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IDENTIFYING A PROFILE FOR NON-TRADITIONAL CYCLE COMMUTERS

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Authored By:

Shaunna K. Burbidge, PhD

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LIST OF ACRONYMS

CDC	Centers for Disease Control
FHWA	Federal Highway Administration
IRB	Institutional Review Board
MAG	Mountainland Association of Governments
MPO	Metropolitan Planning Organization
UDOT	Utah Department of Transportation
USDOT	U.S. Department of Transportation
UTA	Utah Transit Authority
WFRC	Wasatch Front Regional Council

EXECUTIVE SUMMARY

Cycling has frequently been advocated as an easy low cost form of physical activity that is accessible to most individuals, regardless of age or ability. Additionally, when used as a mode of transportation, cycling can lead to reductions in air pollution, carbon emissions, congestion, noise, and traffic dangers, not to mention saving users money in vehicle ownership and maintenance costs. A 2011 Dan Jones survey commissioned by UDOT revealed that 13% of Utahns commute by bicycle at least once per week. This was in stark contrast to census data that measured cycle commuting rates statewide at a mere 0.8% (Salt Lake City Metro Area = 0.6%; Provo-Orem Metro Area = 1.3% (U.S. Census, 2011)). These startling data provide compelling evidence regarding the importance of planning for cyclists as a major part of the transportation system. They also validate the idea that cycling impacts a larger segment of the population than just a small group of motivated recreationists or cycle advocates.

This research analyzes self-reported data collected as a part of the 2012 Utah Household Travel Survey to identify who these non-traditional cyclists are, what are their motivations for cycling, what are the purposes of their cycling trips, and what barriers are keeping them from cycling more frequently. Additionally, this report creates a profile for these non-traditional cyclists.

There are a number of benefits to cycling including improved personal health, environmental quality, economic vitality, etc. However there are also a large number of barriers to cycling for transportation. These barriers can be both physical as well as psycho-social or emotional. The way that individuals respond to these barriers ultimately determines how likely they are to cycle for transportation.

Four types of cyclists are identified in this research using a classification scheme introduced by Geller (2012) as a base model, while a latent class cluster analysis is employed to identify significant demographic differences between cyclist types. “Strong and Fearless” cyclists (4%) are most likely lower income males who also exhibit higher rates of unemployment, while the “No Way No How” or non-cyclist cluster (54.3%) is primarily made

up of women with lower levels of education and household income who have small households with few children. The non-traditional cyclists, (i.e. the target group for this research), are typically individuals with higher incomes and more education who have larger families with more children. These individuals also report having access to an adequate number of bicycles.

An analysis of cycling trip purposes reveals that non-traditional cyclists are most likely to bike for exercise and to escort their children, while the “Strong and Fearless” cyclists are more likely to cycle for utilitarian/transportation purposes. These groups also exhibit different motivations for choosing to cycle. While both groups enjoy the exercise and being outside, “Strong and Fearless” cyclists were significantly more likely to report cycling to save money and to protect the environment.

For individuals who reported that they would “never bike” the major reasons included not owning a bike and being busy or viewing cycling as taking too long. For these individuals there is likely little that can be done to promote cycling as a transportation mode. Even providing every adult in the region with a working bicycle would not likely overcome these barriers considering that one in five respondents stated that they simply do not enjoy cycling.

Key conclusions of this research show that it is unrealistic to assume that individuals in the non-traditional cyclist group will give up their automobile and begin making a majority of their trips for all purposes via bicycle. However, it is incredibly realistic to assume that this group could be persuaded to occasionally leave a vehicle at home and make purpose specific trips by bicycle where appropriate. By focusing promotional materials to address issues that are meaningful to this group of individuals, a significant number of trips could be shifted from auto to non-motorized modes.

1.0 INTRODUCTION

1.1 Problem Statement

A 2011 Dan Jones survey commissioned by UDOT revealed that 13% of Utahns commute by bicycle at least once per week. This was in stark contrast to census data that measured cycle commuting rates statewide at a mere 0.8% (Salt Lake City Metro Area = 0.6%; Provo-Orem Metro Area = 1.3% (U.S. Census, 2011)). These startling data provide compelling evidence regarding the importance of planning for cyclists as a major part of the transportation system. They also validate the idea that cycling impacts a larger segment of the population than just a small group of motivated recreationists or cycle advocates. While these new survey data show that more than 1 in 8 people cycle regularly, little is known about these cyclists. Who are they, what are their motivations for cycling, what are the purposes of their cycling trips, and what barriers are keeping them from cycling more frequently? Currently there is very little data on cycling as a transportation mode in Utah outside of the U.S. Census, and other existing data may exhibit some degree of bias, as it is typically provided by advocacy groups.

This research uses data from the Utah Household Travel Survey to identify the key characteristics described above, as well as others to create a profile for these non-traditional cyclists. By identifying demographic characteristics of this group as well as information about their cycling travel behavior UDOT will be more prepared to adequately accommodate cyclists in the transportation system.

1.2 Objectives

This research provides a profile of non-traditional cyclists by accomplishing the following tasks:

- Create a description of cycling behavior by county for the Salt Lake and Provo-Orem Metropolitan areas

- Identify demographic characteristics for individuals who cycle at least 1 time per week and create a classification scheme for non-traditional cyclists
- Identify typical trip purposes for cycling trips
- Investigate motivations for participating in cycling trips
- Identify barriers to cycling more frequently

1.3 Scope

This research makes use of data collected through the 2012 Utah Household Travel Survey and a subsequent bicycle and pedestrian attitudinal add-on survey. Additionally, this research employs data gathered through the Utah College and University Travel Survey, a survey that was administered to students at all colleges and universities in the state. The data reported on in this analysis signifies a representative sample of individuals from the Salt Lake Metropolitan Area including Weber, Davis, Salt Lake and Utah Counties; sub-sections of UDOT Regions 1, 2 and 3. Additional information on the project sampling is described in Section 3.

1.4 Outline of Report

This report is organized according to the following sections. Section 2 provides a comprehensive literature review examining cycling for transportation and characteristics associated with cyclists. Section 3 provides a description of the study area for this research as well as outlining the data collection methods. Section 4 presents the data collected through this research effort and provides both qualitative and quantitative analysis and evaluations regarding cyclist demographics, trip purposes, motivation for cycling, and barriers to cycling for transportation. Section 5 provides conclusions based upon the data provided in the previous sections, and Section 6 outlines the author's recommendations for implementation.

2.0 LITERATURE REVIEW

2.1 Overview

This section provides an overview of the existing research literature regarding the cycling as a mode of transportation, as well as the benefits of cycling and the barriers faced by cyclists and potential cyclists. This section also provides a description of cyclist types and outlines a framework for the analysis contained in this study.

2.2 Cycling for Transportation

Cycling has frequently been advocated as an easy low cost form of physical activity that is accessible to most individuals, regardless of age or ability. Additionally, when used as a mode of transportation, cycling can lead to reductions in air pollution, carbon emissions, congestion, noise, and traffic dangers, not to mention saving users money in vehicle ownership and maintenance costs.

2.2.1 Promoting Livability

In 2009 the Federal Government announced a new focus on sustainability across agencies. Their renewed emphasis on creating “livable communities” and improving quality of life has contributed to a focus on accommodating cyclists and providing a more holistic multi-modal transportation system (USDOT 2010a). To emphasize this point, the U.S. Department of Transportation emphasized the importance of cycling for transportation, issuing the following policy statement:

The DOT policy is to incorporate safe and convenient walking and bicycling facilities into transportation projects. Every transportation agency, including DOT, has the responsibility to improve conditions and opportunities for walking and bicycling and to integrate walking and bicycling into their transportation systems. Because of the numerous individual and community benefits that walking and bicycling provide — including health, safety, environmental, transportation, and quality of life — transportation agencies are encouraged to go beyond minimum standards to provide safe and convenient facilities for these modes (USDOT, 2010b).

FHWA asserts that the overall costs of transportation can be reduced by increasing multi-modal mobility and improving accessibility in the existing transportation system rather than focusing on building new automobile infrastructure (USDOT, 2010a). Given the current economic condition of the U.S., it makes sense to focus on creating more efficient streamlined systems and reducing the need for new high-cost infrastructure investments.

