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Designing More Inclusive Streets: the Bicycle, Gender, and Infrastructure

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Abstract

The number of bike commuters is increasing in cities across the U.S., but men are cycling at double the rate of women cyclists. This paper focuses on how different bike infrastructure and street design options relate to gender and how streets can welcome or inhibit different users. A survey conducted in October of 2010, analyzes the ways in which men and women cyclists in the Twin Cities prioritize and perceive characteristics of the street. The results and culminating research address how to most effectively and inclusively incorporate all cyclists into the urban geographic setting.

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Introducing the Gender Participation Gap in Cycling

Without the encasing of an automobile, the bicyclist is a visible actor and participant in the urban streets. The simple construction and openness of the bike allows the rider a more visceral and direct experience with the scent, air, noise, and people of its surroundings. This connection to the immediate setting while traveling is part of the environmental, recreational, and even empowering benefits that the bike affords. However, its positive attributes for being an open, self-powered vehicle can also reverse to a state of vulnerability and insecurity based on the context and conditions it enters. In a city, streets that do not enforce or simply ignore the cyclist's right of shared access to a road create unsafe traveling environments that deter potential cyclists from partaking. Across the U.S., women represent one such group underrepresented in the bicycling scene. Studies have repeatedly found women to be less likely to use a bicycle for transportation than men in the U.S., with men cyclists outnumbering women two to one (National Highway Traffic Safety Administration and Bureau of Transportation Statistics 2003; Krizek, Johnson, Tilahun 2004).

There are gendered trends in travel behavior across all modes of transportation, but the bicycle provides both additional layers of visibility and potential barriers. Nationally, general travel behavior patterns reveal differences between men and women in the purpose or destination of trips, the practice of trip-chaining, perceptions of street or traffic safety, and the implications of social roles in transportation. Bicycling can demonstrate similar trends, while also introducing additional factors of exercise, dress, and different safety precautions. Yet how do these patterns replicate and unfold through the planned design of streets? This study aims to explore the factors that underlie the

gender participation gap between men and women cyclists in the United States, and specifically in the Twin Cities. In an effort to narrow the participation gap, it seeks to address the question, how does gender relate to perceptions of the road, safety, and preferences in bike facilities and infrastructure?

The urban street and transportation network present the basic setting for the bicyclist's daily experience. The specific designs and plans of a street, as well as city and transportation planners, police enforcement, and traffic engineers all aim to regulate what modes of transit are accessible and have legitimacy on a road. For instance, not all streets provide the infrastructure to support bicycle use, or an atmosphere that encourages bicycling for transportation. Choosing or needing to bike as a mode of transportation in an American city is often limited by the auto-dominated road system. Zach Furness (2010, 5), author of *One Less Car: Bicycling and the Politics of Automobility*, alludes to the bicyclist's lack of rights to the street, claiming it as "a fringe mode of transportation in a country with more vehicles than licensed drivers." Either by law or through social regulation, the city streets wield a powerful influence over the activities and behaviors that are allowed to occur on them (Berlant and Warner 1999).

Yet city streets are ultimately public spaces that, ideally, provide equitable access to any user or city inhabitant. While a driving goal is to serve practical transportation needs, the spaces of the streets are inseparable from everyday social interactions and social practices (Koskela 1999). As the site where people must necessarily congregate in order to move from one location to the next, streets provide the backdrop for diverse encounters and the visibility and representation of different people and traveling practices. In a zine, *Dames on Frames*, produced by a bike-feminist class and

collaborative, a contributing author encourages readers to redefine the purpose of a street: "the street's role as a public space is too often overlooked. As the primary public space in any city, the street's social role is as important as its role in the transportation system. Through our dependence on the automobile for movement, we have allowed that social role to be undermined" (Wergin 2007). The bicycle offers an opportunity to experience the spatial realm of the street differently and to open it up for increased social interactions. The bicycle functions as one option, and an alternative among many transportation modes, that boasts additional benefits of environmental and personal health, affordability, enjoyment, and ease of use.

However the bicycle, too, has its own prerequisites and points of access to these benefits. The decision to commute by bike often requires extra effort and a level of willpower by the individual. Furness (2010, 5) quotes Portland bike activist Sara Stout who describes biking for transportation as, "At first bicycling is utilitarian, it's just how you choose to get around…but it becomes political really quickly because it's hard to get around. There are difficulties at every turn." Difficulties in a commute by bike can be imposed by street restrictions, the behavior of other street users, and an individual's personal lifestyle or needs. Gender, race, ethnicity, class, and other aspects of identity overlap to produce different spatial and social experiences in the urban street environment. In order to be used as an inclusive tool for reshaping the public sphere of the street, its own social exclusions must also be considered.

The spatial design of the street space can influence the personal decision to bike and either addresses the difficulties associated with urban cycling or it adds complication to them. The provision of bike-specific infrastructure or lack thereof, represents one way

that bicyclists can share the street safely. Bike-specific road accommodations are important to broaden the population for whom cycling is both attractive and feasible. The built environment is only a component of an urban street's character and functions, but it establishes a baseline for a street that must meet the needs of a diverse population.

Though there are a multiplicity of factors that intersect to reinforce streets dominated by the automobile, as well as multiple parts of an identity that are excluded from the current bike-commuter population, this study focuses on how the built environment of the street, gender, and the bicycle all relate to each other. As a female biker, I am often subtly reminded of my gender in the bike community. From the expectations of my speed, cycling behavior, or the assumptions of mechanical knowledge in a bike shop, I recognize when spaces and streets are predominantly male. Yet I also experience countless similarities among men and women cyclists alike as the streets of the Twin Cities become increasingly populated by larger numbers of bikers. The interest for biking in the Twin Cities is growing and as it grows, specific attention to the populations currently under-represented, such as women cyclists, can help bolster the local cycling movement and aid in narrowing the gender participation gap experienced in most American cities.

This paper seeks to address the factors that underlie the gender participation gap by focusing on the cycling preferences and travel behavior of women and men cyclists in the Twin Cities. I will begin by examining the ways in which gender affects travel behavior generally, and then the ways in which gender and social constructions of space may affect cyclists' travel behavior. The relevant literature incorporates comparative gender transportation studies with social representations of women bikers on the road,

and culminates in the grounding theory of Don Mitchell's "right to the city," which advocates for creating public spaces that are inclusive and democratic.

The following sections use primary data from a stated-preference survey, *Cycling Route Preferences*, which aims to uncover differences and similarities between men and women participants as they react to different aspects of a bicycle route. The survey was distributed online through Survey Monkey during the month of October 2010 and received responses from 238 men and women cyclists in the Twin Cities area. The survey records the extent of current bicycle use and typical characteristics of a chosen bicycle route to generate a sense of the sample population's cycling trends. It then draws a comparison to the current baseline with participants' stated preferences of infrastructure and the perceived level of importance to factors typically viewed as barriers. The analysis of the survey results attempts to discern how infrastructure can be a powerful tool to dictate behavior and movement on a street, both with exclusionary or inclusionary results.

My interpretation of the data suggests that the survey participants are a sample of motivated and dedicated cyclists, but whose preferences for infrastructure are still not fully met by the current Twin Cites transportation network. Additionally, the data suggest that while women and men participants share many similar cycling behaviors, some differences in preferences and experience prevail. I argue that women and men cyclists maintain different perceptions of the road that influence their experiences while biking and that specific attention to women's specific preferences can increase their participation as cyclists. Furthermore I argue that different aspects of the street's design and infrastructure influence peoples' participation in the creation and use of it as a public space. Female preference for the cycle-track, as a bike-specific road treatment that values

both efficiency and convenience with increased separation from motorized traffic, indicates gendered travel characteristics that appropriate infrastructure and design can directly address. Understanding the different perceptions of the street while cycling can guide policy decisions and inform street design to encourage more cyclists generally, and hopefully more women cyclists to begin to close the gender participation gap in American biking.

CHAPTER ONE: REVIEW OF THE LITERATURE

Contextualizing the Space for Female Bikers on Streets

To contextualize my research question of how the built environment affects men and women cyclists' perceptions of the road, I will begin by reviewing related general transportation and bicycle-related literature and studies. I will then focus on the connection between gendered travel trends and the role the bicycle holds historically and presently for women. The paper presents the conflicting role of the bicycle in the construction of gender – often heralded as a tool for female empowerment, yet also still steeped in a male dominated culture – and asks: how can these conflicting realities be reconciled? I will then delve into the impact infrastructure can have on shaping the ability to cycle, and how it may differ for men and women. Ultimately, the gender participation gap in cycling begs the question of how effectively do the streets operate as public spaces? Designed appropriately, a public space should serve and be shared by a diversity of populations, encouraging interaction, and avoiding exclusion. Applied to the bicycle, gender, and infrastructure, the street should offer safe opportunities to bike for men and women alike. A theory to examine the public space and open access to the street is the "right to the city," discussed by Don Mitchell (2003), which helps to frame the research question around the ways in which men and women, as cyclists, experience the street environment differently.

1.1. Gendered Travel Behavior

In 2009 an article in the *Scientific American* proclaimed that women are an "indicator species" for a bikeable city. In order to get more cyclists on the road, cities need to encourage and cater to women cyclists more acutely (Baker 2009). Gender is one of the factors among the current demographics of American cyclists in which there is a considerable gap – outnumbered 2:1 by males. The purposes, frequency, and distance of bike travel tend to differ among men and women. Dill and Gliebe (2008) found that women made about the same number of trips by bike as men, but the distances were often shorter. Women typically use the bike for the purposes of shopping and errands and for social and recreational trips, whereas men are more likely to bike to work (Krizek, Johnson, Tilahun 2004; NHTS 2001). These trends in cycling are echoed by national trends across all modes of transportation, as reported by the 2001 National Household Travel Survey. About half of women's trips are for family and personal business (errands, shopping, and children-related responsibilities) and only 13.4 percent of trips are work commutes. Comparatively less than 40 percent of men's trips are for family and personal business and 18 percent of men's trips are for commuting to work.

An understanding of why people are traveling differently and who is traveling differently can inform policy and planning decisions that define street and land-use patterns. Urban design movements such as Transit-Oriented Development, Smart Growth, and New Urbanism emphasize how different factors of the built environment, such as density or mixed-use planning, can influence travel patterns. From a transportation approach, the goal of compact developments is to provide opportunities that encourage the use of transit modes other than the automobile. If successful, the built

environment thus represents one layer of influence in a person's travel patterns. Several studies presented at the Conference on *Research on Women's Issues in Transportation* in 2004 by Krizek, Johnson, and Tilahun; Clifton and Dill; and McGuckin and Nakamoto, analyze the specific aspects of women's travel behavior that are affected by land-use and infrastructure planning. A study conducted by Clifton and Dill (2004, 89) investigates a critical question: "[Does] the built environment present barriers to or opportunities for women and men differently?" Their findings suggest that an environment that specifically includes pedestrian infrastructure is more likely to increase the likelihood of women walking. Though it focuses on walking patterns between men and women, the study also has much to offer the debate regarding women cyclists' perceptions of the streets. At a fundamental level, it draws out the positive relationship between providing opportunities for non-motorized transportation and the increased chances of people taking advantage of those opportunities. Furthermore, it suggests a demand or a preference for pedestrian-specific infrastructure among female pedestrians.

However, even with the support of appropriate design techniques, other social factors, such as uneven household and child-rearing responsibilities and perceptions of safety also influence travel decisions (Clifton and Dill 2004, 98). Nancy McGuckin and Yukiko Nakamoto's study (2004) on women's travel patterns focuses on the behavioral characteristic of trip-chaining. Trip-chaining refers to linking different short stops (30 minutes or less) into one trip. It is reported that women trip-chain more often than men, but overall trip-chaining for both men and women has increased since 1995. Women typically make more stops than men and the purpose and type of stops are also different. McGuckin and Nakamoto (2004) use the 1995 National Personal Transportation Survey

and the 2001 Nationwide Personal Transportation Survey in order to narrow in on the complexities of trip chaining. Their research finds that while both men and women increased their stops for childcare and household errands, women still made the majority of these stops while men more often stopped for a meal or a coffee en route to work (50). Though their study did not isolate any particular mode of transit, understanding the gendered patterns of trip-chaining is especially valuable in the context of bicycling. Trip chaining behavior differences can have significant implications for time constraints, distance traveled, and items carried. These factors of a bicycling commute require extra planning and may be dependent on whether appropriate bike infrastructure is available to allow biking as an efficient and convenient option.

1.2 Impacts of Lived Experiences and Images on Travel Behavior

Recognizing the different ways in which women and men navigate city streets in broad transportation trends and in bicycling directs attention to the layout of the street and how it may contribute to these differences. The street is a space intended for use by the public and is a critical corridor that connects people's daily activities. It is also a space that is in continuous use and that people occupy for substantial portions of time. As such, its function doubles as both a transportation corridor and a public space for the simple purpose of habiting. To address how different genders perceive and experience the space, the design of streets must directly engage with its latter role as a public space. I use theory on the social production of public space in combination with travel behavior research to understand how roads act on each of its roles.

Edward Dimendberg (1992) discusses one such theory of public space, as outlined in Henri Lefebvre's (1991) *Production of Space*, and reiterates that any urban plan that does not address the lived experiences of the urban dweller is inevitably limited. The discussion pertains to public spaces at large, but in direct relation to streets, the inattention to people's lived experiences helps explain the marginalization of non-motorized transportation on roads, as well as the differences in gendered perceptions of the road. To combat exclusive urban planning, Don Mitchell (2003, 18) recounts Henri Lefebvre in his declaration that public space ought to be an *oeuvre*, a work that develops through the participation of all urban inhabitants. Furthermore, the experience of streets is regulated through different social layers, and Dimendberg (1998, 36) argues that in order for full participation, the context of each individual needs to be accounted for, as public space "begins with the individual body that is always already spatially positioned and marked by differences of gender, race, and class." Thus the ability to realize the goal of a public space open to and created by all of its users is often limited by pre-existing social barriers.

Gender introduces one such socially constructed barrier present in the cycling community and on roads. Women often encounter social, rather than physical, constrictions to cycling on streets. For example, in a zine written by Portland bike advocate, Elly Blue, titled, *Taking the Lane, Volume One: Sharing the Road with Boys*, Blue recites and analyzes her own experiences as a woman biker on the street, in local bike shops, and as a community organizer. She explains how media portrays a simplified rendition of the cycling gender gap, "the reason is simple: women are more concerned about safety and don't want to mess up their hair or get sweaty." She quickly points out

other factors that complicate the matter, such as how women are often still responsible for the majority of errands and child-rearing duties (Blue 2010). Transporting kids and running errands often entail multiple trips, time constraints, and further distances. Furthermore men own and operate much of the bike industry, thus creating an atmosphere of intimidation and pressure in bike shops, especially in regards to mechanics. Elly Blue (2010, 3) further emphasizes how barriers can hide the presence of women who are already active in the bike scene, "What you don't hear as much about is the experience women have not just as individuals riding on the road, but as participants – and leaders – in bicycling communities."

