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SUSTAINABLE TRANSPORTATION AT THE UNIVERSITY OF CENTRAL FLORIDA: EVALUATION OF UCF RIDESHARE PROGRAM, ZIMRIDE

by

JOSEPH PATRICK DEFRANCISCO
B.S.C.E., University of Central Florida, 2009

A thesis submitted in partial fulfillment of the requirements
for the degree of Master of Science
in the Department of Civil, Environmental and Construction Engineering
in the College of Engineering and Computer Science
at the University of Central Florida
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ABSTRACT

As the second-largest university in the United States, UCF has experienced the largest enrollment in its history. A more densely populated campus has in turn caused increased traffic congestion. Despite increased parking permit fees and newly constructed parking garages, traveling and parking on campus is unpredictable. In effort to reduce congestion on campus, a rideshare program was implemented in Summer 2010. Several universities across the nation have successfully used carpooling as a viable alternative mode to manage traffic and parking demand.

This thesis evaluates the UCF rideshare program, Zimride, using stated- and revealed-preference surveys. Preliminary results indicate most students prefer to commute to campus using their own car and without incentives there is no reason to change mode choice, regardless of associated costs—e.g. decal cost, parking time and frustration. Despite 70% of respondents considering themselves environmentally friendly and over 80% are aware of savings in money and productive by using alternative modes, 70% still use their car to commute to campus.

Using Explanatory Factor Analysis (EFA) and Structural Equation Modeling (SEM), the observed variables were organized into three (3) latent variables based on the correlation among them. The SEM results of the revealed-preference survey indicate current travel behavior significantly influences attitudes towards carpooling and demographics have a significant effect on current travel behavior. It was also found that demographics influences attitudes towards carpooling at a non statistically significant level.

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I would like to first thank Dr. Essam Radwan for support and guidance as my research advisor, his encouragement provided the desire to pursue writing my thesis. Also, Dr. Rami Harb is very appreciated for his close collaboration with the organization of the work and data methodologies pursued. Next, I want to thank Dr. Mohamed Abdel-Aty for serving on my committee and the graduate program coordinator for our department.

Second, I would like to express my gratitude to my colleagues who assisted in the technical aspects of my work and challenged ideas to provide sound research: Mohamed M. Ahmed, Chowdhury Siddiqui, and Hany Hassan. I also would like to extend my appreciation to Taylor Lochrane, Rongjie Yu, and Donald Marco for their friendship and support during my studies as a graduate student.

Lastly, I want to thank my wife, Heather, and family for providing for me and always being there.

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LIST OF ABBREVIATIONS

EBTR	Employee-Based Trip Reduction
EFA	Exploratory Factor Analysis
FHWA	Federal Highway Administration
GRH	Guaranteed Ride Home
HOV	High-Occupancy Vehicle
MF	Mixed-Flow
RF	Revealed-Preference
SEM	Structural Equation Model
SOV	Single Occupancy Vehicle
SP	Stated-Preference
TDM	Travel/Transportation Demand Management
UCF	The University of Central Florida
VMT	Vehicle Miles Traveled

CHAPTER ONE: INTRODUCTION

1.1 Background and Research Motivation

The University of Central Florida (UCF) became the second-largest university in the nation in terms of student enrollment in Fall 2010 (1). The student population of UCF is continuously growing, at what seems to be an exponential rate. In fact there has been a 2653% increase between academic years 1968 and 2009 (2). As seen in Table 1, this growth is only expected to continue based on the detailed prediction model by UCF FTE Enrollment Plan (3):

Table 1: UCF Fall Fundable Headcount Enrollment

Academic Year	Fall Fundable Headcount
2008-09	50,275 (actual)
2009-10	53,644 (actual)
2010-11	56,337 (actual)
2011-12	58,698 (actual)
	59,481 (predicted)
2012-13	60,755 (predicted)
2013-14	61,656 (predicted)
2014-15	63,098 (predicted)

With such increases and expected continual growth of people (students, staff and faculty), as well as an increasing over-enrollment rate (18.5% in 2010-11 to 25.6% in 2011-12) it

is obvious that the campus will become more crowded and eventually further congested (3).

When arriving at that the University there is a high rate of uncertainty whether or not one will find a parking space. This of course depends on the time of day; for UCF demonstrates standard peak hours of 8AM and 5PM but also experiences relentless traffic throughout the day for as an educational facility, several courses are offered at nearly every hour of the day. To that extent, the turnover rate for student parking spaces is unpredictable. The only expectation a commuting student can have is that it could take up to 30 minutes to find a parking space and even that would be viewed as a 'good day' for some students. Figure 1 displays the relationship of parking decals sold (demand) and parking spaces available (capacity) for the last academic year (4).

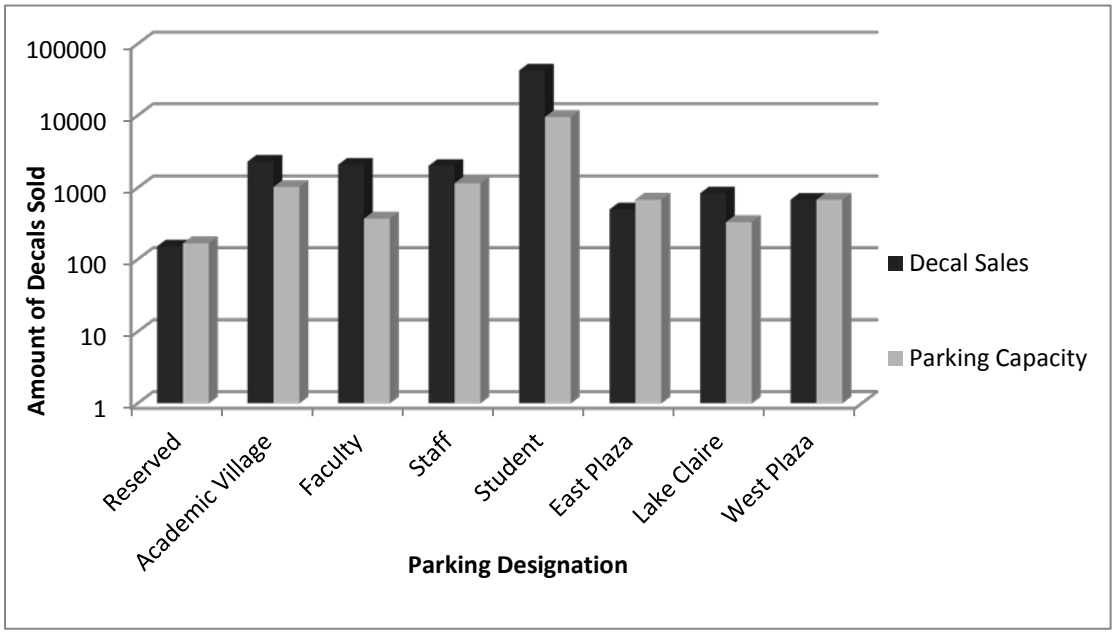
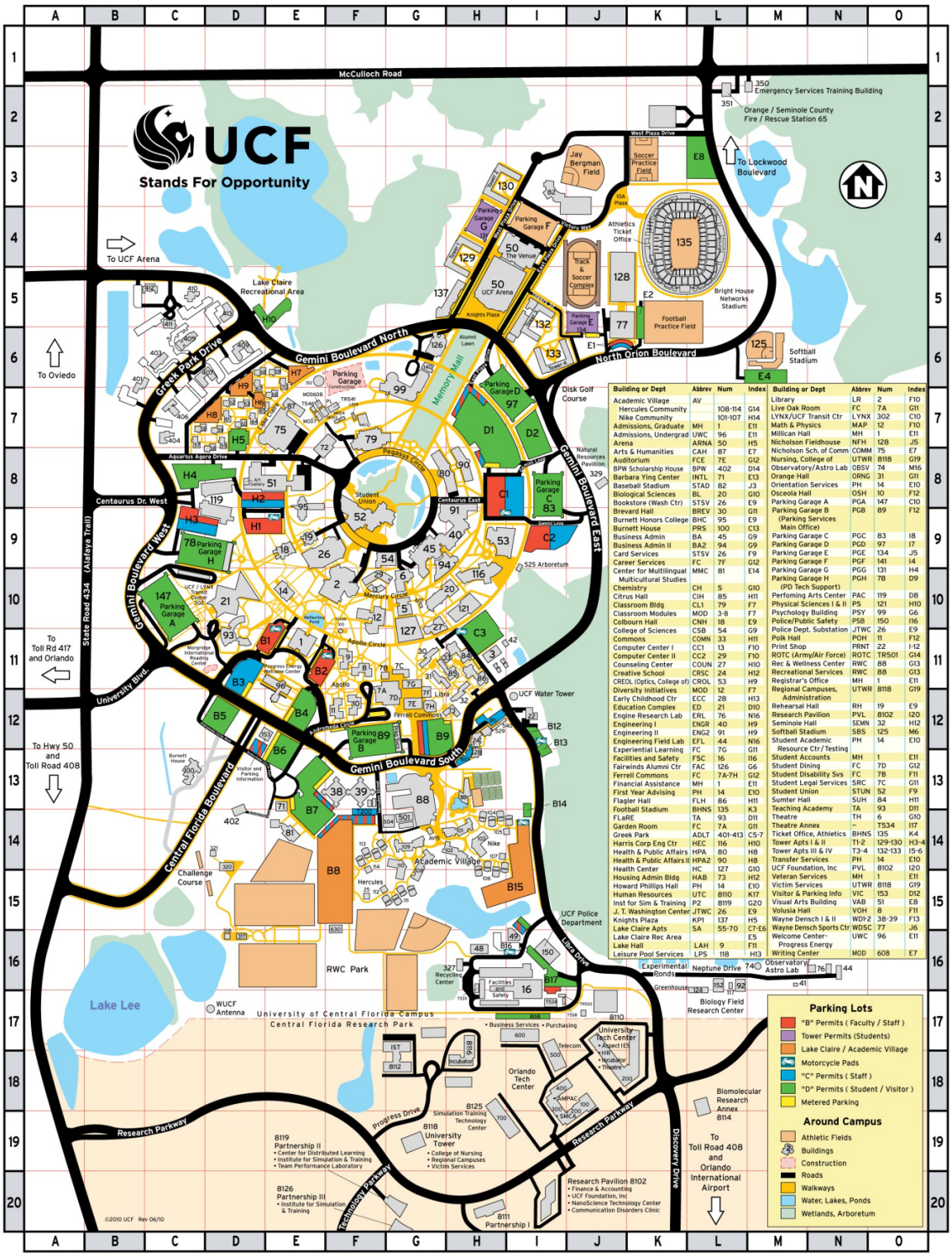


Figure 1: Decal Sales v Parking Capacity (Academic Year 2009-2010)

In the chart the most notable difference between columns is that of the student. While it is unreasonable to provide a parking space for each decal sold, it is important to know that the university sold 42,433 decals between July 2009 and July 2010 with a capacity of 9,519 spaces (4.46 students/spot). In addition to the standard (commuting) student spaces dealing with an excess demand, the residence halls on-campus (Academic Village and Lake Claire) also have a supply deficit albeit of much smaller magnitude. However, it is important to note that the excess demand of on-campus residents directly affects the commuting students for that (general student parking) is their 'overflow'. Furthermore, every other decal designation listed in the chart is permitted to park in the student marked garages and surface lots.

Why not build more parking garages and lots to increase the amount of spaces available? First off, it is not feasible in both fiscal and physical senses to simply provide more parking supply. Financially, aside from being in an unfavorable economy, the cost of a parking garage can be in the magnitude of $17 million just as the one that was recently constructed (5), amounting to about $13,500 per space. Furthermore, there are residual costs with obtaining additional land (depending on location) for UCF is surrounded by Conservation Easements (as defined by St. Johns River Water Management District) and other environmental impacts (6). Geographically, there are not ample amounts of land to simply place concrete monstrosities; eventually sunlight will not be able to reach the inner circle of campus. Even if the capacity is increased in hopes of meeting a small portion of the excess demand, studies have that shown this scenario results in a counter-intuitive outcome. This situation is demonstrated by Anthony Downs

in his books, *Stuck in Traffic* and *Still Stuck in Traffic*, providing more infrastructure produces more congestion (7). To understand the organization of the parking facilities available on campus, Figure 2 shows a UCF campus map (8) indicating where the lots and garages are located as well as their designation.



Building or Dept	Abbrv	Num	Index
Academic Village	AV		
Hercules Community		108-114	G14
Nike Community		101-107	H14
Admissions, Graduate	MH	1	E11
Admissions, Undergrad	UWC	96	E11
Arena	ARNA	50	H5
Arts & Humanities	CAH	87	E7
Auditorium	FCE	7E	G12
BPW Scholarship House	BPW	402	D14
Barbara Ying Center	INTL	71	E13
Baseball Stadium	STAD	82	J3
Biological Sciences	BL	20	G10
Bookstore (Wash Ctr)	STSV	26	E9
Brevard Hall	BREV	30	G11
Burnett Honors College	BHC	95	E9
Burnett House	PRS	100	C13
Business Admin	BA	45	G9
Business Admin II	BA2	94	G9
Card Services	STSV	26	F9
Career Services	FC	7F	G12
Center for Multilingual Multicultural Studies	MMC	81	E14
Chemistry	CH	5	G10
Citrus Hall	CIH	85	H11
Classroom Bldg	CL1	79	F7
Classroom Modules	MOD	3-8	F7
Colbourn Hall	CNH	18	E9
College of Sciences	CSB	54	G9
Commons	COMN	33	H11
Computer Center I	CC1	13	F10
Computer Center II	CC2	29	F10
Counseling Center	COUN	27	H10
Creative School	CRSC	24	H12
CREOL (Optics, College of)	CROL	53	H9
Diversity Initiatives	MOD	12	F7
Early Childhood Ctr	ECC	28	H13
Education Complex	ED	21	D10
Engine Research Lab	ERL	76	N16
Engineering I	ENGR	40	H9
Engineering II	ENG2	91	H9
Engineering Field Lab	EFL	44	N16
Experiential Learning	FC	7G	G11
Facilities and Safety	FSC	16	I16
Fairwinds Alumni Ctr	FAC	126	G6
Ferrell Commons	FC	7A-7H	G12
Financial Assistance	MH	1	E11
First Year Advising	PH	14	E10
Flagler Hall	FLH	86	H11
Football Stadium	BHNS	135	K3
FLaRE	TA	93	D11
Garden Room	FC	7A	G11
Greek Park	ADLT	401-413	C5-7
Harris Corp Eng Ctr	HEC	116	H10
Health & Public Affairs	HPA	80	H8
Health & Public Affairs II	HPA2	90	H8
Health Center	HC	127	G10
Housing Admin Bldg	HAB	73	H12
Howard Phillips Hall	PH	14	E10
Human Resources	UTC	8110	K17
Inst for Sim & Training	P2	8119	G20
J. T. Washington Center	JTWC	26	E9
Knights Plaza	KP1	137	H5
Lake Claire Apts	SA	55-70	C7-E6
Lake Claire Rec Area			E5
Lake Hall	LAH	9	F11
Leisure Pool Services	LPS	118	H13
Library	LR	2	F10
Live Oak Room	FC	7A	G11
LYNX/UCF Transit Ctr	LYNX	302	C10
Math & Physics	MAP	12	F10
Millican Hall	MH	1	E11
Nicholson Fieldhouse	NFH	128	J5
Nicholson Sch. of Comm	COMM	75	E7
Nursing, College of	UTWR	8118	G19
Observatory/Astro Lab	OBSV	74	M16
Orange Hall	ORNG	31	G11
Orientation Services	PH	14	E10
Osceola Hall	OSH	10	F12
Parking Garage A	PGA	147	C10
Parking Garage B (Parking Services Main Office)	PGB	89	F12
Parking Garage C	PGC	83	I8
Parking Garage D	PGD	97	I7
Parking Garage E	PGE	134	J5
Parking Garage F	PGF	141	I4
Parking Garage G	PGG	131	H4
Parking Garage H (PD Tech Support)	PGH	78	D9
Perfoming Arts Center	PAC	119	D8
Physical Sciences I & II	PS	121	H10
Psychology Building	PSY	99	G6
Police/Public Safety	PSB	150	I16
Police Dept. Substation	JTWC	26	E9
Polk Hall	POH	11	F12
Print Shop	PRNT	22	I12
ROTC (Army/Air Force)	ROTC	TR501	G14
Rec & Wellness Center	RWC	88	G13
Recreational Services	RWC	88	G13
Registrar's Office	MH	1	E11
Regional Campuses, Administration	UTWR	8118	G19
Rehearsal Hall	RH	19	E9
Research Pavilion	PVL	8102	I20
Seminole Hall	SEMN	32	H12
Softball Stadium	SBS	125	M6
Student Academic Resource Ctr/Testing	PH	14	E10
Student Accounts	MH	1	E11
Student Dining	FC	7D	G12
Student Disability Svs	FC	7B	F11
Student Legal Services	SRC	7C	G11
Student Union	STUN	52	F9
Sumter Hall	SUH	84	H11
Teaching Academy	TA	93	D11
Theatre	TH	6	G10
Theatre Annex	–	TS34	I17
Ticket Office, Athletics	BHNS	135	K4
Tower Apts I & II	T1-2	129-130	H3-4
Tower Apts III & IV	T3-4	132-133	I5-6
Transfer Services	PH	14	E10
UCF Foundation, Inc	PVL	8102	I20
Veteran Services	MH	1	E11
Victim Services	UTWR	8118	G19
Visitor & Parking Info	VIC	153	D12
Visual Arts Building	VAB	51	E8
Volusia Hall	VOH	8	F11
Wayne Densch I & II	WD1-2	38-39	F13
Wayne Densch Sports Ctr	WDSC	77	J6
Welcome Center- Progress Energy	UWC	96	E11
Writing Center	MOD	608	E7
Experimental Bonds		74	
Observatory/ Astro Lab		76	
Greenhouse		124	

Figure 2: UCF Parking Map

Because of the constraints and consequences of expanding parking facilities on campus, other options must be sought. The University understands the importance of this need and in the Transportation Element of the 2010-2020 UCF Campus Master Plan Update the first goal was stated as: “to plan for future motorized and non-motorized traffic circulation systems to ensure the provision of adequate transit, circulation, and parking facilities to meet future transportation needs (9).” To support this goal the Campus Master Plan has policies (1.2.2) contained in the Transportation Element to maintain a student to parking space ratio range of 3.10:1 to 4.00:1. However, currently the ratio of students to parking spaces is 4.46 students/space for the student decal alone. When considering the overflow of on-campus residences, the ratio becomes 5.5 students/space; therefore making it even more difficult for commuting students to find a parking space. While UCF does provide alternative modes—bike lanes on all roads, private/student exclusive shuttle system, public transit center for county buses—the demand for parking still remains ever increasing and a solution is in order.

In efforts to reduce the amount of vehicles on campus, particularly single occupancy vehicles, the alternative of ridesharing presents itself as a mode that can potentially combat the continuous parking demand on campus. Therefore, the UCF Student Government Association (SGA) and UCF Parking and Transportation Services have implemented a campus wide ridesharing program with a company called Zimride. This company, primarily a software provider/website hosting, allows students to post a ride and find other students or faculty and staff to ride to school with.

1.2 Research Objectives

The purpose of this thesis is to evaluate the feasibility and potential benefits of a sustainable transportation system at the University of Central Florida (UCF). The implementation of the recently established rideshare program, Zimride, is the first step UCF has taken to create a multimodal approach for commuting students, faculty, and staff. How effective this system is and the supplemental efforts required to create a sustainable multimodal transportation network to UCF are the primary goals of this research.

The first survey is a Revealed-Preference (RP) survey intended to measure the use of Zimride. With low awareness and very limited use, it became evident the program was too new to evaluate. Next, a Stated-Preference (SP) survey was used to assess the hypothetical usage of the carpool program and perspectives regarding carpooling as a mode of transportation to campus.

1.3 Organization of Thesis

This thesis is organized into six chapters and two appendices. Following the introductory first chapter is a comprehensive literature review providing history and details regarding implementation of carpooling. Next, the third chapter, a preliminary breakdown of the data is provided to obtain insight on the data collected. Chapter four explains how data was collected and prepared for the analysis, and then discusses how the data was approached and methods used for analysis. Then, in chapter five, statistical models and the respective results are discussed in detail. The final chapter, six, is a

summary and observations of the research, as well as recommendations associated with the subject matter for future work.

The appendices provide supplemental information such as the survey used to collect data, descriptive statistics of the survey results, prepared data, chi-square test results performed on the data, and permission letters for survey use and copyrighted material.

CHAPTER TWO: REVIEW OF LITERATURE

2.1 History of Carpooling

Carpooling in America is not a new concept. It is an idea that is revisited in light of problematic situations at present time. As Figure 3 depicts, carpooling as a commuting mode for workers first presented itself in US policy during World War II era for "oil and rubber shortages dictated a somewhat more sparing use of private vehicles for personal transportation than is now the norm" (10). As World War II elapsed, this notion ended or at least was no longer a national affair being acted upon by the government. About three (3) decades later, in the 1970's carpooling re-emerged as an alternative to driving alone due to the Arab Oil Embargo in 1973 and from the Iranian Revolution in 1979. As the last generation may recall, these historic crises caused a spike in oil prices thus creating rationing of a gasoline and even shortages. Because of this, Americans were encouraged to carpool and even looked down upon by not doing so.

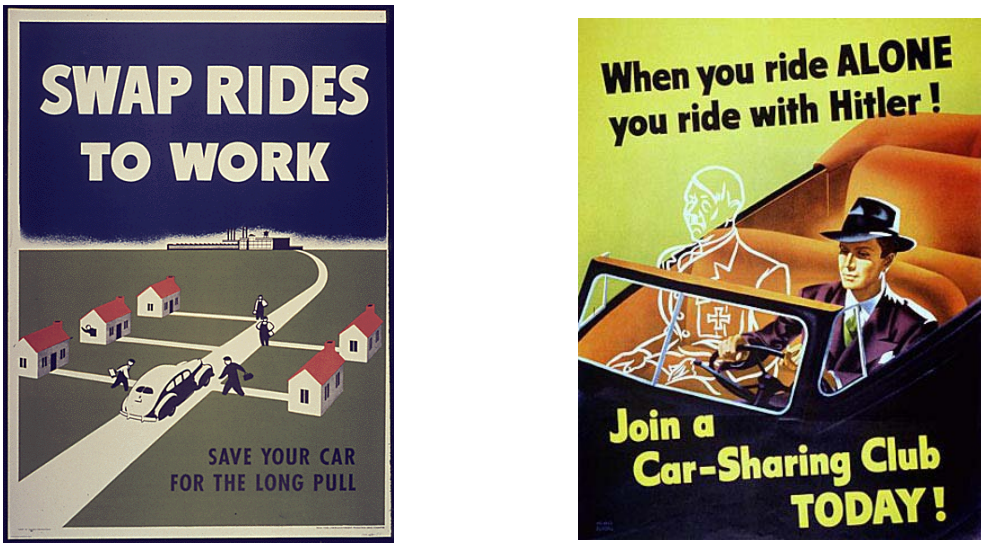


Figure 3: Post World War II Posters (11) (12)

2.1.1 Understanding Carpooling Terms

Chan and Shaheen created a chart to describe carpooling in all of its shapes and forms. As seen in the Figure 4, carpooling is categorized by 3 primary types of association. The first of these is acquaintance based, meaning a ride is shared with familiar individuals such as family, friends or colleagues. Next are organization based carpooling; which are introduced and promoted by a workplace, academic institution or geographical region to minimize vehicle usage of people with similar trip characteristics. Lastly are ad-hoc or impromptu scenarios for carpooling. Carpools that are not prearranged in a formal fashion are usually seen as slugging or dynamic ridesharing (13) (14) (15).

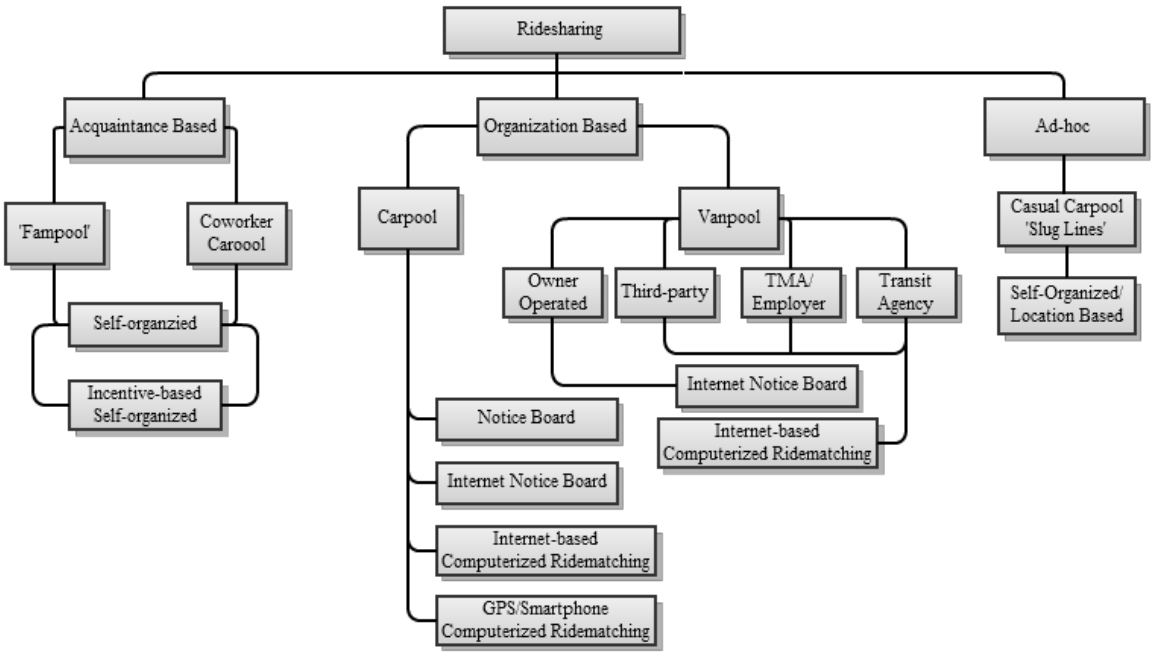


Figure 4: Ridesharing Classification Scheme (13)

2.2 Implementation of Carpooling

To help promote the idea of carpooling the Federal Highway Administration (FWHA) began designating travel lanes exclusive to vehicles with more than one occupant. Less than a decade after the Interstate System was born, the first of these high-occupancy lanes (HOV) was established. Although initially used as an express lane for buses in the metropolitan area of Washington, D.C., the Shirley Highway (currently known as Interstate 395) opened its express lanes to serve as a priority facility for van and carpools (16). Since the inception of HOV lanes on the nation's interstates, HOV lanes have increased in size (lane mileage) by a large magnitude—beginning with less than 25 miles in the early 70's to a current, as of 2007, over 2,500 HOV lane miles (17).

A report in late 2008 by HNTB reports the total HOV lanes miles are contained within 345 facilities (continuous segments of designated HOV use). Of these 345 HOV facilities, 91 (26%) are equipped to provide travel time savings data. The travel time savings provided by the facilities with known data ranges from 0.4 minutes to 37 minutes. In the same report, a survey based performance evaluation indicates 75% of the HOV operators that responded claim their HOV systems are currently achieving the desired performance objectives. On the other hand, unsuccessful scenarios are due one of several reasons: congested lanes (excess demand), low speed differential between facility types, discontinuity (bottlenecking when facilities merge together), high violation rates, and underutilization (18).

To meet the occupancy requirements of HOV lanes and encourage carpooling on congested corridors in metropolitan areas, commuters have established a system referred to as casual carpooling or more commonly known as slugging (14) (19). Slugging currently operates as a daily mode of transportation in Washington, D.C. (20) (21) (22); San Francisco (22) (23) (24); Pittsburgh (24); and Houston (19) (22). In most cases, slugging participants meet in a designated area (slug lines) where drivers and passengers are arranged into a carpool by their final destination. There is no cost to either party since it is mutually beneficial: the drivers reach the HOV requirement and passengers being transported to their required location (25). A 2006 study of Houston sluggers found that 62.8% considered saving money as a primary reason for casual carpooling. The travel time savings for sluggers was 13.5 minutes with an average of about 4 minutes. This study also discovered that more than half (65.3%) of those slugging had not previously met their carpool partner(s) prior to riding together (19).

Researchers at the University of California at Riverside compared the difference in traffic dynamics between HOV lanes and adjacent mixed-flow (MF) or general use lanes to obtain an understanding of travel time savings and greenhouse gas emission rates. Because there was a better flow of traffic in the HOV lanes during congested conditions, vehicles traveling in these HOV lanes emitted10-15% less HC (hydrocarbon) and NO_x (nitrogen oxide), approximately 35% less CO_2 (carbon dioxide) and fuel consumption rates than vehicles traveling in MF lanes. During congested conditions, travelers using the HOV lanes saved up 2.75 minutes per mile driven. On uncongested freeways, the travel time reduction from HOV lane utilization is negligible. When HOV

lanes are under-utilized the result is higher emission and fuel usage rates (per vehicle) compared to that of the MF lanes. Nevertheless, HOV facilities produce a reduction in vehicle miles traveled (VMT) thus yielding a higher greenhouse gas reduction (26).

The people who have the greatest impact in reducing traffic congestion by carpooling are those that travel during the peak hours, commuting workers. Worksite-based carpooling programs have been in existence since carpooling itself albeit in an informal fashion. Containing some of the most congested corridors in America, California and the states' air pollution control agencies established a system known as employee-based trip reduction (EBTR) to reduce congestion and subsequently minimize additional air pollution (27) (28). Just as the name suggests, EBTR was established as a program to minimize the amount of traffic induced by commuting workers and employers were responsible for implementing such in the workplace.

The idea of EBTR strategies to reduce the amount of single occupancy vehicles (SOV), greenhouse gases, and traffic was abandoned in California in 1995 due to opposition of employers not willing facilitate such a program despite city and county ordinances (27). A recent study in Atlanta, Georgia investigated EBTR initiatives to determine why this program was unfavorable in the business community. The study concluded 60% of employees were simply not interested in the motives behind the program. The employers (55%) expressed there was no benefit to them (company) and half of the businesses didn't support the cause (29).

On the contrary, the Washington State Department of Transportation (WSDOT) has had success in trip reduction among urban based employers. A legislative act—

Commute Trip Reduction (CTR) Efficiency Act—passed in 2006, required local governments in urban areas with congested roadways to develop programs to reduce SOV and VMT. After 3 years of the program running workplaces in the urban region reduced morning commute trips by nearly 30,000 while traffic delay was decreased by 8 percent. It is estimated that rush hour commuters saved $59 each per year in fuel and time. There are over 1,050 worksites and 530,000 commuters statewide participating in the program (30).

2.2.1 Carpooling in a University Setting

As the demand for higher education continues to increase, Universities around the nation inherently become more and more populated. To serve the additional students each year more resources are needed—instructors to maintain manageable class sizes, classrooms for a place to teach, and parking spaces so everyone can access campus. In effort to combat overcrowded parking lots at their school, North Dakota State University sought proactive measures to help alleviate congestion on campus. A preliminary survey regarding willingness to carpool was distributed to all students to determine the potential success of a carpool to reduce the parking demand. The survey indicated that about 42% agree with this notion. Furthermore, details such as parking decal prices and the location of carpool parking lots increased the favorability and potential amount of users of the program (31).

A more detailed study done on a yearly basis at The University of California-Davis (UC-Davis), determines the modal split (choice of transportation) of the on-campus population (representative sample of students and faculty/staff). The most recent findings of this study indicate the amount of people participating in carpooling increased by approximately 2%. While 2% may seem like a small figure, if translated to UCF this would remove 850 vehicles from campus. To supplement the increase in carpooling as a mode choice, the average vehicle ridership (occupancy) also increased from one year to the next by 10%—3.20 people/vehicle to 3.51 people/vehicle. In this survey UC-Davis also found that the awareness level of the car/vanpooling program increased by 6% between 2007-08 and 2008-09, thus providing hope for greater participation (32).

Other Universities, such as The University of British Columbia (UBC) and Indiana University-Bloomington (IU), went in so far as to design a transportation demand management (TDM) program to increase use of carpool and other modes (read decrease SOV use). UBC's program, TREK, is intended to encourage more efficient travel to the university campus and reduce overall traffic volumes (33). The potential benefits they acknowledge from use of this program and reduction of SOV in general include: parking cost savings, congestion reduction/road cost savings, reduced accidents/road risk, road and traffic service savings, and reduced pollution. The stated objective of this program, which deemed achievable the institution, is a 20% reduction in SOV trips over a 5 year test period. A follow up report indicates there was only a 9% reduction in SOV use. Interestingly, carpooling figures decreased by 20% with a 56% increase in transit; suggesting a significant mode shift (34).