2.3 Benefits of Cycling

2.3.1 Health Benefits

Cycling has historically proven to be a great source of physical activity. Physical activity has long been shown to promote health and reduce the incidents of both chronic and acute disease. Research has shown that as little as 30 minutes of physical activity per day can “enhance your immune system and decreases the risk of developing diseases such as cancer and heart disease (American Heart Association, 2012)”. Physical activity can also reduce blood pressure and cholesterol, relieve anxiety, depression, and anger, and improve memory and brain function (American Heart Association, 2012). Research has shown that increasing physical fitness plays the largest role in improving health regardless of other factors (CDC, 2004).

2.3.2 Environmental Benefits

The transportation system supports increasing mobility demands for both passengers and freight, but the growth in transportation demand has resulted in increased levels of motorization and congestion. As a result, the transportation sector is becoming increasingly linked to environmental problems such as climate change, air quality, noise, water quality, soil quality, and reductions in biodiversity. An increase in active transportation means fewer motor vehicles on the road, which means less congestion, fewer traffic jams, and improved air quality.

Cycling can provide a plausible alternative to the automobile for a variety of short trips and those trips which access another mode, such as transit. Research has shown that substituting automobile trips with cycling trips can significantly impact air quality, which is important for an area such as the Wasatch Front which regularly deals with the consequences of poor air quality.

It has been shown that walking and biking combined displace between 1.2 and 5.0% of passenger vehicle emissions of carbon monoxide, nitrogen oxides, and volatile organic compounds. Bicycling and walking displace as much as 1.6% of carbon dioxide emissions from passenger vehicles (Komanoff, et al, 1993). Cycling can also provide reductions in fossil fuel consumption. Gotschi (2011) estimated that Portland, Oregon's 40-year \$138 million bicycle facility investments provide \$143-218 million in fuel savings alone (they provide an additional \$388-594 million in healthcare savings as well).

Active transportation differs from motorized modes in the sense that it leaves no ecological footprint through placing human demands on natural resources such as land, water and air (Abelsohn, et al, 2005). By replacing automobile trips with cycling trips, demand on the motorized network is reduced. Lower demand results in less of a need for additional facilities. This can help protect wildlife habitat and ecologically sensitive areas (e.g. wetlands) that may be compromised by the development of future transportation infrastructure. Additionally, water and soil quality are preserved when the number of automobiles on the road is reduced due to the reduction in impact from tires, engine fluids, etc (Canadian Fitness and Lifestyle Research Institute, 2012).

2.3.3 Other Benefits

The benefits of cycling as a transportation and recreation mode cover a number of facets within our communities. In addition to the health and environmental benefits of cycling described above, cycling can also provide benefits to a community through the promotion of recreational opportunities and economic development, the beautification of communities through infrastructure investments, and the promotion of social interaction and a sense of community that come from more individuals being present in community spaces (Burbidge, 2011).

2.4 Barriers to Cycling

After decades of decline in cycling rates, recent data has shown an upswing in active transportation usage (Pucher, et al, 2011). However, for many individuals even a desire to cycle for transportation can be curtailed by real or perceived barriers. These barriers can be both physical and psychological and provide a powerful disincentive for cycling.

2.4.1 Physical Barriers

The relationship between the built environment and walking is different than the relationship between the built environment and driving. This key point is overlooked by most transportation researchers (Burbidge and Goulias, 2009a). There are a large number of physical environmental barriers that keep people from cycling for transportation.

The most common examples of physical barriers are topography, weather/climate, and distance. Topography is a large factor because in many areas of the United States the terrain is so varied that most individuals would not be capable of getting to their destination by active means. For most individuals, topography is a strong deterrent to bicycle commuting because hilly terrain can leave the rider in a relatively disheveled state. This would be unacceptable for many travelers who must be well groomed for the remainder of the day's activities (USDOT, 1992). The determination and physical athleticism of the traveler come in to play as factors when determining the effects that topography can have on an active commute.

The climate and weather of a region also play a role in the number of cyclists an area may have. Wind, rain, and temperature, seem to play the strongest role in a person's decision of travel mode. Individuals can control some aspects of weather and climate, but only by accommodating, not by changing the circumstance. Although Nankervis (1999) found that there was no obvious correlation between climatic variables and levels of commuter cycling, a separate Gainesville, Georgia survey found that 90% of commuters considered poor weather as a severe deterrent to bicycle commuting (USDOT, 1992). Additionally, research has shown that Seattle sees a strong drop in bicycle commuters during the rainy season (USDOT, 1992).

Another significant barrier to cycling for transportation is distance. Distance translates directly to travel time and convenience. These are determinants that are defined differently for each individual and what is considered acceptable by some may not be by others (Burbidge, 2004). A study by Mackett (2003) showed that most individuals rule out cycling for transportation because of a time consideration. Most individuals stated that the automobile is more convenient and thus, would always be their primary mode of transportation. Even short

trips, which could easily be accomplished by cycling, are now reserved for the automobile. Of trips one mile or less, over 50% are made by automobile (Killingsworth and Schmidt, 2001).

Lastly, the availability of infrastructure has often proved to be a strong deterrent for cycle commuting. Research has shown that well-connected cycling networks are crucial for encouraging cycle commuting, particularly in lower income neighborhoods (Butler, Orpana, and Weins, 2007). Additionally, the provision of high-quality facilities such as bike lanes, cycle tracks, bike boulevards, and paved trails, substantially increase the use of biking for local travel and recreation (Ewing and Cervero, 2001). Pucher, et al (2011) assert that special attention should be paid to providing accommodations for vulnerable populations including women, children, and seniors; especially “to protect them from the dangers of motor vehicle traffic”. However, as walking and biking increase, the tendency for drivers to watch for people participating in these modes increases as well, concomitantly making the activity safer (Frank, Kavage and Litman, 2006).

2.4.2 Psychological Barriers

There are a number of perceived barriers to cycling for transportation. These can include the negative perception of safety, or negative attitudes about cycling or physical activity in general. Attitudes, “learned predispositions to respond in a consistently favorable or unfavorable way towards a given object, person, or event”, play a paramount role in mode choice decisions (Hayes, 1993). A study by Beldon, Russonello, and Stewart (2003) surveyed 800 adults nationwide by telephone. This study found that opinions about walking and cycling are generally positive, and the majority of the public recognize their virtues. So why then do so few individuals walk or cycle for transportation. Often perceptions of safety are cited as reasons for not cycling more frequently. Physical characteristics such as lighting patterns, proximity to traffic, and other environmental factors can have major influences on the perceived safety of an area, and for vulnerable groups this can be a strong deterrent for cycling as a transportation mode (Zacharias, 2001).

Perhaps nothing provides more of a barrier to cycling for transportation than personal habits. Habitual behavior and the role that personal habit plays on mode choice decisions is an

important component of travel behavior research. Habits are “learned sequences of acts that have become automatic responses to specific cues, and are functional in obtaining certain goals or end states (Verplanken and Aarts 1999)”. In each transportation situation, individuals must decide how to get where they are going. Burbidge and Goulias (2009) have argued that eventually individuals may become so familiar with a situation and the accompanying decisions that they may not consider any alternatives, but will automatically utilize whatever transportation means they have used in the past. The challenge in dealing with habits with regard to mode choice is that they happen without awareness. That is, many everyday choices and decisions are made without the decision maker being conscious of making the choices (Verplanken and Aarts 1999). Berit Møller (2002) concludes that any attempt to change travel mode choice will largely depend on the motivation behind the behavior, and that policies to change habits should focus on making individuals more conscious of their choices. This research aims to do just that, by identifying a profile of non-traditional cyclists in order to create more informed policies and programs to encourage travelers to utilizing cycling as a mode of transportation.

2.5 Types of Cyclists

In order to better understand and better serve cyclists in their community, the Portland Office of Transportation and researchers from Portland State University developed an index that identified four distinct types of cyclists. They are: “The Strong and Fearless”, “The Enthused and the Confident”, “The Interested but Concerned”, and “The No Way No How” group (Geller, 2012). It is important to mention that Geller (2012) describes this typology as only applying to cycling for transportation, as many people in each group may cycle for recreation.