Women cyclists play pivotal roles in the development of the bike movement across the U.S. Community bike spaces are often founded, organized, or run by women bikers who want to address gender issues in biking and bike mechanics. Many bike shops across the country offer Women and Transgender Only (WTS) open shop nights or mechanics classes (Furness 2010, 185). Shelly Jackson, a bike mechanic in New Orleans, and a writer for *Chainbreaker* zine, expresses barriers in daily routines, "Biking *is* different for us women, from trying to get respect as a mechanic or even as a customer in a bike shop, to being taken seriously when we apply for jobs as messengers, deliverers, or in shops as mechanics, and even (surprisingly in this day and age) how we dress on bikes" (Furness 2010, 181). The anxieties some women experience before entering the American cycling scene and once a member of the biking culture stem from a lack of visibility in public, or a limited representation that can narrowly portray the role of the female cyclist.

Historically, women entered the mainstream cycling community with the advent of the "Safety" bicycle in the 1880s. The Safety bicycle featured equally sized front and rear wheels and introduced the bike frame and braking mechanism still in use today. The Safety cycle presented a bike model that was appropriate for the mainstream populace to afford and ride, including women (Herlihy 2004). For women riders, it provided new opportunities for geographic mobility and independence, as well as sparked a more practical dress reform during the height of Victorian era styles and ideals. Challenging the strict dress code of the 1890s of corsets and long, heavy skirts, women cyclists instead introduced "bloomers," long, baggy trousers that were cinched at the knees. "Bloomers" offered more practical attire that allowed women to cycle more comfortably, as well as represented broader, radical conceptions of femininity and cycling (Herlihy 2004). Leaders of the Women's Suffragist Movement, Susan B. Anthony, Elizabeth Cady Stanton, and Francis Willard, embraced the personal liberations of the bicycle by riding bikes and contributing to a collection of mechanic manuals, touring books, and new cycling road maps produced by women riders (Zheutlin 2006).

However, though the Safety bicycle opened up cycling opportunities for women at the end of the 19th century and dress reform challenged the status quo of feminine conduct, the bike industry reacted to female empowerment with efforts to control the extent of women's involvement in cycling. The physical frame of a women's bike was designed to accommodate a skirt, with a lower top tube; to lessen the chance of sexual stimulation from the bike saddle by placing an open slit in the seat; and to be as upright as possible to encourage women to bike slower than if it had drop-down handlebars (Dando 2007). Additionally, the change in women's garment shocked the public.

Newspaper articles of the 1890s observed, "scores of bloomer-clad Parisian women invaded the public parks on their bicycles, helping to popularize the costume…in 1895, the police of Victoria, British Columbia, decreed that 'bloomers are not suitable for ladies' street wear, even when worn as a bicycling costume'" (Herlihy 2004, 269). As women entered the public sphere in new radical attire and with profound mobility, their visibility became a threat to conservative members of society and even law enforcement officers. Thus, the bike's historical role of both female empowerment and reactionary restrictions from the bike industry and broader public are critical foundations for observing changes in the bike movement of the 21st century.

The fascination with women cyclists persists in contemporary media as well. When women are spotted biking in American cities today, they can all too often become categorized as a different breed of biker than the average, or male, cyclist. Two articles published in the *New York Observer* (2007) and the *New York Times* (2010) focus on the "sex appeal" of women cyclists. The *Observer* begins, "Meet the beautiful bicycle girls of New York, a breed that bears little resemblance to the hard-charging, Spandex-short-wearing species of 20 years ago" (Regan 2007). The *Times* article expresses the idea that these new women are opting out of the more athletic and utilitarian uses of the bicycle and using it instead as a "stylish appendage." *NY Times* author La Ferla writes, "Roadways are the new runways for these style-obsessed cyclists, their bikes no mere conveyance but a racy adjunct to their look" (La Ferla 2010). The authors' tones suggest a particular image of urban female cyclists that highlights fashion as femininity while diminishing "utility." Voiced in major media press, the articles increase the visibility of a cycling population, but it pigeonholes women cyclists as a seemingly unified subgroup

and within a fashion-oriented context – placed under the "Fashion and Style" section of the *New York Times*. The narrow representation of a female cyclist in the media produces one of the social layers that intersects with gendered travel behavior and perceptions of the street.

What the two articles fail to capture is that there is as much diversity within the female bike community as within the entire population of cyclists. Biking in high heels may work for one woman, but another may prefer sandals, and the next clipless pedals and cleats. A female custom wheel builder in Portland, Oregon re-emphasizes the diversity of needs and preferences based on her role as a woman in the bike industry: "I want my nice china, but I also want a nice crescent wrench. It doesn't have to be one or the other… She's that kind of woman or this kind of woman. And I'm not. I'm dynamic, we all are" (Blue 2010). The versatility of the bicycle and bicyclists allow it to be fashionable, utilitarian, and feminine simultaneously, without being mutually exclusive. Moreover, many of the uses are decidedly not fashion-oriented, according to a survey conducted by the Association of Pedestrian and Bicycle Professionals in May of 2010 in which over 13,000 women participated. Prompted to discuss their concerns with biking, the responses overwhelmingly listed issues with drivers and infrastructure as leading inhibitors, with only low levels of concern with factors related to clothes and appearance (APBP 2010). Limited visibility of female cyclists through media represents one medium in which the public space of the street is socially mediated and potentially exclusive.

The popularized images of women on bicycles contrasts with the overwhelming visibility of men bikers in the streets, creating a discrepancy in visual representation that

to an extent reflects the gap in participation of female riders to male riders. A perception of a male-dominated space not only seeps into images and fears of streets, but also into the socially constructed understanding of the act of bicycling. Namely, because the bicycle is a human-powered mode of transport it also reveals inequalities in popular notions of exercise. As a physical exertion and outdoor activity, biking falls within the male arena of fitness, in which women widely participate, but – as asserted by feminist theorist Shari Dworkin – are limited by ideologies (not biology) of femininity and a "glass ceiling" on their muscular strength. Regardless of what women *can do* in muscular growth, emphasis is structured rather on what women *should do* in maintaining feminine bodies (Dworkin 2001, 334). Popular perceptions of exercise and sport certainly feed into the many prerequisites for urban cycling. Pucher and Buehler (2008) and Mapes (2009) all suggest that women are more risk-averse and therefore require different street designs and infrastructure in order to welcome their participation. Urban cycling implies a contract between the rider and the street to take on certain physical and mental burdens: the willingness to adapt to imperfections in the physical road itself, such as potholes or construction; an agreement to a moderate level of physical fitness; and an acceptance to be vulnerable in traffic, i.e. without a surrounding steel encasing (Furness 2010, 75). The social images of women cyclists historically and presently are closely intertwined with lived experiences and perceptions of the urban street environment. An understanding of the dually empowering and restricting aspects of bicycling for women provides a gendered angle for next contextualizing the bicycle's space on the road as a mode of transportation.

1.3 Sharing the Road

"Share the Road" is a gesture towards more inclusive streets that appears on bumper stickers as well as legally through signage on many urban streets. However, the effectiveness of a sign or the thought is varied and can be simply a cheaper form of bicycle integration than actual infrastructural changes to the streetscape. The streets are largely dominated by the presence of and preferential politics towards the automobile. From 1970 to 1990, the number of vehicle miles traveled in the U.S. increased by 90% and have increased consistently to the point where the average person drives 10-12,000 miles per year, and mostly just to run errands or seek entertainment (Kaye 1997). The proliferation of the automobile has impacted American lifestyles on multiple scales, from encouraging sprawling suburbs and metro-regions to privatizing the common public space of the street.

The Federal Highway Act of 1956 ushered in the Freeway Era of post-war transportation, boasting an unprecedented investment of public money in transportation. The federal government paid for 90% of the national interstate system, creating over 41,000 miles of public "space" that is only accessible in a privately owned automobile.

The roads expanded the spatial context for cities and suburbs and resultantly separated the spheres for home, production, and consumption. Many people participated in the shift to an auto-dominated society, with the number of drivers' licenses increasing by 20% in the post-war years (Kaye 1997, 21). Continuing sprawl and automobile-centered transportation results in roughly 120 million people who commute by car each day, 105 million of whom drive alone in separate vehicles. Author Zach Furness (2010, 7) contends that, "this solitary/collective practice is a key practice in defining what it means to be American." Driving a car is an expected right on most American streets, yet its tendency to occur as a solitary and confined activity creates more of a pseudo-public space, in which people are alienated from each other. Even for short distances, of one mile or less, 69% of all daily trips are made by car (5). The decision to drive is both encouraged by the design of the streets, as well as justifies creating new streets geared toward the automobile.

The commitment to providing direct and abundant corridors for automobile transportation is logical, politically, for the majority of Americans who rely on the automobile for daily commuting and other travel needs. However, as the predominant physical space that is publicly owned in a city, streets that cater to only one mode of transportation fail to operate as a public space for people. Don Mitchell, in the *Right to the City* (2003), as well as Henri Lefebvre, in the *Production of Public Space* (1993), declare that opportunities for interaction are essential to creating and maintaining healthy public spaces. The possibility for interaction, however, is easily erased by the isolation created by auto-dominated streets. Though Mitchell's discussion of public spaces focuses on the social interactions of marginalized populations in the parks, sidewalks, education

institutions, and other public arenas of cities, the guidelines for healthy spaces also apply to the streetscape. Streets are defined as a "traditional" public space by the Supreme Court's classification (Mitchell 2003). Traditional public spaces are always public and have the least number of restrictive governing laws. Other types of public space include "dedicated" spaces, such as plazas, schools, trails, and the grounds at federal buildings (Mitchell 2003, 48). Roads, as a traditional public space, are further categorized by their functional purpose as primary arterial, minor arterial, and city road (MetCouncil 2010). They are categorized and planned based on the city's needs for governance, but often do not address the diversity of lived experiences and needs of the urban inhabitants.

A priority of "safe" street design is to be orderly and controlled. Traffic engineers design streets to be predictable and avoid confusion – an important combination for preventing accidents; however, as a result, roads deliberately cater to one mode of transportation and exclude other modes of travel and behavior. The failure to address inter-modal travel and connectivity embodies a critical conflict in public space: the need to be both orderly and disorderly. Planners deem safety and order as primary concerns, yet Mitchell argues that without a balance of order and disorder public spaces cannot function democratically (Mitchell 2003, 132).

Take for example the *woonerf,* a type of street design practiced in the Netherlands since the 1970s. A *woonerf* translates directly into a "living yard" and demonstrates more radically how "Sharing the Road" between different modes of transit can be achieved. The *woonerf* is designed as a curvilinear street where the lines of usage by motorists and non-motorists are blurred and no boundaries exist. Mark Roseland (2005) explains in *Toward Sustainable Communities* that pedestrians and bikers are not just limited to

"small islands," but "are integrated into the whole road network." The curves in the road limit a driver's sight distance and the lack of boundaries between the sidewalk and the street demands that a driver be increasingly aware of the periphery. These street changes subsequently force car drivers to slow down and become more cautious and aware of their surroundings. Limiting drivers' long sightlines is just one technique used to slow traffic and create safer streets for non-motorized users. Additionally, trees and intermittent and sparse parking adds to the street's aesthetics and avoids the "steel wall" that would typically form along the curb. A variety of traffic-calming techniques are employed to allow multi-modal uses of the street, as well as resulting in a diversity of users.

A road lacking boundaries and clearly defined roles for each user may appear disorderly, but even the *woonerf's* more fluid flow of traffic has a certain rhythm. The Dutch government established official traffic regulations for *woonerfs* in 1976, but in practice all the inhabitants and users of the street organize the flow of traffic cooperatively. The shared space breaks down the car-dominated transportation hierarchy and holds the users collectively accountable for maintaining a safe "living yard." Roger Geller, the bicycle coordinator for Portland, Oregon observed the variety of users on the streets of Amsterdam, "Look how close everybody comes and nobody seems to mind… It's a complicated dance and everybody knows the steps" (Mapes 2009, 61). A *woonerf* is an example of how a street can be designed as a more inclusive public space for different modes of transportation and increase opportunities for interaction between its users.

The varied lived experiences and travel needs of the street users suggest that disorder is inevitable and that chaos could even be positive (Mapes 2009, 23). Without

the visibility of different modes of transit and a diversity of individuals, the street lacks opportunities for public debate and participation. The *woonerf* provides an example of how Mitchell's concept of simultaneous order and disorder in a public space applies to a street. Further, it advocates that streets can effectively plan for disorder and rearrange the intentions of the street. Rather than planning for exclusion and deliberately ignoring bicyclists and avoiding gendered characteristics of travel behavior, streets can integrate the inevitable diversity of its users and recognize their right to access and use the road.

1.4 The Role of Infrastructure

While the previous section illustrates the prevalence of the auto-centric landscape in the U.S., bicycle scholars John Pucher and Ralph Buehler demonstrate that an auto-dominated urban society does not have to be the norm. They draw extensively on examples from different European cities in Germany, the Netherlands, and Denmark to prove how a certain balance of "push and pull" measures can lead to a bike mode share as high as 55 percent of all trips into Amsterdam's city center and 50 percent in the city of Muenster, Germany in 2000 (Pucher and Buehler 2007; Mapes 2009, 53). By comparison, the two American cities with the highest percentage of bike commuters, Portland, OR and Minneapolis, MN, have a 5.9 percent and 4.3 percent mode share, respectively, according to a 2008 survey (Friedman 2010). Though the cyclist population is growing, the American cities are nowhere near a road network that supports more bicycles than cars. Additionally, while men heavily dominate the U.S. bike scene, outnumbering women's cycling trips by 2:1, in contrast, women cyclists actually outnumber men cyclists in the Netherlands, making up 55 percent of all riders across the

country, and in Germany women make up 49 percent of all bike trips (Baker 2009). Examples in European cities suggest that just as an auto-dominated city can be dismantled with the right street designs and policies, so too can the gender gap be closed.

Pucher and Buehler (2007) speculate that the disparity in gender among urban bikers is closely linked with the safety of streets. There are five times more bicyclist fatalities in the US than in the Netherlands and three to four times more than in Germany and Denmark. Furthermore, while cycling has increased enormously in these three countries since 1970, cycling fatalities have declined by 70 percent. Conversely over the same period, cycling fatalities declined by only 30 percent in the U.S. (Pucher and Buehler 2007, 10). Pucher and Buehler argue that there is a strong correlation between increasing cycling facilities and increasing overall safety. Jeff Mapes (2009) purports that another factor in the safety equation is a sense of safety in numbers: the more facilities, the more cyclists, thus the safer it is for more people to choose the bicycle. Increasing the sheer number of cyclists can also mean increasing the number of women cyclists, who are typically considered more risk-averse in traffic situations (Mapes 2009).

