-0.513	1.070	0.230	1	0.631	0.598	0.073	4.876
	Age bracket	-0.162	0.951	0.029	1	0.865	0.850	0.132	5.486
	Student class	1.284	0.655	3.842	1	0.050	3.611	1.000	13.038
	Student type	-16.141	0.000		1		9.772E-08	9.772E-08	9.772E-08
	Employment type	-0.050	0.312	0.025	1	0.874	0.952	0.516	1.754
	Vehicle ownership	-3.389	0.972	12.149	1	0.000	0.034	0.005	0.227
Motorcycle	Intercept	-13.381	19303.938	0.000	1	0.999			

	Gender	-28.290	5403.243	0.000	1	0.996	5.173E-13	0.000	.[b]
	Age bracket	-52.634	1775.554	0.001	1	0.976	1.385E-23	0.000	.[b]
	Student class	25.527	800.921	0.001	1	0.975	1.21919E+11	0.000	.[b]
	Student type	29.281	9880.735	0.000	1	0.998	5.20691E+12	0.000	.[b]
	Employment type	-6.682	2965.042	0.000	1	0.998	0.001	0.000	.[b]
	Vehicle ownership	3.220	3990.496	0.000	1	0.999	25.031	0.000	.[b]
Bicycle	Intercept	15.659	4522.382	0.000	1	0.997			
	Gender	0.922	1.181	0.610	1	0.435	2.515	0.248	25.475
	Age bracket	-3.694	5.027	0.540	1	0.462	0.025	1.308E-06	472.563
	Student class	-0.135	0.465	0.084	1	0.772	0.874	0.352	2.172
	Student type	-15.652	4522.363	0.000	1	0.997	1.594E-07	0.000	.[b]
	Employment type	1.715	1.216	1.988	1	0.159	5.556	0.512	60.285
	Vehicle ownership	-2.861	1.083	6.986	1	0.008	0.057	0.007	0.477
Walk	Intercept	-0.114	1.737	0.004	1	0.948			
	Gender	-0.242	0.358	0.457	1	0.499	0.785	0.389	1.584
	Age bracket	-0.020	0.403	0.002	1	0.961	0.980	0.445	2.158
	Student class	0.272	0.186	2.127	1	0.145	1.312	0.911	1.891
	Student type	0.425	0.662	0.413	1	0.521	1.530	0.418	5.601
	Employment type	0.359	0.172	4.375	1	0.036	1.432	1.023	2.006
	Vehicle ownership	-2.024	0.494	16.763	1	0.000	0.132	0.050	0.348
Other	Intercept	-15.022	6.554	5.253	1	0.022			
	Gender	-0.608	1.309	0.215	1	0.643	0.545	0.042	7.082
	Age bracket	0.336	0.952	0.125	1	0.724	1.400	0.217	9.037
	Student class	0.810	0.839	0.933	1	0.334	2.248	0.434	11.639
	Student type	3.241	1.411	5.273	1	0.022	25.564	1.608	406.480
	Employment type	0.646	0.495	1.702	1	0.192	1.908	0.723	5.038
	Vehicle ownership	0.383	1.355	0.080	1	0.778	1.466	0.103	20.892
Rideshare - Uber/Lyft	Intercept	-37.625	36.777	1.047	1	0.306			
	Gender	0.902	4.822	0.035	1	0.852	2.465	0.000	31338.869
	Age bracket	-0.286	3.692	0.006	1	0.938	0.751	0.001	1043.710
	Student class	2.893	3.075	0.885	1	0.347	18.039	0.043	7481.019
	Student type	8.092	8.767	0.852	1	0.356	3268.322	0.000	94791490695

	Employment type	1.185	1.135	1.089	1	0.297	3.270	0.353	30.252
	Vehicle ownership	-0.023	2.677	0.000	1	0.993	0.977	0.005	185.482
E-scooter/e-bike	Intercept	27.805	6287.364	0.000	1	0.996			
	Gender	1.021	1.480	0.476	1	0.490	2.776	0.153	50.508
	Age bracket	-5.562	9.170	0.368	1	0.544	0.004	6.009E-11	245555.937
	Student class	0.096	0.656	0.021	1	0.884	1.100	0.304	3.983
	Student type	-14.722	6287.332	0.000	1	0.998	4.039E-07	0.000	.[b]
	Employment type	-0.634	0.533	1.413	1	0.235	0.531	0.187	1.509
	Vehicle ownership	-3.480	1.583	4.835	1	0.028	0.031	0.001	0.685

[a] The reference category is Drive alone.

[b] Floating point overflow occurred while computing this statistic. Its value is therefore set to system missing.

From Table 26, the negative odds value indicated that vehicle ownership by students negatively influences them to choose regular mode options such as 'Dropped off by relative/friend', 'Blazer express', 'Bicycle', 'Walk', and 'E-scooter'. Only student type may be a significant predicted variable for the outcome variables 'other' option as many students had the opportunity to join their classes remotely.

Model 4-Impact of Students' Commuting Behavior Attributes on Mode Choice

Similar to the employee commuting behavior, student commuting pattern was also analyzed in Model M4 to explore whether these attributes have any significant impact on mode choice where the contributing factors were typical commuting distance, average commuting time, and commute frequency per week. These factors contained categorical data and MNL analysis had been performed using IBM-SPSS version 29.0. Table 27 represented the model case summary where 604 responses were valid responses were analyzed among the total student responses 717.

Table 27: Case Processing Summary (Model 4)

		N	Marginal Percentage
Regular mode options	Drive alone	414	68.5%
	Dropped off by relative/friend	14	2.3%
	Rideshare - organized carpool/vanpool	8	1.3%
	Blazer Express	7	1.2%
	Motorcycle	2	0.3%
	Bicycle	14	2.3%
	Walk	129	21.4%
	Other	9	1.5%
	Rideshare - Uber/Lyft	4	0.7%
	E-scooter/e-bike	3	0.5%
Valid		604	100.0%
Missing		113	
Total		717	
Subpopulation		115[a]	

[a] *The dependent variable has only one value observed in 86 (74.8%) subpopulations*.

Table 28 and Table 29 show the model fitting information and "Goodness of Fit" information respectively. "Goodness of fit" indicates how well Model M4 performs. Table 28 indicates the chi-square value of 382.515 with degrees of freedom 27 and significance level indicates that the model is better fit than the null model (Pallant) which means student commuting pattern attributes significantly influence them to drive alone while commuting to/from UAB. The large Chi-square value in Pearson statistics in Table 29 indicates a poor fit for the model and a statistically significant value confirms that the model is not well fitted to the data. But the non-significance value for the Deviance statistics indicates that the model fits the data well. It is possible that these two goodness-of-fit measures do not always provide the same result (laerd Statistics, 2018). Besides, the goodness of fit indicators: −2 log-likelihood, Pearson chi-square, Cox and Snell R square, and Nagelkerke R square values (Table 30) gave the indication of the suitability and reliability of model M4.

Table 28: Model Fitting Information (Model 4)

Model	Model Fitting Criteria	Likelihood Ratio Tests		
	-2 Log Likelihood	Chi-Square	df	Sig.
Intercept Only	788.723			
Final	406.208	382.515	27	<.001

Table 29: Goodness-of-Fit (Model 4)

	Chi-Square	df	Sig.
Pearson	2248.806	999	<.001
Deviance	288.739	999	1.000

Table 30: Pseudo R-Square (Model 4)

Cox and Snell	.469
Nagelkerke	.540
McFadden	.313

Table 31 represents the likelihood ratio tests and the significance level indicates that the commuting pattern significantly affects mode choice of UAB students.