Another University with a TDM program in place is Cornell. In 1990 the Transportation and Mail Services Department initiated a plan to reduce the demand of parking for commuting students by providing means of transportation aside from SOV. With all the services included in the TDM plan, Cornell reduced the amount of faculty/staff parking permits by 25% and increased ride sharing by 10% in the first year. Also, Cornell states they have successfully reduced traffic to, through, and around campus. Residual benefits of the reduction of SOV on campus include:

- 417,000 less gallons of fuel consumed annually
- Reduction of various emissions
    - 6.5 million pounds of carbon dioxide (CO_2)
    - 600,000 pounds of carbon monoxide (CO)
    - 35,000 pounds of nitrogen oxide (NO_x)
    - 60,000 pounds of hydrocarbons.

Since the program's inception the university reports a net savings of approximately $40 million in costs which would have been encountered via construction, debt service, and maintenance of parking structures (35).

Harvard University, Cambridge Campus has conducted an annual Parking and Transportation Demand Management Plan since 2003. This yearly report indicates a gradual decrease in SOV usage with a record low in 2010 at 11.3% of drive alone commuters. While only 5% shared a ride (car and vanpool), this too is the best figure produced by the annual report. Furthermore, the most amount of carpool groups (110 two-person, 4 three-person) was recorded for the latest report (36).

Georgetown University (GU) recently had their University campus plan rejected by the District of Columbia Department of Transportation (DDOT) due to an insufficient TDM program contained therein (37). Current efforts include preferred parking and reduce permit prices for those that carpool. With 143 faculty/staff officially choosing carpooling at their mode choice, a survey from the Spring 2011 semester indicates that only 5% off the total University population is carpooling (being dropped off or using a taxi). To improve the participation of the carpooling program GU plans to increase the marketing of the program and introduce incentives such as guaranteed ride home and carsharing services (38).

Another institution with an active TDM program is the University of California (UC), Berkley. Between—the initiation of the program in—1997 and 2008 this TDM program has continuously reduced SOV rates on campus from 16% to 7% respectively (39). UC Berkley has not specifically focused on carpooling though for the rate of this mode has been steady at merely 2% over this time period with only an average of 800 employees and 350 students actively carpooling (39) (40). The UC Berkeley Housing & Transportation Survey suggests the modal shift experienced is caused by transit for it has nearly doubled in ridership between 1997-2008 which makes sense due to the availability of service and support from the city (39).

2.3 Perceived Disadvantages of Carpooling

Often mode choice is driven by negative perception of modes not used by individuals. This however is unfortunate since it is merely based on drivers' misunderstanding and preconceived notion (41). One instance is how drivers of personal

vehicles perceive travel time of public transportation as too long, when in fact is it relatively short (42). In spite of this, there are incidents where utilizing public transportation (as captive, non-choice riders) has overcome expected frustration by users realizing the productive time available during travel; a realization where the once captive riders would be more likely to switch to public transportation for their commute (41) (43).

To reduce the fear of being stranded without transportation, guaranteed ride home (GRH), or emergency ride home, programs were introduced as insurance for commuters using modes other than SOV (44). GRH programs have proven to be a factor in the decision of mode choice for some commuters: a 1999 survey of express bus riders in New York found that ridership would decrease by 16% if GRH was no longer offered; a 2002 survey in downtown Boston revealed 9% of SOV commuters switched to an alternative mode because GRH became available; another 2002 survey indicated 41% of ferry riders in New York choose this mode because GRH was offered (4% ranked it as their top reason) (44).

Initial studies of GRH programs suggested promising results to be expected in the future. A study of 11 GRH programs concluded GRH services were successful in reaching the basic goals of encouraging ridesharing established by program administrators albeit none of the programs statistically supported nor rejected this claim (45). A demonstration project of increasing HOV rates by use of GRH proved to be successful in the state of Washington. This study reported a 12% increase in HOV

registration among participants and 69% of registrants expressed the GRH program governed their choice to continue ridesharing (46).

More recent studies of GRH programs have found providing this service would increase carpool frequency by 17% and 8% of SOV commuters would shift modes (44). An annual study in Alameda County, California found that GRH programs incentivized 28% drivers in 2008 and 2009 to use an alternative mode at least 4 days/week. Similarly, 35% would not consider using an alternative mode without a GRH option available. This study estimates $1.1 million in savings on gas alone in 2009 from choosing alternative modes for their commute (47).

Carsharing is another service provided to commuters that provides the freedom to choose transportation modes other than a personal vehicle. Researchers at the University of Texas summarize carsharing as, the “access to a fleet of shared-use vehicles in a network of locations on a short-term, as-needed basis. It allows individuals to gain the benefits of private vehicle use without the costs and responsibilities of ownership (48).” Carsharing was first introduced in the U.S. by two experiments in 1983: a Purdue University research program, Mobility Enterprise and the Short-Term Auto Rental (STAR) demonstration in San Francisco (49). Since then, according to a study by UC Berkeley, the amount of registered carsharing members has increased twofold about every year or two with a current level (in 2009) of 320,000 members sharing over 7,500 vehicles (50) (51). In addition to lowering greenhouse gas (GHG) emissions, VMT and even vehicle ownership has decreased due to carsharing programs (49) (52).

2.3.1 Disincentives of Carpooling

Travel time is often of concern when choosing a travel mode (53) (54). In addition to time, utility considerations (time and reliability) were also found to be influential in mode choice (55) (56) (57). Furthermore, comfort and convenience have also proved to be a deciding factor in mode choice (58). Researchers in the Psychology Department at the University of Sussex have identified five primary reasons why people continue to prefer the use of their personal vehicle: “minimising journey time and achieving positive and/or avoiding negative journey-based affect; minimising physical and psychological effort; creating personal space; and minimising financial expenditure.” (54) The overall motivation of these identified causes of perpetual SOV use is governed by the “desire for control over the transport experience.” (54)

Increases in the perception of risk associated with a given mode choice may reduce the probability of using that mode to commute (59). Rideshare providers realize concerns of safety, making it difficult to encourage sharing rides with strangers (60). And users express trust is a major concern regarding the use of ridesharing systems (61). Integrating ridesharing with social media (Facebook) and using GPS technologies to tracker passengers during a shared ride can potentially reduce the fear of carpooling with a stranger (62) (60). Some rideshare platforms systems also attempt to create confined networks like a workplace or education institution to minimize fear of riding with random passengers (63).

2.4 Successful Carpooling

Although financial deterrents such as fuel cost (42) (64), parking (65), and congestion pricing (66) have been successful in changing mode choice among commuters, research regarding carpool incentive programs indicate people are more likely to change their behavior (mode choice) provided incentives (positive reinforcement) as opposed to disincentive (negative reinforcement) (67). An Annual Survey conducted in Orange County, CA asked employed commuters who drove alone to rate their likelihood of switching from SOV if various fees or incentives were introduced. "Fewer say they would be very likely to stop solo driving if they were charged a parking fee at work (20%), a smog fee (17%) or a congestion fee (16%), than if their employers paid them a cash bonus for stopping solo driving (28%), or if more public transit (33%) or more carpools at work (35%) were available (68) (67)."

In order for carpool incentive programs to be effective there needs to an infrastructure to support the notion of carpooling as a mode of transportation. Although incentives are likely to increase carpool mode share (67), the successfulness of the program depends on the situation—for example; accessibility to HOV facilities (69), high parking rates and concentrated employment areas (like a central business district) (70). Moreover, the financial incentives themselves are most effective when:

- ride matching and GRH programs are also introduced as a supplement resource
- carpooling is implemented as a choice and permitted part-time
- award system based on frequency of use
- users of system are able to provide input (70).

2.4.1 Case Studies of Successful Carpooling

Several programs have been successful in implementing an incentive based carpool program and measuring how well it performed, the results of some are summarized in Table 2 (adapted from National Capital Region Transportation Planning Board Commuter Connections Program). Each individual program had a different incentive offered, as well as specific stipulations and as a result a varying degree of success. In addition to the incentives offered, it is evident the tracking of daily program has contributed to the success of the programs.

Table 2: Summary of Carpool Incentive Programs (67)

Program Name	**Location**	**Incentive Offered**	**Details of Program**	**Retention Rate/Accomplishments**
Commuter Bucks	Knoxville, TN	$10 gift card for use of alternative mode	60 one-way trips per 3 month period	-At least 300 participants have meet the incentive qualification between 2008-2011[1] -Millions of VMT reduced
Cash for Commuters		$2.00/day (Visa check card)	-60 day pilot study -Controlled group of 38 participants (only 25 completed study)	-77% continued use of alternative modes (≥ 1 day/week) 3 months after study -65% continued 6 months after -over 23k VMT saved & 1,200 gallons of gas

[1] Smart Trips. *Progress Reports*. <http://smarttrips.knoxtrans.org/reports.htm>. Accessed 17 Jan. 2012

Program Name	Location	Incentive Offered	Details of Program	Retention Rate/Accomplishments
	Atlanta, GA	-$3.00/day for a max of $180/90 days -Random monthly prize drawing -Established carpools eligible for gas cards	-Online tracking system to qualify for rewards -Initially targeted commuters only using SOV	-71% continued alternative mode use up to 6 months after -64% maintained non-SOV use 9-12 months post study period
Advantage Rideshare	Riverside, CA	$2.00/day (gift certificate) alternative mode is used up to $120	Use 5 days/month minimum	-75% continued carpooling 6 months after program ending -40% continued use post 9 months program end
Rideshare Rewards	Los Angeles, CA	$2.00/day to a max of $120 (gift certificates)	Follow up surveys used to measure success	-Ridesharing experienced 35%, 75.3% & 52.5% share of mode split before, during & after the program, respectively
R-Trip	Redmond, WA	-Point system for gift card -Random monthly prize drawing	Web based interface where users log their trip info	-2.5 million trip avoided -Over 3 million gallons of gas saved -70 million pounds of CO2 reduced

2.5 Innovations in Carpooling

Internet based carpool formation began around 1999. Several ridesharing programs resorted to web based forms and became known as online ridematching. Private software companies soon began hosting these forms and storing them on their database to create a ridematching platform (71) (72). The information you provide (form), e.g. schedule and origin/destination, are linked to other members with similar trip characteristics then arrangements are made between users. A current enhancement to the internet ridesharing software is the integration with social networking websites, such as Zimride and Facebook, allowing for users to find mutual acquaintances, colleagues and coworkers to travel with (62).

With advancements in technology and the overwhelming use of internet capable devices, carpooling has become an instantaneous process. Dynamic ridesharing is similar to ridesharing where it joins individuals with similar trip characteristics (travel time, origin/destination) but differs for it is "on the fly" and goes without advanced arrangements (15). The use of mobile internet is ubiquitous in the US with 63 million users, one-third of which is on a daily basis (73) provides the fundamental grounds of enabling a program like dynamic ridesharing (74).

A case study of dynamic ridesharing at UC Berkeley analyzed the potential of such a program at a university campus. The survey results revealed 39% of UC Berkeley graduate students would be willing to try the service and 21% claimed they would use it regularly (at least once per week). Faculty and staff reported nearly half would try dynamic ridesharing, while 26% stated they would participate at least one time per week.

Individuals that already use auto, carpoolers and drive alone commuters, showed they are more likely to utilize a dynamic ridesharing service than those who use transit, cycling, and walking. Thirty-four percent (34%) of survey respondents noted a preference of scheduling commute trips at least one day in advance. About one-quarter (26%) of the sample population was seeking a steady carpool partner whereas 22% used the service to find a ride only a few hours, even minutes in some cases, ahead of the time they needed a ride. Over 40% of UC graduate students and employees in this study were not previously aware of local ride-matching services and GRH programs (15).

To further support the choice of carpooling and other alternative modes of transportation is the concept of carsharing. Carsharing is a short-term vehicle rental service used to minimize the need of a personal vehicle and provide a car for those that choose to utilize transportation other than a personal vehicle (75). Carsharing was designed to complement other modes of transportation and create a mixed-mode environment in metropolitan areas for that is where 95% of members make use of the service (76). However, universities campuses are establishing a position in carsharing services (77) (78) (79) (80) (81) (82) (83) and it is forecasted to represent 23% of the market share (75).

2.6 Carpooling Best Practices

For carpooling (vanpooling) to be successful and effectively reduce SOV, it should be introduced as part of a comprehensive TDM plan (84). Several universities across the states understand the function and importance of a TDM plan for providing access to their campuses and mobility throughout. With drive alone commuters

constituting for a large majority, 84% in one case (85), of the modal split among college students, the need for a TDM has become a requirement for institutions' master plans (37). The components of a TDM program that colleges and universities emphasize are mostly similar. These components include:

- Increased support of modes other than SOV—availability and incentives
- Discourage SOV use by increased costs such as parking
- Supplemental resources like carsharing and guaranteed ride home services
- Financial rewards such as reducing parking for carpooling and subsidized transit passes (86)

and consequently have positive impacts to the environment that some institutions seek (87) (88) (89).

In addition to a comprehensive TDM plan, carpooling has demonstrated to be most successful when users are provided an incentive (90). The first challenge is targeting habitual SOV commuters to participate in the incentive programs, the hope this will create a mode shift from SOV to carpool. Several programs have also designed rewards systems for continuous carpool users to provide positive reinforcement of their commute mode switch. To keep users interested in carpooling, the incentive was offered at a set future time, usually based on frequency of use. Monitoring and verification processes are also needed to ensure the program is running as intended, providing some degree of effectiveness, and not being abused (67).

2.7 Overview of Carpooling

Although carpooling has been used by some as a mode of transportation and means of reducing SOV through its long history, there has been a near 50% reduction in carpool use for commuting workers since 1980 (91). Since carpooling is only successful in specific scenarios, e.g. slug lines in metropolitan areas for HOV access, there is a need to learn from that success and translate it to other applications. For situations regarding college and university campuses incentives and deterrents, or a combination thereof, are key factors in successfully implementing carpooling as a mode choice to reduce SOV on campus. With supplemental resources available like guaranteed ride homes and carsharing services, a carpool program would be attractive to users. In addition to reducing the use of limited resources and lowering the stress on the environment, cost savings benefits all parties—fuel costs for users and infrastructure maintenance for the institutions. One author suggests that a ‘green’, sustainable multimodal transportation system on a university campus could be influential on the travel mode choices by graduates thereafter (92).

CHAPTER THREE: DATA COLLECTION & PRELIMINARY ANALYSIS

3.1 Data Collection and Preparation

Data were collected using a survey created in Google Docs. Participants anonymously completed the electronic survey and the results were automatically saved on a server. The responses were organized by each participant (rows) and variable (column) in a spreadsheet. Once all responses were collected, the data was sorted and coded to prepare for analysis.

Respondents who omitted several variables while participating in the survey or those providing unrealistic responses, i.e. paying $1000/gallon of gas, were removed from the data set to maintain the integrity of the information. Additionally, a screening of the data lead to approximately 10 participants being removed for suspicion of illogical responses.

The email addresses used to distribute the survey were university affiliated student email address containing '@knights.ucf.edu'. A random sample of students was obtaining from a university emailing list and contained the following breakdown:

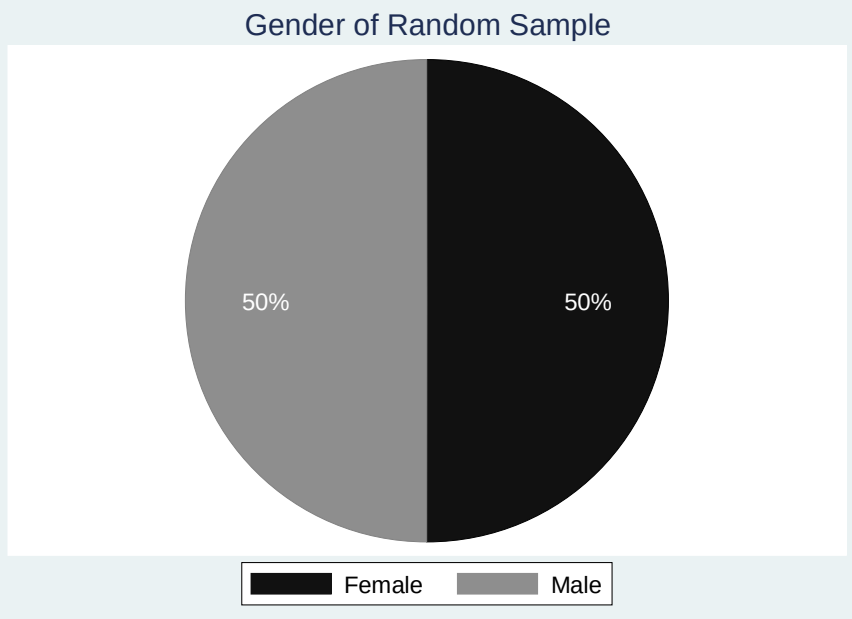


Figure 5: Gender of Random Sample

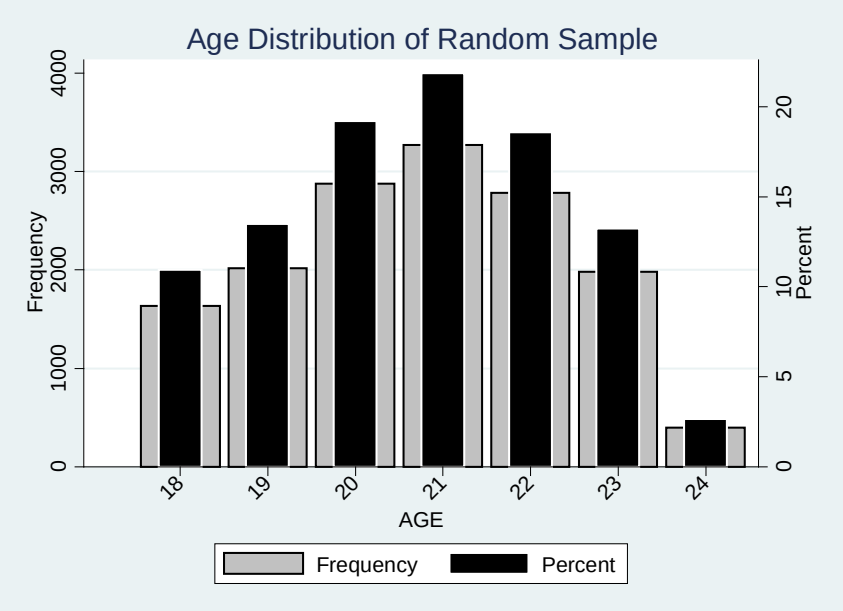


Figure 6: Age Distribution of Random Sample

3.1.1 First Survey

The survey was first made available to UCF students on January 25, 2011 via social media website, Facebook. The low response rate, 53 surveys in one month (all which were completed in the first week) suggested a more active approach was necessary. The remaining responses were obtained through two mass emails using a randomly sent on February 24, 2011 (511 responses received) and April 6, 2011 (310 responses received), thus providing a total sample size of 864.

Once the data was prepared, all variables were preliminary analyzed by looking at each distribution and frequency of each response. A chi-square test was also performed to find correlation between all variables.

The survey technique used in the first survey was revealed-preference. The initial objective was to measure the actual use of the carpool program, but results from this survey indicated a lack of awareness and therefore very little use of Zimride; therefore suggesting another survey was needed to capture additional data.

3.1.2 Second Survey

Due to the market penetration being so low and the subsequent results from the revealed-preference survey, it was concluded a stated-preference survey would capture more conclusive data.

The second survey was also distributed using Facebook and student email addresses. The survey was first released September 6, 2011 and received just over 500

responses during a 2 month span. This survey contained 49 questions and can be seen in the Appendix. For the final analysis, the data was reduced to 482 observations with 17 variables.

A preliminary analysis was also conducted on this data set. The distributions and frequency of responses for each question was reviewed. Moreover, a chi-square test was performed to test for correlation between all variables.

When referring to the survey in the appendix, question 35 was omitted from any analysis for the response was not normalized and the data could have been interpreted in various ways.

3.2 Survey Technique

To understand how UCF students would respond to the implementation of a carpool program and the requirements to provoke them to use carpooling as a mode of transportation to campus the research team chose a stated-preference (SP) survey. The purpose of a SP survey in the transportation field is to determine individual respondents' preferences for a set of transport options to estimate utility functions (93).

For a newly implemented service and concept such a Zimride, knowing the expectations and requirements customers (students) have regarding the service is necessary for the success of the service. Therefore, as mentioned by Yang et al (94), a Stated-Preference survey can be used to understand the market (customer preferences) as well as travel demand (drivers' choices). To obtain these desired results from an SP

survey it is important to design the survey so the applicable data is captured. The information sought after is this study included:

- Demographics (gender, age, income, education level)
- Driving choices (primary mode of transport, commute mode, car use frequency, influential circumstances)
- Attitudes towards carpooling (participation in such, frequency of use, required incentives).

3.3 Summary of Categorical Data of First Survey

In effort to first gauge how the parking problem at UCF is perceived, the first question of the survey was, “How frustrated are you by the parking situation at UCF? Indicate your frustration on a scale from 1-5, with 1 being not frustrating and 5 being very frustrated.”

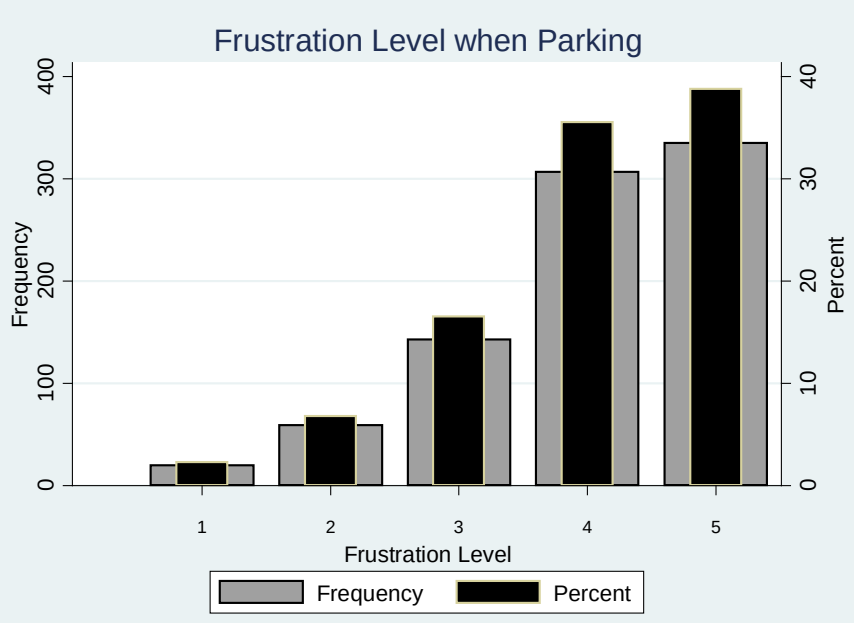


Figure 7: Level of Frustration when Parking

The two highest levels of frustration (responses 4 and 5) was expressed by nearly 75% of the survey sample as shown in Figure 5.

Subsequently, to understand the cause of frustration, a question (#16) regarding time to find a parking space was asked , “On average, how long does it take for you to find a parking space on campus?”

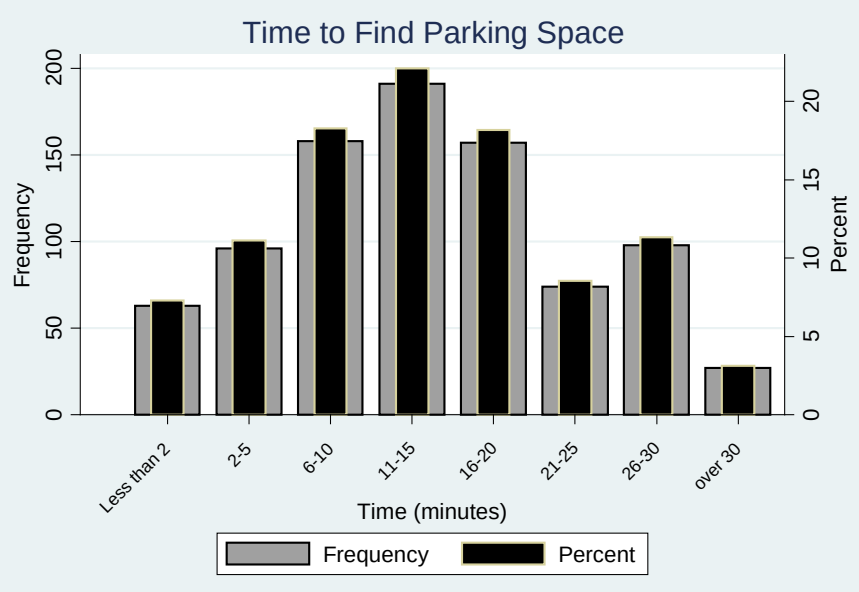


Figure 8: Time to Find Parking Space

With more than nearly half of students searching for parking spaces for at least 15 minutes, it is evident why parking at UCF frustrating as shown in Figure in 6.

To gain an understanding of the characteristics of the sample, questions regarding demographics and general information were asked. The second question of the survey

asked the gender of the respondent, “What is your gender?”

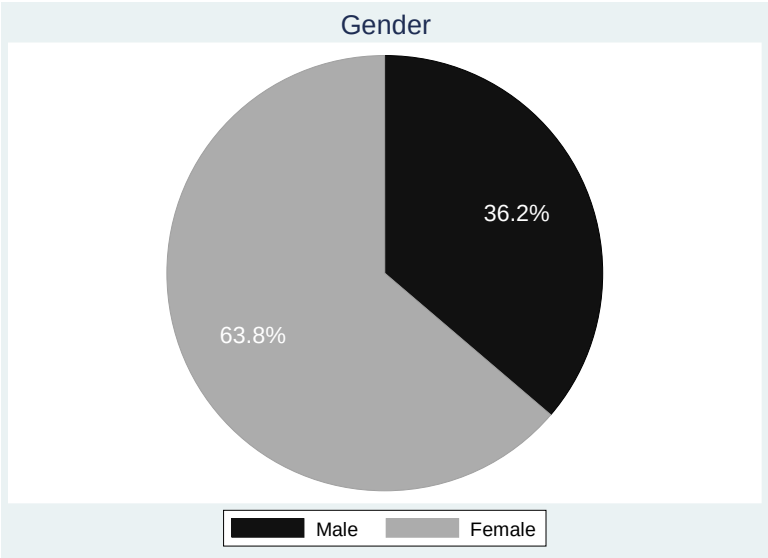


Figure 9: Gender of Survey Respondents

This outcome can be expected for there are more female students enrolled than male students as of last semester, 55% and 45% respectively (95).

To obtain a perspective on travel behavior of UCF students questions regarding mode choice, car use frequency, and knowledge of rideshare program implementation. With students using their vehicles so frequently and about 80% commuting to campus by car—as seen in Figures 8 and 9—it is no surprise how congested campus is.

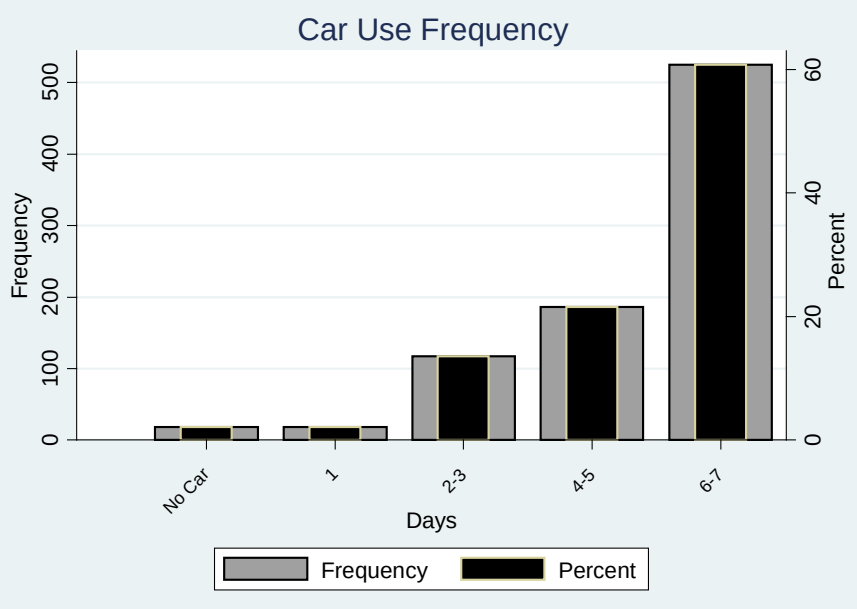


Figure 10: Frequency of Car Use

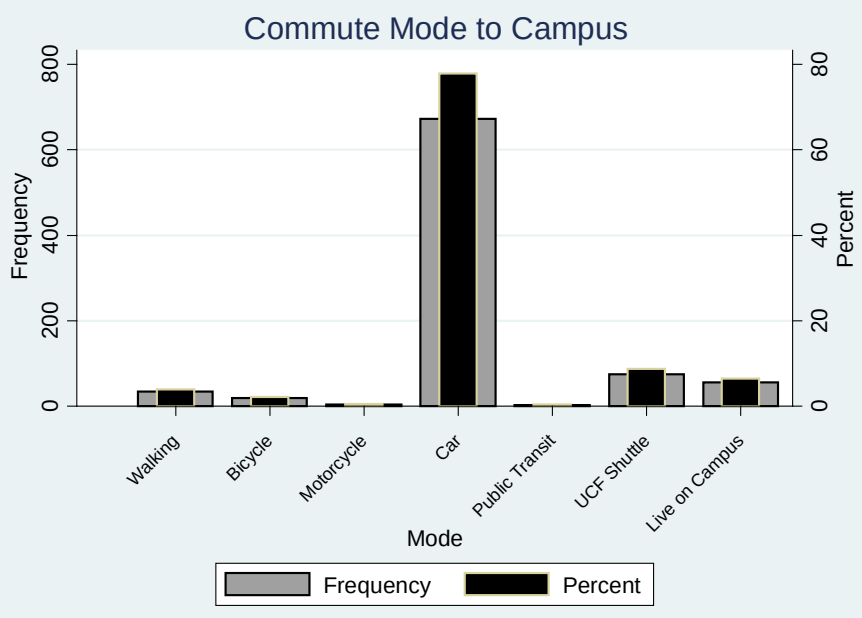


Figure 11: Commuting to Campus Mode

To help alleviate the amount of stress when parking, students were asked if they would consider carpooling to reduce the amount of vehicles on campus.

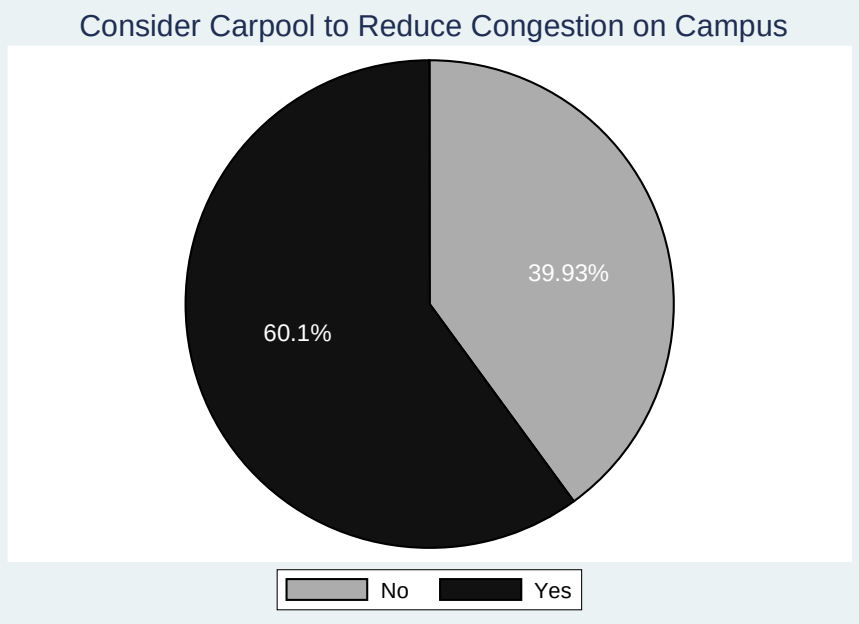


Figure 12: Consider Carpooling to Campus

Surprisingly, Figure 10 indicates 60% of survey takers said they would in fact consider carpooling to reduce congestion on campus; there are however, various stipulations attached. Some of incentives needed to actually get students to carpool include: significant saving in money/financial compensation, preferred/designated parking, reduced decal fee for doing such, backup ride home if carpool partner bails, ensured safety, time savings, and guaranteed reliability. Then there were 30 respondents (3.5%) who would not even consider carpooling.