How exactly then do the celebrated bikeable cities of Amsterdam, Copenhagen, and Muenster incorporate the bicycle into the city streets and create equal opportunities for both men and women cyclists? Pucher and Buehler categorize the infrastructure under eight different categories: 1) bike paths and lanes; 2) traffic-calming; 3) intersection modifications; 4) bike parking; 5) integration with public transport; 6) training and education; 7) promotional events; and 8) complementary taxation, parking, and land-use policies (2007). Combined, these methods create an urban transportation network in which bicycling is more attractive, efficient, safer, and less expensive than driving a car.

Each separate component is a positive step, but supplemental infrastructural and social support is necessary to make cycling a desirable and safe mode of transportation.

1.5 The Right to the Street

The notion of the "Right to the City," theorized by Don Mitchell and Henri Lefebvre is an important framework I use to understand the public nature of a street and the ways in which the bicycle and gender are factored into its use. Lefebvre defines public space as "the product of sometimes competing ideologies about what constitutes that space – order and control or free and perhaps dangerous interaction" (Mitchell 2003, 129). Streets are contradictory as well, designed for safe and efficient travel, but at times stigmatized as dangerous places where loitering is prohibited. Streets are visible and influential public spaces that define the layout of urban development and direct the movement of its inhabitants. They are designed according to specific traffic safety laws and are carefully engineered to move people around with optimum efficiency. The street can also be a vibrant place for interactions and encounters amongst strangers and city residents. Don Mitchell (2003) describes how streets can "define an urban culture" given they inherently provide a space for the visibility of different groups, and the opportunities for representation or protest. Yet, while the physical streets are necessarily public as they dictate the flow and movement of people and goods across space, the context of the areas the streets travel through may be extremely exclusionary. Lefebvre and Mitchell explore who has the right to the city and its public spaces and how the rules of that space come to exist.

The paradox to a street's publicness is the strict regulation through which government policy and social mediation ensure a street's safety. Notions of "safety" vary depending on what neighborhoods a street travels through and for what transit and demographic users the street caters to. In addition to gender, race, ethnicity, and age represent other marginalized factors missing from the "young, skinny, white male" American cyclist scene. In Mitchell's (2003, 136) *The Right to the City*, he similarly uses a marginalized population – the homeless – as an indicator species for the health of public spaces. The homeless represent how a public space fails to be democratic and public. The contradiction of the homeless is that though they are confined to public spaces for living purposes, they are unwelcome and excluded from public participation in that space. Each public space carries an underlying code of conduct and rules of temporality. The homeless are stripped of their right to public space because they surpass the timeframe and typical uses that a visitor to that space would use (Smith 1992). Access and accepted behaviors in public spaces are designed based on social norms, and the physical space becomes inseparable from the social interpretation and expectation placed upon it. The marginalization of the homeless in public space is steeped in notions of "safety" and social expectations for a shared space. Streets carry a similar code of conduct that often pertains to the automobile first, and to other modes of transit second. A pedestrian mall or bus-only lane represents an exception, but the inclusion of cars on the street is never the exception – virtually always the norm.

The foundation of the "right to the city" provides a framework to understand how social norms and expectations are implemented and ingrained as policy or practice in the city. As discussed previously, Lefebvre introduces the city as an *oeuvre*, or as Don

Mitchell summarizes, “a work in which all its citizens participate.” In the open space of the city, heterogeneity is inevitable and different people must negotiate (whether in cooperation or in conflict) over the shape of the city and its terms of access. Mitchell (2003, 18) analyzes this further and questions whether, in this process of working in the “oeuvre,” are the spaces of the city produced *by us* or *for us* – through participation or expropriation by a dominant class? Looking back to the *agora*, the classic place of assembly in ancient Greek civilization, we can see that both forces are at work in the production of that space. Its purpose is to provide a public gathering of debate and politics in the city. The intended user is the “citizen,” or only the white, land-owning male of that time. Thus it is clear that public spaces are both actively created *by* the people in the space, as well as created *for* a certain demographic. Applied to the street, how is safe access granted to different people and how are different modes of transportation included in its use?

Lefebvre frames these forces of participation and expropriation in space through a triple dialectic: Perceived Space (*le perçu*), Conceived Space (*le conçu*), and Lived Space (*le vecu*). The Perceived Space is the general representation of space that is relatively objective and formal in its production (Dimendberg 1998; Purcell 2002). This realm is carefully controlled and orderly, designed by planners, civil engineers, and municipal policies. Conceived Space is the way in which space is mentally constructed. It allows for social mediation and appropriation. The Lived Space is the realm of lived daily experiences, and where the physical and social realms of the perceived and conceived intersect (Purcell 2002). It is embodied at the individual and subjective level and describes how the different forces in a space affect those who use it, and distinguish those

who are unable to use it (Dimendberg 1998, 21). Thus the right to the city and streets is determined by the constant interplay of political and social productions of space. As in the context of the *agora*, membership is conventionally limited to the national citizen. In contrast, Purcell (2002, 102) reiterates Lefebvre's argument that "whereas conventional enfranchisement empowers national *citizens*, the right to the city empowers urban *inhabitants*."

The actual realization of who practices the right to the city depends upon who is visible in that space. On a street, visibility is a clear driver of what purpose the street is meant to serve. Is it intended to be a purely transportation corridor or serve commercial, residential, or recreational interests, or a mix? What types of transit does it support and cater to? Are there sites for interaction or are the sub-spaces of the street – the surrounding neighborhood, the street corner, and the sidewalk and traffic lanes – entirely separate spheres? What are the populations and demographics represented on a particular stretch of street? Mitchell (2003, 33) purports that "representation demands space." Likewise, in a discussion on the politics of visibility in U.S. cities, Eugene McCann (1999, 168) explains how marginalized groups form "spaces of representation…to represent themselves to the wider public." Cyclists, as a marginalized mode of transportation, attempt to carve out their right to use the street by increasing their visibility. The Critical Mass bicycle rides that began in San Francisco in the 1970s demanded that cyclists were given a space on the road among motorists. Critical Mass rides involve a mass of cyclists who gather and flood the streets along a spontaneous route in various cities across the U.S. These rides have a controversial history that often led to arrests and even violence with police, particularly in NY, as a result of contesting

space. Though each side, the cyclists and the police, were not always innocent, Critical Mass rides were an example of *taking space* in order to demand representation.

At the personal level, where the perceived and conceived spaces are experienced, the individual can offer insight into how public spaces impact lifestyle and behavior. Mark Davidson (2007, 492) discusses the individual as an *inhabitant* who partakes in the act of 'habiting.' Through the lived experiences of individuals, a process of " place-making" occurs that is "generated by the agency of individuals." Thus, the users of the street are active agents in producing how the street becomes a place and give meaning to that place. Their travel behavior helps shape the way a street is used and perceived, but it is also influenced by the opportunities to act or travel in certain ways. By analyzing the priorities people hold when determining their cycling route and various traveling characteristics, streets can become more inclusive spaces that directly address the needs of the inhabitant.

CHAPTER TWO: DATA AND METHODOLOGY

2.1 Research Objectives

In order to engage with the lived experiences of people currently using the streets, this study aims to determine the factors that underlie the gender gap in American cities, such as how gender relates to perceptions of the road, safety, lifestyle and preferences in bike facilities and infrastructure. To what extent are men and women cyclists currently using the bike and how would they prefer to travel by bike? How does both the design of the street and lifestyle factors influence the extent to which they choose to bike?

To explore these questions, this study uses an online-stated-preference survey directed at women and men cyclists in the Twin Cities of Minneapolis and St. Paul, Minnesota. As a directed local study, the responses can be used to observe trends in a specific geographic area and guide bike planning and infrastructure decisions in the Twin Cities.

2.2 Setting Context

Minneapolis and St. Paul, Minnesota provide an interesting case study for exploring the infrastructure preferences of cyclists and how they relate to gender. Minneapolis was named America's Number One bike city by *Bicycling* Magazine in 2010 (Freidman 2010). It is one of four cities in the Non-motorized Transportation Pilot Programs granted $25 million in funding in 2005 under the Safe Accountable, Flexible, and Efficient Transportation Equity Act: A Legacy for Users (SAFETEA-LU). The Non-motorized Transportation Pilot Program granted federal funding to four different communities to use over a five-year period on biking and walking projects. The funding

was placed under the control of BikeWalk Twin Cities (BWTC), an organization created out of a local non-profit, Transit for Liveable Communities (TLC).

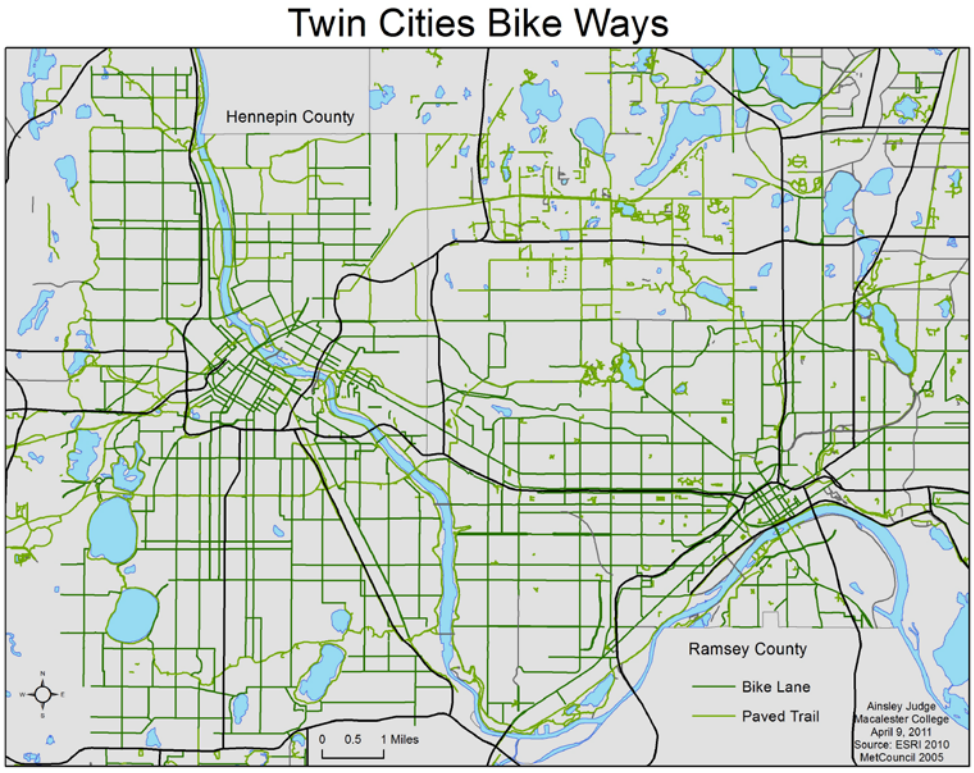
Federal funding dedicated to promoting biking and walking has increased significantly since the 1990s. After decades of auto-dominated federal policy, attention began shifting towards issues of congestion, pollution, and traffic volume. Alternative transportation appeared in the 1991 Intermodal Surface Transportation Efficiency Act (ISTEA), which earmarked funding for bicycle and pedestrian projects and began the Congestion Mitigation and Air Quality Improvement Program (CMAQ) (The National Bicycling and Walking Study 2010). In 1990 there was $6 million in federal spending on bikes and pedestrians, yet by 1997 this had increased to $238 million. SAFETEA-LU was allocated $1.2 billion in 2009, which included funding from the American Recovery and Reinvestment Act (ARRA), in order to integrate transportation systems, offer more transportation options, and encourage more biking and walking. The U.S. Secretary of Transportation, Ray LaHood, expressed his support of the bill, "Fostering the concept of livability in transportation projects will stimulate America's neighborhoods to become safer, healthier, and more vibrant" (The National Bicycling and Walking Study 2010, 13).

Benefiting from the increased federal attention and funding to alternative and safe transportation modes, Complete Streets policies have now passed in 121 different areas since 1971, with 43 new jurisdictions adopting the policy in 2009 alone (14). Minnesota passed Complete Streets policy on May 15, 2010 with bi-partisan support and collaboration with the Minnesota Department of Transportation (MnDOT) (Fawley and Bly 2010). The MN Complete Streets Law defines "Complete Streets" as

> "The planning, scoping, design, implementation, operation, and maintenance of roads in order to reasonably address safety and accessibility needs of all users of all ages and abilities. Complete streets considers the needs of motorists, pedestrians, transit users and vehicles, bicyclists, and commercial and emergency vehicles moving along and across roads, intersections, and crossings in a manner that is sensitive to the local context and recognizes that the needs vary in urban, suburban, and rural settings" (MN Complete Streets Law 2010).

Minnesota also established statewide goals to increase biking and walking as solutions to cut carbon dioxide emissions under the Climate Change Action Plan, which includes 36 states (19). Minneapolis additionally signed the US Conference of Mayors Climate Action Agreement, which established local development requirements for bicycle facilities. In Friedman's (2010) review of Minneapolis as the "#1 Bike City," a local biker credits "how great our government has been" in creating a bikeable city.

Figure 2.1



Minneapolis boasts the second highest bike commuter population for a major city, 4.3% of the working population, according to the 2008 U.S. Census American Community Survey. Portland, OR maintains the highest percentage of the population that commutes to work by bike at 5.9%. Minneapolis and St. Paul already share an extensive network of 44 designated on-street bike lanes and 84 miles of dedicated bike paths, as Image 2.1 illustrates (Friedman 2010). Given the relative success of Minneapolis and St. Paul as a bikeable city, as well as the recent political support and access to federal grant funding, the Twin Cities' cyclists are both familiar with different biking options and can have real impact on where improvements are made. The funding from SAFETEA-LU is channeled through the non-profit, BikeWalk Twin Cities (BWTC), that has allocated money

and research into bike plan proposals, advocacy, education, and other community organizations' and non-profits' projects. BWTC, Transit for Livable Communities (TLC), and St. Paul Smart Trips are three organizations that regularly do Bike and Pedestrian Counts at select locations around the Twin Cities as a way of cataloguing observation data on biking and walking. Using stated-preference data to understand Twin Cities' cyclists' perceptions of their city's bike infrastructure can offer a reflection on what it means to live and bike in supposedly America's #1 Bike City, and can point to where the gaps still remain.

2.3 Existing Relevant and Local Data Sources

Existing studies on travel behavior include the large datasets collected by the National Household Travel Survey of 2001, the 2002 National Survey of Pedestrian and Bicyclist Attitudes and Behaviors (conducted by the U.S. Department of Transportation's National Highway Traffic Safety Administration, NHTSA, the Bureau of Statistics, BTS, and the Gallup Organization), and the Public Use Microdata Sample (PUMS) from the 2000 Census. These surveys help identify broad trends in travel behavior across the U.S. However because bicyclists make up only 0.4% of reported trips made in the 2001 NHTS, the large samples of these surveys hides the intricacies of bike usage and statistics.