Table 31: Likelihood Ratio Tests (Model 4)

Effect	Model Fitting Criteria	Likelihood Ratio Tests		
	-2 Log Likelihood of Reduced Model	Chi-Square	df	Sig.
Intercept	589.471	183.263	9	<.001
Commute distance	673.350	267.142	9	<.001
Commute time	465.767	59.559	9	<.001
Commute frequency per week	425.052	18.844	9	.027

Note: *The Chi-square statistic is the difference in -2 log-likelihoods between the final model and a reduced model. The reduced model is formed by omitting an effect from the final model. The null hypothesis is that all parameters of that effect are 0.*

Parameter estimates of model M4 are presented in Table 32 where the reference category is Drive alone. The significance level below 0.05 indicated that the outcome variables (mode choice options) were significantly influenced by the predictor variables (respective commuting pattern attributes).

Table 32: Parameter Estimates (Model 4)

Regular mode options		B	Std. Error	Wald	df	Sig.	Exp(B)	95% Confidence Interval for Exp(B)	
								Lower Bound	Upper Bound
Dropped off by relative/ friend	Intercept	-4.057	0.759	28.563	1	0.000			
	Commute distance	0.089	0.283	0.100	1	0.752	1.094	0.628	1.904
	Commute time	0.014	0.274	0.003	1	0.958	1.014	0.593	1.736
	Commute frequency	0.123	0.123	0.989	1	0.320	1.130	0.888	1.440
Rideshare - organized carpool/ vanpool	Intercept	-2.189	0.926	5.590	1	0.018			
	Commute distance	-0.791	0.451	3.081	1	0.079	0.453	0.187	1.097
	Commute time	0.463	0.423	1.197	1	0.274	1.588	0.694	3.637
	Commute frequency	-0.295	0.343	0.739	1	0.390	0.745	0.380	1.459
Blazer Express	Intercept	-2.514	0.895	7.899	1	0.005			
	Commute distance	-2.524	0.554	20.745	1	0.000	0.080	0.027	0.237
	Commute time	1.865	0.386	23.385	1	0.000	6.453	3.031	13.740

	Commute frequency	-0.056	0.253	0.049	1	0.824	0.945	0.576	1.553
Motorcycle	Intercept	-6.262	2.117	8.752	1	0.003			
	Commute distance	-0.584	0.859	0.462	1	0.497	0.558	0.103	3.005
	Commute time	0.920	0.594	2.397	1	0.122	2.508	0.783	8.034
	Commute frequency	-0.072	0.394	0.033	1	0.856	0.931	0.430	2.015
Bicycle	Intercept	0.391	0.891	0.192	1	0.661			
	Commute distance	-2.299	0.510	20.345	1	0.000	0.100	0.037	0.273
	Commute time	0.815	0.418	3.795	1	0.051	2.258	0.995	5.124
	Commute frequency	-0.117	0.165	0.506	1	0.477	0.889	0.644	1.229
Walk	Intercept	2.256	0.466	23.473	1	0.000			
	Commute distance	-2.959	0.287	105.990	1	0.000	0.052	0.030	0.091
	Commute time	1.212	0.219	30.674	1	0.000	3.362	2.189	5.163
	Commute frequency	0.140	0.061	5.208	1	0.022	1.151	1.020	1.298
Other	Intercept	-4.922	0.942	27.306	1	0.000			
	Commute distance	-0.323	0.374	0.746	1	0.388	0.724	0.348	1.506
	Commute time	0.367	0.306	1.441	1	0.230	1.443	0.793	2.626
	Commute frequency	0.356	0.114	9.756	1	0.002	1.427	1.142	1.784
Rideshare - Uber/Lyft	Intercept	-4.020	1.160	12.016	1	0.001			
	Commute distance	-1.029	0.622	2.740	1	0.098	0.357	0.106	1.208
	Commute time	0.931	0.472	3.880	1	0.049	2.536	1.005	6.402
	Commute frequency	-0.016	0.272	0.004	1	0.952	0.984	0.577	1.677
E-scooter/e-bike	Intercept	-0.786	1.933	0.165	1	0.684			
	Commute distance	-0.328	1.004	0.107	1	0.744	0.720	0.101	5.153
	Commute time	-1.444	1.383	1.090	1	0.297	0.236	0.016	3.551
	Commute frequency	-0.409	0.677	0.365	1	0.546	0.664	0.176	2.503

[a] *The reference category is Drive alone.*

From the above parameter estimate table, it was shown that commute distance negatively influenced blazer express, walk, and bicycle mode options and commute time positively affected the mode choice options such as blazer express, walk and ride share by uber/lyft. Commute frequency only positively affected ‘other’ option which

indicated that student would more likely choose ‘other’ options if they had to commute UAB more frequently.

Comparison of the Current Commuting Behavior of Students with Previous Commuting Behavior (2015-16)

The recent student commuter survey was compared with the study conducted in 2015-16 to observe any changes in commuting pattern among student over the 7 year span. Similar to the employee commuter survey, a chi-square test was performed to see the changes in regular mode choice (Appendix D). From the test, it was found that significant negative changes were observed for the mode options- ‘Drive alone’, ‘Dropped off by relative/friend’, and ‘Ride share by organized carpool/vanpool’. This change indicates that recently students would be less likely choose these mode options as compared to the previous commuter survey. The analysis from previous study also showed a higher percentile of students’ choice for ‘Drive alone’, ‘Dropped off by relative/friend’, and ‘Ride share by organized carpool/vanpool’ mode options (see Figure 52). Whereas little changes were observed for the mode options ‘Transit (Blazer express and BJCTA bus), ‘Motorcycles’ and Micro-mobility options (Bicycle, E-bike/scooters)’. Only positive changes were found for ‘Walk’ and ‘Other’ mode options indicated that students would more likely choose these modes as compared to the previous study.

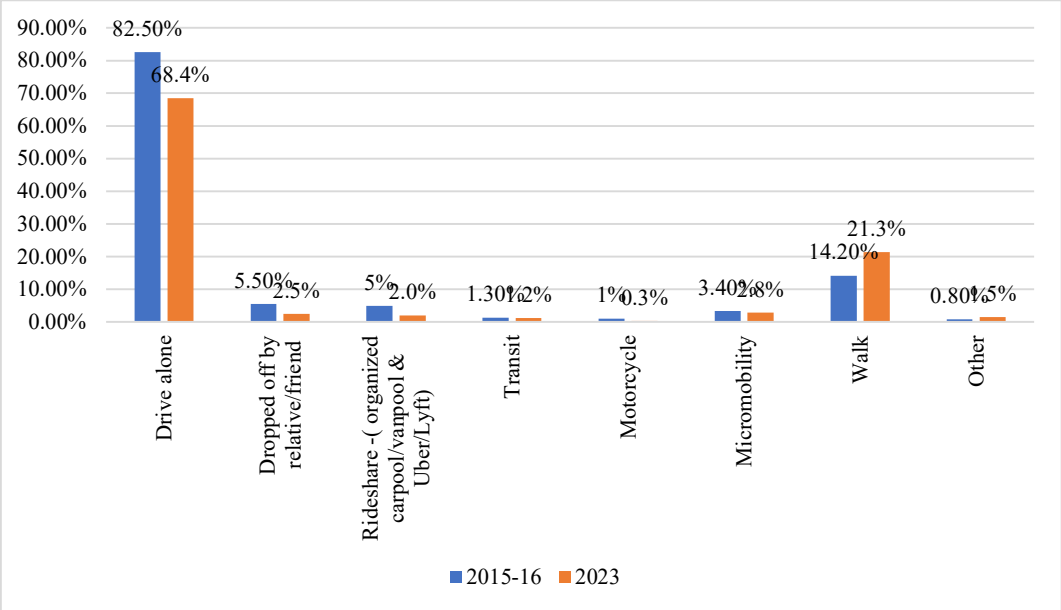

Figure 52: Student Mode Preference (2015-16 and 2013 Studies)

Similarly, another Chi-square test was performed to see the changes of student mode preference if alternative mode options were available. According to the test result student would less likely prefer 'Ride share by organized carpool/vanpool & Uber/Lyft', and 'Motorcycle' mode options as compared to the previous study. The result from previous study also attested this statement (Figure 53).