The newly implemented ridesharing program, Zimride, can assistant students in finding other students to carpool with. Awareness of the program is not as high as expected considering it has been nearly a year since implementation.

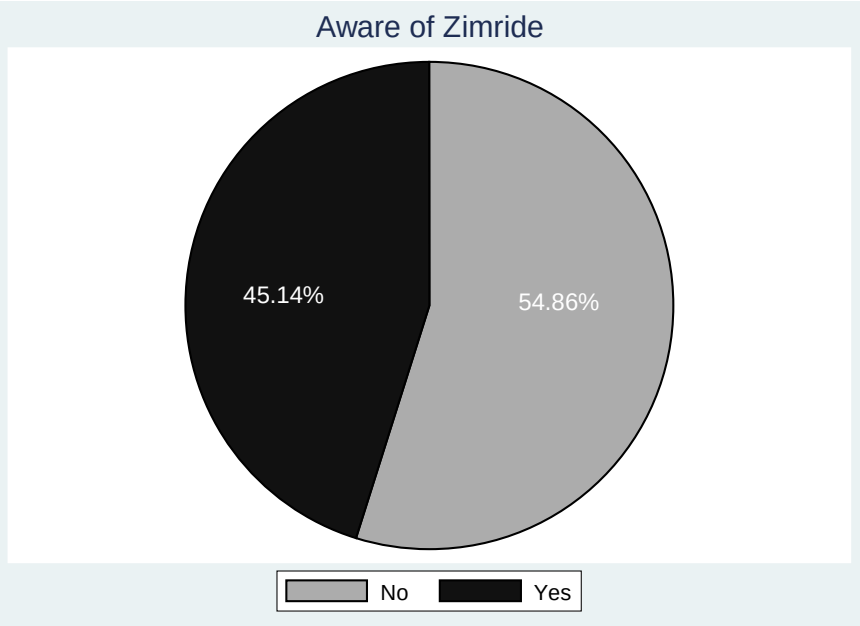


Figure 13: Awareness of Zimride

Less than half of respondents, 45%, heard of Zimride as seen in Figure 11. As a result, Figure 12 shows the amount of registered users is significantly low.

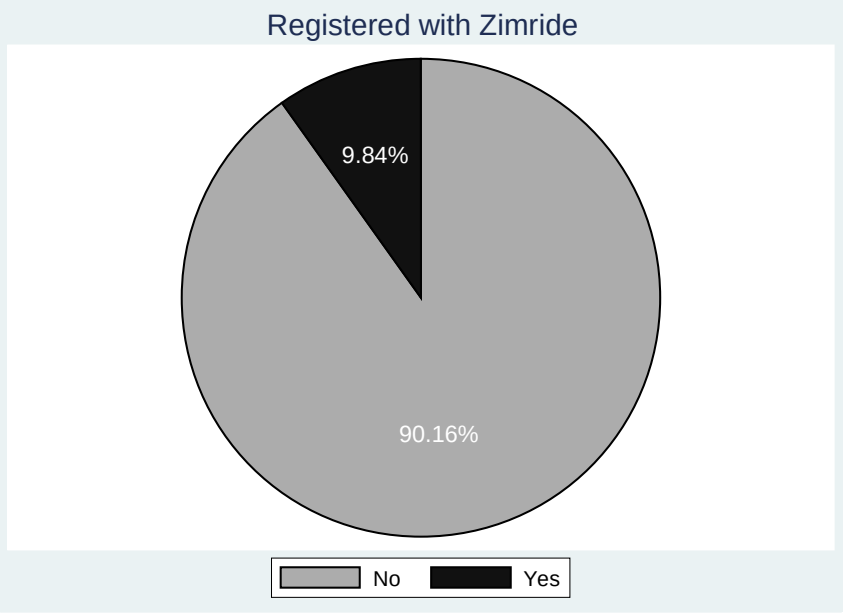


Figure 14: Registered with Zimride

One explanation for this outcome is the ratio of the people aware of Zimride that actually registered as seen in Figure 13.

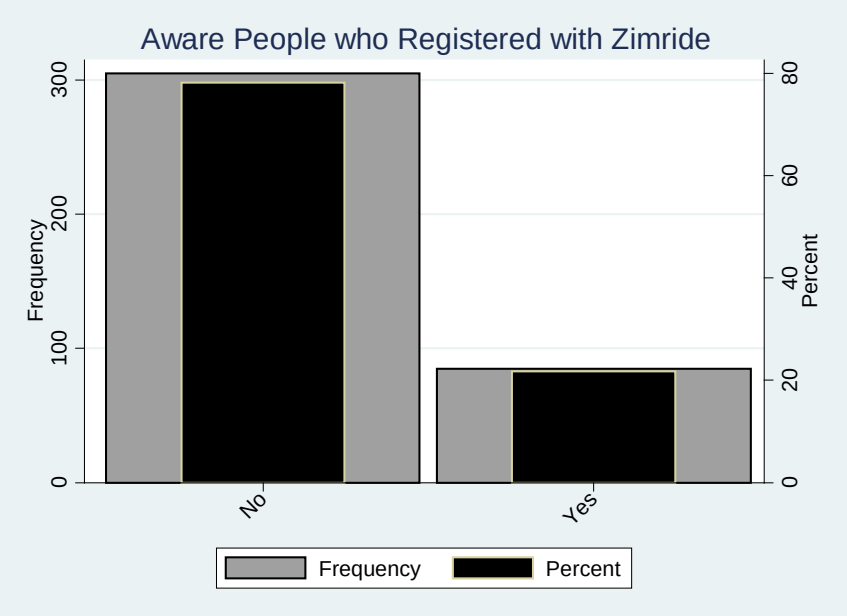


Figure 15: Aware Respondents that Registered with Zimride

Only about 20% of those aware of the service, registered. Accordingly, less than half of registered users posted a ride/commute schedule on the system as Figure 14 depicts.

Figure 16: Registered Users that Posted Ride

This group in the sample represents less than 5% of all respondents as illustrated in Figure 15.

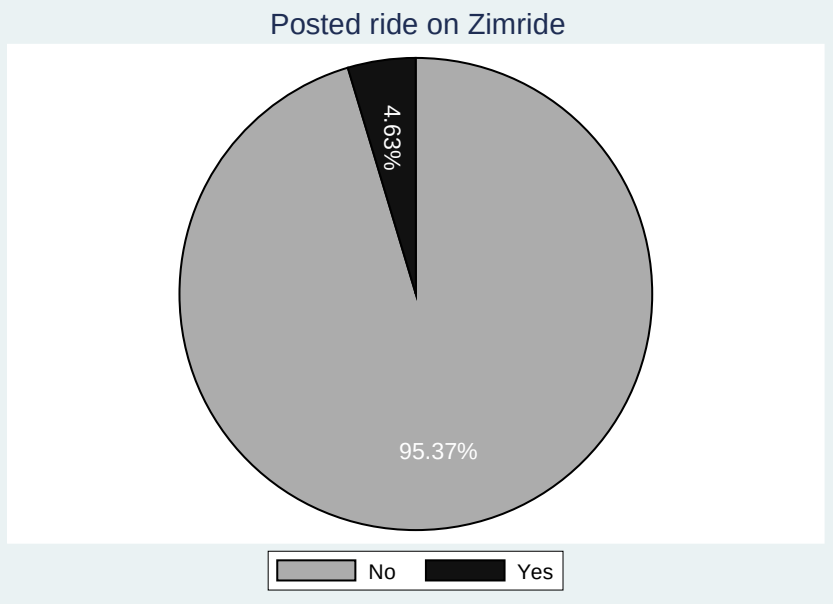


Figure 17: Posted Ride (total sample)

Out of the registered users that posted a ride, more than 80% have not used the system. The users that posted a ride and subsequently shared a ride indicated their role in the carpool as shown in Figure 16.

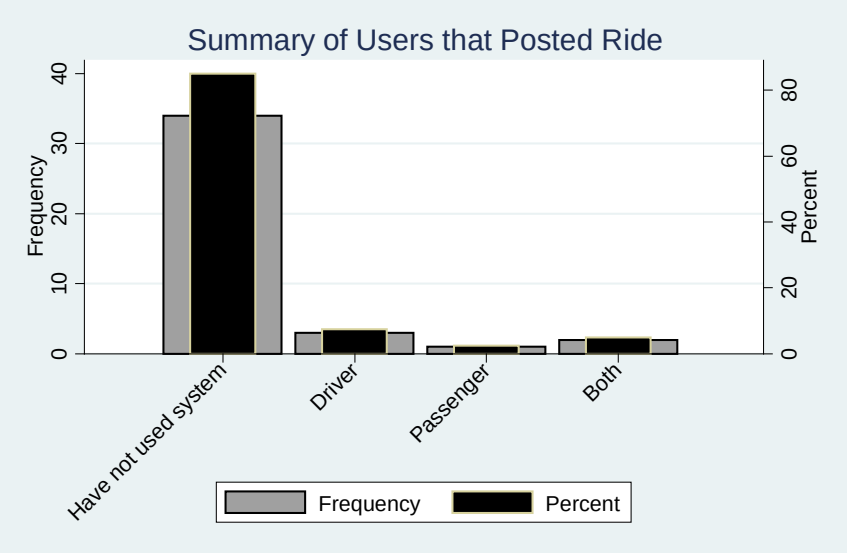


Figure 18: Summary of Users that Posted Ride on System

3.3.1 Qualitative Data from Survey Responses

The last three questions of the survey sought the opinion of respondents, providing an option to write in a response as well as select more than one answer. The objective of the first of these questions was to find the reasons behind the lack of use of Zimride—"If applicable, why don't you participate in the ride sharing program?"

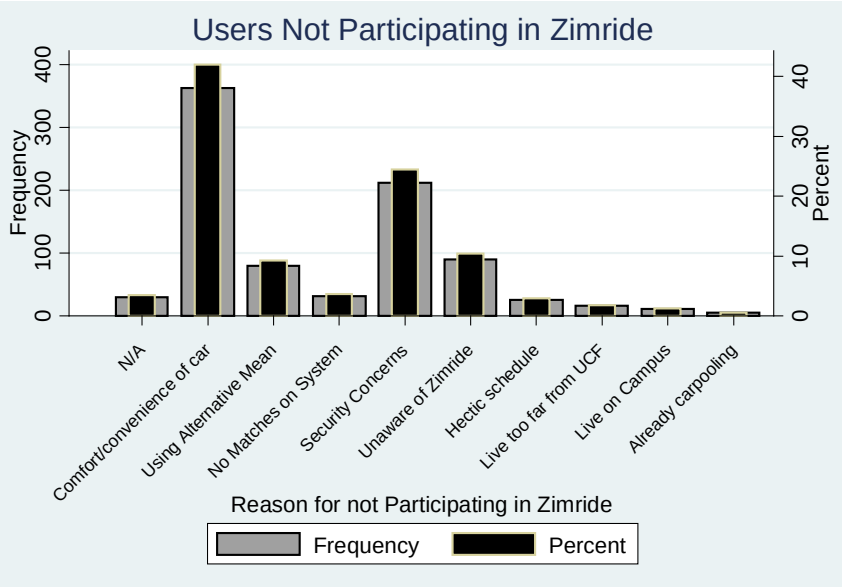


Figure 19: Summary of Reasons to Not Participate in Zimride Program

As previous research has suggested risk, comfort and/or convenience are primary factors in turning people away from unfamiliar modes (41) (58) (59) which is portrayed in Figure 17.

The last two questions of the first survey were open ended, allowing for a wide spectrum of responses. Individual respondents were able to answer with more than one

response. The first of these was, “What incentives would you need to participate in Zimride?” and the summary of responses include:

- Does not matter, I would not carpool
- Significant saving in money/pay me
- Preferred/designated parking
- Reduced decal fee for sharing ride
- Backup ride home if carpool partner bails
- Safety
- Time Savings
- Guaranteed Reliability.

Lastly, participants were asked what solutions would solve limited parking on campus; the responses were:

- Increase parking fees/decal prices
- Construct more parking lots/garages.
- Increase number of UCF shuttle routes/extended operation hours
- Policy changes, i.e. restrict freshman from having vehicles on campus, scheduling of classes, prioritization based on class
- Decrease enrollment rate
- Provide incentives for those using alternative modes
- Unsure/don’t care/why try?

3.4 Summary of Categorical Data of Second Survey

The second survey distributed to UCF students, staff and faculty were first asked questions regarding their association with UCF and general demographics. Figure 18 below shows the distribution of students' grade and participants who work at UCF.

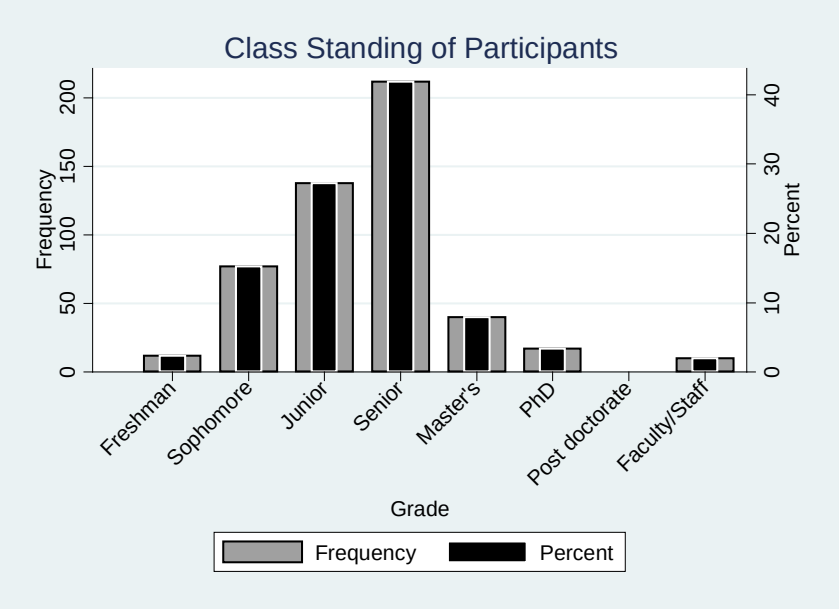


Figure 20: Role at UCF

The following four charts are general demographics of the participants—sex, age, race and citizenship; Figures 19, 20, 21 and 22 respectively.

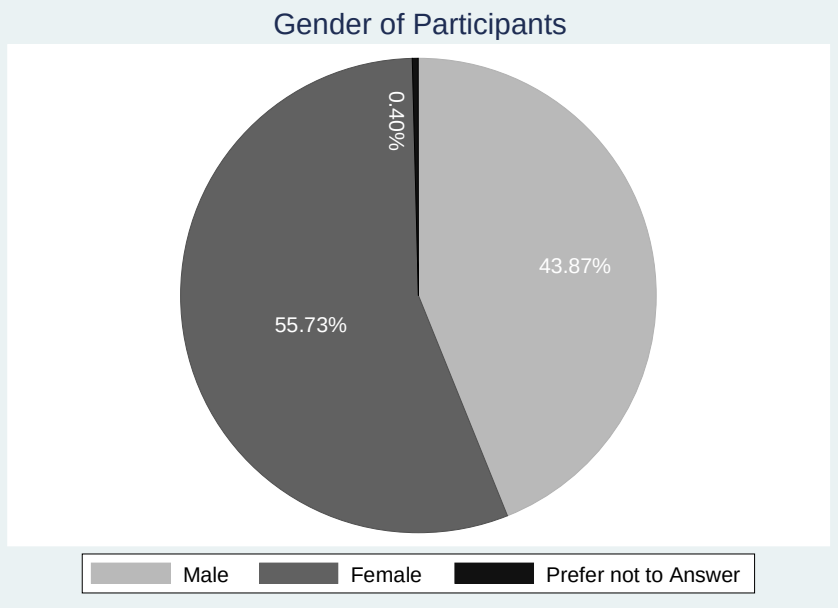


Figure 21: Gender of Survey Respondents

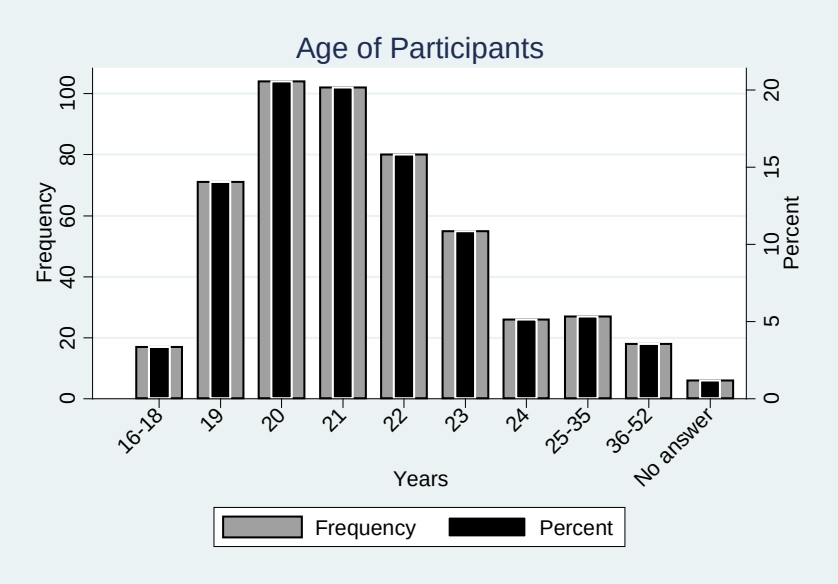


Figure 22: Age of Participants

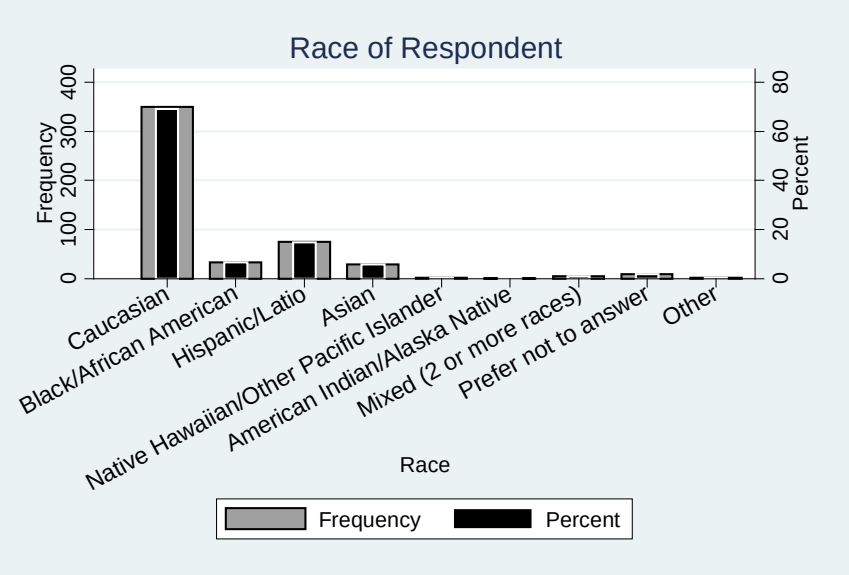


Figure 23: Race of Respondents

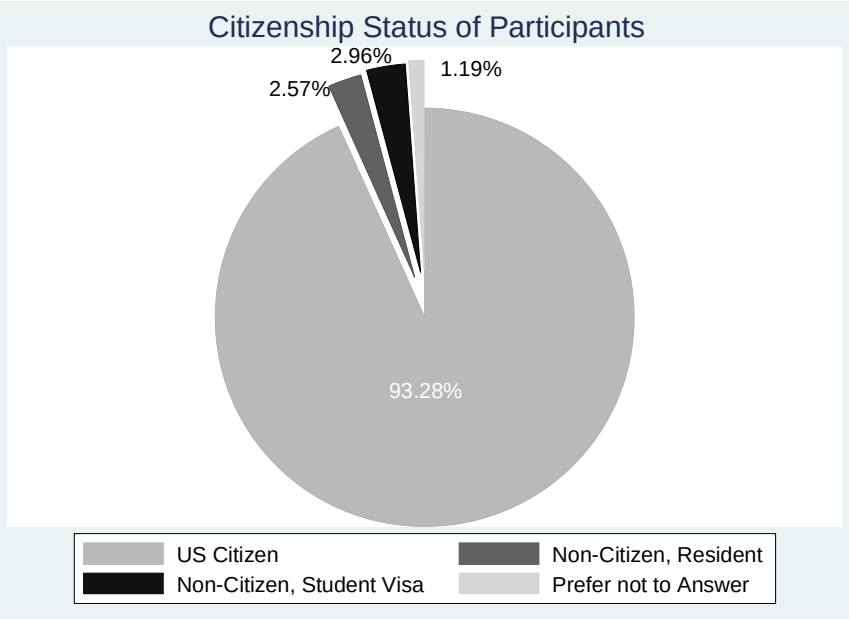


Figure 24: Citizenship Status of Respondents

Next are questions pertaining to the participants' income (amount and source) and financial dependency, Figures 23-26.

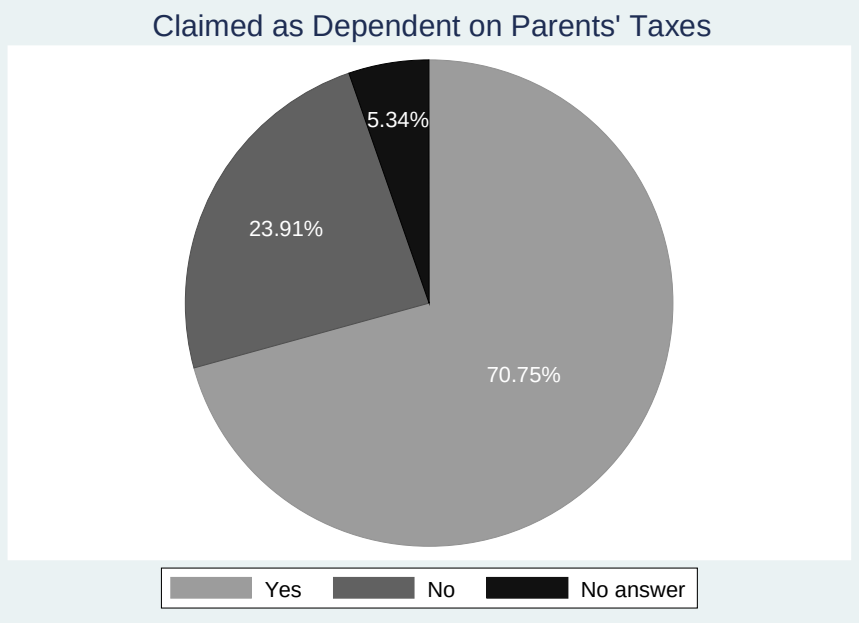


Figure 25: Tax Dependency of Participant

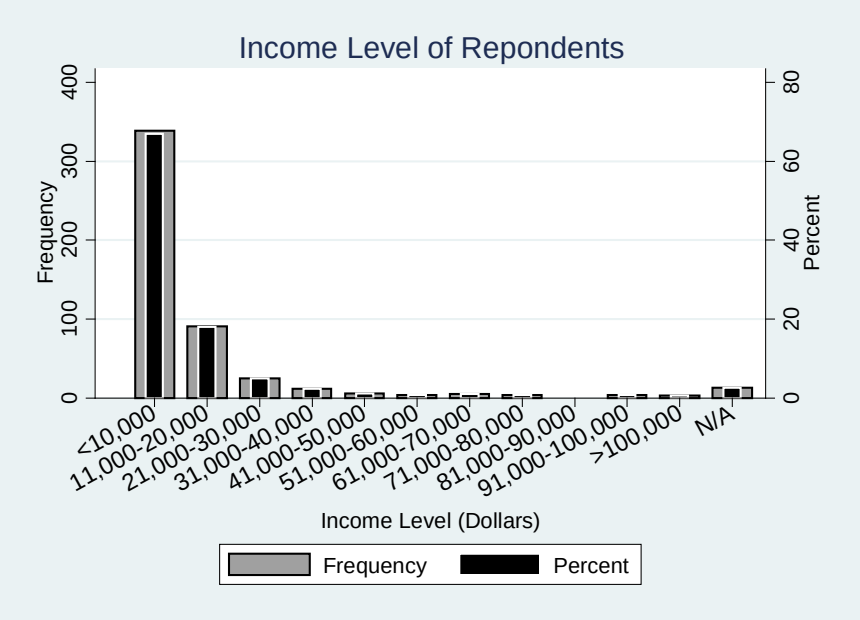


Figure 26: Income Level of Respondent

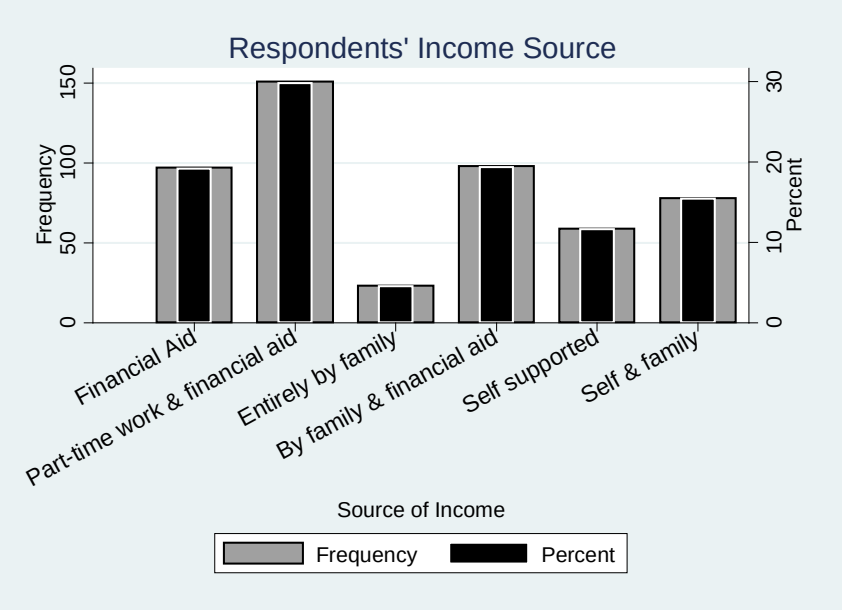


Figure 27: Income Source of Respondent

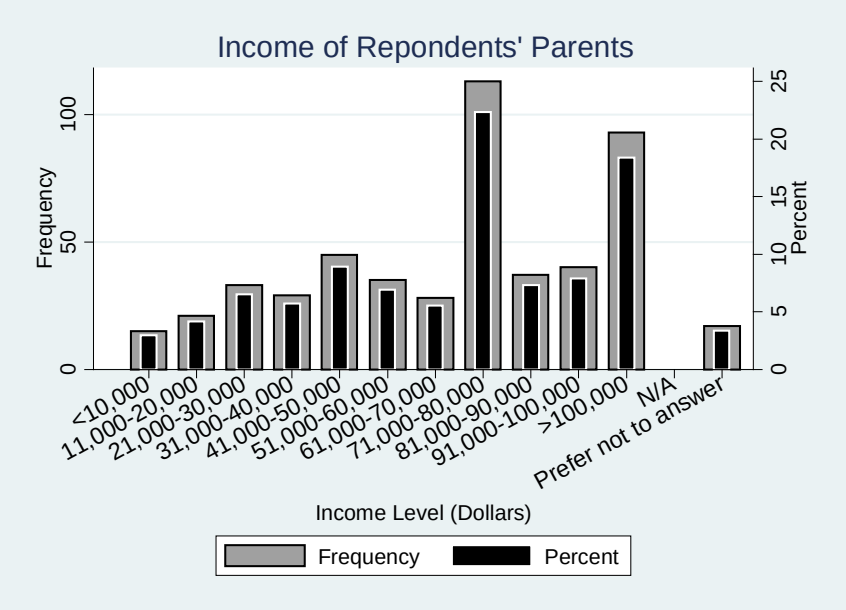


Figure 28: Income Amount of Students' Parents

Details regarding mode choice, vehicle use frequency, car ownership, and alternative transportation mode use were sought next.