Table 1. Characterization of Cyclists

Type	Description
Strong and Fearless	Those who will ride regardless of roadway conditions; they are “bicyclists”; riding is a strong part of their identity and they are generally undeterred by roadway conditions.
Enthusied and Confident	Those who have been attracted to cycling due to new developments and improved infrastructure; they are comfortable sharing the roadway with automobile traffic, but they prefer to do so operating on their own facilities. They are attracted to riding on streets that have been redesigned to make them work well for bicycling. They appreciate bicycle lanes and bike boulevards.
Interested but Concerned	Those who are curious about cycling. They listen to messages about how easy it is to cycle for transportation, and about how people need to be more active. They like riding a bicycle and they would like to ride more, but they are afraid to ride. They don’t like cars speeding down their street. They get nervous thinking about what would happen to them on a bike if a driver runs a red light, or passes too closely too fast. Very few of these people regularly ride bicycles. They would ride if they felt safer on the roadways—if cars were slower and less frequent, and if there were more quiet streets with few cars and paths without any cars at all.
No Way No How	Those who are not interested in bicycling at all, for reasons of topography, inability, or simply a complete and utter lack of interest.

Source: Geller, 2012

In the Salt Lake Region it is estimated that a very small percentage of individuals fall into the “Strong and Fearless” category. These are individuals who would be considered typical or traditional cyclists. It is likely that the 13% of individuals from the UDOT survey who reported cycling for transportation at least once per week, likely fall into either the “Enthusied and Confident” or the “Interested but Concerned” categories. This research will focus on those two groups of “non-traditional” cyclists as they are the most likely to increase their cycle commuting if existing barriers are addressed in an appropriate way. Since by definition those in the “No Way No How” category will resist cycling at any cost, they will not be targeted in this research.

2.6 Research Gaps

Existing research has highlighted the benefits of cycling for transportation well and has amply discussed physical barriers to cycling. However, research regarding psycho-social barriers and perception based inhibitions is still lacking. Additionally, different types of cyclists have been qualitatively identified, but without any additional information on what types of people fall into each category or any discussion of what can be done to move individuals from one category to another. This research will fill a gap in the existing literature by providing a comprehensive look at non-traditional cyclists and will provide a discussion of ways to increase

their transportation cycling frequency by further examining the psychological barriers and motivations for cycling as reported by this target group.

2.7 Summary

There are a variety of benefits to cycling for transportation. These include health and environmental benefits as well as others which have been well documented in the literature. However, there are also a number of existing barriers, both physical as well as psychological, that if left unaddressed can severely limit the potential for individuals to choose cycling as a viable mode of transportation. Four distinct types of cyclists have been identified by prior research and this work will follow that existing characterization to further investigate additional psychological barriers and to evaluate the potential to turn non-traditional cyclists into more dedicated cycle commuters.

3.0 DATA COLLECTION

3.1 Overview

This section describes the data collection efforts employed for this research including the Utah Travel Study and its accompanying add-on surveys. This includes a description of each survey instrument as well as the sampling methodologies, response rates, and spatial distributions for each.

3.2 Data Collection Tools

The research presented in this report makes use of data acquired through the Utah Travel Study. The Utah Travel Study is a statewide transportation survey data collection effort sponsored by the Wasatch Front Regional Council (WFRC), along with other partners, including the Utah Department of Transportation (UDOT), Utah Transit Authority (UTA), and Mountainland Association of Governments (MAG). The purpose of the survey was to provide local agencies with a better understanding of the travel patterns and travel needs of residents from across Utah, including Salt Lake, Davis, Weber and Utah Counties. The data collected from this survey also assists agencies in setting the priority for the 30-year long range transportation plan and guide the spending of billions of dollars on various highway and transit projects.

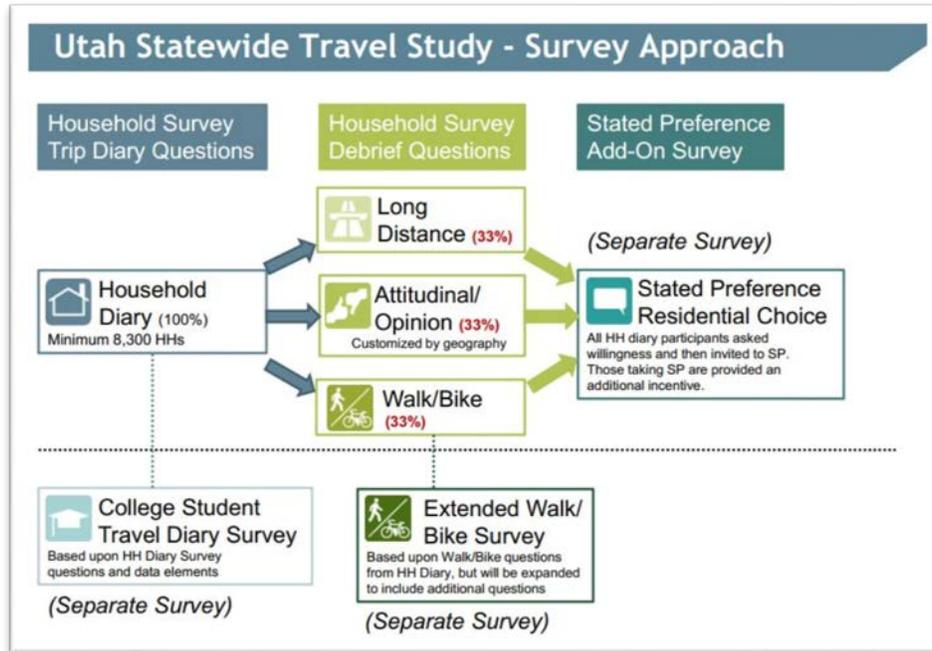


Figure 1. Household Travel Study Approach

As shown in Figure 1, the Household Travel Study consisted of two main components. The first component was a household survey and trip diary (described below in section 3.2.1). The second component of the household study consisted of several specific debrief questionnaires. Households who completed the household survey and trip diary were randomly assigned to complete one of three topically focused debrief questionnaires: Long distance, attitudinal/opinion, or walk/bike (see Section 3.2.2). Three additional add-on surveys were administered addressing other topics including stated preferences and residential choice, an additional in-depth walk/bike questionnaire, and a survey specifically tailored to college and university students (see section 3.2.3).

3.2.1 Household Survey and Trip Diary

The household survey completed by all participating households consisted of several components. First the survey collected basic household information including: number of household vehicles (including make, model, and year), characteristics of members of the household (age, gender, race, employment status, educational attainment, driver’s license possession, etc.), number of household bicycles, residential status (full-time or seasonal) and

housing type (single-family home, apartment, condo, etc.), and household income. Respondents were then randomly assigned to complete one of the three add-on surveys: long distance, attitudes/opinion, or walk/bike.

After completing this portion of the survey, each adult household member was asked to report all trips made over the course of a pre-assigned weekday (24 hour period). The trip log included trip details such as the origin and destination location, purpose, mode(s), and whether or not they traveled with other people. At the conclusion of their participation in the household survey and trip diary respondents were asked about their willingness to be contacted to participate in future follow-up surveys.

3.2.2 Walk/Bike Add-On Survey

Because the walk/bike survey was an add-on that was administered as an extension to the household survey, and participants responded to the questions immediately following the household survey, additional demographic and household questions were not asked. This survey focused solely on walking and biking trips. Respondents were asked the following questions first for walking and subsequently for biking: frequency of trips, trip behavior compared to this same time last year, reasons they do and do not walk/bike, broader motivations for walking/biking, typical trip purposes for walking/biking, and for a characterization of major barriers to walking and biking. Lastly respondents were presented with a number of attitudinal statements about walking and biking and were asked to rate their agreement with each using a 5 point Likert Scale.

3.2.3 College Student Travel Diary and Survey

The web-based college student survey began by asking respondents which university they were currently attending and what program they are affiliated with (certificate program, 2 or 4 year degree, graduate school, etc.). For universities with more than one campus, respondents were asked to identify which one they typically attend. Students were then asked which school or department they affiliate with on campus (i.e. business, social sciences, life sciences, graduate school, etc.). All respondents were then asked about a series of personal characteristics including their age, gender, year in school, residential location (on campus, off campus, etc),

educational status (full-time/part-time student), employment status, race, driver's license possession, and if they have a smart phone. Subsequent questions identified household type (living with roommates, family, etc.), marital status, number of persons in each household, and information about household vehicles (automobiles, motorcycles, bicycles, etc.). Students were then asked to log the trips they made "yesterday" rather than pre-assigning them to a specific day as in the case of the standard household trip diary. Response dates were somewhat controlled for by controlling when the email invitations were sent. Data was collected on each trip using the same interface as the household trip diary including origin and destination location, purpose, mode(s), and whether or not they traveled with other people.