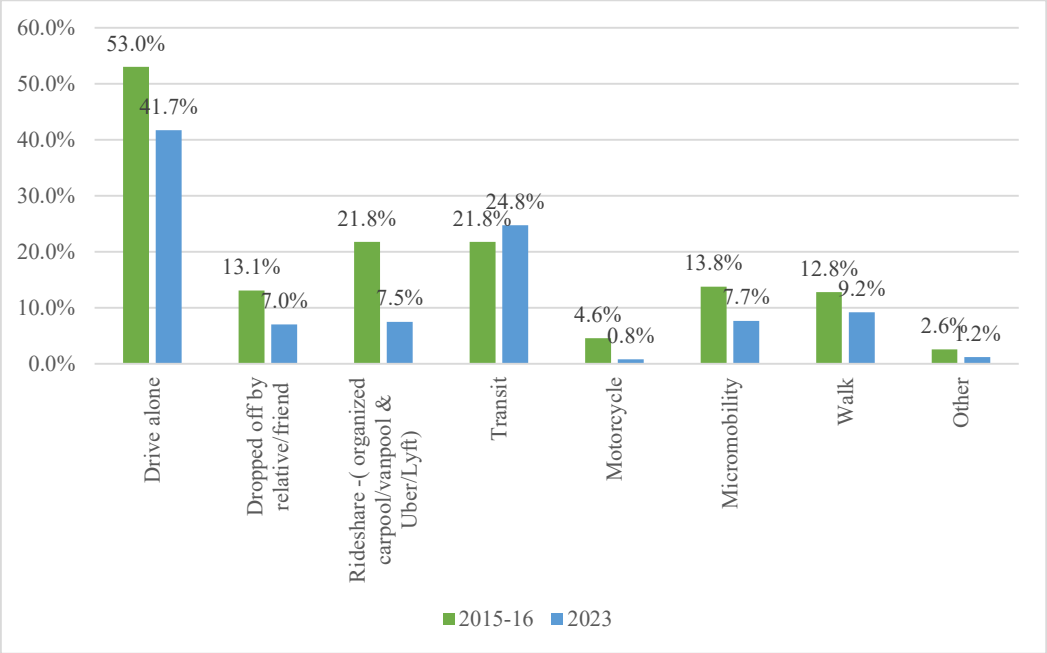

Figure 53: Student Alternative Mode Preference (2015-16 and 2013 Studies)

Students preferred to ‘Drive alone’, ‘Dropped off by relative/friend’, ‘Micro-mobility options (E-scooters/bike, Bicycle)’, ‘Walk’, and ‘Telecommute/Other’ option as they liked previously. But significant positive changes were observed for preferring ‘Transit’ as suitable mode option while commuting to/from UAB.

Students in both surveys were also requested to provide their driving and parking related information. Response result from the previous survey is shown in Figure 54 (Sisiopiku et al., 2016) . In the recent study, responses regarding driving, parking in a parking lot deck or metered parking space and moving their car during workdays are lower as compared to the previous study whereas percentile for street parking, and use of blazer express services are quite higher than the previous study. As micro-mobility option is a recent addition, currently 6.9% of students use it for moving around the campus. However, according to the recent study, 22% of students commented for not driving to school.

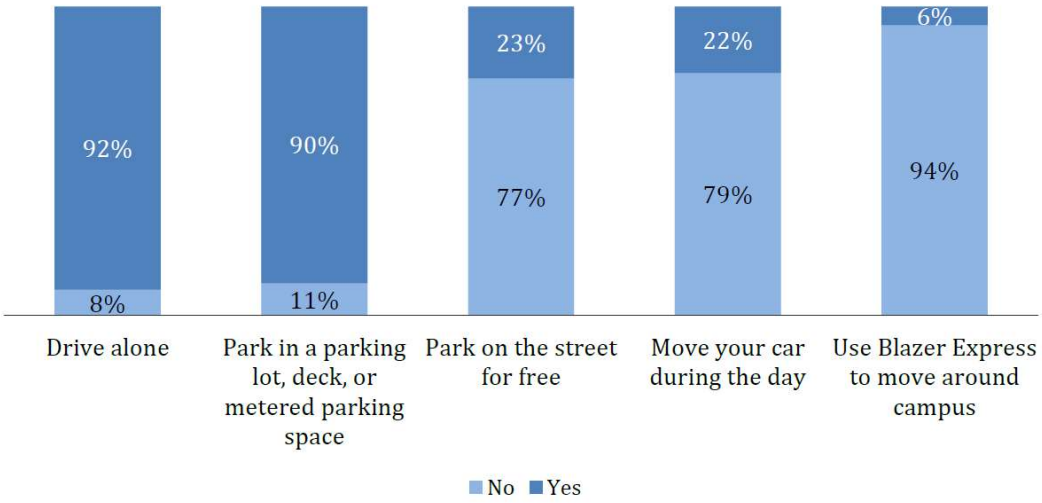

Figure 54: Student Driving and Parking Data (2015-16) (Sisiopiku et al., 2016) .

In both surveys, students were asked about what they would like to see more on the UAB campus. The student ideas for the improvement of the campus from the previous study and the recent one was compiled in Figure 55 (Sisiopiku et al., 2016).

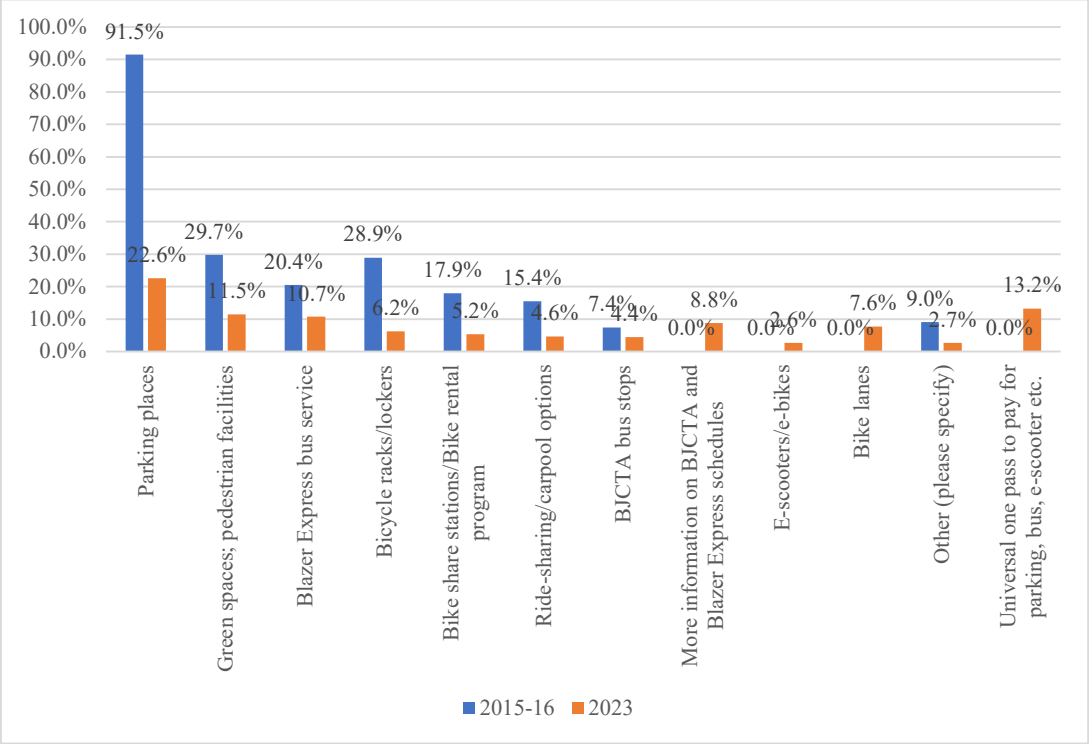

Figure 55: Student Ideas for UAB Campus Improvements (2015-16 and 2023 Surveys)