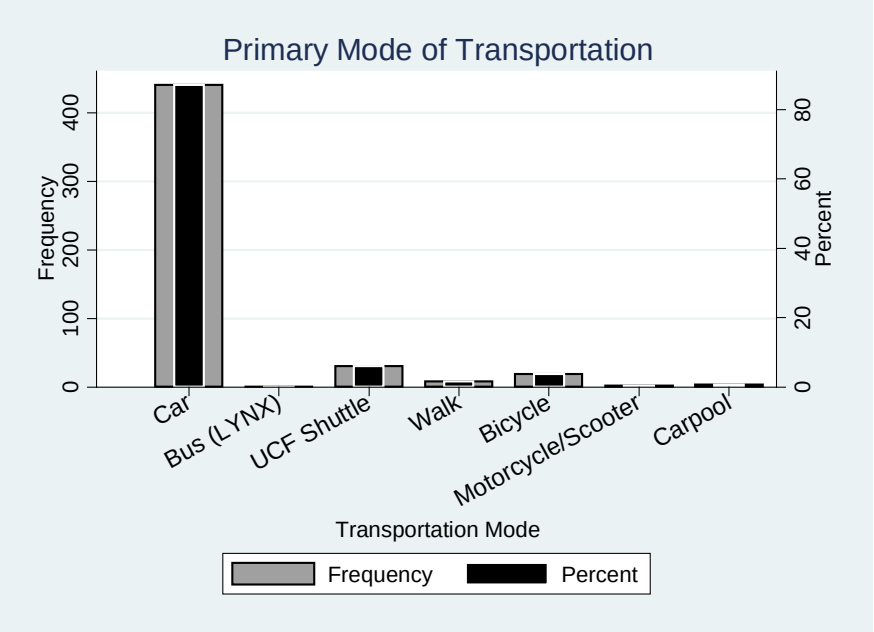


Figure 29: Respondents' Primary Mode of Transportation

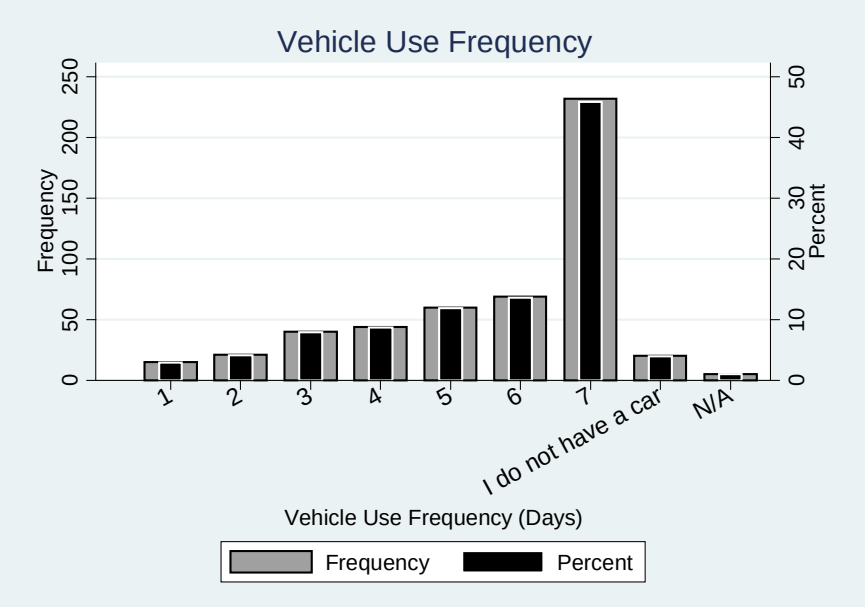


Figure 30: Vehicle Use Frequency

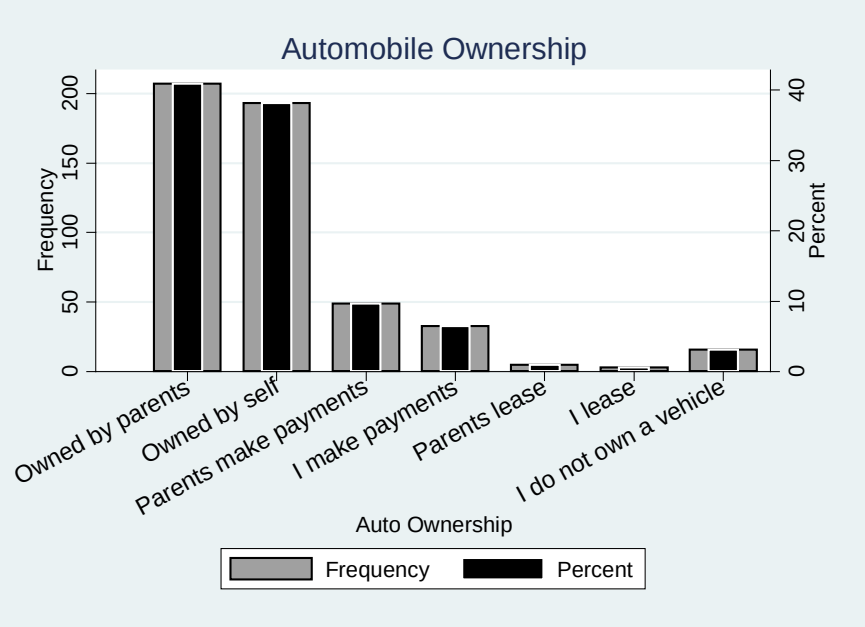


Figure 31: Automobile Ownership of Participant

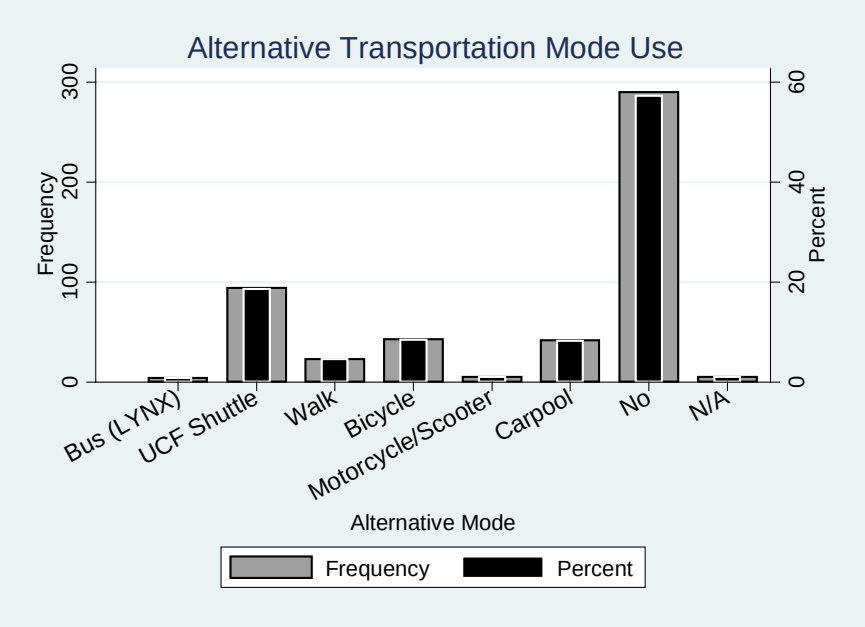


Figure 32: Use of Alternative Transportation Mode

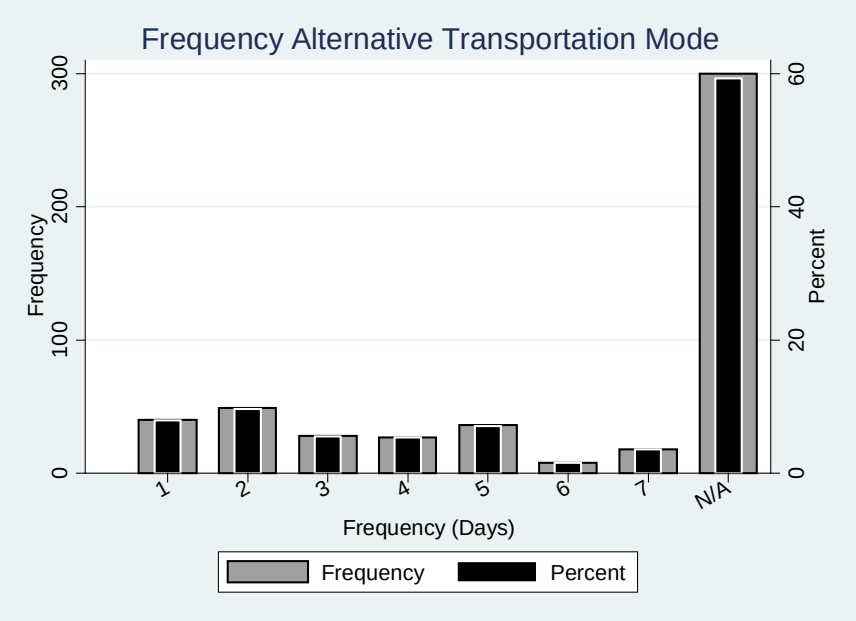


Figure 33: Frequency of Alternative Transportation Mode

The subsequent charts (Figures 32-37) seek the location of the participants' residence (with respect to campus), their primary (and secondary) commute mode, and frequency of commute mode.

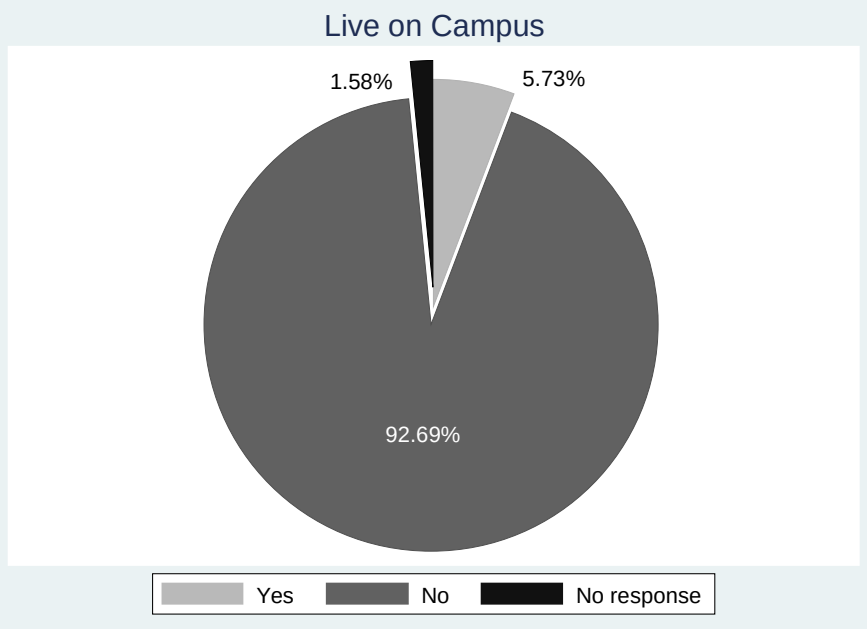


Figure 34: Live on Campus

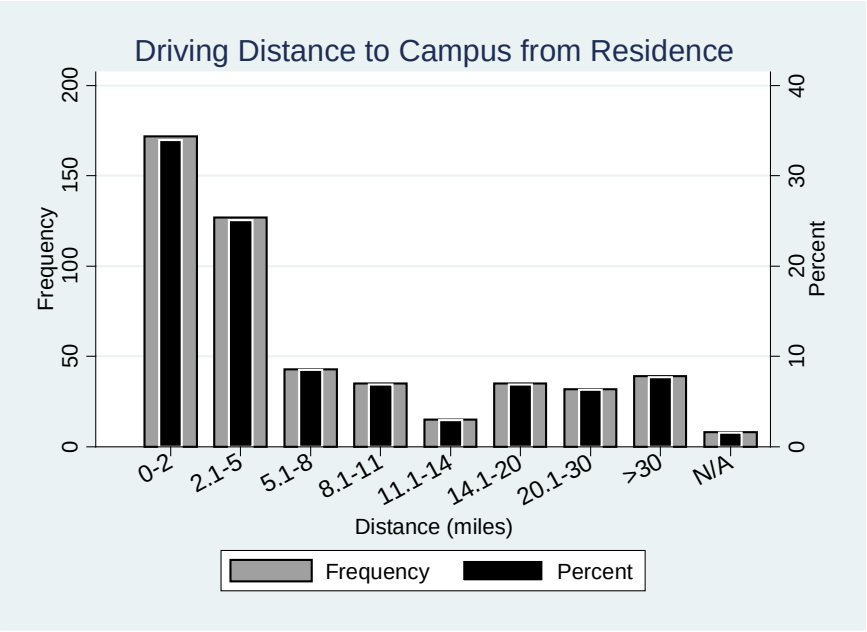


Figure 35: Driving Distance to Campus from Residence (Commute Length)

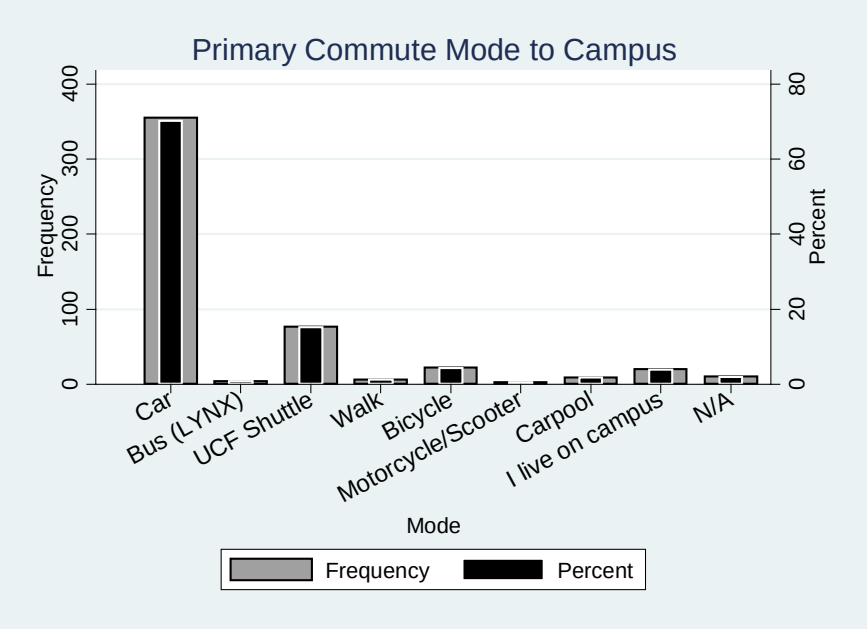


Figure 36: Primary Commute Mode to Campus

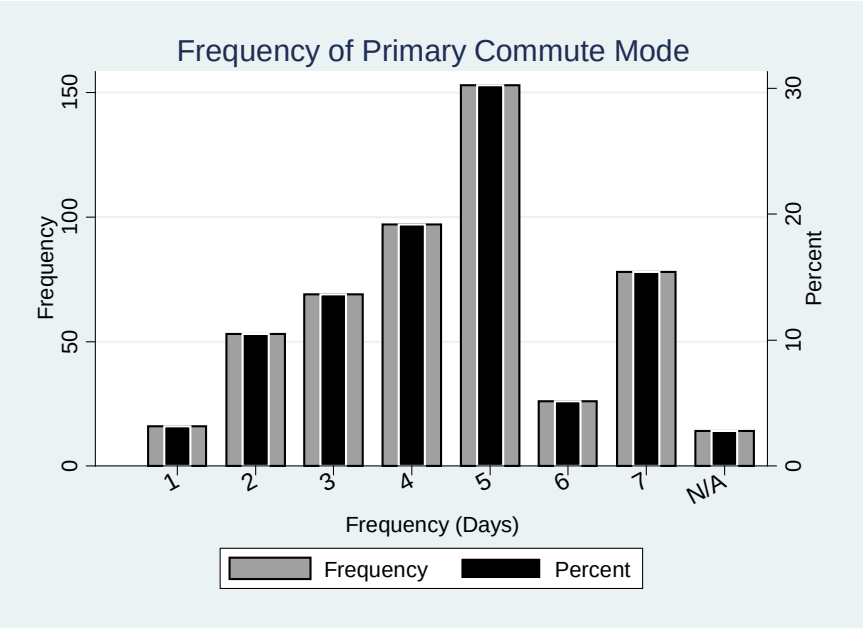


Figure 37: Frequency of Primary Commute Mode (average per week)

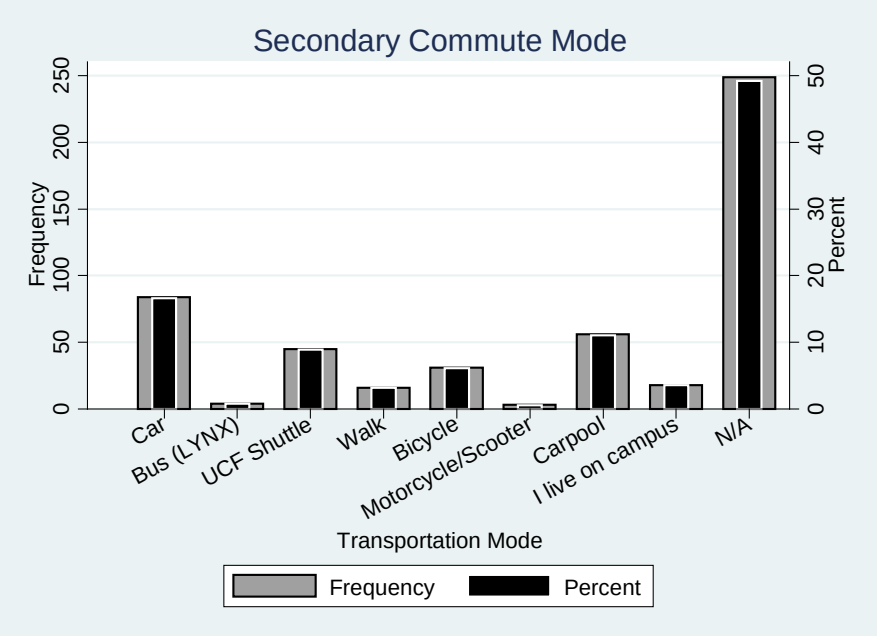


Figure 38: Secondary Commute Mode to Campus

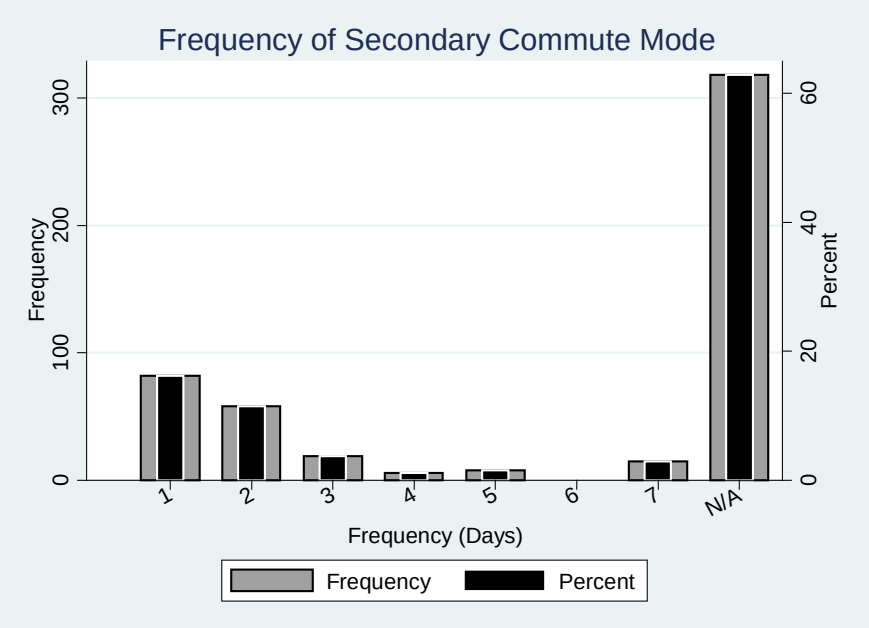


Figure 39: Frequency of Secondary Commute Mode (average per week)

Then questions were asked regarding hypothetical carpool participation based on certain scenarios and certain knowledge regarding benefits of alternative mode use.

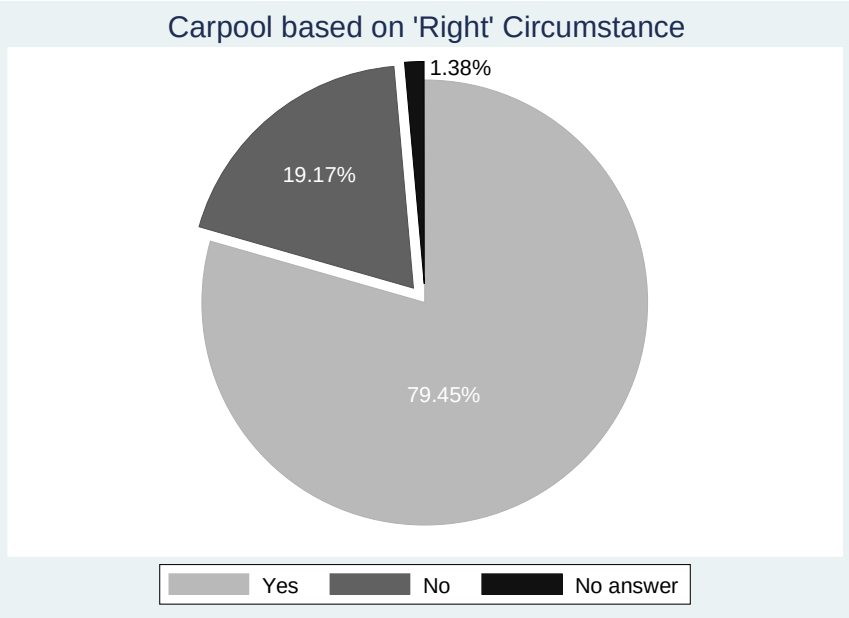


Figure 40: Participant Willingness to Carpool based on Circumstance

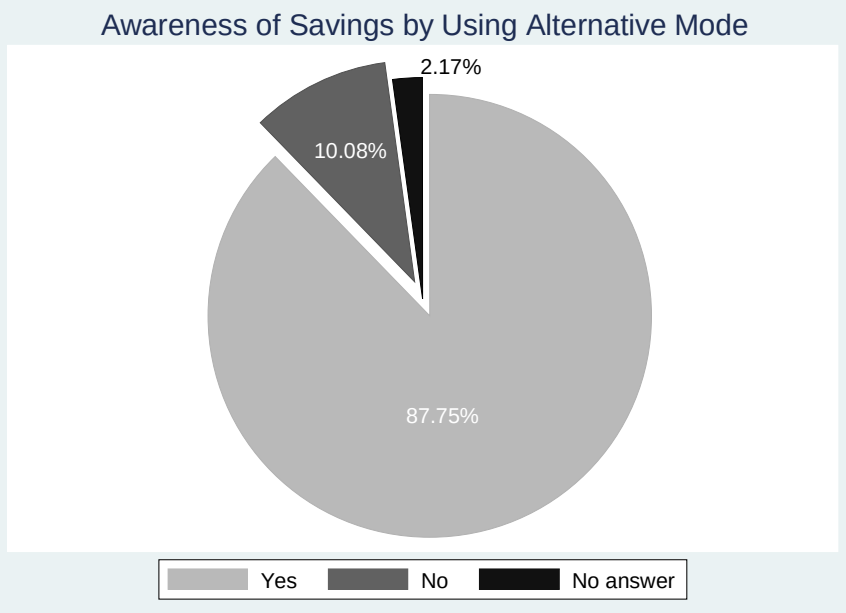


Figure 41: Awareness of Savings by Using Alternative Mode

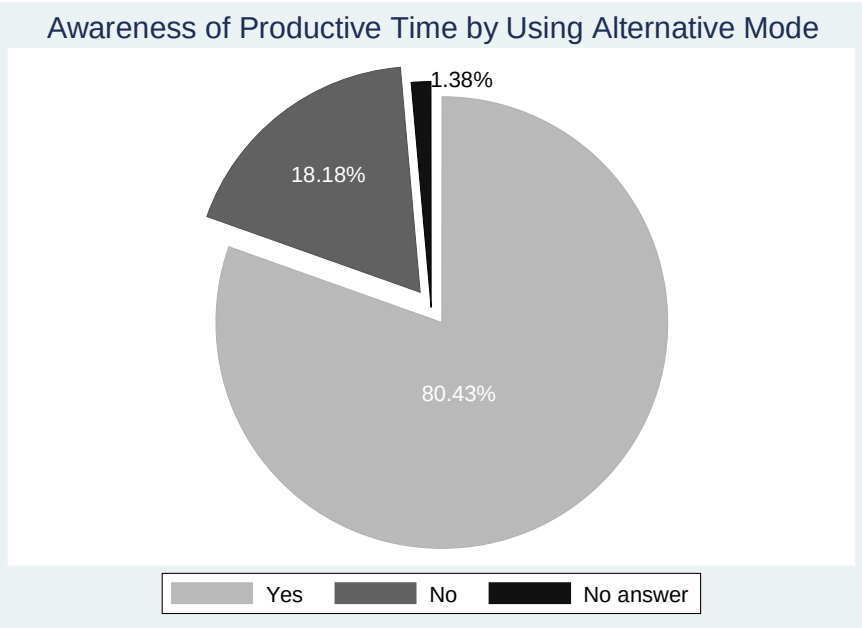


Figure 42: Awareness of Productive Time by Using Alternative Mode

Next factors affecting mode choice and the influence of weather and gas price on mode choice was asked next.

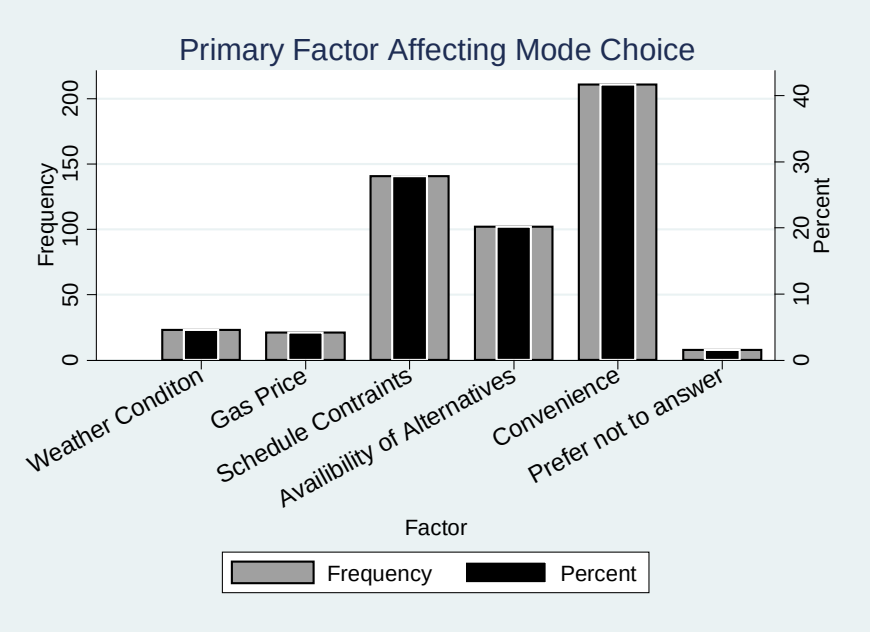


Figure 43: Primary Factor Affecting Mode Choice

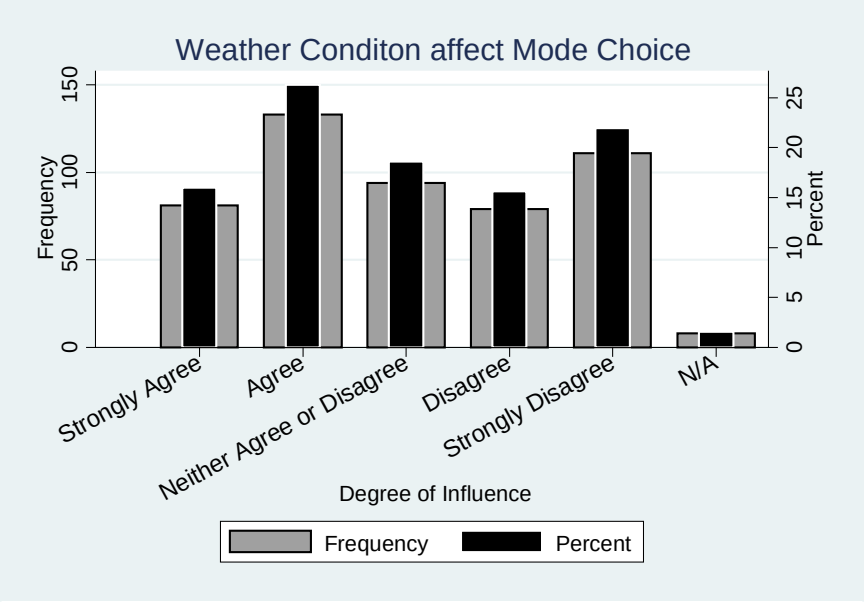


Figure 44: Influence of Current Weather Condition on Commuting

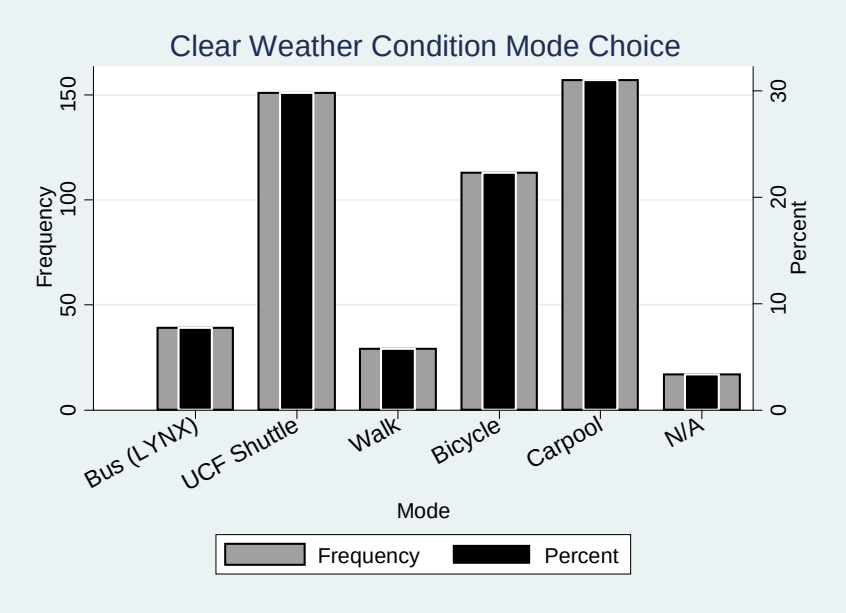


Figure 45: Mode Choice during Clear Weather Conditions

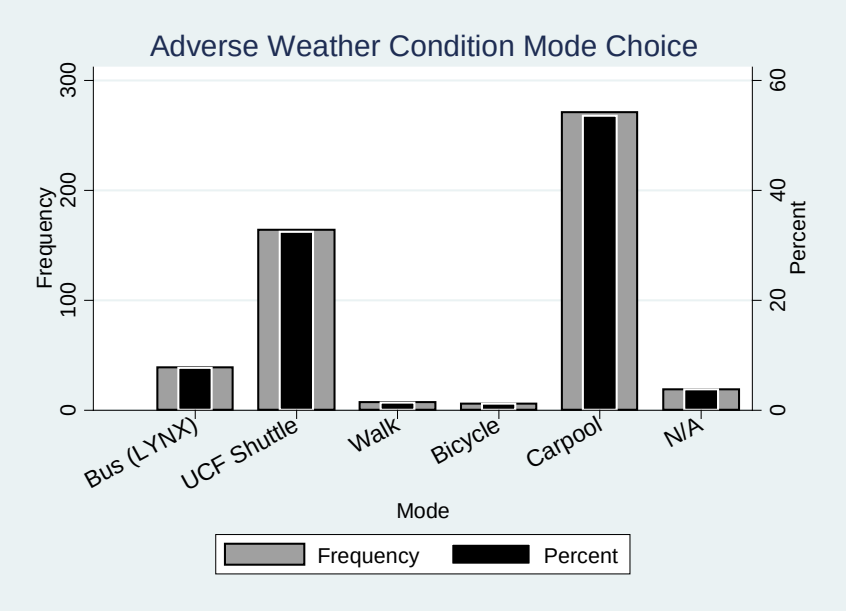


Figure 46: Mode Choice during Adverse Weather Conditions

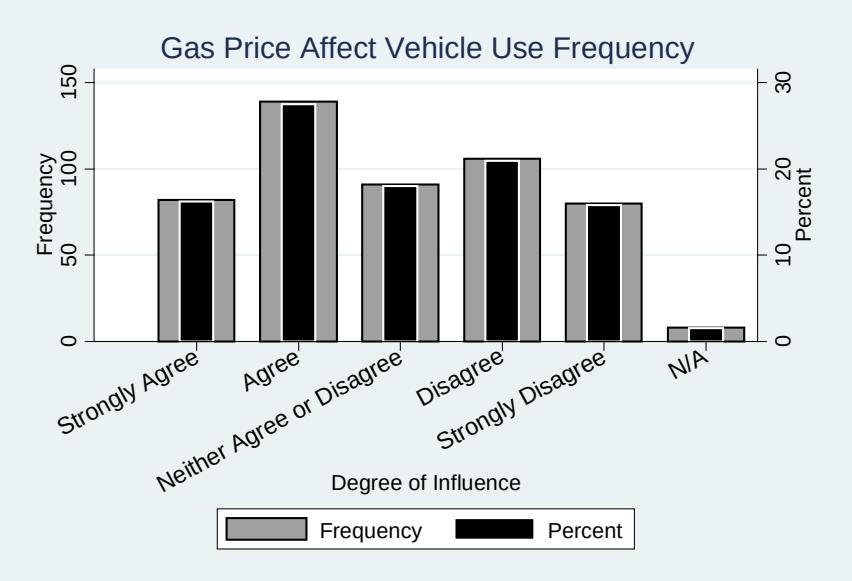


Figure 47: Influence of Gas Price on Vehicle Use Frequency

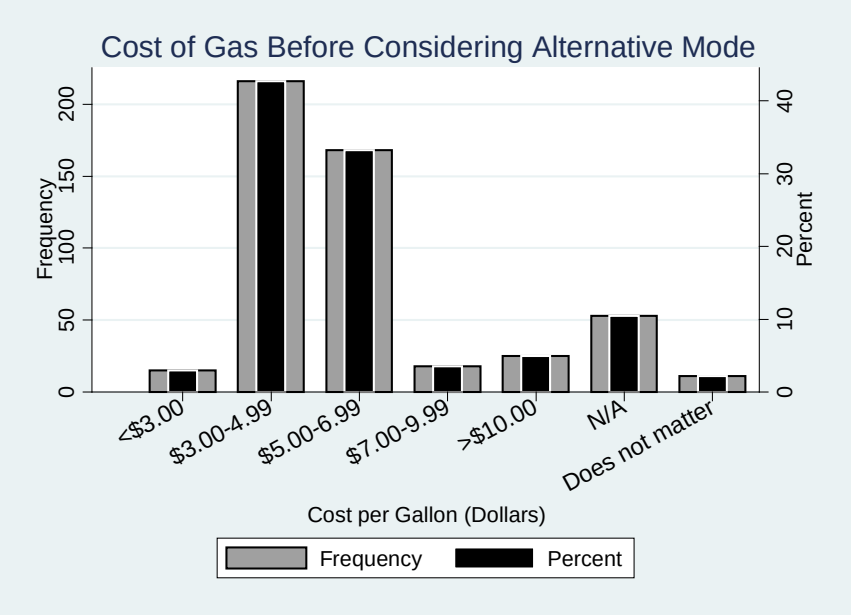


Figure 48: Cost of Gas before Considering Alternative Mode

This set of questions is associated with carpooling to campus and parameters that may influence (positive or negative reinforcement) mode choice as a carpooler.