Other locally pertinent studies to Minnesota and the Twin Cities are the MN Department of Transportation's Statewide Omnibus Study of 2003-2004 and the 2000 Travel Behavior Inventory (TBI) for the Twin Cities Metropolitan Area. The Omnibus Study was a stated-preference survey conducted over the phone using a random sample

of residents to rate the importance of cycling facilities and infrastructure. It surveyed a mostly equal proportion of men to women, but it was focused largely in the suburbs (72% of respondents), and thus not necessarily reflective of urban cycling preferences. Disparities in gender included the importance of paved shoulders and lighting on bike paths, of which women were more likely to rate as "very important" than men. In regards to safety, women were more likely to be concerned with a lack of paths and poor road conditions, while men more often reported unsafe practices of drivers and cyclists (Krizek, Johnson, Tilahun 2004). The TBI gathered data on household travel from the NHTS but at a specific smaller geographic scale and sample size, narrowing in on different mode-shares.

The Association of Pedestrian and Bicycle Professionals (APBP) conducted a national survey on Women and cycling in the spring of 2010, targeted specifically at women. The survey was distributed online and received responses from over 11,000 American women (Sibley 2010). My survey used the questions from the APBP survey as a guide, but directs them toward a smaller scale in the specific urban setting of St. Paul and Minneapolis. While the APBP is useful to track trends in women cyclists' travel patterns, this study uses responses from both women and men in order to draw comparisons.

An additional local study, conducted through the University of Minnesota by Krizek, Johnson, and Tilahun (2004), compiled the results of the NHTS, TBI, Omnibus, Public Use Microdata Sample (PUMS), and another local study by Tilahun, Levinson, and Krizek (2004). Through analyzing the data collected by five different datasets, the study examined frequency of cycle trips, commute-only behavior, urban versus suburban

trends, as well as infrastructure preference by gender. The findings concluded that women make fewer commuter trips by bicycle, a common trend throughout the literature, but it challenged other assertions that women's trip distances are shorter or that they make fewer recreational trips than men. In order to further the research this study begins, the authors suggest a more extensive analysis of available datasets and "direct questionnaires to both current and potential women cyclists" (Krizek, Johnson, and Tilahun 2004).

Tilahun, Levinson, and Krizek (2004) use an adaptive stated-preference (ASP) survey of 127 civil service employees at the University of Minnesota. The survey was created through a computer algorithm that measured how respondents valued travel time with certain bike facilities – specifically how much additional time respondents were willing to travel in order to make use of higher-quality bike facilities. Dill and Gliebe (2008) similarly explore the relationship between travel times, the built environment, and mode choice. Based in Portland, OR, the study used global positioning system (GPS) technology to track 166 bicyclists in 2007 and the distance, purpose, frequency, and supporting infrastructure of the participants' cycling trips.

METHODOLOGY

2.4 Survey Recruitment and Participation

The survey I created for this study, *Cycling Route Preferences* was distributed in 2010 to fifteen different existing online list-serves and community forums of Twin Cities' bike-related organizations (see Appendix B). The organizations consisted of non-profit alternative transportation advocacy groups, bike-specific non-profits and shops, online

community bike blogs, bike-feminist groups, and employee bike e-mail list-serves. The fifteen organizations were chosen through established connections of my own involvement in the Twin Cities bike advocacy scene as well as through networking within the local bike circle. Though not exhaustive, the organizations represent a range of different sizes in membership and funding, as well as geographic location and focus across the Twin Cities.

Using the existing membership of these organizations the survey was distributed to individuals who already subscribe to news updates from the selected organization. Through this method, I was able to target people who cycled regularly in the Twin Cities. However this also meant that access to the survey was limited to a self-selected group of people who not only cycled already, but also were 'active' or at least connected to advocacy and community bike organizations online. Though the results cannot offer explanations of why individuals do not choose to bike, they can instead contribute to an understanding of the local extent of bicycle use in the Twin Cities and the factors that influence its use. A focus on gender and the characteristics of women cyclists, currently, can guide policy towards bike infrastructure and facilities that also cater to women's stated preferences.

The survey was administered during the month of October 2010 and received responses from 238 people. More women responded to the survey at 62.3 percent than men at 36.8 percent and "other" at 0.9 percent. Respondents also identified as predominantly white (85.7%). The majority, 81.1 percent, worked away from home with 6.3 percent of respondents working at home and 11 percent unemployed.

2.5 Survey Structure

The format of the survey contains four sections: "Characteristics of Your Bicycle Trip," "Cycling Route Preferences," "Environmental Perceptions," and a demographics section. The first section, "Characteristics of Your Bicycle Trip" gathers empirical data regarding the purpose, frequency, and distance of trips in a typical week. It also addresses trip-chaining, the act of stringing multiple short trips (30 minute stops or less) together in the same journey, as defined by McGuckin and Nakamoto (2004). Trip-chaining as a travel pattern is increasing for both men and women of all transportation modes, but is often reported to affect women with children and household responsibilities more (McGuckin and Nakamoto 2004). The final question of the first section asks respondents to rank listed factors that may motivate them to bike.

The "Cycling Route Preferences" section presents seven scenarios for different bicycle infrastructure designs on a street with visuals and written descriptions. The examples chosen are of infrastructure options both currently present in the Twin Cities, such as the Midtown Greenway as an Off-Street/ Separated Bike Path and an On-Street Bike Lane, as well as options available in other cities but not yet employed locally (see Figure 2.2). The respondents were asked, depending on the purpose for which they were biking (specifically whether it was to commute to work, school, do errands or shopping, or for recreation) what street design they preferred and what street design they typically used. It has frequently been concluded that the built environment and the presence of bike infrastructure and facilities often encourage increased bike usage and can increase a cyclists' perception of safety (Dill and Carr 2003; Pucher and Buehler 2007; NHTSA 2003; Mapes 2009). Therefore gathering responses of both preferred and typically used

bike infrastructure can highlight where individuals may wish to see changes in the available infrastructure. By separating the route option by trip purpose, the survey addresses the different needs and demands of cyclists according to different destinations or purposes.

The survey questions seek largely subjective responses about individuals' preferences and behaviors. Though the second section, "Cycling Route Preferences" asks cyclists to compare the routes they *prefer* with those they *typically* ride on, the design of the survey gathers stated preferences rather than *revealed* preferences. Dill and Carr (2003) note that "actual behavior does not always reflect stated preferences or desired choices," a point which creates limitations to the results of this study. However, the purpose of the study is to develop an understanding of cyclists' perceptions of the environment and how they imagine or perceive certain infrastructure, road, and lifestyle factors as impacting their decision to cycle.

Figure 2.2: Bike Infrastructure Options

Off-Street/ Separated Bike Path

- Bike and pedestrian only
- Entirely separated from street
- Typically very few intersections or traffic lights

Cycle-Track

- Bike and pedestrian only paved path
- Typically alongside street and separated by curb
- Painted or brick to distinguish it from the street

On-Street Bike Lane

- Bike lane painted into an existing street, typically to the right of the car travel lane.

Bicycle Boulevard

- Shared road on which cars and bikes share priority in the lane of traffic
- Marked by a large bike + arrow symbol painted onto street

Buffered Bike Lane

- A Bike lane painted onto the street, but with a buffer painted in between the bike lane and the lane of car traffic

The third section, "Environmental Perceptions," focused on perceptions of safety and how factors of the road, the built environment, and the individual's lifestyle influenced the decision to bike. Studies and literature assert that safety is correlated with appropriate bicycle infrastructure, so as appropriate infrastructure increases, actual safety – or perceptions of safety – do as well (Buehler, Pucher, and Kunert 2009; Garrard, Rose, Lo 2008; Handy 2004). Perceptions of safety and the relative importance of factors, such as the separation from traffic and adequate lighting, is also critical when analyzing the cycling gender gap. Women are considered to be more risk-averse and cycling is considered to be a 'risky' mode of transportation (Mapes 2009, Pucher and Buehler 2007). Thus this final section of the survey asks respondents to rank a series of factors, pertaining to the road, built environment, and lifestyle, in order of their importance in influencing the individual's decision to bike. Though the sample of participants are cyclists already, how they value certain components of travel and the road can help gage how even cyclists' bicycle use can be limited at times – or conversely, how more cycling can be encouraged. Due to the subjective nature of the questions and the responses, analysis must be wary of how the wording of the questions impacts the results.

CHAPTER THREE: DATA ANALYSIS

3.1 Respondent Overview

Over the course of October 2010, 238 cyclists in the Twin Cities Metropolitan Area took my survey, *Cycling Route Preferences*. Advertised through existing cycling list-serves and networks, the respondents were likely to be participants in the cycling community to some degree. The number of cyclists in the Twin Cities is rapidly growing, with the percent of the working population that bike to work in Minneapolis rising from 2.4 percent in 2005 to 4.3 percent in 2008, according to the U.S. Census American Community Survey (Friedman 2010). This represents 8,200 cyclists who bike to work in Minneapolis, alone. My survey draws from both St. Paul and Minneapolis cyclists, as the cities' bikeways and bike communities are becoming increasingly connected and fluid. Just over half (58 percent) of the respondents stated they live in Minneapolis, while 34 percent of respondents live in St. Paul. A smaller percentage (8 percent) listed different Twin Cities Metro Area suburbs, such as Eden Prairie, Shoreview, and Hopkins. In comparison to the other relevant studies discussed in the previous section, my study captures results from predominantly urban residents from a variety of sources and list-serves. The MN Department of Transportation's Statewide Omnibus Study of 2003-2004 surveyed mostly suburban cyclists, making up 72 percent of respondents, and a study conducted by Tilahun, Levinson, and Krizek (2004) surveyed 127 employees at the University of Minnesota.

My survey was promoted as part of a project studying the relationship between cycling and gender and appeared on the blog space and list serve of fifteen local bike-related organizations, a few of which have Women-specific programming and Women

and Trans-Gender Only workshops and open shop nights. Perhaps due to an interest in the project subject or the influence of the existing women cycling communities in the organizations from whom I solicited help, more women took the survey than men. Sixty-two percent of respondents identified as female and 36.8 percent identified as male. Less than 1.0 percent of respondents identified as a third gender, utilizing the "write-in" option. However, the size of the third gender population who took the survey is too small to make any significant claims or observations about a population group, and is subsequently not included in the inferential statistical analysis. Closer attention to targeting a third or transgender in survey distribution could have possibly allowed for more substantial analysis, but instead I focused on the relationship between female and male cyclists. The large response from women cyclists breaks from previous studies that also target a self-selected group of cyclists, but who receive more participation from men. Dill and Gliebe (2008) note the limitation of surveys that target "avid cyclists" or "dedicated commuting cyclists" were more likely to be men aged 25 – 44; however, the reverse is true for this study where female respondents outnumber male.

The racial and ethnic make up of the respondents are predominantly white, identified as such by 91.1 percent of the respondents. The next three racial and ethnic categories selected by the respondents are Asian (4.5%), Hispanic or Latino (3.1%), and "Other" (3.6%). Additionally, the majority of respondents, 86.2 percent, stated that they "work away from home," while 6.7 percent work at home, and 12.1 percent are unemployed. The unemployed category may also include students, as 36.5 percent of respondents reported biking to school at least once each week. Both questions for race/ethnicity and employment allowed respondents to select multiple answers, so the

percentage breakdowns are not mutually exclusive and each sum surpasses 100 percent. Options for race and ethnicity were also grouped into the same question, so again the divisions include overlaps.

The range of ages for respondents stretched from 18 to 66. Nearly half, at 48.3 percent were ages ranging 20 to 30, with the second highest group, at 21.4 percent, between 31 and 40. Thus the survey was received and filled out by mostly white-identified women and men who are commuting to work, often by bicycle, within the ages of 20 and 40.

3.2 Frequencies and Distance of Cycling

The survey respondents' setting in the Twin Cities provides a backdrop of already established progressive bicycling infrastructure in comparison with other cities in the U.S. The availability of opportunities for cycling and the high rate of bike commuting relative to the nation suggest the population sampled by the survey is likely to be familiar with cycling as a mode of transportation. In *Bicycling Magazine's* article of Minneapolis as the #1 U.S. bike city, author Steve Friedman (2010) concludes with his overall impression of the city's bike culture, "In Minneapolis, cyclists don't talk as much about cycling as they do it... in the dead of winter and every other season… people ride and don't consider it that big a deal." He supplements his theory with an anecdote of a 36-year old mother of two who commutes 20 miles round-trip four days a week and yet does not consider herself a "serious cyclist" (Friedman 2010). The dedication of many riders to cycle through the winter and commute several times a week is spurred by the passion of a growing bike culture and augmented by the federal funding of recent years and the bike

trail networks across the Twin Cities. The snapshot from Friedman's (2010) observations provides an example of the context for cycling behavior in the Twin Cities that the survey is sampling.

Respondents to the survey demonstrated a similarly strong commitment to bike for their daily transportation needs and recreation. The survey offers five destinations: work, school, errands, recreation, and other, and asks respondents the number of trips (0 to "more than 7") and the distance for each one-way trip to the destinations each week. As illustrated in Figures 3.1 and 3.2 and Tables 3.1 and 3.2, a high majority of respondents biked at least once a week to work (79.9%), for errands and shopping (88.9%), and for recreation (94.0%). Nearly half (42.5%) biked five or more times to work each week. Additionally, 17.6 percent of respondents used their bicycle five or more times each week to commute to school and to do errands. The high frequency of bike trips for utilitarian purposes suggests a sample of dedicated, daily cyclists. The most common distance for all respondents' trips was a 1-3 mile range for each one-way trip. Recreational trips were longer, with about half of the respondents stating they bike 10 or more miles one-way for recreational purposes (Table 3.2). These levels of bicycle travel are consistent with a study conducted by Dill and Gliebe (2008) who tracked cyclists using global positioning system (GPS) technology in Portland, Oregon and found the participants made an average of 1.6 bicycle trips per day for an average of 6.2 miles per day.