A higher percentage of students (91.5%) in the previous survey wanted additional parking places whereas in the recent survey only 22.6% of students requested additional parking. In the recent survey. This is an encouraging sign that parking management efforts are working. Moreover, 13.2% of student participants also favored having a universal one pass to pay for parking, and other transportation services. Besides, 2.6% of student respondents countered for e-scooters and 7.6% of students wanted separate bike lanes which were not presented in the previous UAB Commuter Survey.

In both the previous and recently completed UAB commuter surveys, students put the highest emphasis on reliability, time, convenience, and safety and put comparatively low emphasis on costs and environmental impacts respectively while choosing their regular travel mode. While not choosing other modes, availability, convenience, long travel time and sometime safety were the main reasons to the student in the previous survey. But in the recent survey, the main reasons for not choosing transit, carpooling, walking, e-biking, biking are convenience, availability, and safety.

In both the 2015-16 and the 2023 UAB Commuter surveys students commented that they did not prefer carpooling and transit due to its inconvenience and unavailability. In the previous commuter survey, students did not want to bike and walk to campus as it took longer time for travelling and at the same time was not available as well as was not a safe option to travel. In the recent commuter survey, students found those travel options unsafe and inconvenient.

CHAPTER 5

SUMMARY CONCLUSIONS AND RECOMMENDATIONS

This study is conducted in 2023, seven years after the inaugural 'UAB Commuter Survey' that took place in 2015-16. Both surveys aimed to gain insights into commuting patterns of UAB commuters and identify the factors as well as attributes that influence their mode choice. Besides, the 2023 survey sought to understand UAB commuters' perspectives on available travel modes and compare the current commuting patterns to those from the previous survey, exploring the extent to which UAB commuters have embraced new travel mode options and altered their travel behavior accordingly. Understanding the factors influencing mode choice can lead to the development of strategies and initiatives that encourage sustainable and efficient travel options. Moreover, the survey results can help the transportation planners to make informed decisions about transportation infrastructure, services, and policies that align with the needs and preferences of commuters.

Over 5,100 responses were collected in the 2023 UAB Commuter Survey that took place in March 2023. The results from the analysis of valid responses indicated that 90.4% of employee respondents and 68.4% of student respondents drive solo while commuting to/from UAB. Compared to the 2015-16 benchmark survey that reported 88.4% of UAB employees and 82.5% of students drove solo to/from UAB, the UAB Sustainability target to reduce student solo driving was accomplished, while the goal to reduce employee driving alone to UAB was not met. They also reported that reliability,

time, and safety were the most important factors that they were concerned about before choosing any mode.

Results from the statistical analysis of the collected data indicated that gender, age bracket, auto ownership, employment status, and annual income were significant demographic attributes that influence UAB employees to drive alone. Female employees are more likely to drive solo, which may partially explain why the driving solo percentage was higher in the 2023 survey compared to the baseline and given that more female employees participated in this survey than the 2025-16 (72.5% female in 2023; 71% female in 2015-16). Statistical analysis of the 2023 student commuter survey data revealed that auto ownership was the single demographic attribute that significantly motivated students for solo driving while commuting to/from UAB. Similarly, commuting behavior such as commute time, distance and frequency were identified as significant factors for which commuters (employees and students alike) preferred to use their own vehicle instead of choosing other modes.

Although the first preference of UAB commuters was to use their personal vehicle while commuting to/from UAB, survey respondents were willing to choose other sustainable mode options, if those options were available and practical. Approximately, 27.5% of employees and 26.7% of students who reported driving alone, were open to the idea of choosing rideshare options, micro-mobility options, and transit. In addition to that, 5.2% of employees and 7% of student respondents were interested in car-sharing or wished to be dropped off by their relatives or friends. UAB should work closely with CommuteSmart and other organizations to motivate these target commuters in mode switching from private vehicles to shared and other more sustainable mode options. Besides, UAB should market and expand programs to

incentivize commuters to switch to sustainable modes of transportation from driving alone, especially targeting employees.

Among the eleven available mode options, employees are interested in going for telecommuting option after the drive alone option with approximately 11.8% of employee respondents expressing interest in this option. UAB administrators and policy makers should take some steps to allow the employees a flexible work schedule and encourage them to telecommute when practical. Although the vast majority of students (98%) did not change their commuting habits due to COVID-19, 16.4% of students reported attending one or more courses remotely at the time of the 2023 UAB Commuter Survey. Any efforts by UAB to encourage the remote study option are expected to have positive impacts toward reducing the travel demand, parking demand, and congestion at the UAB campus.

A significant percentage of UAB commuters suggested improving the existing transit system of Birmingham and urged the transportation authorities to expand the existing routes as well as include new routes under this service. Many commuters reside in cities outside of Birmingham and the commuting distance forces them to drive to work, given the luck of feasible and practical alternatives. The improvement of transit service as well as increased area coverage can motivate these commuters to use transit rather than their private cars for their commutes to UAB and thus can contribute to reduce congestion, fuel emission as well as parking demand on the UAB campus.

Blazer Express bus service provides free rides around the campus but only 23.4% of employees and 13.4% of students surveyed reported using this service to move around the campus. From this study, it is revealed that many in the UAB community are unaware of this service and its route coverage. Besides many

respondents complained that the bus schedule does not properly serve the user needs and the app often gives wrong information about the bus service. In addition, users pointed out the lack of covered bus stops which makes waiting for the bus inconvenient, especially under adverse weather conditions. UAB commuters' interest in the improvement of Blazer Express and BJCTA bus service indicates that they are willing to consider these services if the above issues are properly resolved. UAB Transportation and BJCTA should take initiatives to address these issues and encourage UAB commuters to use Blazer express and BJCTA bus service instead of their personal vehicle in and around the UAB campus.

Parking is the most demanded improvement that the majority of the UAB commuters wanted to see on the campus. As the majority of the UAB commuters prefer solo driving, demand for parking at and around the UAB campus is very high. UAB already conducted a comprehensive parking and transportation study back in 2016 and developed a five-year plan to manage existing and future parking demand, propose sustainable solutions for the transportation system at or near UAB campus, and improve customer service for the campus community (Sustainability-Strategic-Plan, n.d.). UAB also proposed plans to develop new parking decks to accommodate the continuously growing demand for parking. Despite taking these initiatives, UAB commuters still complain about the UAB parking service, and particularly about the number of parking spaces, location of parking lots relative to their work/study locations, cost of parking, parking access, and safety. UAB Transportation and Facilities Division should continue their efforts to implement a comprehensive and sustainable parking management strategy and encourage commuters to use other alternative modes to reduce the demand for parking and increase the efficiency of existing parking accommodations.