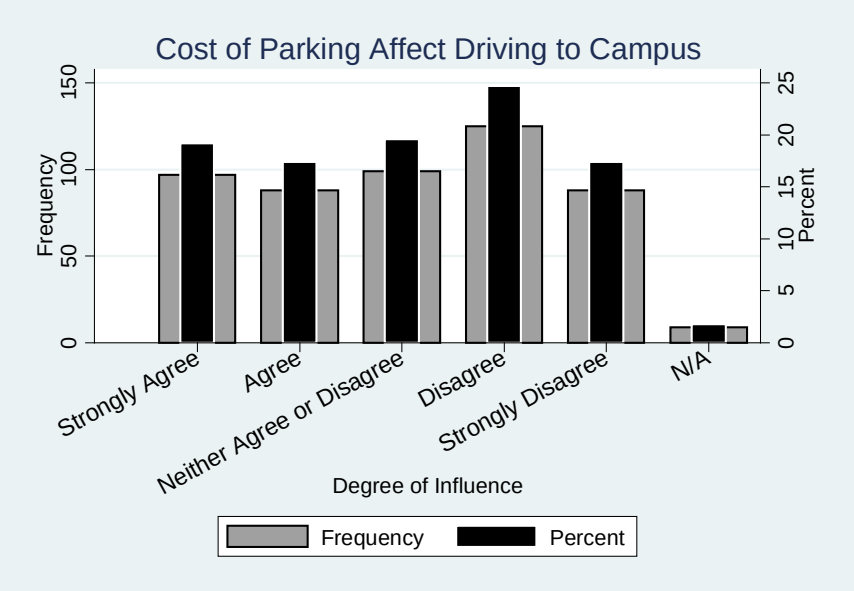


Figure 49: Cost of Parking Affect Driving to Campus

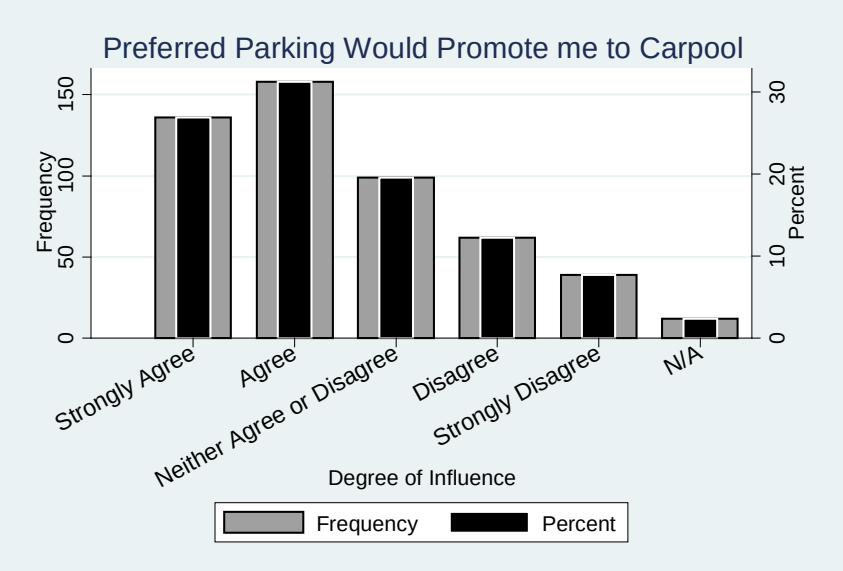


Figure 50: Preferred Parking Would Promote me to Carpool

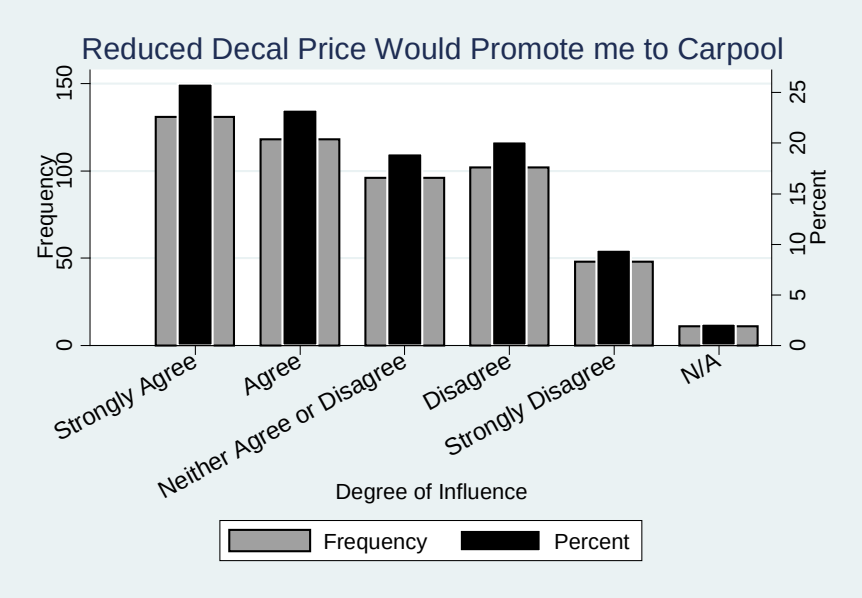


Figure 51: Reduced Decal Price Would Promote me to Carpool

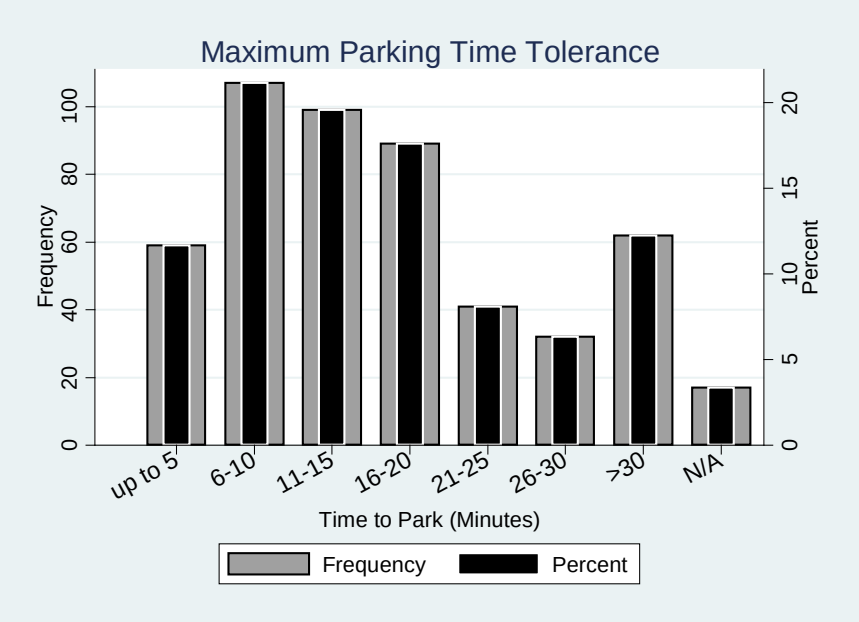


Figure 52: Maximum Parking Time Tolerance before Seeking Alternative Mode

Here information is sought regarding the accessibility of bus—student exclusive service and public—as a mode choice for commuting to campus.

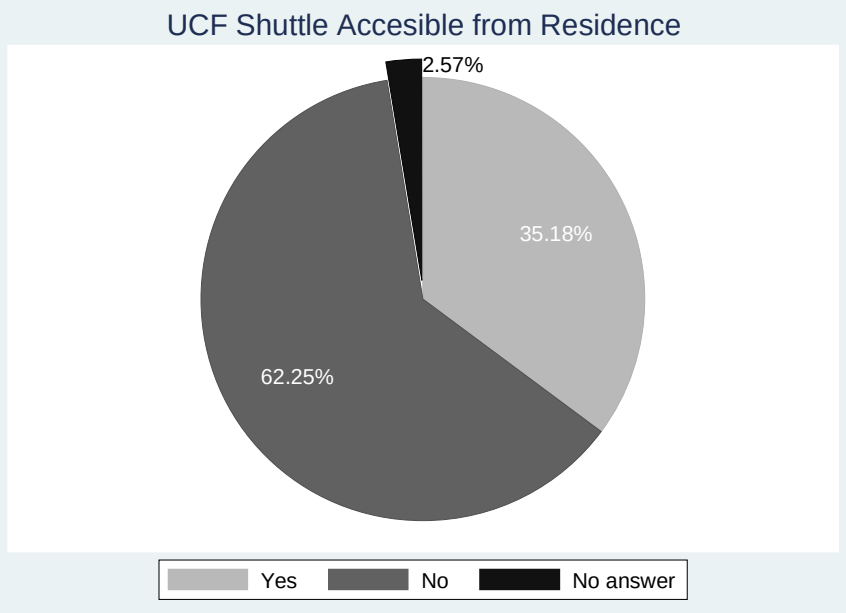


Figure 53: UCF Shuttle Accessible from Residence

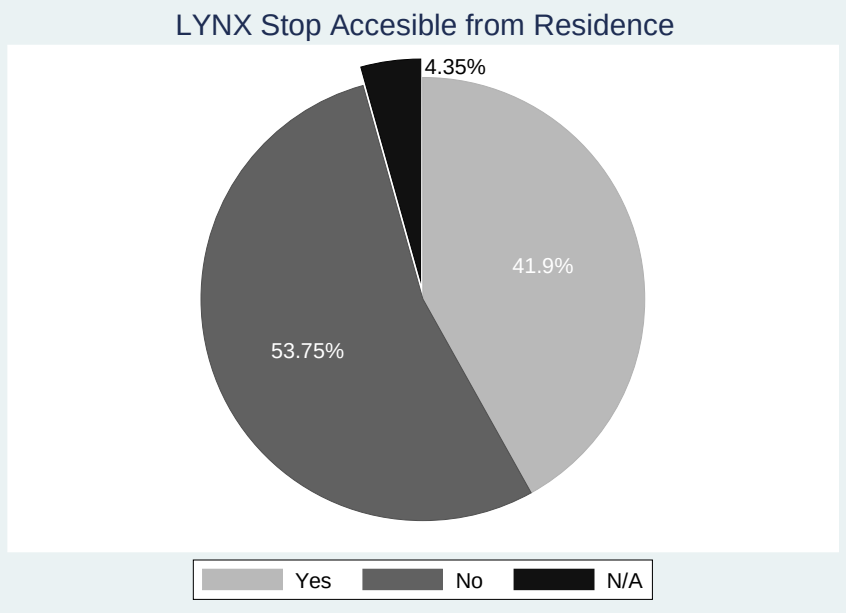


Figure 54: LYNX Stop Accessible from Residence

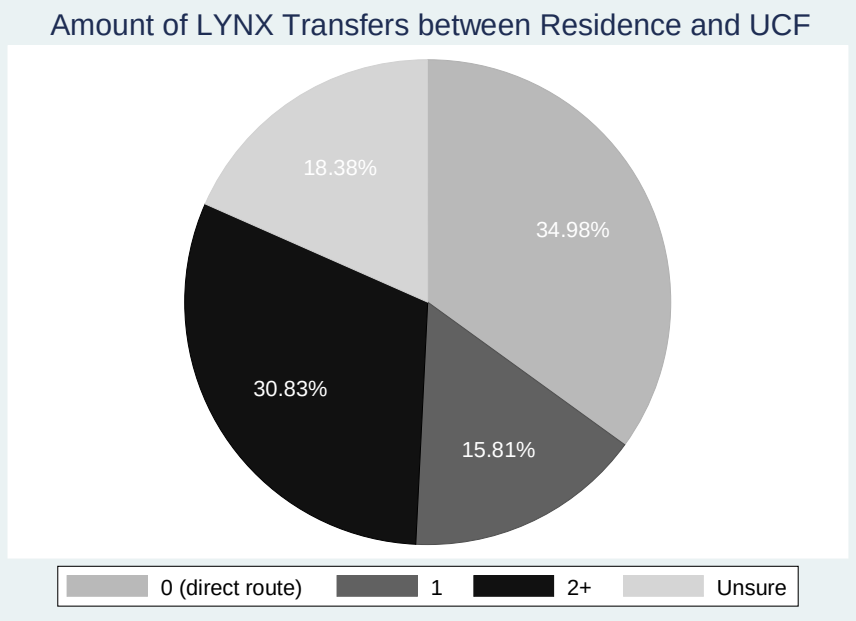


Figure 55: LYNX Transfers between Residence and UCF

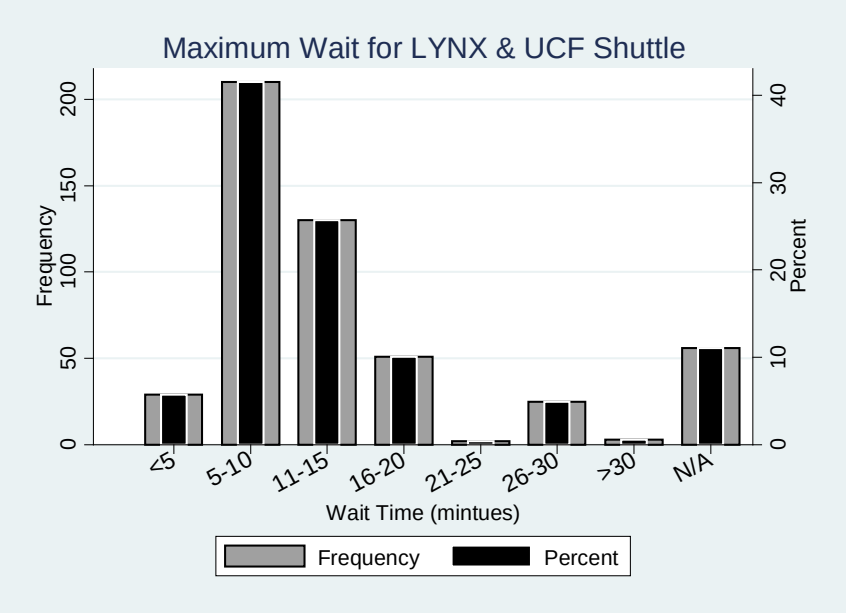


Figure 56: Maximum Wait Time for LYNX and UCF Shuttle

Information regarding carpooling partners and safety is asked next.

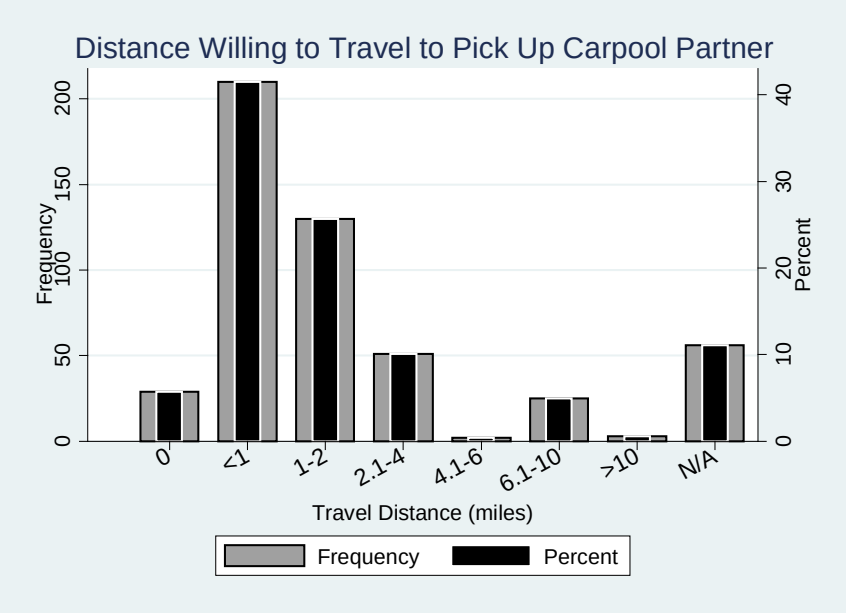


Figure 57: Distance Willing to Travel (off route) to Pick up Carpool Partner

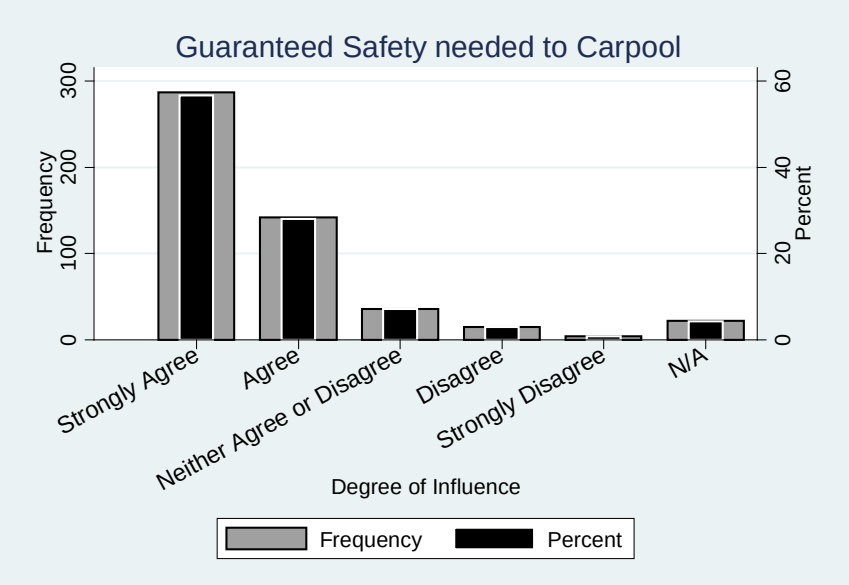


Figure 58: Guaranteed Personal Safety to Carpool

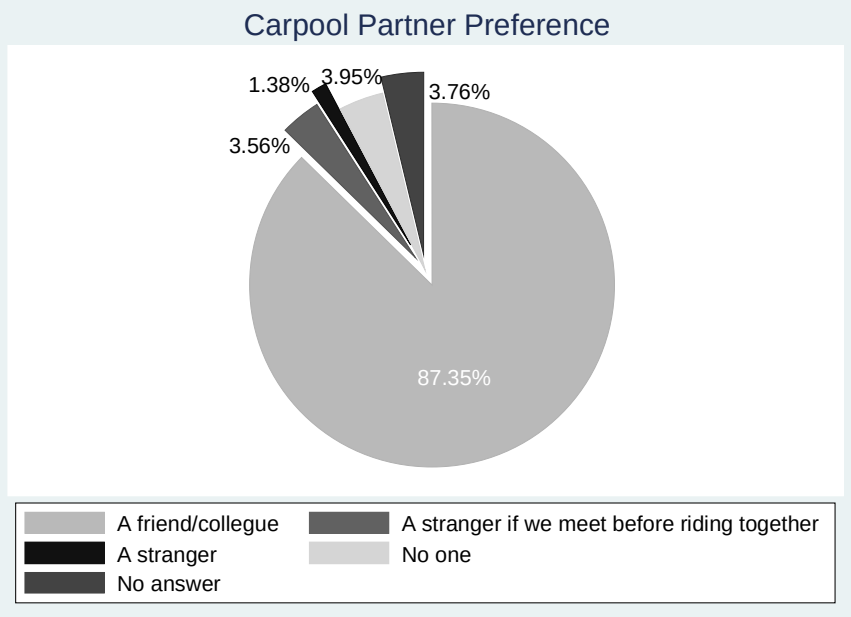


Figure 59: Carpool Partner Preference

Additional questions related to factors influencing individuals to carpool are below.

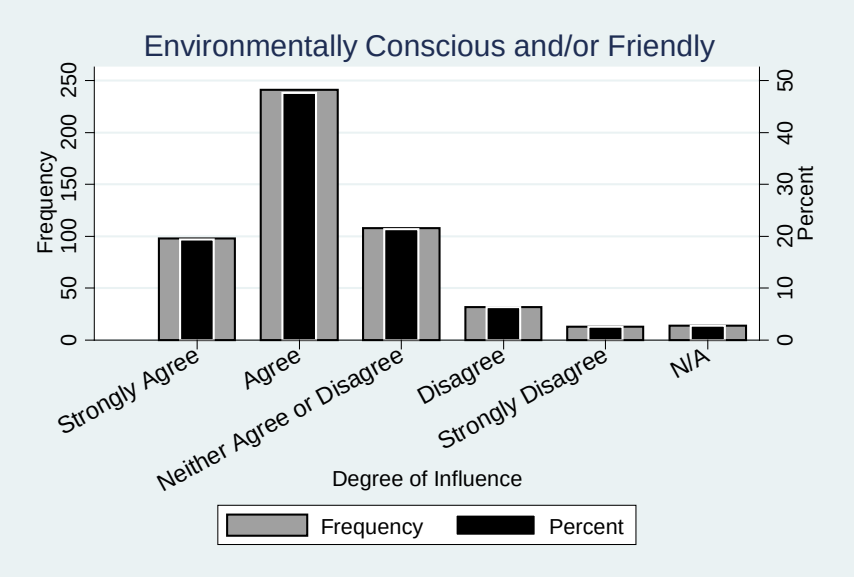


Figure 60: Level of Environmental Consciousness/Awareness

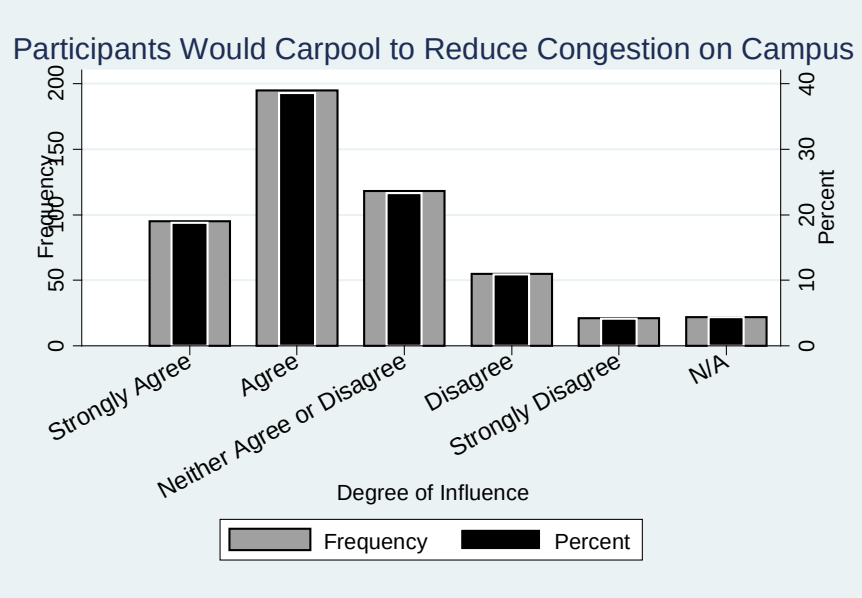


Figure 61: Participants Would Carpool to Campus to Reduce Congestion on Campus

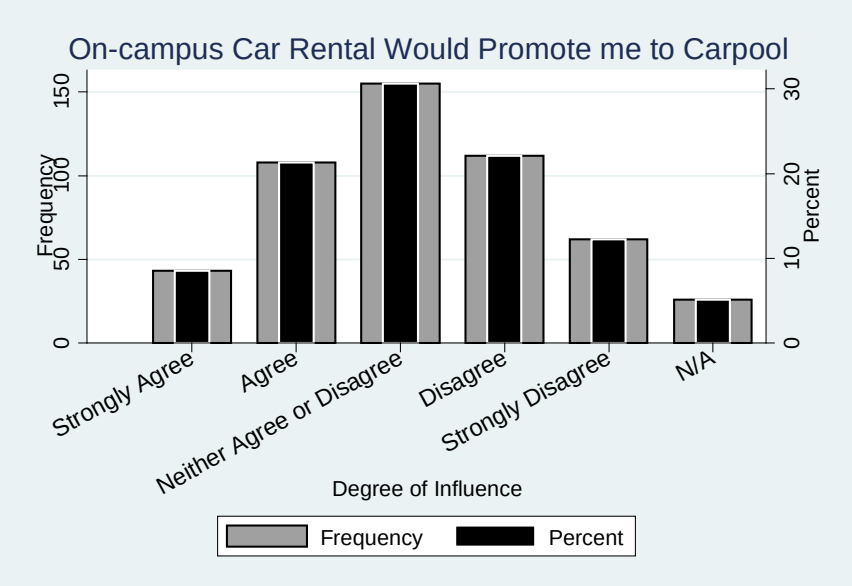


Figure 62: On-campus Car Rental Would Promote me to Carpool

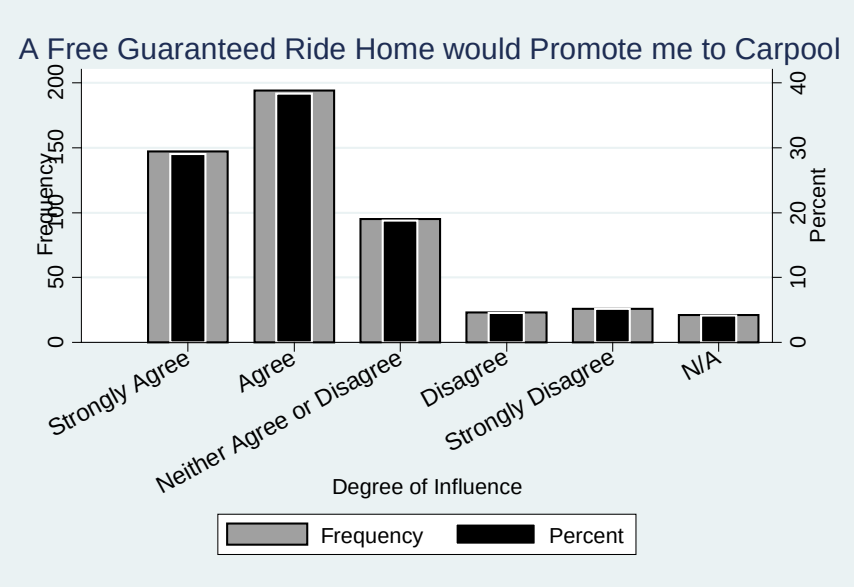


Figure 63: A Free, Guaranteed Ride Home Would Promote me to Carpool

Finally, respondents were asked they have heard of Zimride and whether or they would use it to find a carpool partner.

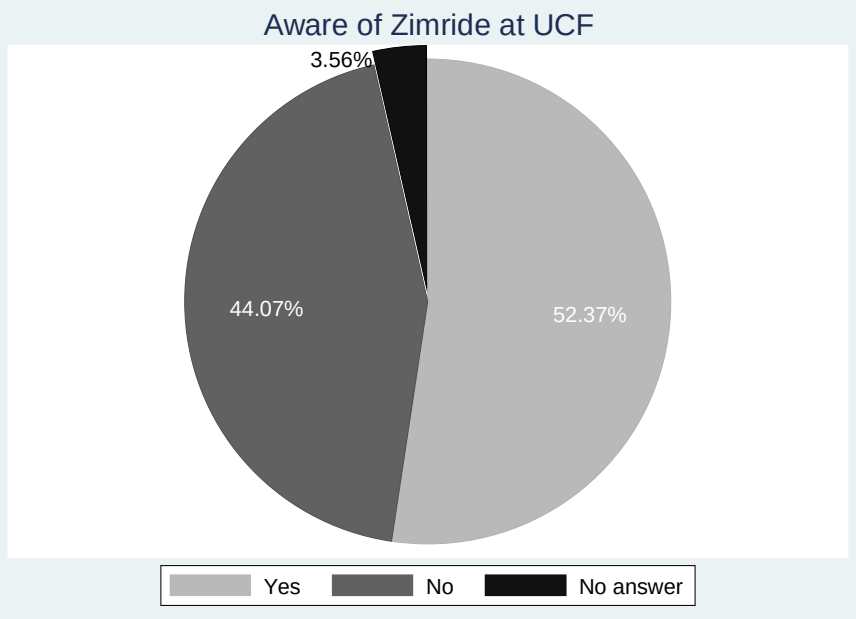


Figure 64: Aware of Zimride at UCF

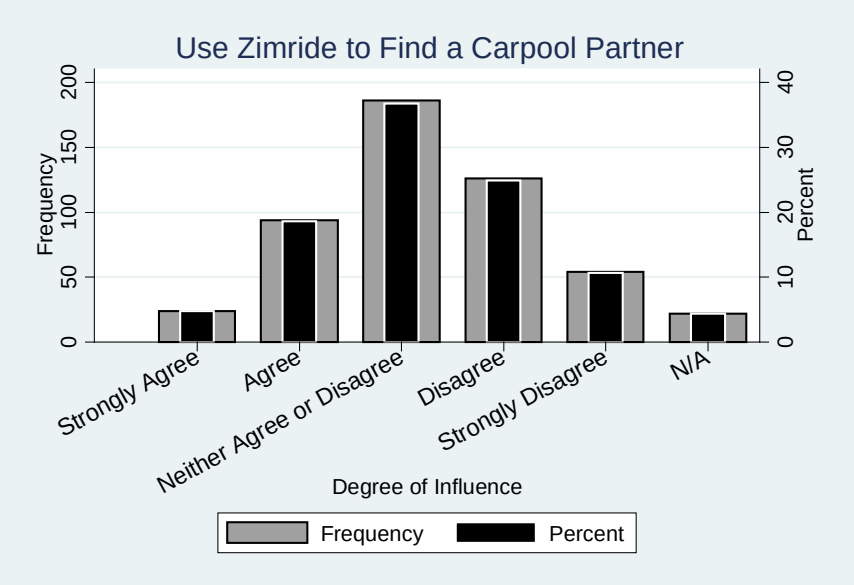


Figure 65: Use Zimride to Find Carpool Partner

CHAPTER FOUR: METHODOLOGY

4.1 Exploratory Factor Analysis

Exploratory factor analysis (EFA) is a statistical method that examines and explores interdependence among observed variables in a data set (96). The goal of factor analysis (FA) is to explain the variance of the observed data in terms of underlying factor (latent variables), which allows the data set to be reduced (97). In order for FA to work correctly, a large sample size is needed. In their text book, Comrey and Lee, state a very good sample size begins with 500 and a minimum of 10 observations per variable is needed (98) (99). The following assumes that the *p* observed variables (the X_i) that have been measured for each of the *n* subjects:

$$X_1 = u_1 + a_{11}F_1 + \cdots a_{1m}F_m + e_1$$

$$X_2 = u_2 + a_{21}F_1 + \cdots a_{2m}F_m + e_2$$

$$\cdots$$

$$X_p = u_p + a_{p1}F_1 + \cdots a_{pm}F_m + e_p \quad (1)$$

The F_j are the *m* common factors, the $e_i$are the *p* specific errors, and the a_{ij} are the factor $p \times m$ factor loadings. The F_j have mean zero and standard deviation one, and are generally assumed to be independent (orthogonal). The e_i terms are also independent while the F_j and e_i are mutually independent of each other. In matrix form this becomes:

$$X_{p\times 1} = A_{p\times m}F_{m\times 1} + e_{p\times 1} \quad (2)$$

Using the standardized score with a mean zero and unit variance the orthogonal factor model

$$X_1 - u_1 = a_{11}F_1 + \cdots a_{1m}F_m + e_1$$

$$X_2 - u_2 = a_{21}F_1 + \cdots a_{2m}F_m + e_2$$

…

$$X_p - u_p = a_{p1}F_1 + \cdots a_{pm}F_m + e_p \quad (3)$$

And the matrix can be written as:

$$X_{p\times 1} = A_{p\times m}F_{m\times 1} + e_{p\times 1} \quad (4)$$

which is equivalent to:

$$\Sigma = AA^T + cov(e) \quad (5)$$

where $\sum_{p\times p}$is the correlation matrix of $X_{p\times l}$. Since the errors are assumed to be independent, $cov(e)$ should be a $p \times p$ diagonal matrix. This implies that:

$$Var(X_i) = \sum_{j=1}^{m} a_{ij}^2 + Var(e_i) \quad (6)$$

The variance of Xcan be split into two parts. Part one is related to the common factors which is called Communality (The sum of X_i's squared factor loadings), part two is unrelated to the common factors which are specificity of X_i.