Figure 3.1: Current Extent of Use (Frequency)

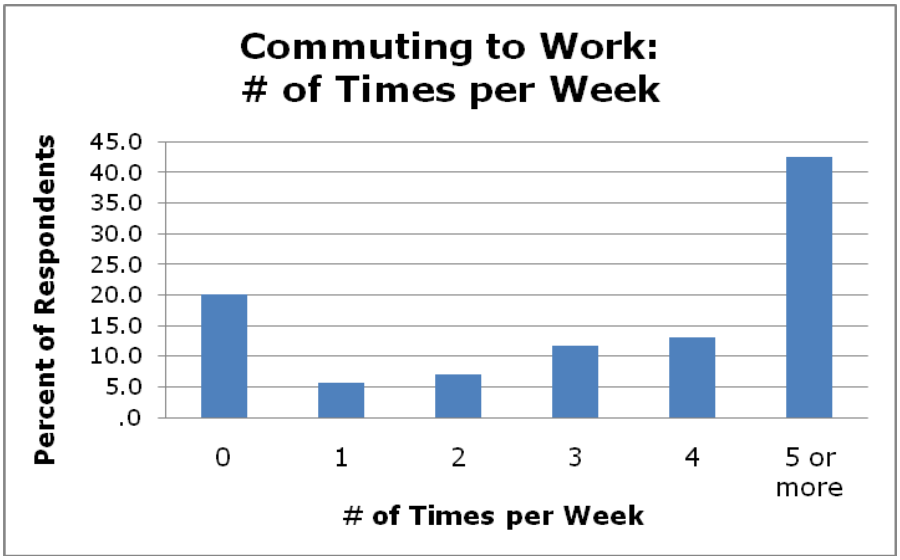


Figure 3.2: Current Extent of Use (Distance)

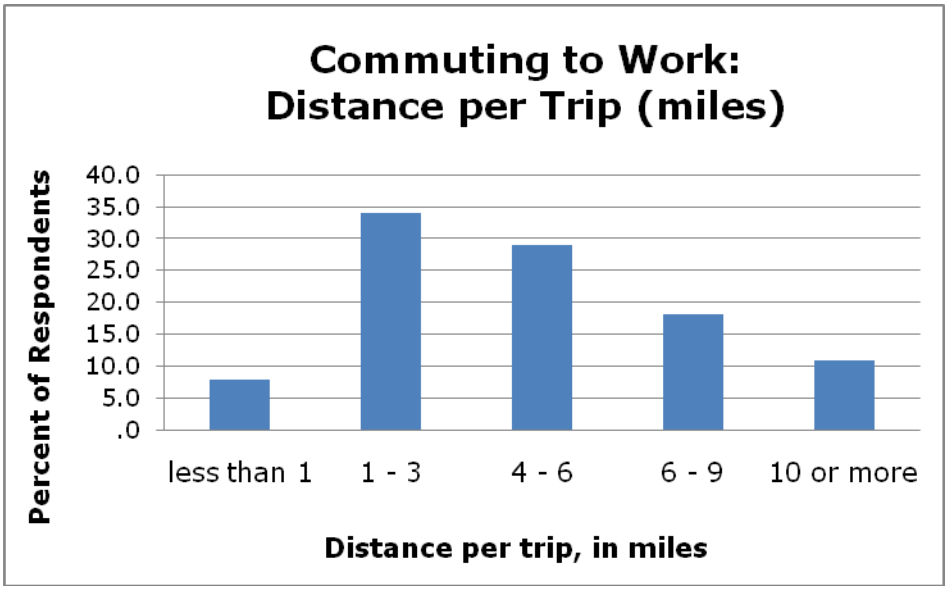


Table 3.1: Number of trips taken by bicycle in a typical week

# Times per Week			
Answer Options	% at least 1	% 5 or more	Response Count
Commuting to Work	79.9	42.5	214
Commuting to School	36.5	17.6	159
Errands/ Shopping	88.9	17.8	225
Recreation	94	11.6	215
Other	62.4	6.5	93

Table 3.2: Distance (miles) for each trip, one-way

Answer Options	Less than 1	1 - 3	4 - 6	6 - 9	10 or more	Response Count
Commuting to Work	8.0%	34.1%	29.0%	18.2%	10.8%	176
Commuting to School	34.8%	36.4%	18.2%	10.6%	0.0%	66
Errands/ Shopping	12.1%	51.5%	30.3%	5.1%	1.0%	198
Recreation	0.5%	12.9%	20.1%	14.4%	52.1%	194
Other	8.1%	32.3%	27.4%	9.7%	22.6%	62

A large majority of respondents used their bicycle at least once a week for the given purposes of commuting to work, conducting errands and shopping, recreation, and other activities, with the exception of commuting to school. School was the least common destination, but this may be attributed to the fact that many respondents are either not in school or the school may be close enough to walk. School in this case likely implies a college or university, given the youngest indicated age is 18 years.

3.3 Factors Affecting the Decision to Bike

Characteristics of the road, the built environment, and an individual's preferences affect whether, when, and where a person will decide to use a bicycle for transportation. I attempt to pinpoint particular factors of the road and the built environment through the *Environmental Perceptions* section of the survey in order to gauge a cyclists' willingness to bike based on the availability of bike-specific infrastructure. Factors of the road include the distance of trip, weather conditions, car traffic volume, road maintenance (snow plowing and potholes), road width, and proximity to parked cars. Factors of the built environment involve connectivity and safety of bicycle infrastructure provided in the Twin Cities, such as convenience of bike paths and lanes, amount of street lighting, proximity to a bike path, connections between paths, and availability of secure bike parking. Third, lifestyle or personal characteristics that may affect bicycle travel include the need to carry items, transporting children, and trip-chaining, concern for arriving sweaty at destinations, level of mechanical knowledge, time constraints, and the quality of the bicycle.

The survey asked participants the extent to which these various characteristics of the road, built environment, and their lifestyle were influential in their decision to bike. They ranked each listed factor on a scale of one to five, one as "Not at all important, of course I will still bike!" and five as "Extremely important, I will not bike in these conditions." The average total rating of each of the three categories was between two and three, indicating the factors presented as possibly inhibiting an individual's decision to bike were only low to moderately important. The "Factors of the road" category was the highest rated of the three, with a mean of 2.91 and a median of 2.96, on a scale of one to five. Within this category, respondents felt most strongly about the statement, "They don't clear the ice and snow from the bikeways," which received an average rating of 3.9 – the highest rated single factor of the three categories. Other relatively important characteristics (scoring a three or higher) are the weather, high car traffic volume, and quantity of potholes. Of the more highly rated factors, the state of weather conditions influenced women cyclists more so than men cyclists. High car traffic volume and the quantity of potholes were weighted similarly among men and women. In contrast, some of the lowest rated factors (rated below two) are the need to transport children, trip-chaining, level of mechanical skills, quality of bicycle, and proximity to a bike path.

The factors rated the lowest, or as "Not important, of course I will still bike!" present a contrast to previous studies that highlight these factors as potential explanations for the gender participation gap in cycling. Childcare responsibilities, such as transporting children, are expected to have a greater influence on women's travel patterns. The need to transport children is often worked into trip-chaining, a travel pattern associated with women's travel behavior. Additionally, in a bike industry that is often

perceived as male-dominated, mechanical prowess can be a limiting factor in depending upon a bike for daily transportation. However, the results for Twin Cities' cyclists from the *Cycling Route Preferences* survey reveal no statistically significant differences between men and women respondents' perceptions of these factors and their influence on the decision to choose the bicycle as a mode of transportation. The respondents did not react aversely to the potential barriers listed, but the sample population surveyed are already dedicated cyclists and are either unaffected by these barriers or have found ways to curtail them. The low ranking of factors does not diminish the importance or debunk their existence, but rather suggests that the barriers presented are more likely to affect non-cyclists or casual cyclists.

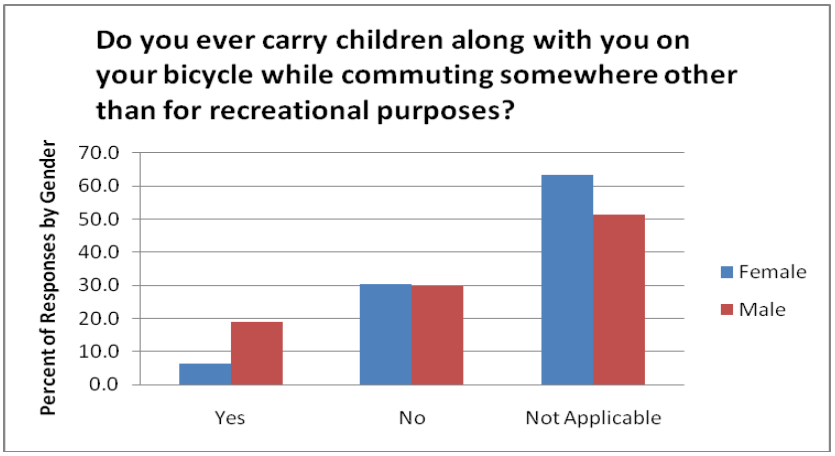
Related studies have discerned that from 1990 to 2000, differences in travel patterns and travel times between men and women decreased. Women's travel time expenditures are increasing at a faster rate than men's, thus lessening differences in travel patterns and times between men and women from 1990 – 2000 (Gossen and Purvis 2004). More women are in the workforce and contribute to a larger percentage of driver's licenses, thus more generally changing the degree and extent of women's travel (Kay 1997). In my study, trip-chaining, explained as making more than one stop on the same journey, was reported as occurring "Sometimes" by 88.6 percent of the respondents, with no statistically significant difference across gender. A study conducted by McGuckin and Nakamoto (2004) deduced that men's level of trip-chaining grew at a rate twice as fast as women between 1995 and 2000. However, their study, utilizing data from the 1995 Nationwide Personal Transportation Survey and the 2001 National Household Travel Survey maintained that women made more stops and trips than men, but the distances

traveled were often shorter. It recorded that single women, as well as women in 2-adult families with children, work closer to home than men in similar occupations, allowing more time for household related responsibilities. The 2003 American Time Use Survey results reveal employed women spend about an hour more per day than employed men in household activities (McGuckin and Nakamoto 2004; Bureau of Labor Statistics 2003).

The results from these nationwide surveys reveal generalized trends about gendered travel behavior and the likelihood of trip-chaining; however, they are not differentiated by transportation mode. For cycling, trip-chaining involves different commitments for time and distance, as well as potential differences in weight or amount of items that can be carried. Linking multiple stops into one journey is be dependent on how fast or far an individual is willing to cycle, the proximity and connectivity of the destinations in relation to safe bike routes, and the willingness or capacity to carry items. When considering these additional factors of trip-chaining while cycling or the travel behavior of adults with children, the survey found that men were more likely to report transporting children for reasons other than recreational riding via bike than women, for whom it was applicable (see Figure 3.3). Slightly under half (41.5%) of respondents reported that the decision to transport children or not was applicable, and of the 95 respondents for whom it was, only 27.4 percent stated they had carried children by bike for non-recreational purposes. In the question that asked participants to consider the impact of lifestyle characteristics on their decision to bike, the statement, “I have to transport my children,” received a total average rating of 1.7 (see Table 3.3 and Figure 3.4 on the following page), suggesting that it was generally of low importance to the survey respondents. Though this statistic includes everyone, including those for whom

childcare responsibilities are not applicable, still the 41.5 percent for whom it applied, did not skew the average rating as higher or more important. Additionally there is no significant difference between male and female responses to the statement. Figure 3.4 illustrates a range of perspectives on the level of importance carrying children by bike presents for only those who currently do it, and based on a small N of 26 respondents, a distinct trend is not discernable. It does indicate that some people are both willing and do transport children by bicycle, but their experiences are varied and are not statistically different by gender, based on survey data. Transporting children by bike intersects two different social roles of carrying extra weight and assuming familial responsibilities and thus may complicate a search for gendered differences. When cross-tabulated with another associated variable, trip-chaining, there was also no statistically significant relationship.

Figure 3.3: Cross-Tabulation



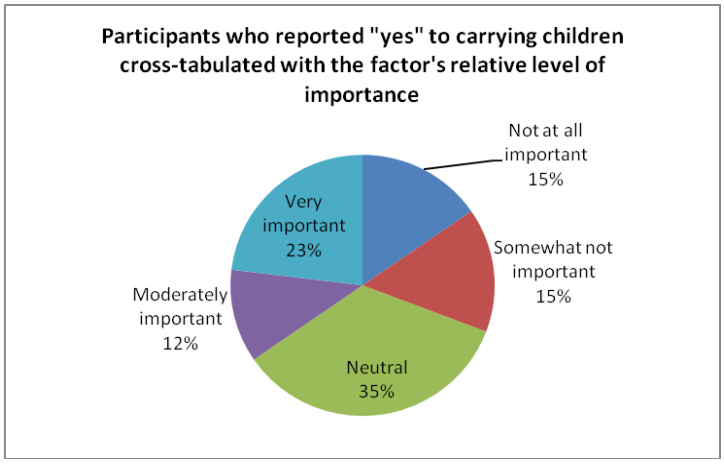
*Pearson Chi-Square value, 5.501 and significance 0.019

Table 3.3: Cross-Tabulation of Carrying Children and the Level of Importance of Carrying Children (for whom it was applicable)

How important is the following lifestyle factor in determining your cycling route or whether you will even bike at all?		" I have to transport my children"					
		Not at all important	Somewhat not important	Neutral	Moderately Important	Very important	Total
Children	Yes	4	4	9	3	6	26
	No	44	1	9	4	3	61
Valid Total		48	5	18	7	9	87
Not Applicable/ Skipped/ Missing							151
Total							238

*Pearson Chi-Square value, 26.482 and significance, 0.00

Figure 3.4



The lower level of importance in transporting children via bicycle can be attributed to a few details about the survey participants. Respondents may not be deterred by the addition of weight on their bicycle or the increased time constraints carrying children may impose. Sixty percent of participants claimed they have carried cargo in some capacity (panniers, a trailer, or other) on their bicycle. Men were more likely to report carrying items by bike, as well as more likely to carry children by bike. Yet, overall when all participants were asked to rate the level of importance that carrying items presented to cyclists, the overall rating was a 2.5 on a scale up to 5, suggesting only moderate importance. Similarly, potential barriers related to trip-chaining, such as "I do not have enough time" and "I make too many stops and errands," received relatively low overall scores of 2.4 and 1.7 respectively. These two factors revealed no statistically significant difference across gender.

Overall, the factors that are typically perceived as barriers to cycling may not be appropriately addressed by this study's survey sample. The stated frequencies and distances of cycling trips, as well as the reported low levels of deterrents to cycling, indicate that the survey participants are dedicated cyclists and are not easily swayed from their decision to bike and that men and women participants are cycling at similar rates with similar travel characteristics. However, the respondents' lower rankings do not devalue the weight these barriers may hold for non-cyclists. The preferences and travel behavior of non-cyclists is more difficult to track, especially how they would respond to bike-specific infrastructure and cycling-related barriers. The low levels of influence the potential barriers hold for survey participants does indicate that not only will the survey

respondents continue to bike, but the listed factors will also likely not impact the extent of their commute.