Rather than assign students to one of the three add-on surveys described in section 3.2.2, all students were asked to respond to a sub-set of questions selected from all three add-ons. These questions included recording any additional bicycle trips that were made and were not accounted for in the trip diary (e.g. recreational trips), and attitudinal and opinion questions about transportation. Lastly students were asked specific questions about their transit and bicycle trips. This survey section asked about frequency of bike trips in the past 2 weeks, how often the respondent bikes compared to last year, and reasons they do and do not bike.

3.3 Sampling and Response Rates

3.3.1 Household Survey Trip Diary

In Spring 2012, over 10,000 households across Utah were recruited via a random selection of postal addresses to participate in the travel survey. Each household received first-class mail invitations and were provided the option of completing the questionnaire via advance web-based survey instrument or by telephone. All written survey forms and informational materials were available in both English and Spanish, and the survey instrument was available online and over the phone in multiple languages. In total, 9,198 households completed the household survey and trip diary. Table 2 below outlines the sample breakdown by Metropolitan Planning Organization (MPO) jurisdictions.

Table 2. Household Survey Participation by MPO Jurisdictions

County	# Households
WFRC	4,251
MAG	1,549
Others	1,791
UDOT (rural)	1,607
Total	9,198

3.3.2 Walk/Bike Add-On Survey

Based on the methods described in Section 3.2.2, households who completed the household survey were randomly assigned to complete one of three add-on surveys. Over 5,000 households statewide completed the walk/bike add-on survey (shown in Table 3).

Table 3. Walk/Bike Survey Participation by County

County	# Households
Weber	399
Davis	629
Salt Lake	1,811
Utah	1,100
Other areas	1,157
Total	5,096

For the purposes of this research, the analysis in Section 4 will focus on the responses of 3,939 households located along the urbanized Wasatch Front in Weber, Davis, Salt Lake and Utah Counties.

3.3.3 College Student Travel Diary Survey

To acquire additional information about the travel behavior of college and university students in Utah, a separate survey was created aimed specifically at that sub-set of the state's population. All registered students attending 9 of Utah's colleges and universities were invited via email and web-based announcements to participate in the survey (Students at Brigham Young University did not participate). Reminder emails were also sent to each student's university issued email account to encourage widespread participation. It should be noted that to comply with Institutional Review Board (IRB) requirements for research involving human subjects several universities sent the survey invitation and link to a sample of their students rather than the entire student body. However, all participating institutions advertised the survey

opportunity on their websites making it available to whoever wished to participate. In all, 7,923 college and university students completed the travel diary survey as shown in Table 4.

Table 4. College Student Participation by Institution

College/University	# Students
Dixie State College	421
LDS Business College	205
Salt Lake Community College	634
Utah State University	2,036
Utah Valley University	1,527
University of Utah	2,035
Weber State University	1,007
Westminster College	58
Total	7,923

Again, for the purposes of this research, only responses from students attending colleges and universities along the Wasatch Front will be reported in the analysis section. This will include 5,261 students from LDS Business College, Salt Lake Community College, the University of Utah, Weber State University and Westminster College.

3.3.4 Sample Characteristics

The sample for this research consists of 10,357 individuals over age 18 representing general households (5,096) as well as college and university students (5,261), and make-up a statistically representative sample for that area, as verified during the sampling and data collection process. Table 5 below shows basic demographic and personal characteristics for the respondents included in this research. The summary is broken down by geographic area for clarity.

Table 5. Sample Characteristics

	Weber	Davis	Salt Lake	Utah	University Students
Gender (% males)	49.4	49.6	49.0	47.7	50.7
Unemployed	3.8	2.5	5.2	2.5	-
College Graduate (Bachelors or higher)	40.1	48.5	54.4	53.1	-
Drivers License	96.0	97.3	95.6	97.8	96.2
Disability	2.0	3.2	3.0	1.9	-

(that limits mobility)					
# Vehicles	2.32	2.50	2.14	2.20	2.05
HH size	3.19	3.69	3.04	3.51	-
# Children	0.92	1.35	0.84	1.26	-
# Adult bikes	1.53	1.73	1.52	1.56	1.39
# children's bikes (If HH has children)	1.64	1.89	1.54	1.65	1.35
n=	399	629	1,811	1,100	5,261

The sample is split nearly even between males and females with females slightly over reporting in Utah County. The unemployment rate among participants was lower than the state as a whole¹ (Utah Department of Workforce Services, 2012), and varied geographically with Davis and Utah Counties reported the fewest unemployed participants (2.5%) and Salt Lake reporting the most (5.2%). Educational attainment also varied geographically. As would be expected (due to the presence of multiple university campuses) a larger portion of respondents from Cache, Salt Lake, and Utah Counties are college graduates. Employment and educational status was not reported by the university student sample.

Over 95% of respondents from all counties have a current, valid driver's license, and only a very small percentage of respondents from each county (<4%) reported having a disability that limits their mobility (which could significantly impact their ability to travel by bicycle). Household size varies significantly across county lines with Davis and Utah County respondents reporting the largest households (>3.5 people). This same trend continued when looking at the number of children per household. With regard to vehicle and bicycle ownership, the response rates nearly mirrored the profile of household size and number of children. Respondents from counties with larger households reported having more vehicles and more bikes with one exception; Salt Lake County respondents reported having a larger than expected number of bicycles (both for children and adults). This is likely due to the more dominant "bike culture" that has developed in recent years and renewed investment in infrastructure supporting cycling.

3.4 Summary

The data utilized in this research was collected as a part of the Utah Travel Study and includes a household survey and trip diary as well as responses from an add-on walk/bike survey

¹ The Utah statewide unemployment rate as of October 21, 2012 was 5.4%.

and a survey completed by college and university students. Responses from 10,357 individuals from the Wasatch Front (Weber, Davis, Salt Lake and Utah Counties) provide the basis for the analysis explained in the Section 4.

4.0 ANALYSIS

4.1 Overview

This section includes analysis of the dataset presented in Section 3. Analysis includes: a description of cycling trips frequencies across both the university and the general sample; description of demographics for “enthused and confident” and “interested but concerned” categories of cyclists referred to herein as “non-traditional cyclists”; A breakdown and description of cycling trip purposes in hierarchical order of stated importance; a description of motivating factors for cycling; and finally an analysis of self-reported barriers to cycling for transportation.

4.2 Cycling Trip Frequencies

4.2.1 Characterization of Cyclist Types

The first question relating to cycling on both the walk/bike add-on survey as well as the college survey asked respondents to indicate how many cycling trips they had made over the past two weeks. Based on the categorical responses provided, a characterization was made aligning the frequency of cycling by survey participants with one of the four categories of cyclists first outlined by Geller (2012). They are: Strong and Fearless, Enthused and Confident, Interested but Concerned, and No Way No How. The percentage of each county falling within each characterization is shown in Table 6.

Table 6. Trip Frequencies and Cyclist Characterization

		Number of bike trips in the last 2 weeks			
		<i>Strong and Fearless</i>	<i>Enthused and Confident</i>	<i>Interested but Concerned</i>	<i>No Way No How</i>
		4+ Trips	1-3 Trips	0 Trips	I never bike
County	Weber	3.0%	13.5%	24.8%	58.6%
	Davis	2.5%	13.4%	27.3%	56.8%
	Salt Lake	4.1%	12.8%	25.6%	58.5%
	Utah	3.9%	12.9%	31.5%	51.6%
University Students		5.0%	16.0%	35.9%	46.9%
100% n=10,357		4.0% n=412	13.1% n=1,354	28.7% n=2,972	54.3% n=5,619

“Strong and Fearless” cyclists, those taking more than 4 bike trips in two weeks account for 4% of the population. The highest geographic concentration of “Strong and Fearless” cyclists is located in Salt Lake County which would be expected based on the preliminary demographics shown in Section 3, as well as the increased awareness currently being paid to cycling as a mode of transportation. The lowest incidence of “Strong and Fearless” cyclists is located in Davis County. This is likely due to the high concentration of residential land-use in that county which results in added distance to reach targeted destinations (e.g. employment centers, recreation sites, etc.).