Below in Figure 64 is an adapted figure from Rietveld et al on the process of using FA as a statistical methodology:

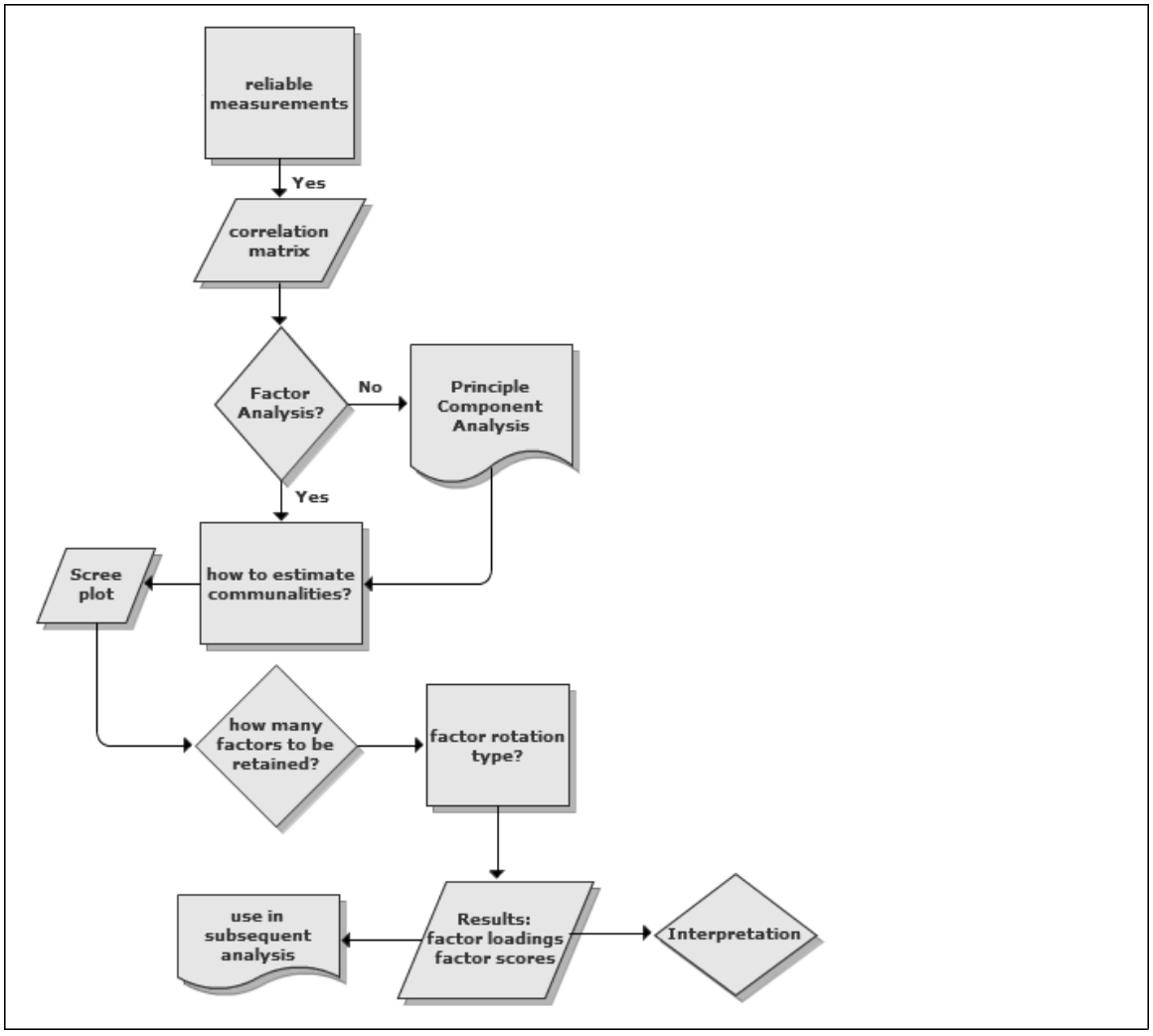


Figure 66: Factory Analysis Overview (100)

4.2 Structural Equation Modeling

Structural Equation Modeling (SEM) is a “comprehensive statistical approach to testing hypotheses about relations among observed and latent variables (101).” SEM is a combination of factor analysis and simultaneous equation models, and includes exogenous or endogenous variables which allows SEM to handle a variety of relationships (102). Advantages of using SEM include the following: (1) ability to deal with intricate relationships among variables, even if those variables are unobserved (latent) or hypothetical; (2) SEM simultaneously estimates all coefficients in the model, allowing for evaluation of significance and strength of individual relationships with respect to the model as a whole; (3) multicollinearity among predictor variables can be accounted for; (4) SEM increases validity of coefficients by eliminating measurement error (102) (103).

To develop SEM, a two-step approach is followed as recommended by Anderson and Gerbing (2008) (104) (105). After conducting the exploratory factor analysis, the first step of SEM—confirmatory factory analysis (CFA)—can be performed. The purpose of CFA is to produce a measurement model which describes the nature of the relationship(s) between observed variables with their respective factors (latent variables). This two-step approach is summarized as the LISREL model as defined by Jöreskog & Sörbom, 1996 and includes the SEM and measurement model(s) (106).The structural equation model takes the general form:

$$\eta = \alpha + B\eta + \Gamma\xi + \zeta \tag{7}$$

where η is a $m \times 1$ vector of endogenous latent variables and where it is assumed that the $m \times 1$vector ξ of exogenous latent variables has mean κ and covariance matrix Φ, and that the $m \times 1$vector ζ of error terms has zero mean and covariance matrix Ψ, and $cov(\xi, \zeta') = 0$. If $I - B \neq 0$, and setting $A = (I - B)^{-1}$, it follows that

$$\mu = A(\alpha + \Gamma\kappa) \tag{8}$$

and

$$Cov(\eta) = A(\Gamma\Phi\Gamma' + \Psi)A'. \tag{9}$$

The measurement model for the *p* endogenous observed variables, represented by the vector y ,and the *q* exogenous observed variables, contained in the vector x , relate the observed (manifest) variables to the underlying factors (latent variables) from which the SEM is developed may be expressed as:

$$y = \tau_y + \Lambda_y \eta + \varepsilon,\ E(\varepsilon) = 0,\ (Cov)\,\varepsilon = \Theta_\varepsilon \tag{10}$$

$$y = \tau_x + \Lambda_x \eta + \delta, E(\delta) = 0, (Cov)\,\delta = \Theta_\delta \tag{11}$$

respectively.

The mean vectors of the observed variables are

$$\mu_y = \tau_y + \Lambda_y A(\alpha + \Gamma\kappa), \mu_x = \tau_x + \Lambda_x\kappa \tag{12}$$

In general, in a single population, τ_y , τ_x , α , and κ will not be identified without the imposition of further conditions. It further follows that

$$\Sigma_y = \Lambda_y\,[A(\Gamma\Phi\Gamma' + \Psi)A']\Lambda'_y + \Theta_\varepsilon \tag{13}$$

$$\Sigma_x = \Lambda_x\Phi\Lambda'_x + \Theta_\delta \tag{14}$$

and

$$\Sigma_{yx} = \Lambda_y A\Gamma\Phi\Lambda'_x. \tag{15}$$

From equations (12) to (15), it follows that the covariance structure for the observed variables of the general LISREL model may be expressed as:

$$\Sigma = Cov\begin{bmatrix} y \\ x \end{bmatrix} = \begin{bmatrix} \Sigma_{yy} & \Sigma_{yx} \\ \Sigma_{xy} & \Sigma_{xx} \end{bmatrix} \tag{16}$$

From (12), the mean structure of the observed variables of the general LISREL model follows as:

$$\mu = E\begin{bmatrix} y \\ x \end{bmatrix} = \begin{bmatrix} \mu_y \\ \mu_x \end{bmatrix}. \tag{17}$$

LISREL fits the mean-and-covariance structure defined in (16) and (17) to the data on the observed variables of the LISREL model. In this regard, LISREL can handle simple random sample data as well as complex survey data which is the case in this research.

CHAPTER FIVE: MODELS AND RESULTS

5.1 Models

After creating a correlation table (located in Appendix B) for all the variables to be used in the model (see Table 4 for variable list and description), the corresponding eigenvalues for each variables' consequent total variance were calculated. As seen in the plot below in Figure 65, eigenvalues are plotted against the number of variables to see where the largest amount of variation in the data exists. As proposed by the first user of the scree test, Cattell, the point on the curve where the eigenvalues start to level off (variance is becoming minimized) is the suggested amount of factors to use in FA (107).

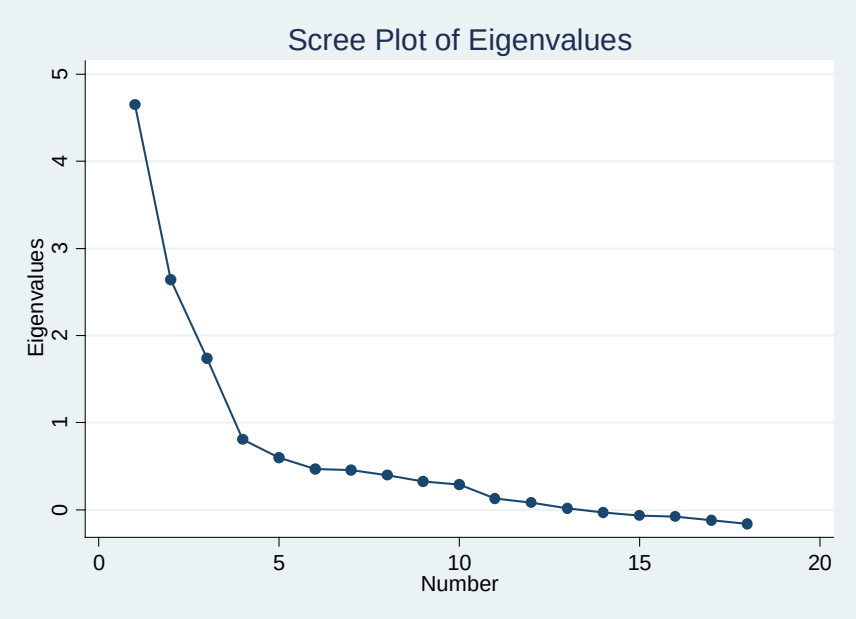


Figure 67: Scree Plot of Eigenvalues

The scree plot indicates 3 factors can summarize all the other variables into latent variables. Once the amount of factors is defined, the factors are then 'loaded' which

simply means the correlation between variables are organized into their respective factor based on correlation among each other. The rotated load factors are generally believed to load on a given factor with a factor load value of 0.4 or greater (108) (109). In Table 3 are the rotated factor loadings:

Table 3: Varimax (Orthogonal) Rotated Factor Loadings

Variable	Factor 1	Factor 2	Factor 3
gas_price_influ	0.4387		
use_zim	0.6606		
circum	0.4907		
congestion	0.6677		
park_cost	0.4606	0.4496	
pref_park	0.6869		
reduce_decal	0.6246		
grh	0.7027		
zipcar	0.6350		
shuttle_access		0.6538	0.5240
primecar		0.8751	
primecommutecar		0.9417	
time_park		0.5455	
age			0.8554
ownauto			0.6276
annual_income			0.7952
grade			0.6046

For variables with factor loadings in two latent variables, the one with higher correlation was used in the structural equation model.

Again, in Table 4 are the descriptions of the variables used in the FA and simple statistics for each.

Table 4: Variable Identification used in SEM

Observed Variables		Description and coding of response		Simple Statistics	
Name	Description	Code	Level	Mean	S.D.
gas_price_influ	Gas price influences frequency of driving	0 →	Strongly Agree	1.9	1.34
		1 →	Agree		
		2 →	Neither Agree or Disagree		
		3 →	Disagree		
		4 →	Strongly Disagree		
use_zim	Use Zimride to find carpool partner	0 →	Strongly Agree	2.2	1.03
		1 →	Agree		
		2 →	Neither Agree or Disagree		
		3 →	Disagree		
		4 →	Strongly Disagree		
circum	Use alternative mode if circumstance was 'right'	0 →	Yes	0.19	0.392
		1 →	No		
congestion	Carpool to reduce congestion on campus	0 →	Yes	1.4	1.06
		1 →	No		
park_cost	Parking cost influences driving to campus	0 →	Strongly Agree	2	1.39
		1 →	Agree		
		2 →	Neither Agree or Disagree		
		3 →	Disagree		
		4 →	Strongly Disagree		
pref_park	Preferred parking would promote carpooling to campus	0 →	Strongly Agree	1.4	1.24
		1 →	Agree		
		2 →	Neither Agree or Disagree		
		3 →	Disagree		
		4 →	Strongly Disagree		
reduce_decal	Reduced decal for carpooling	0 →	Strongly Agree	1.6	1.32

Observed Variables		Description and coding of response		Simple Statistics	
Name	Description	Code	Level	Mean	S.D.
	as incentive to carpool	1 →	Agree		
		2 →	Neither Agree or Disagree		
		3 →	Disagree		
		4 →	Strongly Disagree	1.2	1.07
grh	Free, guaranteed ride home to incentivize carpooling	0 →	Strongly Agree		
		1 →	Agree		
		2 →	Neither Agree or Disagree		
		3 →	Disagree		
		4 →	Strongly Disagree		
zipcar	Zipcar as a supplemental resource to promote carpooling	0 →	Strongly Agree	2.1	1.14
		1 →	Agree		
		2 →	Neither Agree or Disagree		
		3 →	Disagree		
		4 →	Strongly Disagree		
shuttle_access	UCF Shuttle accessible within walking distance of residence	0 →	Yes	0.6	0.481
		1 →	No		
primecar	Primary mode of transportation is a car	0 →	No	0.87	0.337
		1 →	Yes		
primecommutecar	Primary mode of commuting to campus is a car	0 →	No	0.7	0.458
		1 →	Yes		
time_park	Maximum parking time tolerated before seeking additional commute mode	0 →	up to 5 minutes	2.6	1.84
		1 →	6-10 minutes		
		2 →	11-15 minutes		
		3 →	16-20 minutes		
		4 →	21-25 minutes		
		5 →	26-30 minutes		

Observed Variables		Description and coding of response			Simple Statistics	
Name	Description	Code		Level	Mean	S.D.
		6	→	over 30 minutes		
age	Age		→	continuous	22.11	4.63
ownauto	Own vehicle	0	→	Yes	0.45	0.5
		1	→	No		
annual_income	Annual income	0	→	<10,000	0.67	1.54
		1	→	11,000-20,000		
		2	→	21,000-30,000		
		3	→	31,000-40,000		
		4	→	41,000-50,000		
		5	→	51,000-60,000		
		6	→	61,000-70,000		
		7	→	71,000-80,000		
		8	→	81,000-90,000		
		9	→	91,000-100,000		
		10	→	>100,000		
grade	Grade	0	→	Freshman	2.57	1.19
		1	→	Sophomore		
		2	→	Junior		
		3	→	Senior		
		4	→	Master's		
		5	→	PhD		
		6	→	Post Doctorate		
		7	→	Faculty/Staff		

From the measurement model shown in Figure 66 below, the 3 factors first identified from the scree plot are: Attitude towards carpooling (F1), current travel behavior (F2), and demographics (F3); all of which are represented by the elliptical shape. The variables corresponding to the rectangles are the observed variables; the intercept for each variable (inside center), the coefficient (along the endogenous path), the p-value (top left), and standard error (bottom right) are provided. The circles attached are the respective error for each and includes their standard variance.

To interpret the measurement model each latent variable and the corresponding observed variables can be summarized into an equation analogous to that of a regression model, taking the basic form:

$$y = \alpha + \beta x + \varepsilon \tag{18}$$

where y in the dependent variable, α is the is the intercept, β is the slope of the line, and ε is the associated error. In the structural equation model there are several independent (observed) variables contributing to various dependent (latent) variables, therefore providing several equations to explain the model. To visualize the measurement model in equation format, the list of equations below is the subset for F2:

$$y_{10} = 1.324 + 0.57x_{10} + 0.67$$

$$y_{11} = 2.579 + 0.60x_{11} + 0.64$$

$$y_{12} = 1.532 + 0.91x_{12} + 0.18$$

$$y_{13} = 1.391 + 0.39x_{13} + 0.85$$

To elaborate further, Equation 19 depicts observed variable *shuttle_access*. From the measurement model the number coinciding with the exogenous path, 0.57, is the slope of

the fitted line in the equation. The first term in Equation 19 is the coefficient in the model equation; the last term is the error term for the variable.

The structural model developed from the measurement model (confirmatory factor analysis) is not only based on the correlation between observed and latent (factors) variables as seen in the measurement model, but also the relationship between the factors themselves. As seen in Figure 67 below, the SEM shows the relationship between factors. This relationship, once defined, introduces an estimated error term as indicated by ε_1 and ε_{11}. Additionally, because the latent variables have no defined unit of measurement, a non-zero coefficient (usually one) is given to a corresponding observed variable as an indicator or reference variable as a means of standardization (105). Consequently, the loading factor for the indicator variable for each respective factor was constrained to 1 (108) (109). The standardized coefficients for the SEM in Figure 67 are located inside of the rectangle for each observed variable.

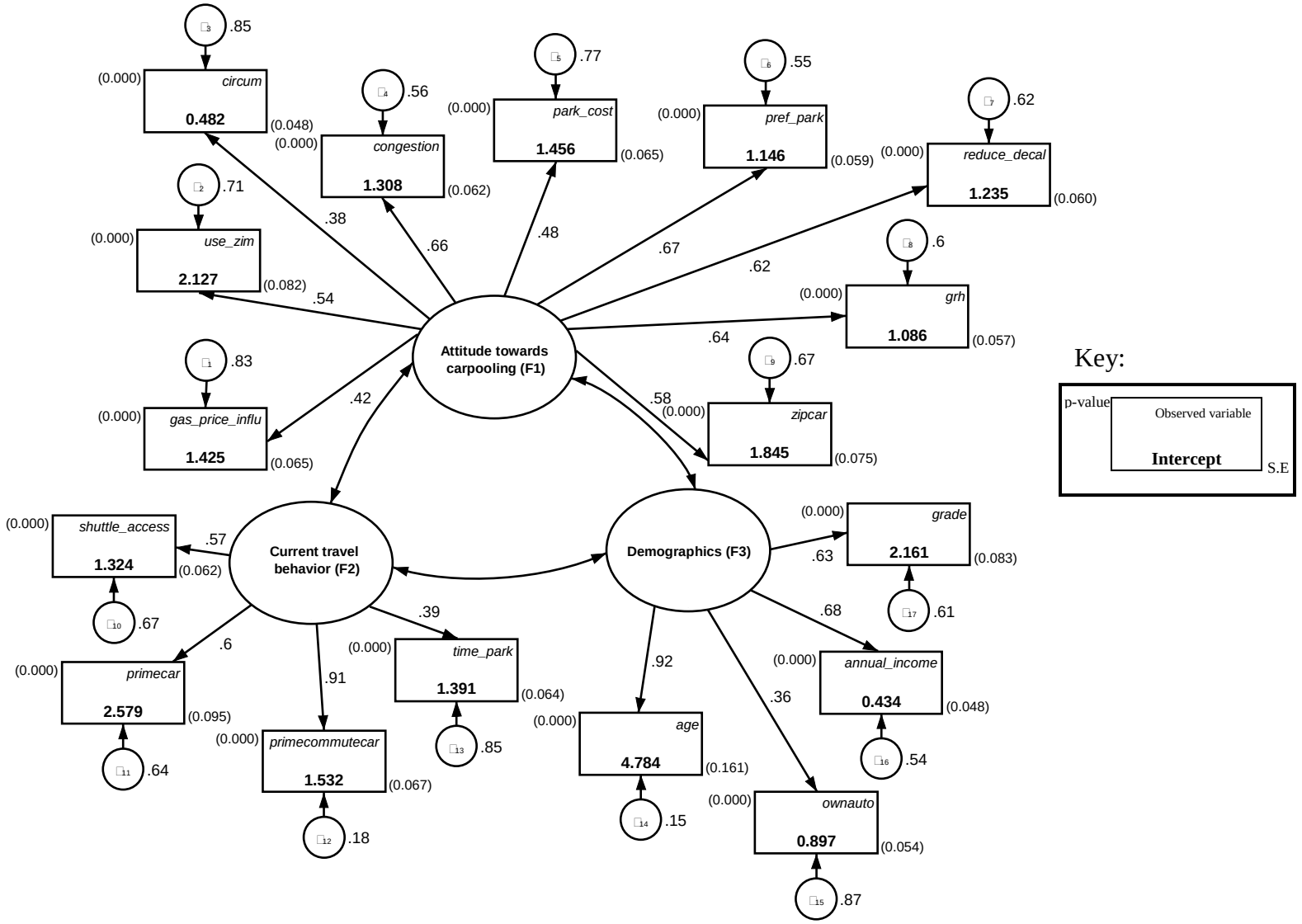


Figure 68: Measurement Model

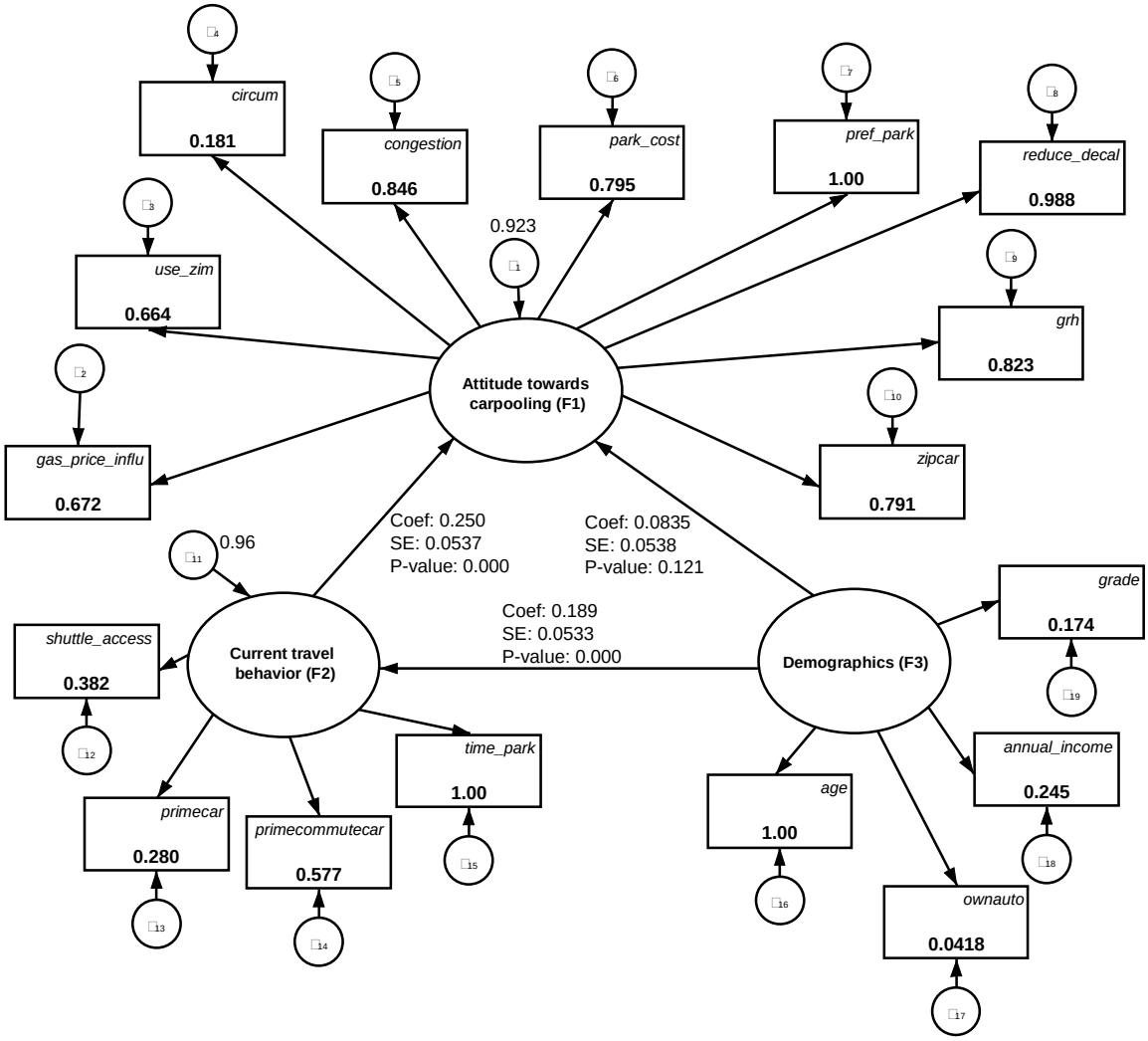


Figure 69: Standardized Structural Equation Model

5.2 Results

As summarized in Table 5, the relationship between each factor is indicated by an individual hypothesis. The SEM reveals that participants' current travel behavior (F2) (i.e., accessibility to UCF shuttle, whether or not a car is the primary mode of transportation or commute mode, and increased time to find parking on campus)

significantly affects the participants' attitude towards carpooling (F1) with a standardized path coefficient (factor loading) of 0.250 and corresponding p-value of 0.00. Furthermore, demographical information (F3) (i.e., increased age, auto ownership, larger income level and higher grade) of participants has significant influence on the current travel behavior (F2) with 0.189 and 0.00 as the loading factor and p-value respectively. However, demographics (F3) did not have a statistically significant effect (at the 95% confidence level) on attitude towards carpooling (F1) although the relationship between F3 and F2 were significant as well as F2 and F1.

Table 5: Verification of SEM Hypotheses

	Hypothesis	Estimate	Standard Error	p-value	Remarks[2]
H_1	Demographics (F3) positively influence current travel behavior (F2)	0.189	0.0533	0.00	Accept
H_2	*Demographics (F3) positively influence attitude towards carpooling (F1)*	*0.0835*	*0.0538*	*0.121*	***Reject***
H_3	Current travel behavior (F2) positively influence attitude towards carpooling (F1)	0.250	0.0537	0.00	Accept

More specifically, to understand how well the model fits the data, various fit indices are used to gain an overall understanding for specific (individual) statistical tests may provide desirable, yet misleading results. The first set of fit statistics is referred to as absolute fit indices and include: Chi-Squared (χ^2), Root Mean Square Error of Approximation (RMSEA), and Standardized Root mean Squared Residual (SRMR). Next incremental fit indices are examined and those used in this analysis include: Comparative

[2] Based on 95% confidence level, p>.05

Fit Index and Non-Normed Fit Index (NNFI)—also known as the Tucker-Lewis Index (110).

The Chi-square test indicates a good fit by a smaller Chi-square with corresponding high (still significant) p-value. However, larger samples tend to increase the value of the Chi-square statistic despite the SEM providing a good fit (111) (108) (112). A Root Mean Square Error of Approximation (RMSEA) range of 0.08 to 0.10 is said to provide a mediocre fit, with values below 0.08 indicating a good fit (113). More recently, RMSEA values closer to 0.06 (114) with a strict upper limit of 0.07 (115) have been considered optimum for model fit. The Standardized Root mean Squared Residual (SRMR) criteria states a value of less than or equal to 0.08 is preferred (114) (116) with 0 indicating a perfect fit (110). The Comparative Fit Index (CFI) ranges from 0.0 to 1.0, with values closer to 1.0 indicative of a good fit and it is preferred to have a minimum of at least 0.95 (114) (110). Lastly, Non-Normed Fit Index (NNFI) also has a range of 0.0 to 1.0 for model acceptance, with 0.80 as a low cutoff and $\geq$0.95 as most desired. With the last two fit indices being close to the accepted criteria, is it important to note the CFI and NNFI tend to worsen with an increased number of variables in the model (117). These results are summarized in Table 6 below:

Table 6: Fit Indices for SEM

Fit Index	Value	Acceptable Criteria
Chi-Squared (χ^2) Test Statistic	514.095	
df	481	
p-value	0.00	<0.05
Root Mean Square Error of Approximation (RMSEA)	0.084	<0.06 - 0.08
Comparative Fit Index (CFI)	0.818	≥0.95
Non-Normed Fit Index (NNFI)	0.787	>0.80 - 0.95
Standardized Root mean Squared Residual (SRMR)	0.071	≤0.08

As seen in Table 6 above, nearly all of the goodness-of-fit tests meet the suggested criteria; thus providing a good-fitting model.

CHAPTER SIX: CONCLUSIONS AND RECOMMENDATIONS

6.1 Conclusions and Observations

Carpooling on a university campus is a simple component of a multimodal transportation system as a means of reducing congestion and SOV use. Therefore, the objective of this thesis is to determine the potential of the current rideshare program, Zimride, and how to increase its usage and effectiveness.

A combination of factor analysis (FA) and structural equation modeling (SEM) was used to analyze the revealed-preference survey data to expose underlying perceptions towards carpooling and factors influencing those perceptions. The benefit of using factor analysis is the data reduction technique involved, allowing for an analysis of useful, relevant information. The advantage of using SEM is the research hypothesis is confirmed and the degree of effectiveness of the parameters is measured by the path coefficients (loading factors); additionally the relationship between observed variables and respective factors, as well as relationships among factors is provided.

The results revealed the most influential factor on participants' attitudes towards carpooling (F1) was their current travel behavior (F2). This outcome suggests the attitude of carpooling among participants can be altered or manipulated by changing the circumstances affecting individuals' current travel behavior; as seen in the SEM these parameters include: shuttle accessibility, whether or not a car is the primary mode of transportation and commuting to campus, and the time it takes to park.

Although demographics (F3) positively influenced attitudes towards carpooling, it was only at about a 90% confidence level (p-value = 0.121). It was also discovered that

demographics significantly influenced current travel behavior. Because demographics are usually independent variables, they cannot be changed to achieve a desired result. One option, although unfeasible, is admitting students to the University based on the observed variables defining demographics in this study: age, auto ownership, annual income and grade.

6.2 Recommendations and Future Research

6.2.1 Recommendations

Carpooling as a mode of transportation for students, faculty, and staff at UCF has the potential to be an effective method of reducing congestion on campus. As found in the literature review, carpool and rideshare programs established at other universities and colleges, even some metropolitan areas too, have measured more success when an incentive of some kind as been offered. Another course of action to promote changing mode choice from SOV is a deterrent such as parking policies or some fashion of congestion pricing to discourage the frequency of SOV use; often though, this is only effective in extreme cases. However, a combination of incentives and deterrents together may improve the appeal of using a carpool program.

Even with about 70% of respondents considering themselves as environmentally conscious and over 80% are aware of savings in money and productive time by using alternative modes, 70% of respondents still use their car to commute to campus. Without a reason to change travel mode choice, empirical evidence (based on first survey) shows the convenience of driving a personal vehicle to campus alone is worth any associated cost, e.g. decal cost, parking time and frustration.

6.2.2 Future Research

To improve the quality of this analysis and ensure non-contradictive data, diagnostic questions can be used to internally screen the responses by verifying the respondents understand the stated-preference scenarios and the series of answers were logical (94). Another enhancement to this research would have been the use of a pilot survey run, or more specifically a focus group. The focus group would consist of a small, randomly selected group of students, faculty and staff who would take the initial survey and essentially provide feedback as to how the survey can be optimized. Although the sample size used is considered good for SEM (98) (99), additional survey distribution methods could have increased the sample size and provide more data for the analysis.

Due to the unawareness of Zimride, lack of market penetration, and incentives to use, evaluating the effectiveness of the program itself would require the aforementioned issues to be resolved first. After the program is in full swing and functioning as a mode of transportation to campus (based on some acceptable criteria), raw data collection—e.g. vehicle occupancy levels, parking turnover rates, incentives used, etc—can take place and be analyzed.

To expand upon this research it is suggested a more comprehensive approach be taken. Although the objective of this study was to evaluate the potential effectiveness of carpooling at UCF, an examination of SOV reduction by various modes and the implementation thereof would provide a more in-depth analysis. Pre and post data collection of a multimodal approach to accessing campus would give insight as to what

reduces SOV usage. Moreover, an annual report by UCF Parking and Transportation Services and/or UCF Office of Sustainability can provide a recurring assessment of UCF's multi-modal accessibility.