E-scooter/e-bike service is a recent addition to the UAB campus that UAB students appear to embrace and support. Low fare or free micromobility services for low-income users and/or students have the potential to increase ridership of these micro-mobility options and serve short-distance trips within and near the UAB campus in a sustainable way. Implementation of universal one pass for payment of transportation services, designate bike lanes, and infrastructure development that supports non-motorized transportation needs can encourage drivers to consider more active modes of transportation thus reducing the automobile footprint on the UAB campus.

Education and encouragement initiatives are also important toward reducing private vehicle use to/from/and within the UAB campus. UAB Transportation and Facilities Division should arrange motivational workshop to educate the UAB commuters about the negative sides of solo driving and positive impacts of using ride sharing, micro-mobility, non-motorized transportation and transit options. Improvement and expansion of the existing transit system as well as low fare or free service can encourage drive alone commuters to use this service, instead of driving to the UAB campus. Besides, university authority should expand the bus route coverage, increase demand-based bus stops to provide transportation facilities for the commuters who reside far away from UAB campus. Moreover, UAB should ensure safety of the commuters at every place of the university campus as well as in the UAB authorized transportation service. Another suggestion for the improvement of the existing transportation system is to provide some sort of financial benefits to the commuters who are willing to choose alternative modes instead of choosing their own vehicle.

Overall, this study collected, analyzed, and documented UAB commuting patterns and user preferences through a comprehensive questionnaire survey of UAB employees and students conducted in March 2023. The study compared findings to those from a benchmarking survey conducted at UAB in 2015-16 to determine progress made over a 7-year period and identify future needs. Statistical analysis revealed significant demographic and travel pattern attributes that influence UAB commuters to choose their transportation mode for their commute. The survey findings are expected to assist UAB administrators and decision makers, the City of Birmingham, local transportation agencies and transportation service providers in refining existing plans and introducing policies and initiative aiming to improve transportation services and addressing transportation needs of the UAB community in the near- and long-term future.

REFERENCES

Al-Salih, W. Q., & Esztergár-Kiss, D. (2021). Linking mode choice with travel behavior by using logit model based on utility function. *Sustainability (Switzerland)*, *13*(8). https://doi.org/10.3390/su13084332

AS TS Student Survey. (2022). *SJSU Associated Students' Transportation Solutions Fall 2022 Student Survey Report*.

Burd, C., Burrows, M., & Mckenzie, B. (2021). *Travel Time to Work in the United States: 2019*. www.census.gov/programs

Cheng Hua, Dr. Youn-Jeng Choi, & Qingzhou Shi. (2021). *Chapter 11 Multinomial Logistic Regression 11.1 Introduction to Multinomial Logistic Regression*.

Crotti, D., Grechi, D., & Maggi, E. (2022). Proximity to public transportation and sustainable commuting to college. A case study of an Italian suburban campus. *Case Studies on Transport Policy*, *10*(1), 218–226. https://doi.org/10.1016/j.cstp.2021.12.003

Eboli, L., Forciniti, C., & Mazzulla, G. (2020). Factors influencing accident severity: An analysis by road accident type. *Transportation Research Procedia*, *47*, 449–456. https://doi.org/10.1016/j.trpro.2020.03.120

AS TS Employee Survey. (2022). *SJSU Associated Students' Transportation Solutions Fall 2022 Employee Survey Report*.

Eom, J. K., Stone, J. R., & Ghosh, S. K. (n.d.). *Daily Activity Patterns of University Students*. https://doi.org/10.1061/ASCEUP.1943-5444.0000015

Etminani-Ghasrodashti, R., Paydar, M., & Hamidi, S. (2018). University-related travel behavior: Young adults' decision-making in Iran. *Sustainable Cities and Society*, *43*, 495–508. https://doi.org/10.1016/j.scs.2018.09.011

Fabozzi, F. J., Focardi, S. M., Rachev, S. T., & Arshanapalli, B. G. (2014). Appendix E: Model Selection Criterion: AIC and BIC. In *The Basics of Financial Econometrics* (pp. 399–403). John Wiley & Sons, Inc. https://doi.org/10.1002/9781118856406.app5

Institute of Transportation Engineers (ITE). (2011). Manual of Transportation Engineering Studies 2nd ed., Vol. 12.

Khattak, A., Wang, X., Son, S., & Agnello, P. (2011). Travel by university students in Virginia: Is this travel different from travel by the general population? *Transportation Research Record*, *2255*, 137–145. https://doi.org/10.3141/2255-15

Logan, K. G., Nelson, J. D., Osbeck, C., Chapman, J. D., & Hastings, A. (2020). The application of travel demand management initiatives within a university setting. *Case Studies on Transport Policy*, *8*(4), 1426–1439. https://doi.org/10.1016/j.cstp.2020.10.007

Ma, Y. (2015). *Travel Patterns of University Students in North Carolina*. https://doi.org/https://doi.org/10.17615/3bzs-mj30

Pallant, J. (2016). *For the SPSS Survival Manual website*. www.allenandunwin.com/spss

Pothina, A., Adnan, M., & Professor, A. (2022). *Using A Multinomial Logit Model To Study The Mode Choice Behavior Of Commuters In Flanders* (Vol. 10). www.ijcrt.org

Sisiopiku, V. P., Thompson, R. C., & Ramadan, O. E. (2016). *UAB COMMUTER SURVEY FINAL REPORT*.

St John, F. I., Watts, R. L., Benoit, P., Bolton, A., Kay Ivey Mike Brock Karen Brooks John England Jr Ronald Gray Barbara Humphrey Vanessa Leonard Davis Malone III Evelyn V Mauldin Harris Morrissette Scott Phelps William Sexton W Stancil Starnes Marietta Urquhart Kenneth Vandervoort James Wilson III, G. W., Allen, D., Relations Marie Bakitas, E., Brown, C., Curtis Carver, R., Darley-Usmar, V., Floyd, J., Student Government Susanne Fogger, G., Jones, J., Martinez, P., Mullins, S., Affairs Greg Parsons, F., & Sprayberry, B. (2020). *THE UNIVERSITY OF ALABAMA AT BIRMINGHAM 2020 CAMPUS*.

Sustainability-strategic-plan. (n.d.).

Tripp Umbach. (2023). *The Economic and Community Impacts of the University of Alabama at Birmingham*.

Tuveri, G., Sottile, E., Piras, F., & Meloni, I. (2020). A panel data analysis of tour-based university students' travel behaviour. *Case Studies on Transport Policy*, *8*(2), 440–452. https://doi.org/10.1016/j.cstp.2020.03.005

APPENDIX A

2023 UAB EMPLOYEE COMMUTER SURVEY

A UAB EMPLOYEE COMMUTER SURVEY, 2023

UAB COMMUTER SURVEY

March 2023

Welcome to the 2023 UAB Commuter Survey!

Thank you for taking a few moments to complete this survey about your daily commute to UAB. Your feedback is very important as it will help UAB to better understand the commuting patterns and needs of employees and students.

The survey takes approximately 6-8 minutes to complete, and your participation is voluntary. There is no risk in taking part in this survey. The survey is anonymous, and the data captured will not include any personally identifiable information about you.

Your kind assistance in providing input through this survey is greatly appreciated. If you have any questions, please do not hesitate to reach out to the study's Principal Investigator, Dr. Virginia Sisiopiku. Her contact information follows.

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We would love to receive your valuable feedback. If you want to participate, please click the consent button to start the survey. By clicking that button, you acknowledge that your participation is voluntary, you are 18 years of age, and that you are aware that you may choose to terminate your participation at any time and for any reason.