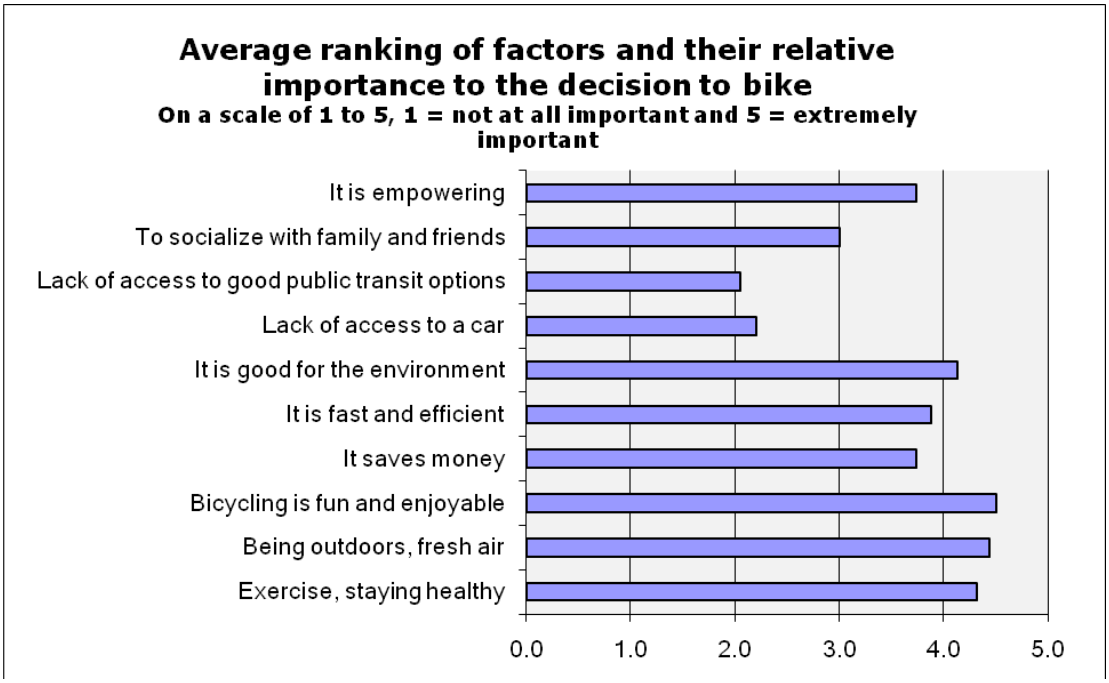
However, though the overall rankings were low, the relatively higher importance given to characteristics of the road, such as road maintenance, high car traffic volume, and ice and snow marks an area to study further. The lowest barriers of trip-chaining and transporting children reflect conditions of an individual's lifestyle or personal travel behaviors. The score of 3.9 given to the presence of ice and snow on roads represents the level of commitment a city invests to maintain and protect cyclists' right to the street. A slightly higher aversion to streets with high car traffic volume suggests a preference for different types of infrastructure or different cycling conditions than what the streets presently offer. The role infrastructure and street characteristics hold in determining cycling preferences is discussed in more depth under section 3.5.

3.4 The Will to Bike

The factors of the road, the built environment, and lifestyle presented above imply that the Twin Cities cyclists who participated in the survey are not easily discouraged from cycling. The exceptions include weather conditions, adequate plowing of streets and bike facilities, and a high car traffic volume on streets. The former is less controllable, while the latter two reflect concerns with road maintenance and type of street. Thus the question becomes, what are the motivational factors that encourage cycling for transportation? The survey reveals a sampling of avid cyclists, where about 80 percent bike at least once a week to work and nearly half bike daily to work each week. To supplement the extent to which they cycle and their preferences for cycling, the survey

also asked the relative importance of certain positive factors of cycling behavior. The factors included personal benefits of empowerment, fun and enjoyment, being outdoors in fresh air, socializing, and the health benefit of exercising. More utilitarian factors included a lack of access to a car or good public transit options, saving money, lighter environmental impact, or greater speed and efficiency by bicycle. Several of these factors were reported as positively contributing to the decision to bike as a mode of transportation, as illustrated by Figure 3.5.

Figure 3.5: Motivational factors behind the decision to bike



Among the highest ranked factors was the benefit of bicycling being "fun and enjoyable," scoring an average total rating of 4.5 on a scale of 5. Also scoring above a 4 on the scale are the benefits of exercising, being outdoors, and its positive impact on the environment. The next category of factors, scoring between a 3 and 4 include speed and efficiency, saving money, and a sense of empowerment. Alternately, the lowest rated factors were access to a car and good public transit options. The data suggest the participants are voluntary cyclists – choosing to cycle, rather than dependent upon it due to a lack of access to other transportation and transit modes.

However, women were more likely to report that a lack of public transit options was more important in their decision to cycle than for men. Increased public transit options might then present a more viable traveling option for some women. Overall, a lack of access to public transit was rated a 2.1, the lowest of all given factors for the question. Its role in determining cycling behavior may best apply to a desire for more options through a well-connected multi-modal network in the Twin Cities. Women were also more likely to rate weather conditions as more important in their decision to cycle than men, implying that when weather is not suitable for cycling, public transit could provide a more desirable option.

Women cyclists were also statistically more likely to rate a sense of empowerment as more important than men cyclists in their decision to bicycle. Though each individual definition of empowerment may vary or represent different connotations for different people, it is worth noting that more women cyclists chose to identify with a sense of "empowerment" than men. The higher ranking placed upon personal empowerment suggests that female respondents experience a level of agency, or

recognize a personal change through the act of cycling that either men do not experience or do not associate with "empowerment." This is not to claim that men respondents were disempowered or indifferent, but rather they may not recognize an "empowerment" of cycling as any different than other areas of empowerment. The positive correlation for women cyclists though, indicates a desire to cycle for personal fulfillment and independence.

3.5 Preferences in Street Design and Bike-Specific Infrastructure

The aspects of the data detailed above target the extent to which men and women cyclists are traveling in distance and frequency, as well as subjective and objective factors that influence their decision to cycle. A third component of discerning the gender participation gap among cyclists involves how men and women cyclists relate to their surrounding environment. Three multi-part questions of the survey ask survey respondents what type of street and route options they *prefer* to travel on, what they *typically* travel on, and what characteristics of a route do they value most.

For work commutes, the most commonly used (typical use) route options included on-street bike lanes, commercial or main streets, and residential side streets (see Figure 3.6). Participants were encouraged to indicate any and all street options that applied in order to represent the variety of street and bike facility options that can be combined into a typical route to work. Thus, 53.2 percent of cyclists used on-street bike lanes, 46.4 percent used a residential street, 43.2 percent used a commercial street, and 37.8 percent used an off-street or separated bikeway. To bike to school, 21.0 percent of respondents used an on-street bike lane and 18.5 percent used a residential side street, however for

most respondents (61.5%) a school commute was not applicable. Biking to run errands and go shopping typically involved using a fairly even combination of on-street bike lanes (used by 59.5% of bikers), commercial (59.9%) and residential (62.6%) streets. Recreational biking was mostly experienced on off-street/ separated bikeways (representing 84.7% of people's typical route), with a lesser extent of riding in on-street bike lanes (50.9%) and residential streets (50.5%). With the exception of recreational biking, the routes most typically traveled on consisted of street infrastructure with a close or informal proximity between bicycles and motorized traffic.

Figure 3.6: Stated Current Route

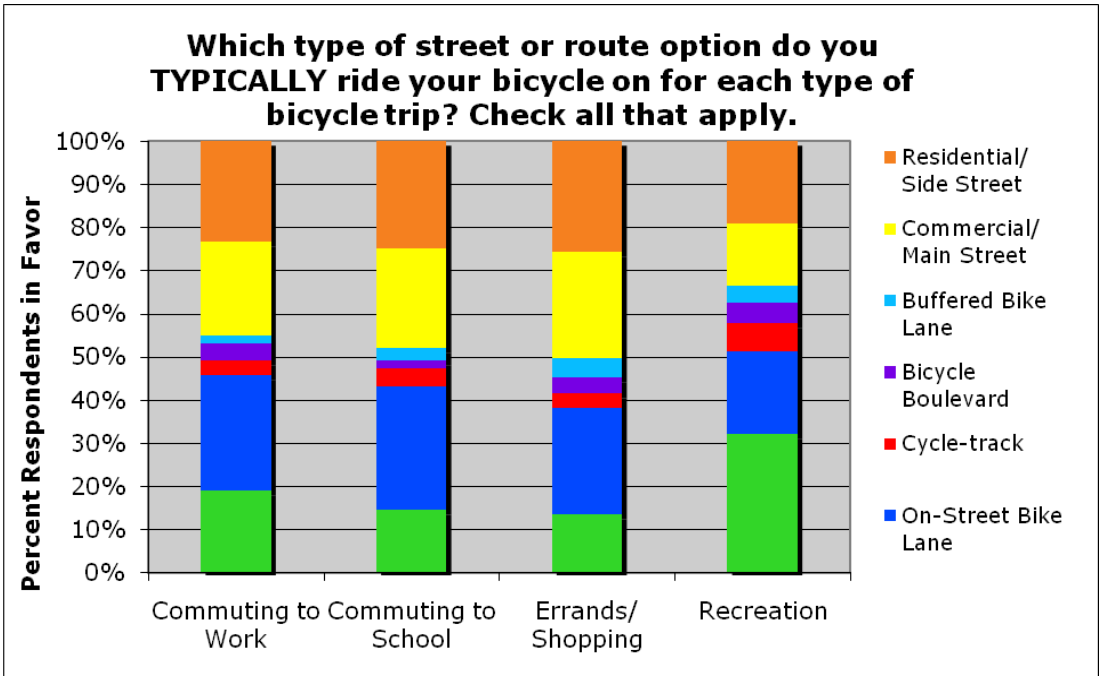
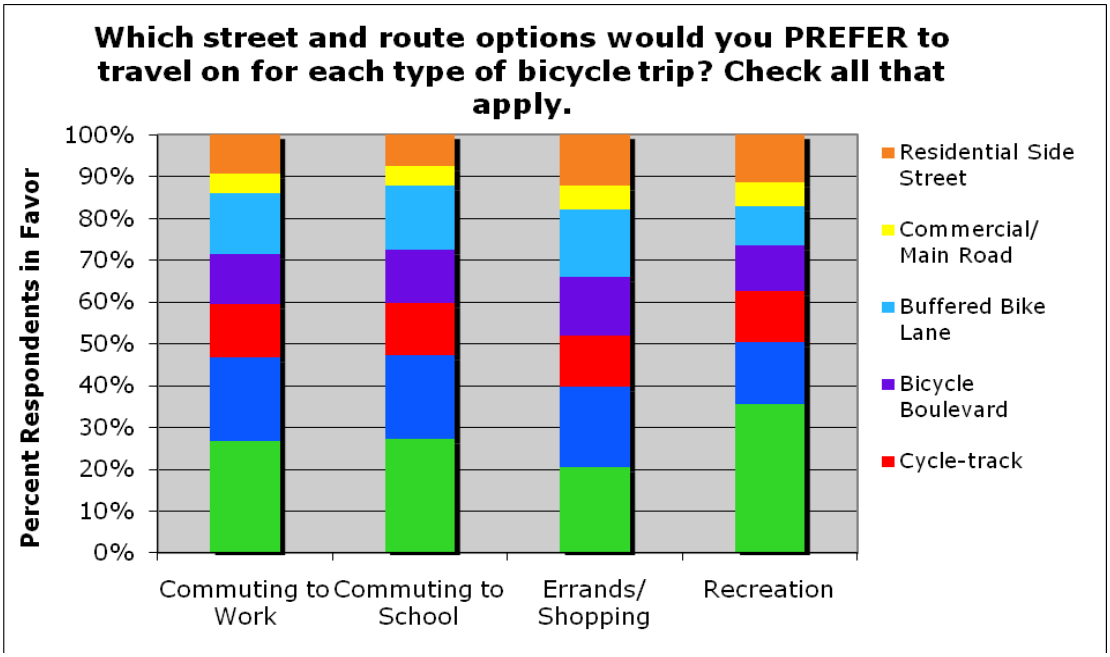


Figure 3.7: Stated Preferred Route



As Figure 3.6 illustrates, the least commonly used bike facilities and street options are cycle-tracks, bicycle boulevards, and buffered bike lanes. Within the context of the Twin Cities, these street design options are not yet implemented and are controversial in even the proposal stages. However, when propositioned with the same bike-specific infrastructure options, and asked which ones respondents would prefer to travel on, stark contrasts appear. Survey respondents expressed preferences in mostly off-street/ separated bikeways (70.1%) and on-street bike lanes (52.8%) (see Figure 3.7). An additional change from the typical routes traveled on is the peaked interest in cycle-tracks, bicycle boulevards, and buffered bike lanes. Only 6.8 percent of respondents stated they use a cycle-track in their typical work commute, but 33.8 percent stated they would prefer this option. Similarly, 7.7 percent indicated they typically use a bicycle boulevard, while 31.6 percent would prefer it, and for buffered bike lanes, the difference in use and preference increased from 4.1 percent to 38.53 percent. The preference for bikeways that are more deliberately separated from motorized traffic suggests that there is a demand for a legitimized place for bicycles on the road.

Similar patterns are expressed for other commuting purposes, with the most preferred route option including an off-street/ separated bike path and on-street bike lane. Interest in cycle-tracks, bicycle boulevards, and buffered bike lanes is noted by approximately a third of all participants for each trip purpose, increasing from about only a tenth or less of participants that report to use them in a typical trip.

Street options such as a commercial road and residential road were commonly used, but not highly preferred. The low levels of preference given to these street options implies that streets without bike infrastructure are used, by default, around the Twin

Cities in order to connect cyclists from their origin to their destination when more preferable options are unavailable. However, given the low levels of preference for non-bike-specific streets and the relatively higher levels of preference for bike-specific infrastructure, it is evident that if given the opportunity, many cyclists would opt to ride on streets catered to the bicycle. If bike-specific infrastructure is preferred by survey respondents and increases the extent to which they already cycle, the provision of bike-specific infrastructure may also create more viable incentives for non-cyclists who are currently deterred by non-bike-specific streets. Carving a specific lane on a street for bicycles creates more equal opportunities to choose to cycle for a mode of transportation. A cycling advocate interviewed by Jeff Mapes (2009, 197) explains that "motorists have their space, pedestrians have their space on the sidewalks, and cyclists need their space too." The street cannot operate as a truly public and democratic space without equal opportunities for participation by different transit users.