APPENDIX A: SURVEYS

A.1 First Survey Results (categorical variables)

Table 7: Summary of Categorical Variables (First Survey)

Question	Variable	Categories	Frequency	Percent
How frustrated are you by the parking situation at UCF?	Frustration	1 (Not frustrating)	20	2.31
		2	59	6.83
		3	143	16.55
		4	307	35.53
		5 (Very frustrating)	335	38.77
What is your gender?	Gender	Female	313	36.23
		Male	551	63.77
How do you support yourself while in school?	Source of Income	Entirely by parents/family	91	10.53
		Entirely by scholarships (merit based)	40	4.63
		Entirely by federal funds (need based, incorporates loans)	38	4.40
		Self-supported (full time job(s))	83	9.61
		Family support & scholarships	277	32.06
		Family support & federal funds	96	11.11
		Scholarships & federal funds	122	14.12
		Self-supported & scholarships/financial aid	58	6.71
		Family & self	18	2.08
		Family, self and combination of financial aid	39	4.51
		Other	2	0.23
What is your yearly income	Yearly	No answer	178	20.60

Question	Variable	Categories	Frequency	Percent
based on resources from above?	Income	0-5000	139	16.09
		5001-15000	262	30.32
		15001-30000	126	14.58
		30001-45000	12	1.39
		45001-60000	10	1.16
		60001-85000	7	0.81
		85001-100000	3	0.35
		>100000	11	1.27
What year in school are you?	Year in School	Freshman	115	13.31
		Sophomore	140	16.20
		Junior	282	32.64
		Senior	272	31.48
		Master's	47	5.44
		PhD	8	0.93
How old are you?	Age	17	3	0.35
		18	56	6.48
		19	138	15.97
		20	177	20.49
		21	224	25.93
		22	150	17.36
		23	89	10.30
		24	17	1.97
		25	3	0.35
		26	1	0.12

Question	Variable	Categories	Frequency	Percent
		>27	5	0.58
What college are you enrolled with?	College	College of Arts and Humanities	83	9.61
		College of Business Administration	110	12.73
		College of Education	57	6.60
		College of Engineering and Computer Science	150	17.36
		College of Health and Public Affairs	111	12.85
		Interdisciplinary Studies	26	3.01
		College of Medicine	50	5.79
		College of Nursing	24	2.78
		College of Optics and Photonics	1	0.12
		Rosen College of Hospitality Management	31	3.59
		College of Sciences	211	24.42
		Undecided/undeclared	10	1.16
How many credit hours are you taking?	Credit Hours	2-4 hours	15	1.74
		5-8 hours	18	2.08
		9-12 hours	328	37.96
		13-15 hours	381	44.10
		16-18 hours	107	12.38
		19+ hours	5	0.58
Do you live on campus?	Live on campus	No	759	87.85
		Apollo	13	1.50
		Nike	15	1.74
		Hercules	8	0.93

Question	Variable	Categories	Frequency	Percent
		Lake Claire	11	1.27
		Libra	23	2.66
		Rosen College Student Apt	3	0.35
		Towers	29	3.36
		Greek Housing	2	0.23
Do you drive to class?	Drive to class	No	152	17.59
		Yes	696	80.56
		N/A	16	1.85
What is your primary mode of transportation?	Primary Mode	Walking	35	4.05
		Bike	5	0.58
		Motorcycle	4	0.46
		Car	806	93.29
		Public Transit (LYNX)	4	0.46
		Taxi	0	0.00
		Skateboard	6	0.69
		UCF Shuttle	4	0.46
How often do you use your car per week?	Car use frequency	Don't have one	18	2.08
		1 day	18	2.08
		2-3 days	117	13.54
		4-5 days	186	21.53
		6-7 days	525	60.76
How do you primarily commute to campus?	Commute to campus	Walking	34	3.94
		Bike	19	2.20
		Motorcycle	4	0.46

Question	Variable	Categories	Frequency	Percent
		Car	673	77.89
		Public Transit (LYNX)	3	0.35
		UCF Shuttle	75	8.68
		Live on campus	56	6.48
On average, how long does it take for you to find a parking space on campus?	Time to park	Less than 2 minutes	63	7.29
		2-5 minutes	96	11.11
		6-10 minutes	158	18.29
		11-15 minutes	191	22.11
		16-20 minutes	157	18.17
		21-25 minutes	74	8.56
		26-30 minutes	98	11.34
		over 30 minutes	27	3.13
		I don't drive a car to campus	0	0.00
Do you drive to campus more than one time per day?	Trip per day	No	656	75.93
		Yes	206	23.84
To reduce congestion on campus, would you consider sharing a ride (carpooling)?	Consider carpool	No	345	39.93
		Yes	519	60.07
Have you heard of or are aware of Zimride, UCF's exclusive ride matching system?	Aware of Zimride	No	474	54.86
		Yes	390	45.14
Have you registered with UCF Zimride?	Registered with Zimride	No	779	90.16
		Yes	85	9.84

Question	Variable	Categories	Frequency	Percent
Have you posted a ride on the system?	Posted a ride	No	824	95.37
		Yes	40	4.63
Have you shared a ride through this system?	Shared a ride	I have not shared a ride using this system	855	98.96
		Driver	4	0.46
		Passenger	2	0.23
		Both	3	0.35
If so, how often?	Freq	N/A	853	98.73
		Daily	0	0.00
		1 day/week	0	0.00
		2 days/week	1	0.12
		3 days/week	5	0.58
		4 days/week	0	0.00
		Single trip (non-commuting)	5	0.58

A.2 UCF Driver Choice Survey

To understand driver choices made by those commuting daily to the University of Central Florida, a research study is being conducted to determine which travel modes need to be improved in effort to reduce the amount of single occupancy vehicles on campus and relieve the ever increasing parking demand. By participating in this survey you can contribute to identifying ways to improve alternative modes and how to get more people to use them. This anonymous survey should take approximately 15 minutes to complete. The answers you provide will be used to model choices made by UCF students when commuting to campus.

You are being invited to take part in a research study. Whether you take part is up to you. We appreciate your time and assistance. You must be 18 years of age or older to participate.

If you have questions, concerns, or complaints, please contact Joe DeFrancisco either email or phone: joseph.defrancisco@knights.ucf.edu or [redacted] or Dr. Essam Radwan, faculty supervisor, at [redacted] or e-mail Ahmed.Radwan@ucf.edu .

IRB contact about your rights in the study or to report a complaint: Research at the University of Central Florida involving human participants is carried out under the oversight of the Institutional Review Board (UCF IRB). This research has been reviewed and approved by the IRB. For information about the rights of people who take part in

research, please contact: Institutional Review Board, University of Central Florida, Office of Research & Commercialization, 12201 Research Parkway, Suite 501, Orlando, FL 32826-3246 or by telephone at (407) 823-2901. Refer to IRB number SBE-11-0781.

Please choose the appropriate answer for each question. Write in the answer where necessary.

1) Are you a student at UCF?

   0 Yes

   1 No

   2 Other:

2) If student, what grade are you currently in?

   0 Freshman

   1 Sophomore

   2 Junior

   3 Senior

   4 Master's

   5 PhD

   6 Post doctorate

   7 N/A

3) If not a student, what is your role at UCF?

0 Part-time staff

1 Full-time staff

2 Adjunct Professor

3 Assistant Professor

4 Associate Professor

5 Full Professor

6 Chair, Dean, Vice President

7 N/A

8 Other:

4) What is your gender?

0 Male

1 Female

2 Prefer not to answer

5) How old are you?

0 16-18

1 19

2 20

3 21

4 22

5 23

6 24

7 25-35

8 36-52

9 Prefer not to answer

6) What is your race?

0 Caucasian

1 Black/African American

2 Hispanic/Latino

3 Asian

4 Native Hawaiian/Other Pacific Islander

5 American Indian/Alaska Native

6 Mixed (2 or more races)

7 Prefer not to answer

8 Other:

7) What is your citizenship status?

0 US Citizen

1 Non-Citizen, Resident

2 Non-Citizen, Student Visa

3 Prefer not to answer

8) What is your annual income level?

0 <10,000

1 11,000-20,000

2 21,000-30,000

3 31,000-40,000

4 41,000-50,000

5 51,000-60,000

6 61,000-70,000

7 71,000-80,000

8 81,000-90,000

9 91,000-100,000

10 >100,000

11 N/A

9) What is your source of income?

0 Financial Aid (loans, scholarships, grants, fellowships, etc)

1 Part-time work & financial aid

2 Entirely by family

3 By family & financial aid

4 Self supported (full/part-time work, personal savings)

5 Self & family

10) If a student, what is your parent's income level?

0 <10,000

1 11,000-20,000

2 21,000-30,000

3 31,000-40,000

4 41,000-50,000

5 51,000-60,000

6 61,000-70,000

7 71,000-80,000

8 81,000-90,000

9 91,000-100,000

10 >100,000

11 N/A

12 Prefer not to answer

11) Do your parents claim you on their taxes as a dependent?

If you file taxes of your own, answer No.

0 Yes

1 No

2 N/A

12) What is your primary mode of transportation?

0 Car

1 Bus (LYNX)

2 UCF Shuttle

3 Walk

4 Bicycle

5 Motorcycle/Scooter

6 Carpool

13) If you drive a vehicle, how often do you use it per week?

Provide frequency of car use

0 1 day

1 2 days

2 3 days

3 4 days

4 5 days

5 6 days

6 7 days

7 I do not have a car

8 N/A

14) Describe your automobile ownership

This includes car, motorcycle/scooter

0 Owned by parents

1 Owned by self

2 Parents making payments

3 You make payments

4 Parents lease

5 You lease

6 I do not have a car, motorcycle or scooter

15) Do you currently use an alternative mode of transportation?

0 Bus (LYNX)

1 UCF Shuttle

2 Walk

3 Bicycle

4 Motorcycle/Scooter

5 Carpool

6 No

7 N/A

16) How often do you use this alternative mode?

Provide frequency of alternative transportation use

0 1 day

1 2 days

2 3 days

3 4 days

4 5 days

5 6 days

6 7 days

7 N/A

17) Do you live on campus?

0 Yes

1 No

2 N/A

18) How far from campus do you live (driving distance)?

Enter 0 if you live on campus, otherwise provide mileage

0 0-2 miles

1 2.1-5 miles

2 5.1-8 miles

3 8.1-11 miles

4 11.1-14 miles

5 14.1-20 miles

6 20.1-30 miles

7 >30 miles

8 N/A

19) What is your primary means of commuting to campus?

0 Car

1 Bus (LYNX)

2 UCF Shuttle

3 Walk

4 Bicycle

5 Motorcycle/Scooter

6 Carpool

7 I live on campus

8 N/A

20) How often do you use this mode per week?

0 1 day

1 2 days

2 3 days

3 4 days

4 5 days

5 6 days

6 7 days

7 N/A

21) What is your secondary or additional means of commuting to campus?

0 Car

1 Bus (LYNX)

2 UCF Shuttle

3 Walk

4 Bicycle

5 Motorcycle/Scooter

6 Carpool

7 I live on campus

8 N/A

22) How often do you use this mode per week?

0 1 day

1 2 days

2 3 days

3 4 days

4 5 days

5 6 days

6 7 days

7 N/A

23) Would you consider using an alternative mode to campus if the circumstance was 'right'? e.g. high gas price, increased parking cost, reduced/limited parking spaces, increased travel time (more congestion)

0 Yes

1 No

2 N/A

24) Are you aware of the potential savings in money that using alternative modes can provide?

0 Yes

1 No

2 N/A

25) Are you aware of the increase in productive time that using alternative modes can provide? e.g. studying as a passenger, doing makeup, cell phone use (texting/internet), etc

0 Yes

1 No

2 N/A

26) What factor primarily affects which mode of transportation you choose?

0 Weather Condition

1 Gas Price

2 Schedule Constraints

3 Availability of Alternatives

4 Convenience

5 Prefer not to answer

27) The current weather condition is included when choosing my travel mode

Choose the response that describes how you feel

0 Strongly Agree

1 Agree

2 Neither Agree or Disagree

3 Disagree

4 Strongly Disagree

5 N/A

28) If I were to choose an alternative mode in clear weather conditions, it would be:

0 Bus (LYNX)

1 UCF Shuttle

2 Walk

3 Bicycle

4 Carpool

5 N/A

29) If I were to choose an alternative mode in adverse (heavy rain, cold temperatures) weather conditions, it would be:

0 Bus (LYNX)

1 UCF Shuttle

2 Walk

3 Bicycle

4 Carpool

5 N/A

30) The price of gas affects how often you choose to drive your car

Choose the response that describes how you feel

0 Strongly Agree

1 Agree

2 Neither Agree or Disagree

3 Disagree

4 Strongly Disagree

5 N/A

31) How expensive will gas need to be for you to consider an alternative mode of transportation than your car?

Provide answer in unit cost (price/gallon), x.xx

0 Less than $3.00/gallon

1 $3.00-4.99/gallon

2 $5.00-6.99/gallon

3 $7.00-9.99/gallon

4 Greater than $10.00/gallon

5 N/A

6 Does not matter

32) The cost of parking affects your choice to drive to campus

Choose the response that describes how you feel

0 Strongly Agree

1 Agree

2 Neither Agree or Disagree

3 Disagree

4 Strongly Disagree

5 N/A

33) Preferred/guaranteed parking would promote me to carpool

Choose the response that describes how you feel

0 Strongly Agree

1 Agree

2 Neither Agree or Disagree

3 Disagree

4 Strongly Disagree

5 N/A

34) Reduced decal price would promote me to carpool

Choose the response that describes how you feel

0 Strongly Agree

1 Agree

2 Neither Agree or Disagree

3 Disagree

4 Strongly Disagree

5 N/A

~~35) How much are you willing to pay to park on campus before seeking another transportation mode?~~

Provide maximum price of decal you would pay, xxx.xx

36) What is the amount of time you will tolerate to find a parking space on campus before using another means of transportation?

0 up to 5 minutes

1 6-10 minutes

2 11-15 minutes

3 16-20 minutes

4 21-25 minutes

5 26-30 minutes

6 over 30 minutes

7 N/A

37) I consider myself environmentally conscious/friendly?

Choices you make show some initiative of preserving the planet

0 Strongly Agree

1 Agree

2 Neither Agree or Disagree

3 Disagree

4 Strongly Disagree

5 N/A

38) Is a UCF shuttle accessible within walking distance from your residence?

The shuttle stop does not have to be located in your complex, but a convenient distance away (less than 1/4 mile)

0 Yes

1 No

2 N/A

39) Is a LYNX stop accessible within walking distance from your residence?

A walking distance away (less than 1/4 mile), http://trip1.golynx.com/tripplanner/

0 Yes

1 No

2 N/A

40) How many transfers are there between your residence and UCF if using LYNX?

Use this for trip details: http://trip1.golynx.com/tripplanner/

0 0 (direct route)

1 1

2 2+

3 Unsure/don’t care

41) How long would you be willing to wait for a bus if you were to take one? Either UCF shuttle or LYNX. Assume stop location is convenient distance away (1/4 mile or less)

Provide answer in minutes

0 Less than 5 minutes

1 5-10 minutes

2 11-15 minutes

3 16-20 minutes

4 21-25 minutes

5 26-30 minutes

6 More than 30 minutes

7 N/A

42) How far would you travel off of your route to pick up a carpool partner?

Provide distance in miles

0 0 miles, I would not go out of my way

1 Less than 1 mile

2 1-2 miles

3 2.1-4 miles

4 4.1-6 miles

5 6.1-10 miles

6 More than 10 miles

7 N/A

43) I would carpool to campus if it helped reduce congestion on campus

Choose the response that describes how you feel

0 Strongly Agree

1 Agree

2 Neither Agree or Disagree

3 Disagree

4 Strongly Disagree

5 N/A

44) My safety must be guaranteed in order to carpool

Choose the response that describes how you feel

0 Strongly Agree

1 Agree

2 Neither Agree or Disagree

3 Disagree

4 Strongly Disagree

5 N/A

45) I would feel most comfortable carpooling with

0 A friend/acquaintance/co-worker

1 Someone I don't know if we meet before riding together

2 A stranger

3 No one

4 Prefer not to answer

46) I would carpool if I could rent a car on-campus to leave when needed (car-sharing: http://www.zipcar.com/universities/)

Choose the response that describes how you feel

0 Strongly Agree

1 Agree

2 Neither Agree or Disagree

3 Disagree

4 Strongly Disagree

5 N/A

47) A free, guaranteed ride home if my carpool partner(s) abandoned me would allow me to carpool

Choose the response that describes how you feel

0 Strongly Agree

1 Agree

2 Neither Agree or Disagree

3 Disagree

4 Strongly Disagree

5 N/A

48) Are you aware of UCF's carpool program, Zimride? (http://zimride.ucf.edu/)

0 Yes

1 No

2 N/A

49) I would use Zimride to find a carpool partner to share a ride to UCF

Choose the response that describes how you feel

0 Strongly Agree

1 Agree

2 Neither Agree or Disagree

3 Disagree

4 Strongly Disagree

5 N/A

A.2.1 Second Survey Results (categorical variables)

Table 8: Summary of Categorical Variables (Second Survey)

Question	Variable	Categories	Frequency	Percent
Are you a student at UCF?	student	Yes	495	97.83
		No	11	2.17
		Other:		
If student, what grade are you currently in?	grade	Freshman	12	2.37
		Sophomore	77	15.22
		Junior	138	27.27
		Senior	212	41.90
		Master's	40	7.91
		PhD	17	3.36
		Post Doctorate	0	0.00
		N/A	10	1.98
If not a student, what is your role at UCF?	not student role	Part-time staff	4	0.79
		Full-time staff	21	4.15
		Adjunct Professor	4	0.79
		Assistant Professor	1	0.20
		Associate Professor	2	0.40
		Full Professor	0	0.00
		Chair, Dean, Vice President	0	0.00
		N/A	474	93.68

Question	Variable	Categories	Frequency	Percent
		Other:	0	0.00
What is your gender?	gender	Male	222	43.87
		Female	282	55.73
		Prefer not to answer	2	0.40
How old are you?	age	18 and under	17	3.36
		19	71	14.03
		20	104	20.55
		21	102	20.16
		22	80	15.81
		23	55	10.87
		24	26	5.14
		25-35	27	5.34
		36-52	18	3.56
		Prefer not to answer	6	1.19
What is your race?	race	Caucasian	350	69.17
		Black/African American	33	6.52
		Hispanic/Latino	75	14.82
		Asian	29	5.73
		Native Hawaiian/Other Pacific Inslander	2	0.40
		American Indian/Alaska Native	1	0.20
		Mixed (2 or more races)	5	0.99
		Prefer not to answer	9	1.78
		Other:	2	0.40
What is your citizenship status?	citizen	US Citizen	472	93.28
		Non-Citizen, Resident	13	2.57

Question	Variable	Categories	Frequency	Percent
		Non-Citizen, Student Visa	15	2.96
		Prefer not to answer	6	1.19
What is your annual income level?	annual income	<10,000	339	67.00
		11,000-20,000	91	17.98
		21,000-30,000	25	4.94
		31,000-40,000	12	2.37
		41,000-50,000	6	1.19
		51,000-60,000	4	0.79
		61,000-70,000	5	0.99
		71,000-80,000	4	0.79
		81,000-90,000	4	0.79
		91,000-100,000	3	0.59
		>100,000	13	2.57
What is source of income?	income source	Financial Aid (loans,scholarships, grants, fellowships, etc)	97	19.17
		Part-time work & financial aid	151	29.84
		Entirely by family	23	4.55
		By family & financial aid	98	19.37
		Self supported (full/part-time work, personal savings)	59	11.66
		Self & family	78	15.42
If a student, what is your parent's income level?	parent income	<10,000	15	2.96
		11,000-20,000	21	4.15
		21,000-30,000	33	6.52
		31,000-40,000	29	5.73
		41,000-50,000	45	8.89

Question	Variable	Categories	Frequency	Percent
		51,000-60,000	35	6.92
		61,000-70,000	28	5.53
		71,000-80,000	113	22.33
		81,000-90,000	37	7.31
		91,000-100,000	40	7.91
		>100,000	93	18.38
		N/A	0	0.00
		Prefer not to answer	17	3.36
Do your parents claim you on their taxes as a dependent?	tax depend	Yes	358	70.75
		No	121	23.91
		N/A	27	5.34
What is your primary mode of transportation?	primary mode	Car	441	87.15
		Bus (LYNX)	1	0.20
		UCF Shuttle	31	6.13
		Walk	8	1.58
		Bicycle	19	3.75
		Motorcycle/Scooter	2	0.40
		Carpool	4	0.79
If you drive a vehicle, how often do you use it per week?	veh use freq	1 day	15	2.96
		2 days	21	4.15
		3 days	40	7.91
		4 days	44	8.70
		5 days	60	11.86
		6 days	69	13.64
		7 days	232	45.85

Question	Variable	Categories	Frequency	Percent
		I do not have a car	20	3.95
		N/A	5	0.99
Describe your automobile ownership	auto own	Owned by parents	207	40.91
		Owned by self	193	38.14
		Parents making payments	49	9.68
		You make payments	33	6.52
		Parents lease	5	0.99
		You lease	3	0.59
		I do not have a car, motorcycle or scooter	16	3.16
Do you currently use an alternative mode of transportation?	use alter mode	Bus (LYNX)	4	0.79
		UCF Shuttle	94	18.58
		Walk	23	4.55
		Bicycle	43	8.50
		Motorcycle/Scooter	5	0.99
		Carpool	42	8.30
		No	290	57.31
		N/A	5	0.99
How often do you use this alternative mode?	alter mode freq	1 day	40	7.91
		2 days	49	9.68
		3 days	28	5.53
		4 days	27	5.34
		5 days	36	7.11
		6 days	8	1.58
		7 days	18	3.56
		N/A	300	59.29

Question	Variable	Categories	Frequency	Percent
Do you live on campus?	live campus	Yes	29	5.73
		No	469	92.69
		N/A	8	1.58
How far from campus do you live (driving distance)?	distance	0-2 miles	172	33.99
		2.1-5 miles	127	25.10
		5.1-8 miles	43	8.50
		8.1-11 miles	35	6.92
		11.1-14 miles	15	2.96
		14.1-20 miles	35	6.92
		20.1-30 miles	32	6.32
		>30 miles	39	7.71
		N/A	8	1.58
What is your primary means of commuting to campus?	commute mode	Car	355	70.16
		Bus (LYNX)	4	0.79
		UCF Shuttle	77	15.22
		Walk	6	1.19
		Bicycle	22	4.35
		Motorcycle/Scooter	3	0.59
		Carpool	9	1.78
		I live on campus	20	3.95
		N/A	10	1.98
How often do you use this mode per week?	commute mode freq	1 day	16	3.16
		2 days	53	10.47
		3 days	69	13.64
		4 days	97	19.17

Question	Variable	Categories	Frequency	Percent
		5 days	153	30.24
		6 days	26	5.14
		7 days	78	15.42
		N/A	14	2.77
What is your secondary or additional means of commuting to campus?	second mode	Car	84	16.60
		Bus (LYNX)	4	0.79
		UCF Shuttle	45	8.89
		Walk	16	3.16
		Bicycle	31	6.13
		Motorcycle/Scooter	3	0.59
		Carpool	56	11.07
		I live on campus	18	3.56
		N/A	249	49.21
How often do you use this mode per week?	second mode freq	1 day	82	16.21
		2 days	58	11.46
		3 days	19	3.75
		4 days	6	1.19
		5 days	8	1.58
		6 days	0	0.00
		7 days	15	2.96
		N/A	318	62.85
Would you consider using an alternative mode to campus if the circumstance was 'right'?	circumstance	Yes	402	79.45
		No	97	19.17
		N/A	7	1.38
Are you aware of the potential	save	Yes	444	87.75

Question	Variable	Categories	Frequency	Percent
savings in money that using alternative modes can provide?	money	No	51	10.08
		N/A	11	2.17
Are you aware of the increase in productive time that using alternative modes can provide?	productive time	Yes	407	80.43
		No	92	18.18
		N/A	7	1.38
What factor primarily affects which mode of transportation you choose?	factor affect mode choice	Weather Condition	23	4.55
		Gas Price	21	4.15
		Schedule Constraints	141	27.87
		Availability of Alternatives	102	20.16
		Convenience	211	41.70
		Prefer not to answer	8	1.58
The current weather condition is included when choosing my travel mode	weather cond influ	Strongly Agree	81	16.01
		Agree	133	26.28
		Neither Agree or Disagree	94	18.58
		Disagree	79	15.61
		Strongly Disagree	111	21.94
		N/A	8	1.58
If I were to choose an alternative mode in clear weather conditions, it would be:	alt mode good weather	Bus (LYNX)	39	7.71
		UCF Shuttle	151	29.84
		Walk	29	5.73
		Bicycle	113	22.33
		Carpool	157	31.03
		N/A	17	3.36
If I were to choose an alternative mode in adverse	alt mode bad	Bus (LYNX)	39	7.71
		UCF Shuttle	164	32.41

Question	Variable	Categories	Frequency	Percent
(heavy rain, cold temperatures) weather conditions, it would be:	weather	Walk	7	1.38
		Bicycle	6	1.19
		Carpool	271	53.56
		N/A	19	3.75
The price of gas affects how often you choose to drive your car	gas price influ	Strongly Agree	82	16.21
		Agree	139	27.47
		Neither Agree or Disagree	91	17.98
		Disagree	106	20.95
		Strongly Disagree	80	15.81
		N/A	8	1.58
How expensive will gas need to be for you to consider an alternative mode of transportation than your car?	gas price	Less than $3.00/gallon	15	2.96
		$3.00-4.99/gallon	216	42.69
		$5.00-6.99/gallon	168	33.20
		$7.00-9.99/gallon	18	3.56
		Greater than $10.00/gallon	25	4.94
		N/A	53	10.47
		Does not matter	11	2.17
The cost of parking affects your choice to drive to campus	park cost influ	Strongly Agree	97	19.17
		Agree	88	17.39
		Neither Agree or Disagree	99	19.57
		Disagree	125	24.70
		Strongly Disagree	88	17.39
		N/A	9	1.78
Preferred/guaranteed parking would promote me to carpool	prefer park	Strongly Agree	136	26.88
		Agree	158	31.23

Question	Variable	Categories	Frequency	Percent
		Neither Agree or Disagree	99	19.57
		Disagree	62	12.25
		Strongly Disagree	39	7.71
		N/A	12	2.37
Reduced decal price would promote me to carpool	reduce decal	Strongly Agree	131	25.89
		Agree	118	23.32
		Neither Agree or Disagree	96	18.97
		Disagree	102	20.16
		Strongly Disagree	48	9.49
		N/A	11	2.17
How much are you willing to pay to park on campus before seeking another transportation mode?	park cost			
What is the amount of time you will tolerate to find a parking space on campus before using another means of transportation?	park time	up to 5 minutes	59	11.66
		6-10 minutes	107	21.15
		11-15 minutes	99	19.57
		16-20 minutes	89	17.59
		21-25 minutes	41	8.10
		26-30 minutes	32	6.32
		over 30 minutes	62	12.25
		N/A	17	3.36
I consider myself environmentally conscious/friendly?	enviro	Strongly Agree	98	19.37
		Agree	241	47.63
		Neither Agree or Disagree	108	21.34

Question	Variable	Categories	Frequency	Percent
		Disagree	32	6.32
		Strongly Disagree	13	2.57
		N/A	14	2.77
Is a UCF shuttle accessible within walking distance from your residence?	shuttle access	Yes	178	35.18
		No	315	62.25
		N/A	13	2.57
Is a LYNX stop accessible within walking distance from your residence?	lynx access	Yes	212	41.90
		No	272	53.75
		N/A	22	4.35
How many transfers are there between your residence and UCF if using LYNX?	lynx transfer	0 (direct route)	177	34.98
		1	80	15.81
		2+	156	30.83
		Unsure/don't care	93	18.38
How long would you be willing to wait for a bus if you were to take one? Either UCF shuttle or LYNX. Assume stop location is convenient distance away (1/4 mile or less)	bus wait	Less than 5 minutes	29	5.73
		5-10 minutes	210	41.50
		11-15 minutes	130	25.69
		16-20 minutes	51	10.08
		21-25 minutes	2	0.40
		26-30 minutes	25	4.94
		More than 30 minutes	3	0.59
		N/A	56	11.07
How far would you travel off of your route to pick up a carpool partner?	carpool prox	0 miles, I would not go out of my way	39	7.71
		Less than 1 mile	26	5.14
		1-2 miles	174	34.39
		2.1-4 miles	65	12.85

Question	Variable	Categories	Frequency	Percent
		4.1-6 miles	108	21.34
		6.1-10 miles	36	7.11
		More than 10 miles	11	2.17
		N/A	47	9.29
I would carpool to campus if it helped reduce congestion on campus	reduce congestion	Strongly Agree	95	18.77
		Agree	195	38.54
		Neither Agree or Disagree	118	23.32
		Disagree	55	10.87
		Strongly Disagree	21	4.15
		N/A	22	4.35
My safety must be guaranteed in order to carpool	carpool safety	Strongly Agree	287	56.72
		Agree	142	28.06
		Neither Agree or Disagree	36	7.11
		Disagree	15	2.96
		Strongly Disagree	4	0.79
		N/A	22	4.35
I would feel most comfortable carpooling with	carpool partner	A friend/acquaintance/co-worker	442	87.35
		Someone I don't know if we meet before riding together	18	3.56
		A stranger	7	1.38
		No one	20	3.95
		Prefer not to answer	19	3.75
I would carpool if I could rent a car on-campus to leave when needed (car-sharing:	zipcar	Strongly Agree	43	8.50
		Agree	108	21.34
		Neither Agree or Disagree	155	30.63

Question	Variable	Categories	Frequency	Percent
http://www.zipcar.com/universities/)		Disagree	112	22.13
		Strongly Disagree	62	12.25
		N/A	26	5.14
A free, guaranteed ride home if my carpool partner(s) abandoned me would allow me to carpool	ride home	Strongly Agree	147	29.05
		Agree	194	38.34
		Neither Agree or Disagree	95	18.77
		Disagree	23	4.55
		Strongly Disagree	26	5.14
		N/A	21	4.15
Are you aware of UCF's carpool program, Zimride?	aware Zim	Yes	265	52.37
		No	223	44.07
		N/A	18	3.56
I would use Zimride to find a carpool partner to share a ride to UCF	use Zim carpool	Strongly Agree	24	4.74
		Agree	94	18.58
		Neither Agree or Disagree	186	36.76
		Disagree	126	24.90
		Strongly Disagree	54	10.67
		N/A	22	4.35

APPENDIX B: TABLES OF RESULTS

B.1 Correlation Matrix

Polychoric correlation matrix

	age	shuttle_access	gas_price_influ	primecar	ownauto	primecommutecar
age	1					
shuttle_access	.4810201	1				
gas_price_influ	.06964945	.20534592	1			
primecar	.21248736	.50144637	.21706552	1		
ownauto	.58853264	.29300637	.07800913	.1780707	1	
primecommutecar	.20671694	.75076571	.30830133	.89231885	.21571765	1
use_zim	-.04590789	-.04804565	.22932018	.02597272	-.06508377	.08216932
annual_income	.62955875	.38783946	.1176907	.14698525	.45192004	.10252577
circum	.21951791	.27872177	.36024148	.29306901	.18064536	.39631977
congestion	.05363296	.19881591	.26774089	.21280655	.06511244	.29324625
enviro	-.06861038	.10905596	.29689547	.2736906	.01835474	.24161514
grade	.54979971	.33895583	.12433615	.25407608	.24748955	.17615888
park_cost	.02236368	.27448086	.55818222	.34805674	.07081412	.39464967
pref_park	.16430235	.09287826	.24402176	.08299371	.07074561	.11480239
reduce_decal	.12867186	.14466646	.29900016	.09908393	.0346382	.15433447
grh	.05344054	.04669442	.21760637	.10695638	.03067724	.12169898
time_park	.11191965	.32087195	.23569407	.46940848	-.00342385	.46911183
zipcar	.00725421	.01381315	.26602209	.12075609	-.0347592	.11856326

Table 9: Correlation Matrix for Explanatory Factor Analysis, Part 1

	use_zim	annual_income	circum	congestion	enviro	grade
use_zim	1					
annual_income	.05466016	1				
circum	.35202101	.1612185	1			
congestion	.42373913	.03126291	.40881776	1		
enviro	.18228568	-.06265922	.28928734	.39369246	1	
grade	-.01761449	.37446863	.16177446	.0767286	-.04994107	1
park_cost	.13145273	.03738109	.38595354	.27095347	.30597712	.01691735
pref_park	.31488883	.15492569	.3175304	.51166574	.20627686	.05323985
reduce_decal	.20464531	.08392025	.28695595	.4691688	.21643796	.07637715
grh	.54427519	.01829405	.24696608	.52042412	.12690581	-.01650896
time_park	.06930722	-.01889797	.34642715	.1455471	.20080882	.07152907
zipcar	.54419365	.01172531	.32960409	.37696325	.21192818	-.01623219

	park_cost	pref_park	reduce_decal	grh	time_park	zipcar
park_cost	1					
pref_park	.3379561	1				
reduce_decal	.48271415	.66700219	1			
grh	.24229782	.45708663	.35980351	1		
time_park	.26835729	.11288675	.15404639	.00771398	1	
zipcar	.30935986	.36691119	.2760553	.54372707	.10134941	1

Table 10: Corrleation Matrix for Explanatory Factor Analysis, Part 2

B.2 Chi-Square Test (First Survey)

Table 11: Chi-square Correlation Results (First Survey)