- ○ I consent, please begin the survey
- ○ I do not consent, I do not wish to participate

Choose the one that best describes you.

- ○ An employee at UAB
- ○ A student at UAB
- ○ None

1. How far is your typical commute to UAB (one way)?

- ○ 1 mile or less
- ○ 1 to 3 miles
- ○ 4 to 10 miles
- ○ 11 to 15 miles
- ○ 16 to 20 miles
- ○ 21 miles or more

2. What is your average commute time to get to UAB?

- ○ 10 minutes or less
- ○ 11-20 minutes
- ○ 21-30 minutes
- ○ 31-40 minutes
- ○ 40-50 minutes
- ○ 50-60 minutes
- ○ 61-75 minutes
- ○ over 75 minutes

3. How do you enter the UAB campus?

- ○ From I-65 Northbound (traveling from the south)
- ○ From I-65 Southbound (traveling from the north)
- ○ From US 280
- ○ From an arterial street
- ○ I live on campus
- ○ Other (please specify) _____

4. In a typical week, how often do you commute to UAB?

- ○ 5 **days** per week
- ○ 4 days per week
- ○ 3 days per week
- ○ 1 to 2 days per week
- ○ 5 **nights** per week
- ○ 4 nights per week
- ○ 3 nights per week
- ○ 1 to 2 nights per week
- ○ 0 **days/nights** per week

5. What is your travel schedule on a typical travel day (e.g., 6:45 AM)?

	Time (hh: mm)	AM/PM
Leave home for UAB	_____	AM PM
Leave UAB for home	_____	AM PM

6. In a typical weekday, how do you travel to UAB?

- ○ Drive alone
- ○ Dropped off by relative/friend
- ○ Rideshare - organized carpool/vanpool
- ○ Rideshare - Uber/Lyft
- ○ BJCTA bus
- ○ Blazer Express
- ○ Motorcycle
- ○ Bicycle
- ○ E-scooter/e-bike
- ○ Walk
- ○ Telecommute/other

7. Have your commuting patterns changed as a result of the COVID-19 pandemic?

- ○ No
- ○ Yes, I work 1 day/week remotely now
- ○ Yes, I work 2-3 days/week remotely now
- ○ Yes, I work fully remotely now
- ○ Yes, I changed my mode of transportation

8. Do you use any of the following during your typical day at the UAB campus? Check all that apply.

- ○ Uber/Lyft
- ○ E-scooters/E-bikes
- ○ Transit-on-demand
- ○ Blazer Express
- ○ None

9. If alternative options were available, how do you prefer to travel to UAB?

- ○ Drive alone
- ○ Dropped off by relative/friend
- ○ Rideshare - organized carpool/vanpool
- ○ Rideshare - Uber/Lyft
- ○ BJCTA bus
- ○ Blazer Express
- ○ Motorcycle
- ○ Bicycle
- ○ E-scooter/e-bike
- ○ Walk
- ○ Telecommute/Other

10. How important is each of the following factors in selecting your regular travel mode to work (car, bus, walk, etc.)?

	Not at all important	Slightly important	Neutral	Important	Very important
Cost (in dollars)	○	○	○	○	○
Time	○	○	○	○	○
Convenience	○	○	○	○	○
Reliability	○	○	○	○	○
Safety	○	○	○	○	○
Environmental impacts	○	○	○	○	○

11. If you rarely carpool, use transit, bike, or walk to UAB, what are the reasons? Select all that apply.

	Reason		
I do not carpool. It is not	a) Safe	b) Convenient	c) Available
I do not use transit. It is not	a) Safe	b) Convenient	c) Available
I do not bike to campus. It is not	a) Safe	b) Convenient	c) Available
I do not walk to campus. It is not	a) Safe	b) Convenient	c) Available
I do not use e-bike/e-scooter. They are not	a) Safe	b) Convenient	c) Available

12. If you drive to work, do you typically (please answer all):

	Yes	No
Drive alone	○	○
Park in a parking lot, deck, or metered parking space	○	○
Park on the street for free	○	○
Move your car during the workday	○	○
Use Blazer Express to move around campus	○	○
Use e-scooter/e-bike to move around campus	○	○

13. If you currently drive alone, would you consider switching to carpooling or transit use if

- ○ Gas price exceeds $4/gallon
- ○ Special incentives were available (monetary, benefits, etc.)
- ○ Transit fare was free
- ○ I wouldn't consider switching my travel mode
- ○ I already use alternative transportation modes

14. Where do you live?

City: _____

Nearest intersection (e.g., Hickory Trc and Magnolia):

_____

Zip Code: _____

15. Where do you work?

- ○ Building Name: _____
- ○ Nearest intersection (e.g., Hickory Trc and Magnolia Dr): _____
- ○ Campus code (optional): _____

16. What is your gender?

a) Man b) Woman c) Non-binary/Third Gender d) Prefer not to answer

17. What is your age bracket?

- ○ 17 or less
- ○ 18 to 24
- ○ 25 to 34
- ○ 35 to 44
- ○ 45 to 54
- ○ 55 to 64
- ○ 65 or more

18. Which of the following best describes your current occupation?

- ○ UAB Hospital Employee - Full time
- ○ University Employee – Full time
- ○ UAB Hospital Employee - Part time
- ○ University Employee - Part time

19. How many of the following do you have in your household?

Adults (including yourself)	a) 1 b) 2 c) 3 d) 4 e) 5 f) 6 or more
Children	a) 1 b) 2 c) 3 d) 4 e) 5 f) 6 or more
Cars/vans	a) 1 b) 2 c) 3 d) 4 e) 5 f) 6 or more
Motorcycles	a) 1 b) 2 c) 3 d) 4 e) 5 f) 6 or more
Bicycles	a) 1 b) 2 c) 3 d) 4 e) 5 f) 6 or more

20. Which of the following best describes the total annual income of your household (before taxes)?

- ○ Less than $12,000/year
- ○ $12,001 to $20,000/year
- ○ $20,001 to $40,000/year
- ○ $40,001 to $60,000/year
- ○ $60,001 to $80,000/year
- ○ $80,001 to $100,000/year
- ○ $100,001 to $130,000/year
- ○ $130,001 to $160,000/year
- ○ $160,001 to $200,000/year
- ○ Over $200,000/year

21. Which of the following would you like to see more on the UAB campus? Check all that apply.

- ○ Parking places
- ○ Green spaces; pedestrian facilities
- ○ Blazer Express bus service
- ○ Bicycle racks/Bicycle lockers
- ○ Universal one pass to pay for parking, bus, e-scooter etc.
- ○ Bike share stations/Bike rental programs
- ○ Ride-sharing/carpool options
- ○ BJCTA (MAX) bus stops
- ○ More information on BJCTA and Blazer Express schedules
- ○ E-scooters/e-bikes
- ○ Bike lanes
- ○ Other (please specify) _____

22. What suggestions do you have for improving transportation to/from and on the UAB campus?

_____

Thank you for participating to the survey.

APPENDIX B

2023 UAB STUDENT COMMUTER SURVEY

B UAB STUDENT COMMUTER SURVEY, 2023

UAB COMMUTER SURVEY

March 2023

Welcome to the 2023 UAB Commuter Survey!

Thank you for taking a few moments to complete this survey about your daily commute to UAB. Your feedback is very important as it will help UAB to better understand the commuting patterns and needs of employees and students.

The survey takes approximately 6-8 minutes to complete, and your participation is voluntary. There is no risk in taking part in this survey. The survey is anonymous, and the data captured will not include any personally identifiable information about you.