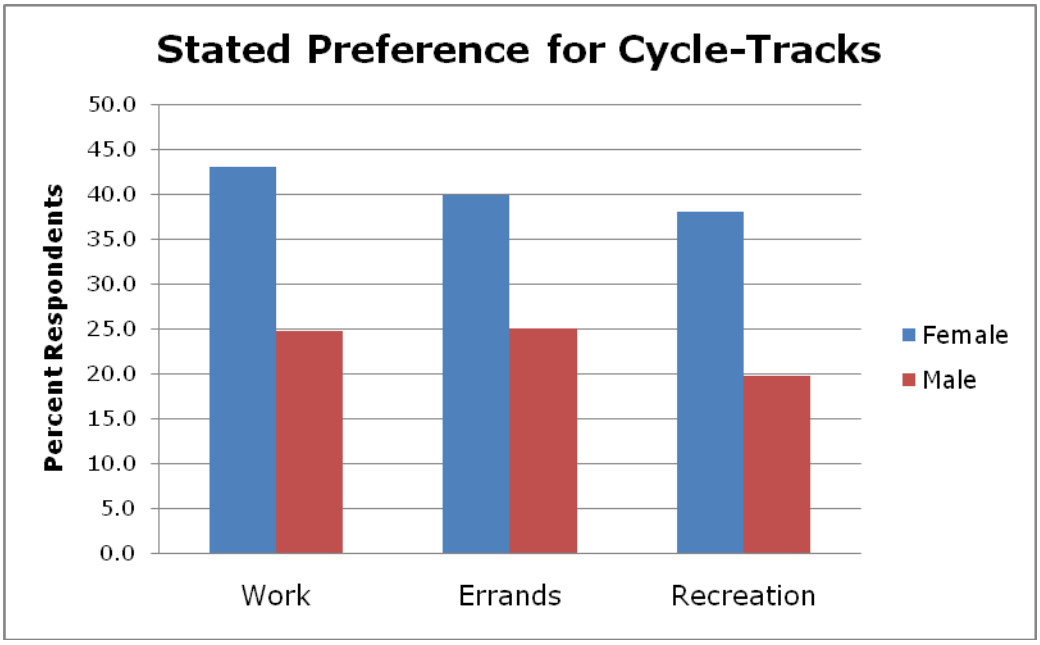
3.6 Gendered preferences in street design and bike-specific infrastructure

The trends stated above for typical usage and stated preferences describe a general shift towards routes that are explicitly intended for bicycle transportation. Within this broader trend among participating Twin Cities cyclists, gender appears to correlate with patterns of route selection and preference. A critical research question the survey seeks to answer is do women and men cyclists perceive the streets differently, and do they have different preferences for street designs? With a peaked interest in different street options that are new to the Twin Cities, when preferences were cross tabulated with gender, according to a chi-square test for statistical significance, women were more likely to

select cycle-tracks as a preferable option for commuting to work, running errands, or recreating (see Figure 3.8 and Table 3.4). Women were also more likely to *not* select a commercial or main road as a preferable option for recreational riding. Stated preferences for bike-specific infrastructure reflects trends indicated for current typical use of bike routes. Within options typically used, men were more likely to report traveling on commercial and residential streets for work commutes, errands, and recreation.

A significant difference in a preference for cycle-tracks between genders presents a possible street design option that could encourage more female cyclist participation. A cycle-track is also an interesting design option, because it is not (yet) widely used in the Twin Cities or the U.S., but it is extensively used in Europe. The structure of a cycle-track serves the utilitarian purposes of an on-street bike lane and commercial street in the sense that it typically runs parallel to traffic on a main road. It also serves the safety and efficiency purposes of a separated bike path because it is physically separated from the lanes of motorized traffic by a curb or small median. It is not delineated by a mere painted line on pavement (or a painted zone such as for a buffered bike lane), nor does it border a lane of parked cars, which pose the threat of car doors opening into the lane of bicycle traffic. Thus it combines the benefits of safe and efficient travel along a major commercial or transportation corridor.

Figure 3.8: Infrastructure of Statistical Significance by Gender



*Percents based on total number of male/ female respondents who answered each question.

Table 3.4: Cross-Tab and Chi-Square Results for Significance

Cycle-Track as a Preferable Option			
Trip Purpose	% Female	% Male	Pearson Chi-Square Asymp. Sig (2-sided)
Work	43.0	24.7	0.007
Errands	39.8	25.0	0.027
Recreation	38.0	19.8	0.005

*Percents and Sig. Results based on N for each question. Respondents were encouraged to select multiple routes as a preferred route, thus N varies between each trip purpose.

Cycle-tracks, as depicted in Image 3.1, are prevalent in certain European cities, such as Amsterdam and Copenhagen, where bicycle use reaches upwards of 30% of the transportation mode-share and the female cyclist participation outnumbers male cyclists. Pucher and Buehler (2007) associate higher rates of female cyclists with the availability of safe and bike-specific street infrastructure. The data collected from the survey reveal a higher preference for cycle-tracks among women and reflect broader gendered perceptions of the street environment such as increased separation from traffic and bike-specific road accommodations.

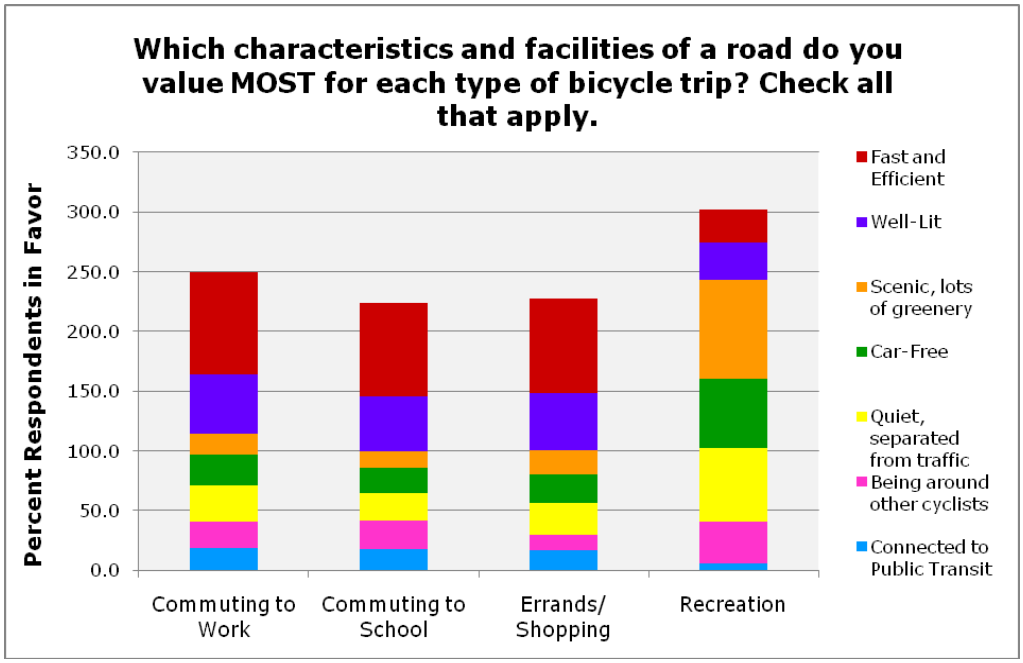
However, the data also reveal similarities between men and women cyclists' preferences for bike facilities. For the most popularly used and preferred bike infrastructure/ street option, the off-street/ separated bike path, there was no statistically significant difference between men and women. The example provided for a separated bikeway in the survey was the Midtown Greenway, a "bicycle freeway" located along a converted railroad right-of-way, as illustrated in Image 3.2 on the following page. The separated bike path option was the most preferred of all respondents. Within the context of the Twin Cities, the popularity of separated bikeways may be due to the success of the Midtown Greenway, the East and West River Roads, the Gateway Trail, Bruce Vento Trail, and the Grand Rounds network in Minneapolis. In general Twin Cities' cyclists have a greater familiarity with this option and may be more inclined to desire increased connections between the separated facilities that already exist.

Image 3.1: Cycle-track example as provided in *Cycling Route Preferences* survey

Image 3.2: Separated Bikeway (Midtown Greenway in Minneapolis) example as provided in the *Cycling Route Preferences* survey

The desirability of a specific street design provided is also affected by its supplemental characteristics of amenities and experiences and how those characteristics are valued by the user. Amenities such as paved shoulders and adequate lighting on bike paths impact the perceived safety of a route. Other chracteristics, such as a route that is fast or efficient, scenic with greenery, quiet and away from traffic, or likely to have other cyclists, influence the type of experience a user will have on that route. Users may perceive or value these characteristics differently based upon the purpose of each trip, and so the survey asked participants to select the attributes they valued *most* for four different trip purposes (see Figure 3.9).

Figure 3.9: Preferences for Road Amenities



Overall the attribute of speed and efficiency was valued highly for different trip purposes, most notably commuting to work and for shopping. In total, 86.1 percent of respondents selected “Fast and efficient” as one of the characteristics they value most for the work commute and 79.3 percent valued speed and efficiency for errands/shopping. The next highly valued characterstic for mulitple trip purposes is the factor, “Well-lit,” selected by nearly half of all respondents for commutes to work (49.1%), school (46.0%), errands/shopping (47.5%), and a third of respondents for recreational purposes. Not surprisingly, the attribute of being scenic with lots of greenery is most desireable for recreational trips, as well as a route that is “Car-free” and “Quiet, seperated from traffic.”

The provision of adequate lighting is a street facility often associated with perceptions of safety and fear on a street. Literature of public space participation and travel behavior notes that women tend to be more cautious of safety concerns and more “risk-averse” in traffic situations than men. In relation to cyclists’ position on a street, safety concerns are heightened by the vulnerability of traveling by bike, due to the bike’s size, openness, speed, and visibility. In the *Cycling Route Preferences* survey, women respondents were more likely than men to rate paved shoulders and adequate lighting on bike paths as “very important.” However the overall rating average for men and women combined was a 2.5 on a scale from 1, “Not important at all” to 5, “Extremely important.” The rating scale from one to five was presented in a question that sought to weigh the potential barriers a lack of lighting may present to cyclists. In the question illustrated by Figure 3.9, the provision of lighting was included as a street facility that cyclists valued or appreciated. While the lighting received a moderate rank of 2.5 on a scale to five, in the results presented in Figure 3.9, approximately half of all respondents

selected it as one of the "most valuable" road characteristics – second only to speed and efficiency. Additionally, there is no statistically significant difference between men and women respondents' selection of a "Well-Lit" route. Given the contrast between the lower ranking of lighting as a barrier, but the high value placed upon lighting as a preference, the responses suggest that overall the survey participants are not significantly deterred by the lack of lighting, but given the opportunity, they would prefer to improve their cycling routes with sufficient lighting. The survey results also suggest that the lack of lighting poses a greater barrier to women cyclists – not necessarily deterring them from bicycling entirely, but it is considered in their decision to a higher degree than men.

The desire to be fast and efficient on a cycling route stood out as a preferred characteristic for bike commuting for both men and women. However, men were more likely to value the speed and efficiency than women for a commute to work. Men were also more likely to value the characteristics of scenery/ greenness on the work commute.

The data find that gender impacts various factors in how cyclists perceive the street, from type of infrastructure, lighting, and speed. While the sample population surveyed may reveal only nuanced discrepancies in preferences, the differences nonetheless exist and represent ways that streets can be designed to either encourage or inhibit participation by certain users. Appropriate infrastructure and road amenities, such as lighting along bikeways, not only recognize the rights of cyclists generally to the road, but also create safer opportunities for cycling that directly address concerns of women. The results of the survey may inform the greater disparity between men and women bike commuters at the national level, and furthermore suggest that infrastructure can provide a

means to address the social barriers to cycling that are more likely to deter the potential or non-cyclists.

3.7 Gender and the Extent of Bicycle Use

The differences revealed in men and women's preferences for bicycle infrastructure are significant, but also more minute than existing literature suggests. As illustrated by the general survey descriptive statistics for respondents' demographics and extent of bicycle use, it is apparent that the sample featured by the survey represents frequent and dedicated cyclists. Thus, it is appropriate that barriers to cycling would be lessened and differences narrowed. However, given that certain differences still remain, it is important to consider these as potential areas of focus in the larger gender participation gap for cyclists.

Related studies find that the extent to which women cycle and the purpose of the trip varies from the cycling behavior of men. Dill and Gliebe (2008) found that women make the same number of trips as men, but the distances are often shorter. Using an Independent Samples T-Test of my survey data, the results hold that there is no statistically significant difference in the number of trips made by men and women cyclists. As stated previously, 80 percent of all respondents biked at least once a week to work, and nearly half biked to work five or more times a week. These rates of bike commuting are comparable to rates in one of the best bike cities in the world: in Amsterdam, over 85 percent of residents rode their bike at least once a week in 2003 - not differentiated by trip purpose (Pucher and Buehler 2007). Of course, the sample featured in my survey responses are not reflective of the Twin Cities as a whole, but it

illustrates a level of commitment to bike commuting that is present by a population in the Twin Cities.

Additionally, there is no statistically significant difference for the number of trips for any destination/ trip purpose (commuting to work, school, errands, recreation, or other) between men and women. This sample of Twin Cities' survey respondents breaks from a previous local study as well as national trends in the nature of cycling trip destinations. Krizek (2004) and the National Household Travel Survey in 2001 find that women are more likely to bike for errands and recreation, whereas men are more likely to bike to work. Male and female survey participants were proportional in their employment status as either working away from home, working at home, or unemployed, which does not skew the results for trip purposes.

A difference is highlighted in the distances traveled by men and women cyclists. Though the number of trips and the trip destination are similar, men cyclists were more likely to commute a longer distance for work and recreation than women. This finding is consistent with the study conducted by Dill and Gliebe (2008). However, when asked the importance of distance as a factor in determining the decision to cycle or choose a route, men and women cyclists appear to have a similarly low or moderate concern for the distance a trip will take by bicycle (scoring a 2.7 on a scale of one to five).

The difference in work commuting distances between men and women help inform the differences in preference for road characteristics illustrated by Figure 6.3. Men were more likely to value speed and efficiency and scenery for the commute to work than women. These preferences are more applicable for a person traveling a farther distance and for a longer period of time.

The similarities between men and women and the frequency of bicycle use are not outliers or an anomaly, but rather reflect cities' ability to address some of cyclists' concerns. The Twin Cities are heralded as prominent bike cities in the U.S. and offer a variety of bike-specific infrastructure, which has contributed to high levels of cycling among men and women. As evidenced by Figure 3.4, respondents are taking advantage of the separated bikeways and on-street bike lanes that already exist. However, even in a setting where bicycling has become accepted through the provision of some infrastructure, there are still factors that prevent streets from being wholly inclusive. The stated significant differences in how men and women respondents perceive the streets indicates that women's specific needs and concerns must be addressed in order to create more public and inclusive street environments.

3.8 Data Limitations and Further Research

My survey and research explore gender as one of the gaps in American cycling, and more broadly, only one of the factors that affects how people experience the public space of the street. Other variables play equally important roles that can measure the "publicness" of a street and how people are either allowed to or prevented from participating democratically in a space. Within the bicycling scene, other variables are missing from the "skinny, white, male" identity that cycling is often associated with or that is visible on American streets. Race, ethnicity, and class also impact the level of access people have to a bicycle, helmet, lock, or information about how to cycle safely. Also, similar to how images of women cyclists are portrayed and contrasted in public and through media institutions, images (or lack thereof) of immigrant, race, or class groups

affect how people associate themselves with a certain mode of transportation. As Mitchell (2003), Furness (2010), and Mapes (2009) all note, representation matters, and whoever is present and visible on a street influences who may feel welcome in that space.

Future research may explore differences of gender within another subgroup, such as a minority or immigrant group. Even in Amsterdam where cycling rates are among the highest in the world and women cycle more than men, the city finds that there is notable variation in bike usage. Lower-income groups and recent immigrants and their children cycle less than the average Amsterdam resident (Pucher and Buehler 2007). Amsterdam provides a plethora of bike-specific infrastructure and amenities throughout the city and its streets, but there are still holes in bike usage by certain users. Therefore it is crucial to explore each group's perceptions of the street separately and address their specific needs in order to create more inclusive streets.