The second group of interest was made up of individuals who reported that they never bike. These individuals were classified as “No Way No How” cyclists. This group is made up of over half of respondents from all counties, with a slightly lower response rate in Utah County. College students were less likely than the sample as a whole to self-identify with this category, although non-cyclists still made-up nearly half of the student sample (46%).

The group of greatest concern and the focus of this research were those individuals who made 3 or fewer cycling trips over the course of the past two weeks. Individuals who had made 1-3 trips were characterized as “Enthusied and Confident”, while individuals who claimed that they do bike occasionally, but had not taken any biking trips in the past two weeks were characterized as “Interested but Concerned”. As discussed in Section 2, the “Strong and Fearless” cyclists are likely to cycle regardless of conditions while individuals in the “No Way No How” characterization are not likely to participate in cycling regardless of conditions. Therefore individuals identifying with the two middle groups (41.8% of the sample) provide the greatest potential for increasing cycle mode split for transportation purposes. However, in order to determine what will encourage these individuals to cycle more frequently, their general demographic and travel behavior needs to be better understood.

4.2.2 Spatial Distribution of Cycling Trips

Cycling trips tend to differ based on spatial location. The following figures show the average number of cycling trips taken in the past two weeks across the Wasatch Front region.

Trips are calculated at the spatial resolution of a Traffic Analysis Zone (TAZ). The darker the shade of blue, the higher the average frequency of cycling trips for individuals living within the boundaries.

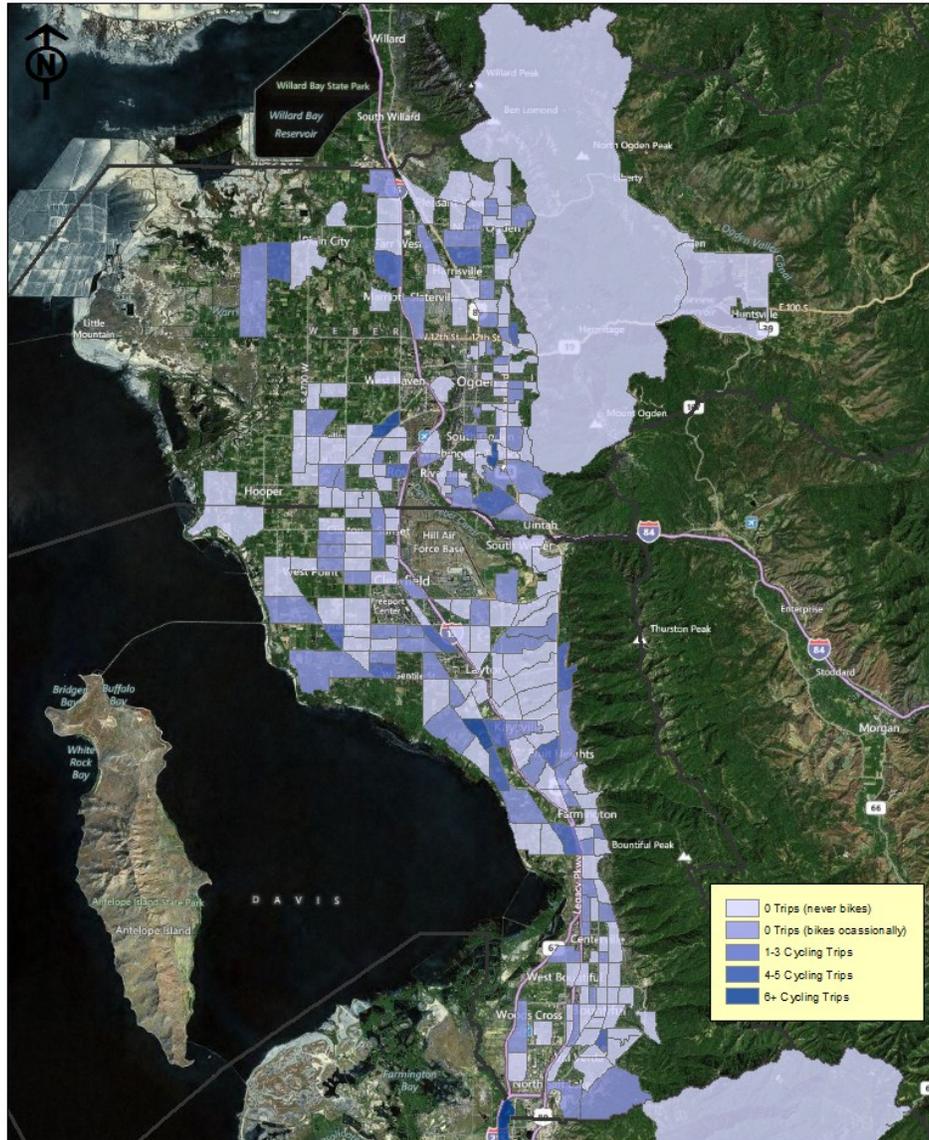


Figure 2. Average Cycling Frequency by TAZ- Weber/Davis Counties

Figure 2 shows the spatial distribution of cycling trips for Weber and Davis Counties. There is a strong clustering of cycling frequency for populations living near Ogden's downtown, along Highway 89 in eastern Davis County, along a linear strip in western Davis County and at

the southwestern end of North Salt Lake/Woods Cross. For the latter two locations the presence of the Denver and Rio Grande Rail Trail and junction of the Legacy Parkway and Jordan River Parkway Trails are likely influences for higher frequencies of cycling.