Your kind assistance in providing input through this survey is greatly appreciated. If you have any questions, please do not hesitate to reach out to the study's Principal Investigator, Dr. Virginia Sisiopiku. Her contact information follows.

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We would love to receive your valuable feedback. If you want to participate, please click the consent button to start the survey. By clicking that button, you acknowledge that your participation is voluntary, you are 18 years of age, and that you are aware that you may choose to terminate your participation at any time and for any reason.

- ○ I consent, please begin the survey
- ○ I do not consent, I do not wish to participate

Choose the one that best describes you.

- ○ An employee at UAB
- ○ A student at UAB
- ○ None

1. How far is your typical commute to UAB (one way)?

- ○ One mile or less
- ○ 1-5 miles
- ○ 6-10 miles
- ○ 11-15 miles
- ○ 16-20 miles
- ○ 21 miles or more

---

2. What is your average commute time to get to UAB?

- ○ 10 minutes or less
- ○ 11-20 minutes
- ○ 21-30 minutes
- ○ 31-40 minutes
- ○ 40-50 minutes
- ○ 50-60 minutes
- ○ 61-75 minutes
- ○ over 75 minutes

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3. How do you enter the UAB campus?

- ○ From I-65 Northbound (traveling from the south)
- ○ From I-65 Southbound (traveling from the north)
- ○ From US 280
- ○ From an arterial street
- ○ I live on campus
- ○ Other (please specify)

_____

4. In a typical week, how often do you commute to UAB?

- ○ 5 days per week
- ○ 4 days per week
- ○ 3 days per week
- ○ 1 to 2 days per week
- ○ 5 nights per week
- ○ 4 nights per week
- ○ 3 nights per week
- ○ 1 to 2 nights per week
- ○ 0 days/nights

5. What is your travel schedule on a typical travel day?

	Time (hh: mm)	AM/PM
Leave home for UAB	_____	AM PM
Leave UAB for home	_____	AM PM

6. In a typical week day, how do you travel to UAB?

- ○ Drive alone
- ○ Dropped off by relative/friend
- ○ Rideshare - organized carpool/vanpool
- ○ Rideshare - Uber/Lyft
- ○ BJCTA bus
- ○ Blazer Express
- ○ Motorcycle
- ○ Bicycle
- ○ Walk
- ○ E-scooter/e-bike
- ○ Other

7. Have your commuting patterns changed as a result of the COVID-19 pandemic?

- ○ No
- ○ Yes, 1 or more of my courses are online now
- ○ Yes, I study and/or do my work remotely now
- ○ Yes, I changed my mode of transportation

8. Do you use any of the following during your typical day at the UAB campus? Check all that apply.

- ○ Uber/Lyft (1)
- ○ E-scooters/E-bikes (3)
- ○ Transit-on-demand (5)
- ○ Blazer Express (6)
- ○ None (7)

9. If alternative options were available, how do you prefer to travel to UAB

- ○ Drive alone
- ○ Dropped off by relative/friend
- ○ Rideshare - organized carpool/vanpool
- ○ Rideshare - Uber/Lyft
- ○ BJCTA bus
- ○ Blazer Express
- ○ Motorcycle
- ○ Bicycle
- ○ Walk
- ○ E-scooter/e-bike
- ○ Other

10. How important is each of the following factors in selecting your regular travel mode to class (car, bus, walk, etc.)?

	Not at all important	Slightly important	Neutral	Important	Very important
Cost (in dollars)	○	○	○	○	○
Time	○	○	○	○	○
Convenience	○	○	○	○	○
Reliability	○	○	○	○	○
Safety	○	○	○	○	○
Environmental impacts	○	○	○	○	○

11. If you rarely carpool, use transit, bike, or walk to UAB, what are the reasons? Select all that apply.

	Reason		
I do not carpool. It is not	a) Safe	b) Convenient	c) Available
I do not use transit. It is not	a) Safe	b) Convenient	c) Available
I do not bike to campus. It is not	a) Safe	b) Convenient	c) Available
I do not walk to campus. It is not	a) Safe	b) Convenient	c) Available
I do not use e-bike/e-scooter. They are not	a) Safe	b) Convenient	c) Available

Q41 12. If you drive to UAB, do you typically (answer all):

	Yes	No
Drive alone	○	○
Park in a parking lot, deck, or metered parking space	○	○
Park on the street for free	○	○
Move your car during the workday	○	○
Use Blazer Express to move around campus	○	○
Use e-scooter/e-bike to move around campus	○	○
I don't drive to work	○	○

13. Where do you live?

City: _____

Nearest intersection (e.g., Hickory Trc and Magnolia):

_____

Zip Code: _____

14. Where do you take most of your classes or do most of your work while at UAB?

○ Building Name:

_____

○ Nearest intersection (e.g., Hickory Trc and Magnolia Dr):

_____

○ Campus code (optional):

_____

15. What is your gender?

a) Man b) Woman c) Non-binary/Third Gender d) Prefer not to answer

16. What is your age bracket?

- ○ 17 or less
- ○ 18 to 24
- ○ 25 to 34
- ○ 35 to 44
- ○ 45 to 54
- ○ 55 to 64
- ○ 65 or more

17. Are you a

- ○ Freshman
- ○ Sophomore
- ○ Junior
- ○ Senior
- ○ Graduate student
- ○ Professional student

18. Do you live

- ○ Alone
- ○ With roommate
- ○ With significant other/spouse
- ○ With parents

19. Which of the following best describes your current status?

- ○ Full time student
- ○ Part time student
- ○ Not currently enrolled

20. Do you have a job?

- ○ Yes
- ○ No

21. What type of job do you have?

- ○ Full time, off campus
- ○ Full time, on campus
- ○ Part time, off campus
- ○ Part time on campus

22. How many of the following do you own?

Cars/vans	a) 1 b) 2 c) 3 d) 4 e) 5 f) 6 or more
Motorcycles	a) 1 b) 2 c) 3 d) 4 e) 5 f) 6 or more
Bicycles	a) 1 b) 2 c) 3 d) 4 e) 5 f) 6 or more
E-scooters/E-bikes	a) 1 b) 2 c) 3 d) 4 e) 5 f) 6 or more

23. Which of the following would you like to see more on the UAB campus? Check all that apply.

- ○ Parking places
- ○ Green spaces; pedestrian facilities
- ○ Blazer Express bus service
- ○ Bicycle racks/lockers
- ○ Universal one pass to pay for parking, bus, e-scooter etc.
- ○ Bike share stations/Bike rental program
- ○ Ride-sharing/carpool options
- ○ BJCTA bus stops
- ○ More information on BJCTA and Blazer Express schedules
- ○ E-scooters/e-bikes
- ○ Bike lanes
- ○ Other (please specify)

_____

24. What suggestions do you have for improving transportation to/from and on the UAB campus?

_____

Thank you for participating to the survey.