	Frustration	Gender	SourceofIncome	YearlyIncome	YearinSchool	Age
Frustration		14.97 (0.005)	37.10 (0.602)	57.24 (0.004)	29.87 (0.072)	72.19 (0.071)
Gender			27.48 (0.002)	22.30 (0.004)	15.53 (0.008)	25.75 (0.028)
SourceofIncome				201.35 (0.00)	127.70 (0.00)	198.08 (0.001)
YearlyIncome					124.63 (0.00)	171.43 (0.00)
YearinSchool						1400 (0.00)
Age						
College						
CreditHours						
Liveoncampus						
Drivetoclass						
PrimaryMode						
Carusefreq						
Commutetocampus						
Timetopark						
Tripperday						
Considercarpool						
AwareZim						
RegisterZim						
Postedride						
Sharedride						

	College	CreditHours	Liveoncampus	Drivetoclass	PrimaryMode	Carusefreq
Frustration	45.51 (0.057)	17.04 (0.651)	20.49 (0.942)	7.89 (0.445)	35.28 (0.064)	47.31 (0.00)
Gender	154.80 (0.00)	5.03 (0.412)	11.58 (0.171)	2.03 (0.363)	9.38 (0.153)	3.73 (0.443)
SourceofIncome	109.82 (0.015)	86.97 (0.001)	78.44 (0.528)	27.997 (0.109)	53.21 (0.720)	66.34 (0.006)
YearlyIncome	66.01 (0.407)	68.85 (0.003)	184.14 (0.00)	21.004 (0.178)	93.33 (0.00)	71.25 (0.00)
YearinSchool	101.93 (0.00)	107.53 (0.00)	321.65 (0.00)	169.81 (0.00)	122.66 (0.00)	107.73 (0.00)
Age	157.45 (0.003)	179.875 (0.00)	543.465 (0.00)	159.83 (0.00)	96.79 (0.161)	126.14 (0.00)
College		84.51 (0.00)	167.73 (0.00)	33.47 (0.006)	54.86 (0.231)	39.20 (0.178)
CreditHours			40.92 (0.430)	10.295 (0.415)	13.08 (0.997)	12.53 (0.897)
Liveoncampus				438.71 (0.00)	218.10 (0.00)	192.63 (0.00)
Drivetoclass					201.96 (0.00)	290.09 (0.00)
PrimaryMode						289.10 (0.00)
Carusefreq						
Commutetocampus						
Timetopark						
Tripperday						
Considercarpool						
AwareZim						
RegisterZim						
Postedride						

	Commutetocampus	Timetopark	Tripperday	Considercarpool	AwareZim
Frustration	31.04 (0.153)	397.72 (0.00)	4.41 (0.354)	13.55 (0.009)	1.64 (0.801)
Gender	8.45 (0.207)	21.30 (0.003)	1.60 (0.205)	0.082 (0.774)	0.912 (0.340)
SourceofIncome	71.51 (0.147)	108.59 (0.002)	10.84 (0.370)	7.37 (0.690)	17.80 (0.058)
YearlyIncome	56.115 (0.197)	59.91 (0.336)	14.72 (0.065)	20.06 (0.010)	6.401 (0.602)
YearinSchool	222.88 (0.00)	25.105 (0.892)	13.94 (0.016)	8.475 (0.132)	4.635 (0.462)
Age	195.32 (0.00)	96.11 (0.535)	17.01 (0.256)	14.11 (0.442)	18.74 (0.175)
College	58.73 (0.138)	50.85 (0.670)	3.98 (0.859)	4.42 (0.818)	28.42 (0.00)
CreditHours	21.92 (0.857)	57.02 (0.011)	6.603 (0.252)	7.46 (0.189)	1.95 (0.856)
Liveoncampus	685.74 (0.00)	43.25 (0.894)	19.13 (0.014)	8.18 (0.416)	16.32 (0.038)
Drivetoclass	535.01 (0.00)	15.54 (0.343)	37.47 (0.00)	7.32 (0.026)	31.34 (0.00)
PrimaryMode	1100 (0.00)	43.98 (0.388)	11.89 (0.065)	9.66 (0.140)	12.14 (0.059)
Carusefreq	312.64 (0.00)	66.13 (0.00)	36.97 (0.00)	20.94 (0.00)	17.264(0.002)
Commutetocampus		59.06 (0.042)	27.77 (0.00)	12.65 (0.049)	51.19 (0.00)
Timetopark			14.88 (0.038)	18.19 (0.011)	7.24 (0.404)
Tripperday				0.0235 (0.878)	0.387(0.534)
Considercarpool					2.24 (0.134)
AwareZim					
RegisterZim					
Postedride					
Sharedride					

	RegisterZim	Postedride	Sharedride	Freq
Frustration	1.79 (0.774)	3.67 (0.453)	16.71 (0.161)	13.59 (0.327)
Gender	0.275 (0.600)	0.7144 (0.398)	3.75 (0.289)	2.36 (0.501)
SourceofIncome	8.03 (0.626)	10.40 (0.406)	27.36 (0.604)	39.16 (0.122)
YearlyIncome	5.953 (0.653)	5.569 (0.695)	6.075 (1.00)	3.954 (0.999)
YearinSchool	5.761 (0.330)	10.394 (0.065)	60.829 (0.00)	29.949 (0.012)
Age	31.05 (0.005)	36.62 (0.00)	150.18 (0.00)	67.87 (0.007)
College	9.37 (0.312)	13.104 (0.108)	26.84 (0.312)	39.79 (0.023)
CreditHours	2.49 (0.778)	0.842 (0.974)	35.26 (0.002)	18.44 (0.240)
Liveoncampus	17.92 (0.022)	12.16 (0.144)	11.904 (0.981)	18.77 (0.764)
Drivetoclass	2.44 (0.295)	1.40 (0.497)	30.89 (0.00)	16.71 (0.010)
PrimaryMode	17.60 (0.007)	18.85 (0.004)	67.38 (0.00)	53.56 (0.00)
Carusefreq	4.01 (0.404)	3.27 (0.514)	25.08 (0.014)	11.18 (0.513)
Commutetocampus	10.01 (0.124)	5.03 (0.540)	41.573 (0.001)	21.18 (0.270)
Timetopark	7.77 (0.353)	3.20 (0.866)	20.74 (0.475)	38.04 (0.013)
Tripperday	0.8561 (0.355)	0.0197 (0.888)	2.05 (0.562)	6.34 (0.096)
Considercarpool	28.63 (0.00)	18.39 (0.00)	4.08 (0.253)	5.68 (0.128)
AwareZim	114.58 (0.00)	46.44 (0.00)	4.06 (0.255)	3.74 (0.291)
RegisterZim		363.36 (0.00)	24.88 (0.00)	28.64 (0.00)
Postedride			81.16 (0.00)	88.41 (0.00)
Sharedride				1100 (0.00)

B.3 Chi-Square Test (Second Survey)

Table 12: Chi-square Correlation Results (Second Survey)

	student		grade		not student role		gender		age		race	
student			459.2	0	271.55	0	1.8	0.406	132.42	0	2.68	0.953
grade					321.01	0	36.06	0	1100	0	54.43	0.243
not student role							9.26	0.507	170.46	0	38.89	0.52
gender									65.72	0	34.19	0.005
age											81.77	0.202

	citizen		annual income		income source		parent income		tax depend		primary mode	
student	2.34	0.506	157.91	0	55.72	0	69.35	0	30.74	0	23.38	0.001
grade	160.51	0	304.26	0	130.29	0	133.24	0	93.62	0	105.64	0
not student role	16.75	0.334	377.79	0	45.86	0.007	102.35	0	53.53	0	266.56	0
gender	54.79	0	38.17	0.008	17.33	0.067	28.6	0.157	16.75	0.002	17.48	0.132
age	86.36	0	339.64	0	159.96	0	166.97	0	199.51	0	93.66	0.001
race	165.51	0	77.92	0.545	52.55	0.088	193.96	0	34.58	0.005	22.87	0.999
citizen			111.49	0	35.87	0.002	92.55	0	62.72	0	11.75	0.86
annual income					225.9	0	232.19	0	159.76	0	89.12	0.009
income source							156.01	0	82.28	0	38.82	0.13
parent income									83.26	0	87.44	0.04
tax depend											16.76	0.159

	veh use freq		auto own		use alter mode		alter mode freq		live campus		distance	
student	5.74	0.676	10.28	0.114	21.32	0.003	3.32	0.854	0.887	0.642	18.55	0.017
grade	101.62	0	81.38	0	82.87	0	122.52	0	52.25	0	89.14	0
not student role	61.77	0.015	31.19	0.406	43.29	0.159	30.53	0.684	4.77	0.906	37.72	0.573
gender	17	0.385	20.48	0.059	20.1	0.127	33.98	0.002	1.36	0.852	41.68	0
age	100.96	0.014	108.21	0	80.12	0.072	115.45	0	62.43	0	150.85	0
race	94.25	0.008	21.24	1	82.39	0.012	51.57	0.643	32.53	0.009	126.68	0
citizen	81.23	0	18.22	0.441	87.91	0	23.71	0.307	93.66	0	105.9	0
annual income	96.86	0.097	137.03	0	100.58	0.01	62.23	0.734	25.35	0.188	215.2	0
income source	60.3	0.021	121.43	0	49.14	0.057	45.9	0.103	11.48	0.321	77.74	0
parent income	136.16	0.001	93.24	0.015	144.99	0	69.87	0.705	38.73	0.015	155.99	0
tax depend	16.93	0.39	89.9	0	14.97	0.38	16.41	0.289	11.46	0.022	39.54	0.001
primary mode	409.4	0	154.86	0	255.24	0	259.55	0	107.58	0	77.5	0.004
veh use freq			440.61	0	355.56	0	248.99	0	167.5	0	206.54	0
auto own					67.13	0.008	137.29	0	26.51	0.009	62.56	0.077
use alter mode							627.75	0	181.58	0	275.29	0
alter mode freq									65.94	0	122.84	0
live campus											120.8	0

	commute mode		commute mode freq		second mode		second mode freq		circumstance		save money	
student	59.2	0	3.8	0.802	5.48	0.706	2.04	0.916	2.24	0.326	1.02	0.6
grade	151.48	0	55.01	0.086	95.34	0	77.66	0	15.23	0.229	6.24	0.904
not student role	239.22	0	36.92	0.38	43.17	0.337	28.68	0.535	3.26	0.975	2.7	0.988
gender	16.48	0.42	10.5	0.725	34.64	0.004	9.92	0.623	3.6	0.463	2.49	0.647
age	125.18	0	91.39	0.011	120.32	0	78.45	0.017	28.28	0.058	14.12	0.721
race	61.81	0.554	72.69	0.066	126.79	0	58.08	0.151	50.12	0	28.41	0.028

	commute mode		commute mode freq		second mode		second mode freq		circumstance		save money	
citizen	44.69	0.006	38.09	0.013	34.88	0.07	41.3	0.001	49.57	0	36.28	0
annual income	146.43	0	86.47	0.088	77.29	0.565	62.24	0.397	39.51	0.006	34.44	0.023
income source	57.18	0.038	56.89	0.011	46.1	0.235	34.5	0.261	21.61	0.017	18.73	0.044
parent income	91.96	0.365	104.09	0.022	90.18	0.416	71.11	0.312	53.05	0	45.04	0.003
tax depend	27.75	0.034	19.91	0.133	33.06	0.007	16.23	0.181	2.09	0.719	4.49	0.344
primary mode	1100	0	80.06	0	170.52	0	94.22	0	8.23	0.767	5.88	0.922
veh use freq	415.08	0	244.68	0	207.43	0	118.73	0	143.7	0	97.68	0
auto own	120.9	0	52.33	0.132	98.5	0	57.08	0.014	23.68	0.023	20.37	0.06
use alter mode	844.28	0	176.93	0	668.67	0	196.4	0	155.83	0	100.58	0
alter mode freq	411.53	0	246.39	0	282.51	0	422.92	0	35.49	0.001	14.78	0.393
live campus	446.31	0	107.67	0	323.86	0	16.1	0.187	78.76	0	50.09	0
distance	235.89	0	160.15	0	158.58	0	77.29	0.005	98.23	0	72.42	0
commute mode			339.1	0	617.03	0	181.87	0	275.84	0	170.69	0
commute mode freq					99.09	0	110.55	0	194.17	0	114.6	0
second mode							354.38	0	32.15	0.01	17.52	0.353
second mode freq									34.78	0.001	10.35	0.585
circumstance											234.31	0

	productive time		factor affect mode choice		weather cond influ		alt mode good weather		alt mode bad weather		gas price influ	
student	2.59	0.273	5.83	0.323	4.004	0.549	6.61	0.251	4.97	0.42	7.06	0.216
grade	5.89	0.922	24.93	0.729	21.55	0.389	69.85	0	40.15	0.102	34.46	0.263
not student role	8.2	0.61	46.6	0.005	28.08	0.304	23.88	0.527	11.9	0.987	22.45	0.61
gender	2.66	0.617	8.18	0.611	9.41	0.493	20.8	0.023	7.95	0.633	13.84	0.181
age	7.09	0.989	39.44	0.706	54.66	0.153	74.7	0.004	52.55	0.205	46.64	0.405
race	35.24	0.004	94.74	0	63.27	0.011	39.94	0.473	45.96	0.239	76.19	0

	productive time		factor affect mode choice		weather cond influ		alt mode good weather		alt mode bad weather		gas price influ	
citizen	47.9	0	54.24	0	61.35	0	30.58	0.01	22.09	0.105	51.17	0
annual income	26.44	0.152	64.78	0.078	63.83	0.09	80.48	0.004	65.01	0.075	76.26	0.01
income source	12.46	0.255	30.76	0.197	30.01	0.224	46.62	0.005	33.91	0.11	32.68	0.139
parent income	45.66	0.002	103.26	0	76.76	0.028	69.98	0.084	81.03	0.013	91.6	0.001
tax depend	3.97	0.41	11.85	0.295	8.34	0.595	23.36	0.009	13.16	0.215	12.01	0.284
primary mode	16.63	0.164	82.05	0	27.07	0.619	187.99	0	159.79	0	41.29	0.082
veh use freq	145.71	0	165.77	0	151.89	0	150.56	0	131.96	0	165.77	0
auto own	21.2	0.048	41.46	0.08	36.15	0.203	66.43	0	53.07	0.006	25.61	0.695
use alter mode	134.19	0	184.64	0	187.98	0	416.96	0	201.55	0	179.73	0
alter mode freq	16.19	0.302	68.45	0.001	53.67	0.023	135.66	0	101.33	0	65.5	0.001
live campus	79.08	0	74.83	0	77.71	0	133.45	0	113.93	0	76.6	0
distance	91.11	0	133.79	0	152.46	0	207.32	0	136.03	0	127.41	0
commute mode	274.98	0	324.12	0	278.86	0	389.44	0	273.07	0	275.8	0
commute mode freq	190.22	0	186.42	0	194.75	0	135.97	0	121	0	195.53	0
second mode	12.44	0.713	103.36	0	86.53	0	300.84	0	146.05	0	62.31	0.013
second mode freq	12.6	0.399	56.97	0.002	47.41	0.023	108.65	0	83.25	0	49.48	0.014
circumstance	371.1	0	332.99	0	357.24	0	191.03	0	147.3	0	353.83	0
save money	394.52	0	282.6	0	287.07	0	140.97	0	121.33	0	287.32	0
productive time			449.88	0	444.07	0	204.76	0	184.45	0	449.01	0
factor affect mode choice					452.7	0	244.49	0	192.27	0	456.98	0
weather cond influ							275.98	0	176.96	0	500.92	0
alt mode good weather									874.76	0	236.15	0
alt mode bad weather											191.81	0

	gas price		park cost influ		prefer park		reduce decal		park time		enviro	
student	27.09	0	7.01	0.22	9.705	0.084	5.42	0.367	10.73	0.151	3.07	0.689
grade	73.71	0	39.44	0.116	27.18	0.614	33.15	0.316	56.76	0.064	30.62	0.434
not student role	43.8	0.05	29.14	0.258	50.22	0.002	28.14	0.302	34.81	0.477	11.95	0.987
gender	17.42	0.134	14.15	0.166	8.73	0.558	11.26	0.338	12.67	0.552	13.51	0.197
age	106.26	0	49.3	0.305	47.32	0.378	47.45	0.373	84.88	0.034	44.64	0.487
race	55.48	0.213	56.43	0.044	49.02	0.155	54.12	0.067	72.43	0.069	46.48	0.223
citizen	25.29	0.117	20.62	0.15	35.64	0.002	38.85	0.001	34.82	0.03	28.4	0.019
annual income	124.96	0	42.57	0.763	77.18	0.008	74.77	0.013	82.6	0.144	62.74	0.107
income source	52.55	0.007	29.31	0.251	42.14	0.017	25.66	0.426	33.17	0.557	17.56	0.861
parent income	86.93	0.043	58.27	0.356	92.03	0.001	94.97	0.001	120.48	0.001	87.65	0.003
tax depend	25.8	0.011	6.21	0.797	27.36	0.002	12.26	0.268	6.84	0.941	13.03	0.222
primary mode	91.74	0	42.67	0.063	19.85	0.92	26.23	0.663	76.79	0.001	66.26	0
veh use freq	133.99	0	60.23	0.021	98.76	0	112.04	0	154.31	0	113.92	0
auto own	89.75	0	31.42	0.395	30.73	0.429	25.09	0.721	42.37	0.455	48.75	0.017
use alter mode	133.67	0	67.18	0.001	106.43	0	129.85	0	112.27	0	105.68	0
alter mode freq	103.45	0	52.16	0.031	36.34	0.406	40.89	0.228	87.23	0.001	82.89	0
live campus	15.86	0.198	17.82	0.058	47.97	0	54.25	0	53.36	0	47.88	0
distance	100.32	0	58.84	0.028	80.81	0	98.48	0	132.08	0	71.81	0.001
commute mode	125.76	0	149.16	0	228.02	0	209.82	0	199.56	0	181.98	0
commute mode freq	67.97	0.007	55.15	0.016	172.27	0	137.71	0	143.24	0	117.03	0
second mode	67.49	0.033	64.18	0.009	30.4	0.864	38.48	0.539	81.28	0.015	49.99	0.134
second mode freq	62.38	0.004	42.29	0.068	30.49	0.441	34.9	0.246	76.48	0.001	38.8	0.13
circumstance	81.53	0	90.5	0	240.05	0	254.63	0	180.84	0	211.94	0
save money	59.58	0	81.25	0	184.22	0	204.75	0	138.35	0	161.59	0
productive time	74.56	0	132.59	0	303.71	0	321.66	0	220.48	0	256.75	0

	gas price		park cost influ		prefer park		reduce decal		park time		enviro	
factor affect mode choice	115.86	0	127.04	0	280.24	0	303.71	0	203.55	0	251.34	0
weather cond influ	110.06	0	154.51	0	304.63	0	338.69	0	225.33	0	240.57	0
alt mode good weather	113.19	0	83.36	0	136.49	0	151.43	0	120.35	0	153.77	0
alt mode bad weather	144.37	0	63.61	0	127.09	0	136.34	0	124.01	0	141.8	0
gas price influ	179.59	0	283.43	0	323.73	0	359.88	0	234.95	0	277.4	0
gas price			39.81	0.109	85.29	0	81.05	0	137.41	0	54.25	0.004
park cost influ					186.43	0	257.75	0	154.04	0	148.01	0
prefer park							999.53	0	304.76	0	327.58	0
reduce decal									324.93	0	356.29	0
park time											356.37	0

	shuttle access		lynx access		lynx transfer		bus wait		carpool prox		reduce congestion	
student	6.82	0.033	2.84	0.241	2.38	0.497	24.44	0.001	5.64	0.582	2.62	0.758
grade	40.02	0	17.25	0.14	29.44	0.043	78.53	0.001	49.7	0.193	28.25	0.557
not student role	3.29	0.974	11.99	0.286	11.72	0.7	87.54	0	48.37	0.066	44.31	0.01
gender	1.89	0.756	5.22	0.265	6.1	0.412	5.08	0.985	25.97	0.026	18.22	0.051
age	61.85	0	21.05	0.277	38.88	0.065	80.38	0.069	92.9	0.008	32.37	0.921
race	30.93	0.014	18.29	0.307	23.89	0.468	51.95	0.629	64.15	0.212	44.79	0.278
citizen	30.89	0	13.56	0.035	7.81	0.553	40.59	0.006	47.41	0.001	63.23	0
annual income	63.62	0	32.52	0.038	23.46	0.796	69.2	0.505	113.65	0.001	136.14	0
income source	36.59	0	20.69	0.023	28.24	0.02	31.47	0.639	58.36	0.008	38.75	0.039
parent income	47.27	0.001	47.11	0.001	35.95	0.332	112.79	0.005	97.88	0.054	75.49	0.035
tax depend	15.13	0.004	5.62	0.23	6.8	0.339	10.46	0.728	19.86	0.135	9.56	0.48
primary mode	70.87	0	30.19	0.003	31.19	0.027	51.67	0.146	68.8	0.006	59.12	0.001
veh use freq	147.86	0	84.03	0	56.05	0	78.67	0.025	71.98	0.074	107.28	0

	shuttle access		lynx access		lynx transfer		bus wait		carpool prox		reduce congestion	
auto own	35.28	0	11.8	0.461	17.78	0.47	48.78	0.219	50.24	0.179	35.86	0.213
use alter mode	250.54	0	74.05	0	56.56	0	85.25	0.001	77.54	0.006	93.24	0
alter mode freq	113.77	0	28.73	0.011	38.98	0.01	69.93	0.026	56.08	0.227	68.33	0.001
live campus	84.74	0	24.9	0	22.93	0.001	25.19	0.033	32.45	0.003	65.59	0
distance	282.03	0	90.95	0	153.16	0	66.85	0.152	219.83	0	108.04	0
commute mode	334.15	0	153.24	0	59.11	0	128.34	0	114.71	0	178.3	0
commute mode freq	110.9	0	118.52	0	52.53	0	100.97	0	155.63	0	151.87	0
second mode	180.23	0	38	0.002	62.89	0	55.57	0.491	46.78	0.805	60.42	0.02
second mode freq	91.67	0	33.45	0.001	42.98	0.001	43.36	0.413	26.21	0.973	37.74	0.157
circumstance	208.67	0	117.78	0	31.74	0	52.84	0	56.26	0	157.06	0
save money	180.19	0	100.31	0	27.77	0	58.61	0	62.25	0	130.62	0
productive time	276.03	0	156.18	0	31.68	0	67.79	0	78.85	0	163.91	0
factor affect mode choice	258.36	0	165.4	0	61.99	0	94.55	0	98.57	0	169.22	0
weather cond influ	265.63	0	159.98	0	65.32	0	105.03	0	102.61	0	170.08	0
alt mode good weather	264.77	0	88.34	0	83.57	0	82.97	0	85.47	0	97.14	0
alt mode bad weather	222.29	0	81.1	0	68.64	0	103.08	0	67.18	0.001	85.2	0
gas price influ	261.56	0	147.79	0	40.17	0	84.01	0	87.22	0	216.08	0
gas price	76.89	0	45	0	32.51	0.019	168.92	0	128.58	0	98.15	0
park cost influ	125.68	0	65.26	0	32.26	0.006	68.53	0.001	81.6	0	120.92	0
prefer park	327.33	0	229.3	0	49.9	0	115.73	0	155.69	0	488.91	0
reduce decal	357.97	0	210.45	0	51.85	0	101.74	0	127.76	0	401.33	0
park time	366.15	0	235.54	0	90.78	0	138.82	0	191.28	0	242.64	0
enviro	403.55	0	243.61	0	67.05	0	160.28	0	142.1	0	353.18	0
shuttle access			377.27	0	117.83	0	115.78	0	152.2	0	305.82	0

	shuttle access		lynx access		lynx transfer		bus wait		carpool prox		reduce congestion	
lynx access					89.75	0	83.71	0	113.55	0	199.72	0
lynx transfer							66.89	0	69.02	0	63.86	0
bus wait									346.91	0	202.36	0
carpool prox											271.11	0

	carpool safety		carpool partner		zipcar		ride home		aware Zim		use Zim carpool	
student	4.097	0.536	6.11	0.191	6.35	0.274	8.44	0.134	0.824	0.662	3.06	0.691
grade	36.74	0.185	39.05	0.027	32.11	0.362	38.15	0.146	12.67	0.394	19.51	0.929
not student role	57.18	0	36.55	0.013	31.17	0.184	38.61	0.04	5.56	0.85	28.3	0.294
gender	44.19	0	17.18	0.028	13.04	0.222	5.46	0.859	7.39	0.116	13.12	0.217
age	60.94	0.057	37.71	0.391	37.61	0.775	53.41	0.183	28.25	0.058	35.61	0.841
race	89.05	0	92.34	0	43.2	0.336	58.11	0.032	17.64	0.345	38.76	0.526
citizen	71.76	0	63.7	0	40.14	0	28.98	0.016	24.78	0	29.36	0.014
annual income	161.73	0	116.57	0	74.72	0.013	89.54	0.001	32.69	0.036	59.55	0.167
income source	25.86	0.415	20.65	0.418	21.99	0.636	16.69	0.893	11.79	0.299	17.36	0.868
parent income	88.73	0.003	72.92	0.004	73.18	0.051	76.45	0.029	34.47	0.044	84.58	0.006
tax depend	8.62	0.569	3.05	0.931	3.16	0.977	4.28	0.934	3.72	0.445	6.74	0.75
primary mode	41.27	0.083	7.95	0.999	30.52	0.439	27.5	0.597	9.98	0.618	18.4	0.952
veh use freq	76.45	0	64.97	0.001	73.1	0.001	81.04	0	68.31	0	65.53	0.007
auto own	32.01	0.367	28.74	0.23	37.37	0.166	23.18	0.808	20.2	0.063	34.4	0.265
use alter mode	67.48	0.001	70.07	0	69.78	0	77.5	0	71.92	0	64.76	0.002
alter mode freq	29.27	0.741	36.08	0.141	52.56	0.029	44.26	0.136	29	0.01	34.09	0.512
live campus	47.39	0	53.03	0	69.64	0	31.95	0	29.58	0	29.79	0.001
distance	107.48	0	51.32	0.017	81	0	91.74	0	50.69	0	79.97	0
commute mode	148.87	0	147.85	0	134.69	0	142.23	0	117.58	0	118.25	0

	carpool safety		carpool partner		zipcar		ride home		aware Zim		use Zim carpool	
commute mode freq	172.99	0	110.46	0	104.71	0	106.07	0	78.28	0	75.34	0
second mode	46.53	0.221	41.44	0.123	43.02	0.343	39.64	0.486	19.35	0.251	56.69	0.042
second mode freq	47.88	0.02	48.97	0.002	34.11	0.277	40.23	0.1	9.19	0.687	31.76	0.379
circumstance	124.56	0	149.11	0	127.77	0	141.21	0	140.18	0	145.79	0
save money	100.07	0	113.39	0	91.23	0	104.89	0	131.88	0	104.83	0
productive time	158.78	0	183.92	0	139.56	0	169.08	0	200.73	0	158.89	0
factor affect mode choice	152.36	0	230.21	0	131.82	0	170.8	0	181.25	0	150.58	0
weather cond influ	186.46	0	191	0	204.7	0	194.05	0	176.85	0	183.31	0
alt mode good weather	87.03	0	104.04	0	69.94	0	86.13	0	83.1	0	109.72	0
alt mode bad weather	95.28	0	100.24	0	63.12	0	78.82	0	71.93	0	84.98	0
gas price influ	201.73	0	191.66	0	195	0	200.19	0	189.46	0	217.12	0
gas price	62.45	0	44.01	0.008	57.26	0.002	56.88	0.002	30.51	0.002	45.23	0.037
park cost influ	115.02	0	106.13	0	123.73	0	117.72	0	77.18	0	93.9	0
prefer park	317.48	0	383.78	0	311.78	0	433.45	0	234.92	0	265.45	0
reduce decal	279.37	0	301.78	0	270.78	0	344.28	0	255.12	0	286.07	0
park time	216.78	0	243.52	0	200.17	0	239.19	0	241.72	0	252.59	0
enviro	284.18	0	294.6	0	263.62	0	285.73	0	293.75	0	291.15	0
shuttle access	296.67	0	342.22	0	249.83	0	312.1	0	378.26	0	295.13	0
lynx access	195.73	0	230.95	0	165.57	0	211.58	0	217.38	0	168.53	0
lynx transfer	54.17	0	65.26	0	73.59	0	67.56	0	44.55	0	78.66	0
bus wait	210.21	0	172.31	0	224.58	0	229.26	0	125.82	0	165.31	0
carpool prox	261.11	0	260.45	0	259.71	0	262.6	0	170.73	0	223.11	0
reduce congestion	566.48	0	443.05	0	407.86	0	513.39	0	286.95	0	404.81	0
carpool safety			459.49	0	420.89	0	446.96	0	369.98	0	370.9	0

	carpool safety	carpool partner	zipcar		ride home		aware Zim		use Zim carpool	
carpool partner			435.2	0	529.06	0	379.46	0	409.55	0
zipcar					685.3	0	309.11	0	619.16	0
ride home							387.48	0	640.2	0
aware Zim									387.44	0
use Zim carpool										

APPENDIX C: PERMISSION LETTERS

University of Central Florida

University Marketing

February 27, 2012

Mr. Joe DeFrancisco

UCF Marketing grants permission to include the UCF campus map in your graduate thesis/dissertation.

Since the art contains © UCF in the bottom left corner, you do not need to include an additional caption.

UCF Marketing wishes you all the best for a successful defense.

Sincerely,

Sandy Poulion

Sandy Poulion
Production Manager

Strategy, Marketing, Communications, and Admissions
P.O. Box 160090 • Orlando, FL 32816-0090 • (407) 823-2704 • FAX (407) 823-2567
An Equal Opportunity and Affirmative Action Institution

University of Central Florida Institutional Review Board
Office of Research & Commercialization
12201 Research Parkway, Suite 501
Orlando, Florida 32826-3246
Telephone: 407-823-2901 or 407-882-2276
www.research.ucf.edu/compliance/irb.html

Approval of Exempt Human Research

From: **UCF Institutional Review Board #1**
FWA00000351, IRB00001138

To: **Joseph P. DeFrancisco**

Date: **February 24, 2011**

Dear Researcher:

On 02/24/2011, the IRB approved the following activity as human participant research that is exempt from regulation:

Type of Review:	Exempt Determination
Project Title:	UCF Parking Demand Study
Investigator:	Joseph P DeFrancisco
IRB Number:	SBE-11-07480
Funding Agency:	University of Central Florida(UCF)
Grant Title:	
Research ID:	N/A

This determination applies only to the activities described in the IRB submission and does not apply should any changes be made. If changes are made and there are questions about whether these changes affect the exempt status of the human research, please contact the IRB. When you have completed your research, please submit a Study Closure request in iRIS so that IRB records will be accurate.

In the conduct of this research, you are responsible to follow the requirements of the Investigator Manual.

On behalf of Joseph Bielitzki, DVM, UCF IRB Chair, this letter is signed by:

Signature applied by Joanne Muratori on 02/24/2011 02:03:04 PM EST

IRB Coordinator

University of Central Florida Institutional Review Board
Office of Research & Commercialization
12201 Research Parkway, Suite 501
Orlando, Florida 32826-3246
Telephone: 407-823-2901 or 407-882-2276
www.research.ucf.edu/compliance/irb.html

Approval of Exempt Human Research

From: **UCF Institutional Review Board #1**
FWA00000351, IRB00001138

To: **Joseph P. DeFrancisco** :

Date: **August 18, 2011**

Dear Researcher:

On 8/18/2011, the IRB approved the following activity as human participant research that is exempt from regulation:

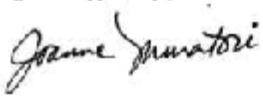
Type of Review:	Exempt Determination
Modification Type:	A few questions were added to the survey regarding respondents' role at UCF to separate sample into different groups. Document, which incorporates consent and survey, has been approved for use.
Project Title:	UCF Driver Choice Survey
Investigator:	Joseph P DeFrancisco
IRB Number:	SBE-11-07810
Funding Agency:	University of Central Florida(UCF)
Grant Title:	
Research ID:	N/A

This determination applies only to the activities described in the IRB submission and does not apply should any changes be made. If changes are made and there are questions about whether these changes affect the exempt status of the human research, please contact the IRB. When you have completed your research, please submit a Study Closure request in iRIS so that IRB records will be accurate.

In the conduct of this research, you are responsible to follow the requirements of the Investigator Manual.

On behalf of Sophia Dziegielewski, Ph.D., L.C.S.W., UCF IRB Chair, this letter is signed by:

Signature applied by Joanne Muratori on 08/18/2011 10:58:40 AM EDT



IRB Coordinator

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