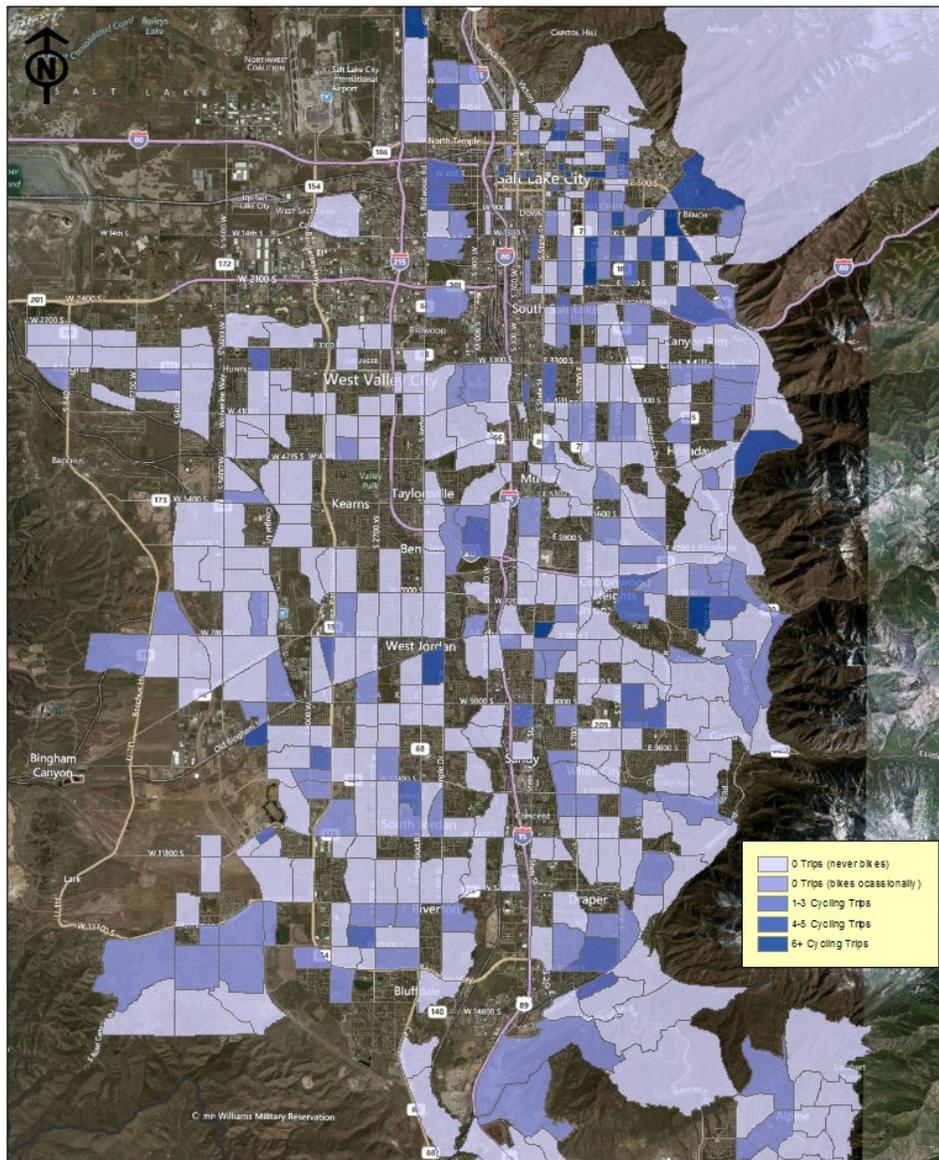


Figure 3. Average Cycling Frequency by TAZ- Salt Lake County

In Salt Lake County there are several cycling clusters as well. These are concentrated around North-Eastern Salt Lake City near the University of Utah and the Harvard-Yale/Sugarhouse Districts, the northern end of Redwood Road, near the mouth of Big

Cottonwood Canyon, near the I-15/I-215 junction north of Murray Parkway Golf Course (near a Jordan River Parkway trailhead), along Highland Drive in Draper, within the Daybreak development, and within Herriman.



Figure 4. Average Cycling Frequency by TAZ- Utah County

Spatial clustering in Utah County can be found along Redwood Road in Saratoga Springs, in downtown Lehi, surrounding the Lindon Aquatics Center and Lindon City Park, near Utah Valley University in Orem, surrounding Brigham Young University and downtown Provo,

surrounding the Spanish Fork Sports Park Complex, and in Woodland Hills. Once again this clustering seemingly aligns with activity promoting facilities.

4.3 Cyclist Demographics

One of the key components of this research is to identify who the “non-traditional” cyclists are. A latent class cluster analysis was employed alongside a comprehensive demographic analysis to isolate variation between groups and identify a profile for each cyclist type. Table 7 below shows a demographic breakdown for each of the four cyclist characterizations outlined in the previous section. For the interest of comparison, all four cyclist types are described in this section even though the target groups of non-traditional cyclists encompass only the Enthused and Confident and the Interested but Concerned characterizations. By comparing the non-traditional groups to the “Strong and Fearless” and the “No Way No How” groups, it paints a clearer picture of the target sample while also clarifying the boundaries of each cluster within the sample.

Table 7. Demographic Variation between Cyclist Types

	<i>Strong and Fearless</i>	<i>Enthused and Confident</i>	<i>Interested but Concerned</i>	<i>No Way No How</i>
Gender (% males)*	67.7	53.4	53.4	43.8
Unemployed	6.3	3.3	2.9	4.5
College Graduate (Bachelors or higher)	56.1	60.4	55.8	45.4
Mean Income**	\$39,800	\$49,100	\$44,000	\$37,100
Drivers License*	93.1	98.2	98.6	95.5
Disability (that limits mobility)	2.1	0.7	1.0	4.0
# Vehicles*	2.1	2.2	2.3	2.2
HH size	3.17	3.57	3.26	3.07
# Children	1.04	1.45	1.18	0.80
# Adult bikes*	2.7	2.5	2.1	0.9
# children’s bikes* (If HH has children)	2.1	1.9	1.8	1.2
Chi-square = 343.72 (p=0.000) n=10,357				

*Includes student frequencies

**Mean income is calculated as a relational approximation based upon the average rating within a categorical variable

4.3.1 Strong and Fearless Cyclists

Cyclists in this category are more likely to be male with a higher rate of unemployment than the general public. Approximately half of these cyclists are college graduates. While a

majority (93.1%) of cyclists in this group possess a driver's license, the driver's license rate is lower than for other groups. Strong and Fearless cyclists have a lower income than the non-traditional cyclist groups which may indicate that affluence plays a role in the decision to cycle for utilitarian purposes (discussed in more detail in Section 4.4). Members of this group have the second highest rate of reporting a disability that limits their mobility and they report having the fewest vehicles per household of all the groups. Their households are small with few children, although not as small as those who will never cycle. They report owning a large number of both adult and children's bicycles which is likely due to their commitment to cycling as a lifestyle characteristic.

4.3.2 Enthused and Confident Cyclists

Members of this category are almost evenly split between males and females, and these cyclists have a relatively low rate of unemployment (3.3%). They are highly educated and have the highest reported income of any group. Nearly all members have a valid driver's license (98.2%). They are unlikely to report having a disability that limits their mobility. Cyclists in this category have the largest households with the most children; however, their auto ownership rates are lower than the "Interested but Concerned" cyclists.

4.3.3 Interested but Concerned Cyclists

These individuals are equally likely to be male or female, and are the least likely to be unemployed (only 2.9%). Educational attainment and mean income is lower for these individuals than the "Enthused and Confident" cyclists, but still greater than the other two groups. This group is the most likely to have a valid driver's license and also owns the most vehicles. Cyclists in this category have the second largest households and number of children and own fewer bikes than their "Fearless" or "Enthused" counterparts. They are unlikely to have a disability that limits their mobility.

4.3.4 No Way No How

Individuals who claim that nothing would make them cycle are more likely to be women. While their unemployment rate is lower than the state average, it is higher than the non-traditional cyclists groups. These individuals have the lowest levels of education and the lowest

reported incomes. Approximately 95% of these non-cyclists possess a valid driver’s license and 4% reported having a disability that limits their mobility; the highest of any group. These individuals have the smallest households with the fewest children, and report the fewest bicycles (both adult and children’s) of any group.

4.3.5 Non-Traditional Cyclists

As shown in Table 7, there are statistically significant differences between each group of cyclists, and by evaluating the demographic data above a profile for non-traditional cyclists begins to emerge. When aggregating the “Enthusied and Confident” and “Interested but Concerned” groups, we see that these non-traditional cyclists are likely to be better educated with higher income than the remainder of the sample. They most likely have a driver’s license and do not report having any disabilities. These individuals have larger families with more children, and own more vehicles than individuals on the ends of the cycling spectrum. Perhaps most importantly, they have access to bicycles for both adults and children.

4.4 Cycling Trip Purpose

Nearly 90% of respondents who reported taking cycling trips did so for exercise (See Table 8). Accompanying children (27.9%), socializing (14.1%), and visiting with friends and family (12.2%) were also frequently reported trip purposes. Cycling was more frequently used than walking as a transportation mode to/from work (10%), however other trip purposes which would classify cycling as a transportation mode were not highly reported (<10%). One startling difference was between university students and the general public sample with only 1/3 of university students identifying utilitarian (transportation) purposes for their typical cycling trips.

Table 8. Trip Purpose- % response in aggregate

Utilitarian Trips	49.1 (public) 34.1 (students)
Accompany children	27.9
Visit friends/family	12.2
Shopping	7.2
To/from school	5.4
To/from other travel mode	4.3
To/from work	10.0
Personal business	5.6
Other**	4.6

Non-Utilitarian Trips	89.1 (public) 87.8 (students)
Exercise	87.5
Socialize	14.1
Recreation event	6.4

*Based on responses from persons who participated in at least 1 cycling trip in the past 2 weeks

**Most commonly reported “other” purposes included: “recreation/leisure” and “family time”

By breaking it down further to determine which trip purposes were identified by each of the characterized cycling groups, we see significant variation between each type of cyclist. The “Strong and Fearless” cyclists are highly likely to utilize a bicycle for utilitarian trips while the percentage of utilitarian trips drops substantially for the non-traditional cyclists. However, the non-traditional cyclists are more likely to cycle to escort children, or to exercise.