APPENDIX C

CHI-SQUARE TEST FOR THE COMPARATIVE ANALYSIS OF THE PRESENT COMMUTING BEHAVIOR OF UAB EMPLOYEES WITH PREVIOUS COMMUTING BEHAVIOR (2015-16)

Null Hypothesis: There is no significant difference between the current and previous mode choice pattern of employee
Research Hypothesis: There is significant difference between the current and previous mode choice pattern of employee

Confidence Level = 95%

	Observed Frequency (O)			Proportion of Current situation w.r.t. Previous situation P = A/(A+B)	Expected Frequency (E)		O - E		$X^2 = \frac{(O-E)^2}{E}$		Total Chi-square for each option	Comment
Mode Choice	Current mode choice = A	Previous mode choice= B	Total = A+B		Current mode choice	Previous mode choice	Current mode choice	Previous mode choice	Current mode choice	Previous mode choice		
Drive alone	3737	5256	8993	0.42	3542.00	5451.00	195.00	-195.00	10.74	6.98	17.71	significant positive change
Dropped off by relative/friend	117	400	517	0.23	203.63	313.37	-86.63	86.63	36.85	23.95	60.80	significant negative change
Rideshare - organized carpool/vanpool & Uber/Lyft	50	262	312	0.16	122.88	189.12	-72.88	72.88	43.23	28.09	71.32	significant negative change
Transit(BJCTA +Blazer Express)	105	74	179	0.59	70.50	108.50	34.50	-34.50	16.88	10.97	27.85	significant positive change
Motorcycle	6	39	45	0.13	17.72	27.28	-11.72	11.72	7.75	5.04	12.79	significant negative change
Micromobility options (Bicycle, E-bike/E-scooter)	18	96	114	0.16	44.90	69.10	-26.90	26.90	16.12	10.47	26.59	significant negative change
Walk	64	192	256	0.25	100.83	155.17	-36.83	36.83	13.45	8.74	22.19	significant negative change
Telecommute/ other	35	40	75	0.47	29.54	45.46	5.46	-5.46	1.01	0.66	1.67	No significant change
Total	4132	6359	10491				0.00	0.00	146.03	94.89		

For each mode option, degree of freedom 1 and chi-square value is 3.841 for α =0.05.

Ho: There is no significant difference between the current and previous mode preferences of employees if alternative options are available

H1: There is significant difference between the current and previous mode preferences employees if alternative options are available

Confidence Level = 95%

Mode Choice	Observed Frequency (O)			Proportion of Current situation w.r.t. Previous situation	Expected Frequency (E)		O - E		$X^2 = \frac{(O-E)^2}{E}$		Total Chi-square for each option	Comment
	Current mode preferences = A	Previous mode preferences= B	Total = A+B	P = A/(A+B)	Current mode prefernces	Previous mode preferences	Current mode preferences	Previous mode preferences	Current mode preferences	Previous mode preferences		
Drive alone	2595	3028	5623	0.46	1886.21	3736.79	708.79	-708.79	266.34	134.44	400.78	significant positive change
Dropped off by relative/friend	217	913	1130	0.19	379.05	750.95	-162.05	162.05	69.28	34.97	104.25	significant negative change
Rideshare - organized carpool/vanpool & Uber/Lyft	287	1162	1449	0.20	486.06	962.94	-199.06	199.06	81.52	41.15	122.67	significant negative change
Transit(BJCTA+	299	1409	1708	0.18	572.94	1135.06	-273.94	273.94	130.98	66.11	197.10	significant negative change
Motorcycle	24	134	158	0.15	53.00	105.00	-29.00	29.00	15.87	8.01	23.88	significant negative change
Micromobility options (Bicycle, E-bike/E-scooter)	129	423	552	0.23	185.17	366.83	-56.17	56.17	17.04	8.60	25.64	significant negative change
Walk	88	279	367	0.24	123.11	243.89	-35.11	35.11	10.01	5.05	15.07	significant negative change
Telecommute/ot	489	830	1319	0.37	442.45	876.55	46.55	-46.55	4.90	2.47	7.37	significant positive change
Total	4128	8178	12306				0.00	0.00	595.94	300.81		

For each mode option, degree of freedom 1 and chi-square value is 3.841 for α =0.05.

APPENDIX D

CHI-SQUARE TEST FOR THE COMPARATIVE ANALYSIS OF THE PRESENT COMMUTING BEHAVIOR OF UAB STUDENTS WITH PREVIOUS COMMUTING BEHAVIOR (2015-16)

Null Hypothesis: There is no significant difference between the current and previous mode choice pattern of Students
Research Hypothesis: There is significant difference between the current and previous mode choice pattern of students

Confidence Level = 95%

Mode Choice	Observed Frequency (O)			Proportion of Current situation w.r.t. Previous situation	Expected Frequency (E)		O - E		$X^2 = \frac{(O-E)^2}{E}$		Total Chi-square for each option	Comment
	Current mode choice = A	Previous mode choice= B	Total = A+B	P = A/(A+B)	Current mode choice	Previous mode choice	Current mode choice	Previous mode choice	Current mode choice	Previous mode choice		
Drive alone	414	3386	3800	0.11	487.28	3312.72	-73.28	73.28	11.02	1.62	12.64	significant negative change
Dropped off by relative/friend	15	226	241	0.06	30.90	210.10	-15.90	15.90	8.18	1.20	9.39	significant negative change
Rideshare - organized carpool/vanpool & Uber/Lyft	12	205	217	0.06	27.83	189.17	-15.83	15.83	9.00	1.32	10.33	significant negative change
Transit(BJCTA+Blazer Express)	7	53	60	0.12	7.69	52.31	-0.69	0.69	0.06	0.01	0.07	No change
Motorcycle	2	40	42	0.05	5.39	36.61	-3.39	3.39	2.13	0.31	2.44	No change
Micromobility options (Bicycle, E-bike/E-scooter)	17	140	157	0.11	20.13	136.87	-3.13	3.13	0.49	0.07	0.56	No change
Walk	129	62	191	0.68	24.49	166.51	104.51	-104.51	445.93	65.59	511.52	significant positive change
Telecommute/other	9	1	10	0.90	1.28	8.72	7.72	-7.72	46.45	6.83	53.28	significant positive change
Total	605	4113	4718				0.00	0.00	523.26	76.97		

For each mode option, degree of freedom 1 and chi-square value is 3.841 for α =0.05.

Null Hypothesis: There is no significant difference between the current and previous mode preferences of Students if alternative mode options are available
Research Hypothesis: There is significant difference between the current and previous mode preferences students if alternative mode options are available

Confidence Level = 95%

Mode Choice	Observed Frequency (O)			Proportion of Current situation w.r.t. Previous situation	Expected Frequency (E)		O - E		$X^2 = \frac{(O-E)^2}{E}$		Total Chi-square for each option	Comment
	Current mode preferences = A	Previous mode preferences= B	Total = A+B	P = A/(A+B)	Current mode prefernces	Previous mode preferences	Current mode preferences	Previous mode preferences	Current mode preferences	Previous mode preferences		
Drive alone	249	2141	2390	0.10	223.19	2166.81	25.81	-25.81	2.99	0.31	3.29	No significant change
Dropped off by relative/friend	42	528	570	0.07	53.23	516.77	-11.23	11.23	2.37	0.24	2.61	No significant change
Rideshare - organized carpool/vanpool & Uber/Lyft	45	881	926	0.05	86.47	839.53	-41.47	41.47	19.89	2.05	21.94	significant negative change
Transit(BJCTA+Blazer Express)	148	880	1028	0.14	96.00	932.00	52.00	-52.00	28.17	2.90	31.07	significant positive change
Motorcycle	5	187	192	0.03	17.93	174.07	-12.93	12.93	9.32	0.96	10.28	significant negative change
Micromobility options (Bicycle, E-bike/E-scooter)	46	556	602	0.08	56.22	545.78	-10.22	10.22	1.86	0.19	2.05	No significant change
Walk	55	518	573	0.10	53.51	519.49	1.49	-1.49	0.04	0.00	0.05	No significant change
Telecommute/other	7	105	112	0.06	10.46	101.54	-3.46	3.46	1.14	0.12	1.26	No significant change
Total	597	5796	6393				0.00	0.00	65.78	6.78		

For each mode option, degree of freedom 1 and chi-square value is 3.841 for α =0.05.