Table 9. Trip Purpose- % response by cyclist characterization

	<i>Strong and Fearless</i>	<i>Enthusied and Confident</i>	<i>Interested but Concerned</i>
Utilitarian Trips	66.1	54.0	44.4
Accompany children	21.2	29.8	27.8
Visit friends/family	22.8	16.6	8.6
Shopping	25.9	8.6	4.0
To/from school	21.2	4.5	3.7
To/from other travel mode	15.3	4.7	2.7
To/from work	37.6	9.9	6.3
Personal business	19.6	6.8	3.2
Other	5.3	4.5	4.6
Non-Utilitarian Trips	86.8	88.9	89.5
Exercise	85.2	86.8	88.2
Socialize	18.0	15.1	13.0
Recreation event	17.5	8.0	4.2

This provides additional details regarding the ideas first posed in Section 4.3.5. As these data show, non-traditional cyclists are from higher income households with higher levels of education, and past research has shown that both demographics tend to spend more time exercising (CDC, 2012). Section 4.3.5 also showed that non-traditional cyclists have a larger number of children, which would again imply that they would spend their trips escorting young household members.

4.5 Motivation for Cycling

For those who reported making at least one cycling trip in the past two weeks, the survey asked the respondent to identify their motivations in general for doing so. In aggregate, enjoying the outdoors (82.2%) and health/exercise (81.1%) were by far the most influential factors, as shown in Table 10.

Table 10. Motivation for Cycling- % response by cyclist type

	All cyclists	<i>Strong and Fearless</i>	<i>Enthusied and Confident</i>	<i>Interested but Concerned</i>
Enjoy outside	82.3	73.1	83.8	83.2
Health/Exercise	81.1	84.3	82.5	79.6
Save money (gasoline and travel costs)	34.6	70.1	34.2	27.7
Improve environment	26.0	52.2	25.9	20.7
Convenience	18.2	42.5	21.4	11.4
Avoid traffic	13.6	34.3	14.2	9.1
Faster than other modes	9.3	31.3	10.0	4.5
Other reasons	5.5	10.4	6.0	4.2

When isolating the responses by cyclist type, the data paint a somewhat different picture. For non-traditional cyclists enjoying being outside was the biggest motivating factor for cycling. Health and exercise came in second (whereas it was reversed for the “Strong and Fearless” cyclists). As hypothesized in section 4.3, nearly ¾ of “Strong and Fearless” cyclists reported saving money as a motivating factor; whereas it was not nearly as important to the non-traditional cyclists. The least motivating factors for the non-traditional group were avoiding traffic and cycling being faster than other modes.

4.6 Self-Reported Barriers to Cycling

4.6.1 “I Never Bike Because...”

Before attempting to understand the barriers faced by the non-traditional cyclist groups, it can be informative to identify why a large portion of the population choose to never cycle. In the walk/bike add-on survey, members of the No Way No How group were asked their reasons for never biking. Results are shown in Table 11 below. The number one reason for never biking was that they reported not owning or having access to a bike. Secondly, these individuals feel that they are too busy and that biking takes too long.

Table 11. Reasons for Never Biking

Reason Given	% Response
Do not own a bike	53.8
Temporal (busy, takes too long)	24.6
Do not enjoy biking	21.0
Do not feel safe	15.2
Poor health	13.9
Other reasons	10.2
Need vehicle	9.9
Lack of Infrastructure (too few bike lanes, paths, trails, etc)	7.6
Weather	3.1
No showers/changing facilities	2.3

Additionally, one in five respondents simply do not enjoy biking. Because this research is seeking to identify planning and policy interventions that can promote cycling as a mode of transportation it is important to recognize that for a large portion of the population (the No Way No How group) it will never be considered an option, and the reasoning for this is largely attitudinal.

4.6.2 Attitudinal Barriers

While it is interesting to learn the reasoning behind why individuals will absolutely not choose to cycle, it is more compelling and more useful to identify degrees to which individuals subscribe to different notions about cycling. As a part of the walk/bike add-on survey, respondents were asked to rate their level of agreement with several position statements. Results for the sample in its entirety as well as for each type of cyclist are shown in Table 12.

Table 12. Attitudes Regarding the Built Environment and Cycling- Mean score*

	All Respondents	<i>Strong and Fearless</i>	<i>Enthusied and Confident</i>	<i>Interested but Concerned</i>	<i>No Way No How</i>
The ability to walk and bike to places in my neighborhood is important to me	3.72	4.48	4.19	3.95	3.45
Overall, there are enough bike paths in my region to meet my travel needs	3.10	2.72	2.89	2.97	3.23
I support using transportation funds to help pay for projects such as sidewalks and bike paths	3.76	4.28	4.10	3.88	3.59
I would bike on streets also designed for bicycles even if	3.05	3.62	3.52	3.31	2.79

they are slightly out of my way					
Having to share the road with motor vehicles is the main reason I don't bike more often	2.99	3.05	3.08	3.20	2.86
I would like to walk and/or bike more often, but I have trouble fitting it into my current lifestyle	3.33	2.94	3.41	3.61	3.20
Chi-square = 637.071 ($p=0.000$)					

*Based on 5 point Likert Scale of Agreement: 1=Strongly Disagree, 3=Neutral, 5=Strongly Agree

Across all responses cycling characterization was significantly correlated to attitudes about cycling infrastructure and policies. The ability to walk and bike to places in the neighborhood was most important for the “Strong and Fearless” cyclists. It decreased in importance as the level of cycling proficiency decreased. Respondents who reported higher cycling frequency were also less likely to agree that there are enough bike paths in the region to meet their needs, and were the most likely to state they would go out of their way to cycle on streets designed for bicycles. Additionally, the more experienced an individual is as a cyclist (by type) the more likely they are to support using transportation funds to pay for bike paths.

Non-traditional cyclists were the most likely to agree that sharing the road with motor vehicles is the main reason they don't bike more often, and that they would like to bike more often, but they have trouble fitting it into their current lifestyle.

The non-cyclists were the most likely to be satisfied with existing cycling infrastructure. This is likely due to both familiarity and personal need. Individuals who frequently use the street network for cycling are more likely to be tuned into the condition and availability of facilities. Individuals who never cycle are unlikely to be familiar with the location of bike lanes and it would be expected that this group perceives the system as adequate regardless of its condition.

4.6.3 Additional Barriers

Lastly, survey respondents were asked to provide any comments on things that were keeping them from cycling more often. Rather than attempt to provide a tabular summary of these open ended responses, this analysis employed Wordle, a tool that creates word clouds that give greater prominence to words that appear more frequently in a source text. The open ended

purposes for cycling, motivating factors for cyclists and concluded with an analysis of barriers faced by non-traditional cyclists.

5.0 CONCLUSIONS

5.1 Summary

This section provides a summary of the findings of the analysis provided in Section 4. This includes an outline of key findings alongside an in depth discussion of implications for future policies and practices. Also provided is a discussion of research limitations and challenges that should be remedied in any future studies.

5.2 Findings

The goal of this research was to utilize data from the Utah Travel Study to investigate cycling as a mode of transportation along the Wasatch Front, and to provide a profile of non-traditional cyclists by accomplishing the following tasks:

- Create a description of cycling behavior by county for the Salt Lake and Provo-Orem Metropolitan areas
- Identify demographic characteristics for individuals who cycle at least 1 time per week and create a classification scheme for non-traditional cyclists
- Identify typical trip purposes for cycling trips
- Investigate motivations for participating in cycling trips
- Identify barriers to cycling more frequently

5.2.1 Cycling Behavior Across the Wasatch Front

Mapping the distribution of cycling trips across the Wasatch Front revealed some spatial variation and clustering, primarily around areas that would be expected to promote “active” lifestyles or physical activity (e.g. parks, trails, canyons, city centers, and university campuses). These patterns held across all counties. This promotes the idea of spatial autocorrelation which also introduces a “chicken or the egg” problem of self-selection. The main question then becomes, do individuals who prefer to cycle or participate in physical activity self-select to live

in areas that provide opportunities for that type of lifestyle, or does the built environment promote a more active lifestyle and encourage individuals to cycle more frequently? This is a topic that has been addressed in several recent studies with mixed results (Burbidge and Goulias, 2009b).

5.2.2 Profile of Cyclists

Four types of cyclists were identified in this research using a classification scheme introduced by Geller (2012) as a base model, while a latent class cluster analysis was employed to identify significant demographic differences between cyclist types. The analysis found that “Strong and Fearless” cyclists (4%) are most likely lower income males who also exhibit higher rates of unemployment, while the “No Way No How” or non-cyclist cluster is primarily made up of women with lower levels of education and household income who have small households with few children. The non-traditional cyclists, (i.e. the target group for this research), are typically individuals with higher incomes and more education who have larger families with more children. These individuals also report having access to an adequate number of bicycles.

This profile allows for a great deal of conjecture regarding why these individuals may or may not choose to cycle in any given situation. For example, their higher level of education and income and lower levels of unemployment may infer that these individuals have higher paying jobs which are typically higher stress and more demanding than other lines of work. This may prohibit them from having the time to cycle (as described in the barriers discussion in Section 4.6). Their employment may also require a more formal dress code, and superiors/peers would expect these individuals to be dressed appropriately when arriving at work without the disheveled appearance that can often accompany a bike ride. Concomitantly, these individuals also report having larger households with more children. Typically, taking children to and from their activities requires the use of an automobile, especially if there are a number of siblings along for the ride. It is uncommon that a parent would have the ability to escort a child to school or soccer practice on a bicycle with additional children in tow. While not impossible, it would prove difficult and may produce enough of a barrier to encourage using an automobile instead.

5.2.3 Cycling Trip Purposes

An analysis of cycling trip purposes revealed that non-traditional cyclists were most likely to bike for exercise and to escort their children, while the “Strong and Fearless” cyclists were more likely to cycle for utilitarian/transportation purposes. These groups also exhibit different motivations for choosing to cycle. While both groups enjoy the exercise and being outside, “Strong and Fearless” cyclists were significantly more likely to report cycling to save money and to protect the environment. As alluded to in the previous discussion of affluence, disposable income has a pronounced impact on how people spend their free time. Although individuals with more disposable income likely have the means to afford more high-end cycling gear and equipment, they may simply not view cycling as a feasible utilitarian transportation mode and may compartmentalize it as a form of recreation and exercise. While this research does not specifically address those types of perceptions, it may prove to be a deciding factor of whether or not individuals choose to cycle for transportation.

5.2.4 Barriers to Cycling

Lastly, this section identified key barriers faced by individuals when it comes to choosing cycling as a transportation mode. For individuals who reported that they would “never bike” the major reasons included not owning a bike and being busy or viewing cycling as taking too long. For these individuals there is likely little that can be done to promote cycling as a transportation mode. Even providing every adult in the region with a working bicycle would not likely overcome these barriers considering that one in five respondents stated that they simply do not enjoy cycling.

An additional examination of attitudes and opinions regarding specific policy/planning issues affecting cycling found that the greater the degree of experience and comfort cycling an individual possessed (as measured by frequency), the more important infrastructure was to them. This is an intuitive result, as those who spend more time utilizing the infrastructure would likely pay more attention to its condition and presence. Individuals who never cycle or rarely do, would not have the familiarity with any existing (or lacking) infrastructure and would perhaps view it as less important. For example, an individual who drives an automobile for all trips is not likely to consider or be tuned into the presence or condition of local bike lanes.

Lastly, non-traditional cyclists reported that sharing the road with automobiles was a significant deterrent to cycling. Perhaps this is due to their more limited experience cycling. Automobile, in most instances, travel at a much higher rate of speed than a cyclist (particularly a novice). There is some degree of implied danger when riding a bicycle next to fast moving traffic without the benefit of a protective barrier. Most non-traditional cyclists would not consider a helmet or other protective gear to be adequate in making them feel comfortable in that situation. Infrastructure becomes increasingly important for this group because providing adequate right of way and buffers from traffic can go a long way toward making this less experienced group feel safe.

One characteristic that may prove difficult to overcome is the view by many non-traditional cyclists that they find it difficult to fit cycling into their current lifestyle, and individuals most often identified having children as their primary reason for not cycling more often. The demographic breakdown determined that non-traditional cyclists were more likely to have large families with a larger number of children. For a large number of these individuals their children may prove to be the largest barrier to cycling; and one that may be near impossible to overcome. Cycling to escort children to activities (as shown in this analysis) may be feasible, but conducting a greater number of utilitarian trips via bicycle may not be realistic for individuals who have a number of children in their care.

5.3 Limitations and Challenges

While care was taken to control for as many aspects of internal and external validity as possible within this research, there are still some limitations and challenges posed by the survey instrument itself, spatial aggregation methods, and methodological drawbacks.

The main drawback inherent in a survey of this nature is the inability to ask an exhaustive number of questions. The survey instrument had limited space and in order to maximize participation and limit respondent burden the survey was capped at a certain number of questions. This meant that there was a limited space to ask questions which therefore limited the amount of information that could be collected. Also, to streamline the data collection process

and make the resultant data more manageable there were very few open ended questions. This limited that ability to ask for more personalized responses regarding bicycle travel behavior or attitudes and opinions, and required respondent to identify with one of the categories provided. This also limited the ability to ask follow-up and clarification questions. For example “what would make you cycle more”? For that purpose a focus group format would have been more appropriate, however it would not have been feasible to conduct a focus group with a sample this large. This is a trade-off presented in choosing a data collection method. It was determined that the benefits of sample size outweighed the potential benefits a richer dataset for a small number of people. It is recommended that additional research be conducted with a targeted focus group of representatives from each of the cyclist types to gain more in depth information about attitudes, opinions, and barriers. Also, the instrument did not provide questions requiring respondents to make tradeoffs which would have more accurately pinpointed underlying impacts on cycling behavior.

The second major limitation of this analysis was the spatial aggregation of the dataset. Due to a combination of privacy concerns and the nature of the data collection effort, a travel survey which will be used to calibrate a travel demand model, data was aggregated to the TAZ level rather than the household or even block group level.

The last major limitation of this research is a respondent limitation. Many individuals do not know what motivates their behavior and even when posed with a question asking them to identify “barriers” or factors limiting their behavior. Past research has shown that individuals often identify that they would behave in a given way given a certain set of circumstances (e.g. “if there were more trails I would bike more”); when in fact, even if those circumstances existed they do not behave that way (e.g. a new trail is built and they continue to not bike). To address this issue a before and after or time series study would need to be structured in order to acquire longitudinal factors that do have a significant impact on cycling travel behavior.

6.0 RECOMMENDATIONS AND IMPLEMENTATION

6.1 Recommendations

These research results may have profound policy implications. Municipal, county, and state transportation planners have traditionally focused on utilitarian infrastructure, such as bike lanes in downtown, and have placed priority on routes that serve cyclists for transportation purposes. However, the results of this survey show that a large majority of respondents in the targeted non-traditional cyclist group are cycling for non-utilitarian purposes. This is not to say that providing infrastructure to support cycling as a transportation mode is inappropriate, however, planners may need to refocus their energies on supporting the specific trip purposes and types of destinations that these end users desire. For example, this work shows that non-traditional cyclists are likely to utilize cycling as a transportation mode when escorting their children. Therefore, it would make sense to improve infrastructure and provide amenities around areas that are prime destinations for children such as sports fields, schools, parks and playgrounds, and even to improve within neighborhood connectivity.

Additionally, this research has shown that non-traditional cyclists are less concerned with congestion, delay, and environmental impacts, and are more focused on cycling for exercise and to enjoy the outdoors. Therefore, approaching all encouragement and promotional campaigns from the perspective of benefits to personal health and improved quality of life will likely be more effective than emphasizing the environmental or transportation system benefits of changing travel behavior. The key is to keep the perspective of the end result for regardless of the method of delivery, a change in travel behavior toward more active mode trips would concomitantly result in better air quality and less congestion by reducing the number of cars on the road. Therefore the ends justify the means even if the individuals who changed their behavior, did so for other reasons.

The main take-away from this research is that it is unrealistic to assume that individuals in the non-traditional cyclist group will give up their automobile and begin making a majority of their trips for all purposes via bicycle. However, it is incredibly realistic to assume that this

group could be persuaded to occasionally leave a vehicle at home and make purpose specific trips by bicycle where appropriate. By focusing promotional materials to address issues that are meaningful to this group of individuals, a significant number of trips could be shifted from auto to non-motorized modes. Then, as these individuals begin making a larger number of specific trips by bicycle, they will inevitably become more comfortable on their bikes and will be more inclined to make additional trips by bike, even those which would have seemed inappropriate or infeasible under previous experience. In aggregate this could ultimately lead to a tipping point where cycling would become a reasonable alternative for members of the non-traditional group, which would shift enough auto trips to non-motorized modes to improve the transportation system region wide.

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