As stated in Chapter Two and reiterated through Chapter Three, the respondents to the survey are not representative of Twin Cities' cyclists as a whole. The group is self-selected through existing bike-related organizations and expressed a strong commitment to frequent bike commuting regardless of distance and various potential barriers. Yet, the 238 respondents do indicate that the subgroup of dedicated cyclists in the Twin Cities is a strong and visible one throughout the cities, of which 63 percent are women. The similarities present between men and women participants' current use of the bike indicates that gender does not need to influence or impede on the rates at which each group cycles. Yet, by analyzing the differences that persist between men and women cyclists in the Twin Cities, I can begin to understand and draw connections to either the casual cyclist or the non-cyclist. If certain infrastructural changes will further increase the

extent to which female cyclists are currently using the streets, then visibility of current female cyclists will increase and a general shift among potential bikers may increase as well. Stated female preferences for particular infrastructure can also indirectly influence the social barriers to cycling through the creation of safer opportunities to cycle for transportation purposes, and by increasing the visibility of current women bikers and the visibility of safe cycling generally.

Responses from the survey point infrastructural changes in a few directions. Men and women cyclists reported differences in preferences that were statistically significant and did not diverge in the type of infrastructure preferred, but instead diverged on the level of importance of a certain provision or barrier. In general men and women approved and preferred bikeways that are more separated from traffic than a street with no bike-specific infrastructure or simply an on-street bike lane. Cycle-tracks stand out as a desirable design to incorporate bicycles onto the road by women survey participants and are also commonly used in European cities with higher rates of cycling than in the U.S. Considering that factors of a bike commute pertaining to a participant's "lifestyle," such as trip-chaining, carrying cargo, and transporting children, were perceived of a lower importance than the provision of lighting and road design and maintenance, the demand for infrastructural changes seems clear. The "lifestyle" factors may remain potential barriers for current non-cyclists, but changes in infrastructure provide a tangible method to target new cyclists and create safer roads for biking. In a general survey in 1996 on physical activity across the U.S., a report by the U.S. Surgeon General found that 53 percent of people who had cycled in the previous year said they would commute to work by bike if they could do so on "safe, separated designated bike paths" (Maps 2009, 196).

The design of the street dictates the type of activity that can occur on it and without the basic provision of bike-specific networks, cycling remains a marginalized mode of transportation – in regards to other modes as well as who is able to participate as a cyclist.

This study emphasizes the role of the street as an urban public space with social and transportation-related implications. Yet, in addition to exploring other identities excluded from the current population of bicyclists, it is important to also analyze the inclusiveness of other spaces within the bicycle movement. The spaces of representation may be most visible on the public streets, but the practice and identity formed as a biker is also experienced in bike shops, in the realm of mechanics, in the sport, through products of the bike industry, and in the media. Further research of creating more inclusive community or media spaces will likely spill over and reflect onto the representation of women and other missing groups biking on the road.

Spaces created through street infrastructure and spaces arranged in media or bike retail influence each other concurrently and are each mediated through the social behavior and perceptions of the cyclist. I argue that the appropriate provision of infrastructure offers a tangible method to address the social dynamics of travel behavior. In addition, attention to social programming and auto-reduction policies can supplement changes in the built environment to holistically influence gendered trends in travel behavior and encourage more inclusive cycling spaces.

CONCLUSION: Moving Towards More Inclusive Streets

This paper explores the differences and similarities in how men and women cyclists perceive the streets as a means to investigate the national gender participation gap in American cycling. On average, women use the bicycle as a mode of transportation at half the rate than men do in U.S. cities. There is a range of factors that contributes to differences in bicycle use between men and women, and this study aims to target the factors that affect how a street can provide equal opportunities for men and women cyclists. Lifestyle factors and personal choice play pivotal roles in determining travel behavior, but the design of streets and provision of appropriate infrastructure lay the foundation for the types of transportation activities that are expected and safely accessible. By surveying the preferences of current cyclists in the Twin Cities in relation to cycling travel behavior, we can ensure that our streets are meeting the needs of a variety of users and serve as effective public spaces. Responding to women's preferences of certain bike-specific options can broaden the accessibility of cycling to larger populations and begin to increase the participation of women bikers.

The data results from the survey provide helpful insight to city and transportation planners and bike advocates as cities continue to make decisions regarding non-motorized modes of transportation. In the Twin Cities, the program BikeWalk Twin Cities manages federal funding designated for new infrastructure to help increase rates of biking and walking for transportation. Future planning decisions need to include the differentiated preferences of women cyclists in order to target a larger population of casual or potential cyclists. Women are often considered a target population or an "indicator species" due to characteristics of female-specific needs and behaviors in

transportation that may require a different transportation network than currently available. The results from the survey suggest that women are already prominent in the bike culture of the Twin Cities and are taking advantage of the current opportunities; however, as policy moves forward and aims to increase the percentage of commuters who bike, the small differences in preferences from this survey's sample will likely widen when applied to the general population.

The significance of catering to these specified needs and differences is rooted in the framework of "the right to the city," as theorized by Don Mitchell (2003), Henri Lefebvre (1993), and Dimendberg (1998). The streets of a city are necessarily public and are the thoroughfares of mobility, travel, and interaction. Roads built for the automobile alone restrict the access, uses, and behaviors that are allowed to safely take place on the road. In their design for speed and efficiency of automobile traffic, roads can limit the opportunities for a multi-modal and participatory public space. Purcell (2002) and Lefebvre (1993) argue that a city is an *oeuvre*, or an open space that is constantly shaped and reshaped by its inhabitants, but it is also mediated by overlapping layers of policy and social dynamics. The increasing population of bicycle commuters in the Twin Cities demonstrates a stage in the process of reshaping the streets and bicycle network of St. Paul and Minneapolis. Their visibility urges representation for cycling socially and spatially on the road. However, the practice of cycling in the street remains socially mediated and differences in cyclists' experiences persist. The survey participants indicate that there is a strong presence of women bikers, but that at times their preferences may vary from men's. Additionally, a lack of participation from other non-white populations may indicate that other variables and groups are also under-represented in the Twin Cities

cycling scene. Further research could inquire into the preferences and travel behavior of other population groups and direct street design and information toward a broader array of transportation options.

With a goal of creating more inclusive streets, it is important to note that changes in the built environment offer one medium to influence travel behavior and provide equitable access to transportation options, but do not expressly or immediately remove all barriers to public space. There are multiple scales at work that impact how effective a plan for more inclusive streets will be at allowing various groups the ability to represent themselves. Mitchell (2003, 35) warns that, "Even the most well designed spaces for interaction often lead to limited and ineffectual public discourse." Thus, adding a cycle-track, or even a network of cycle-tracks to the urban grid alone will not resolve the gender participation gap. The characteristics that a cycle-track represent, such as a convenient and efficient route with distinct separation from motorized traffic, and a legitimized space on the road, offer key guidelines for future street design and implementation of Complete Streets policy. Additionally, supplemental programming, signage, and information with the infrastructural changes can target some of the other social and spatial levels of the biking experience. Nonetheless, stated-preferences in infrastructure and the deliberate provision of bike-specific facilities demonstrate a critical component of the street that can encourage participation from a wider set of the population, particularly women.

The input of the survey participants is a glimpse into the diversity of opinions and travel needs that Twin Cities' cyclists encounter in their daily or weekly commutes. The personal views of cyclists help contribute to a process of imagining a democratically

produced street space (Dimendberg 1998). The current process that caters to predominantly one mode of transportation generates streets that lack a diversity of travel experiences and may present barriers to populations seeking access to other means of travel. Specific designs in the urban street environment can provide a means to integrate the bicycle more effectively into the transportation network, as well as address specified needs of female cyclists that help narrow the gender participation gap in American cycling.

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Appendix A: Stated-Preference Survey, *Cycling Route Preferences*

Welcoming Page

Hi, welcome to the survey on Cycling Route Preferences!

The purpose of the study is to develop a sense of bicycling behaviors and preferences in the Twin Cities, and understand how gender relates to the ways cyclists may perceive the streets differently.

Understanding the varying perspectives and preferences cyclists may have can hopefully lead to designing streets that are more inclusive and welcoming to new and increasing numbers of cyclists.

Your responses are extremely valuable and will help inform my larger Geography Honors Research Project at Macalester College, titled, "Designing More Inclusive Streets: The Bicycle, Gender, and Infrastructure."

Your participation is greatly appreciated!

The survey should take 10 - 15 minutes. Your answers will be used for research purposes only and will remain anonymous and confidential.

If you have questions, feel free to contact myself, Ainsley Judge: ajudge@macalester.edu or my project adviser, Dan Trudeau: trudeau@macalester.edu | 651-696-6872

To continue with the survey, please click "Next" below

Section 1: Characteristics of your typical bicycle trip

1. How many times do you travel by bicycle for the following purposes in a typical week? How many miles do you travel for each purpose?

	# of Times per week	Distance (miles) for each trip, one-way
Commuting to work		
Commuting to school		
Errands/ Shopping		
Recreation		
Other		

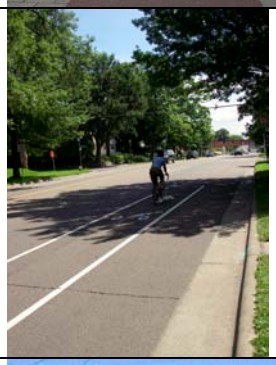
2. Do you make more than one stop on the same journey while bicycling?
    a. Always
    b. Sometimes
    c. Never

3. On a scale of 1 to 5, 1 = not at all important and 5 = extremely important, please rank the following factors in order of their importance to your decision to bike.

	1 - Not at all Important	2	3	4	5 – Extremely Important
Lack of access to good public transit options					
It is empowering					
To socialize with family and friends					
Being outdoors, fresh air					
It is good for the environment					
Bicycling is fun and enjoyable					
It is fast and efficient					
Lack of access to a car					
Exercise, staying healthy					
It saves money					

Section 2: Cycling Route Preferences

Please refer to the following images and descriptions of bike infrastructure to answer the questions in this section.

Off-road/ separated bike path		- Bike and pedestrian only - Entirely separated from street - Typically very few intersections or traffic lights
Cycle-track		- Bike and pedestrian only paved path - Typically next to street and separated by a curb - Either brick or painted to distinguish it from the street
On-street bike lane		- Bike lane painted into an existing street, typically to the right of the car travel lane.
Bicycle Boulevard		- Shared road on which cars and bikes share priority in the lane of traffic - Marked by a large bike + arrow symbol painted onto street
Buffered Bike Lane		- A Bike lane painted onto the street, but with a buffer painted in between the bike lane and the lane of car traffic

4. Which street and route options would you PREFER (if they were all available options) to travel on for each type of bicycle trip? Check all that apply.

	Off-Street/ Separated Bike Path	Cycle-track	On-Street Bike Lane	Bicycle Boulevard	Buffered Bike Lane	Commercial/ Main Road	Residential / Side Street	N/A
Commuting to Work								
Commuting to School								
Errands/ Shopping								
Recreation								

5. Which street and route options do you TYPICALLY travel on for each type of bicycle trip? Check all that apply.

	Off-Street/ Separated Bike Path	Cycle-track	On-Street Bike Lane	Bicycle Boulevard	Buffered Bike Lane	Commercial/ Main Road	Residential/ Side Street	N/A
Commuting to Work								
Commuting to School								
Errands/ Shopping								
Recreation								

6. Which facilities and characteristics of a route do you value MOST for each type of bicycle trip? Check all that apply.

	Fast and Efficient	Well -Lit	Connected to Public Transit	Car-Free	Scenic, lots of greenery	Quiet, separated from traffic	Busy with other cyclists
Commuting to Work							
Commuting to School							
Errands/ Shopping							
Recreation							

Section 3: Environmental Perceptions

The following questions address potential safety concerns, actual or perceived barriers, and factors of the surrounding environment and built infrastructure that could influence your decision to cycle or not.

7. When bicycling on a street with no bicycle infrastructure, where do you position yourself in the lane?
    a. As far to the right as possible
    b. Within the shoulder – if there is one
    c. In the middle, traveling with traffic
    d. On the sidewalk
    e. I do not travel via bicycle on roads without bicycle infrastructure

8. Do you wear a helmet when you cycle?
    a. Always
    b. Sometimes
    c. Never

9. Do you ever carry or bring children along with you on your bicycle while commuting somewhere other than for recreational purposes?
    a. Yes
    b. No

10. Do you ever travel with saddle bags/ panniers or haul a trailer on your bicycle?
    a. Yes
    b. No

11. How important are the following factors of the road in determining your cycling route or whether you will even bike at all?
    1 = Not at all important, "Of course I will still bike!" and
    5 = Extremely Important, "I will not bike in these conditions."

	1 - Not at all Important	2	3	4	5 – Extremely Important
High car traffic volume					
Too many potholes					
Distance is too far					
They don't clear the ice and snow from the bikeways					
I don't like riding next to parked cars					
Roads are too narrow					
Weather is not suitable (too wet/hot/cold)					

12. How important are the following factors of the built environment in determining your cycling route or whether you will even bike at all?
    1 = Not at all important, "Of course I will still bike!" and
    5 = Extremely Important, "I will not bike in these conditions."

	1 – Not at all Important	2	3	4	5 – Extremely Important
I do not live near a bike path					
There are not enough safe bike parking places at my destinations					
The bike paths or lanes are not convenient or direct enough					
There are not enough connections between bike paths					
Not enough street lights to ride after dark					

13. How important are the following lifestyle factors in determining your cycling route or whether you will even bike at all?
    1 = Not at all important, "Of course I will still bike!" and
    5 = Extremely important, "I will not bike in these conditions."

	1 – Not at all Important	2	3	4	5 – Extremely Important
I do not have enough time					
I do not like to arrive sweaty at my destinations					
I do not have many mechanical skills					
I have to transport my children					
I make too many different stops and errands					
I do not trust my bike enough - it never works quite right					
I have too many things to carry					

Section 4: Tell Us About Yourself

This information is important to help understand what types of streets and bicycle infrastructure is encouraging to different types of people. To make streets more inclusive, we want to address the needs of a variety of people.

14. Do you identify as
    a. Female
    b. Male
    c. _____

15. What is your age? _____

16. What is your race/ ethnicity? Select all that apply.
    a. American Indian and Alaska Native
    b. Asian
    c. Black or African American
    d. Hispanic or Latino
    e. Native Hawaiian and Other Pacific Islander

f. White
g. Other: _____

17. What is your employment status?
    a. Work away from home
    b. Work at home
    c. Unemployed

18. Where do you currently live?
    a. City _____
    b. State _____

19. OPTIONAL: Do you have any further comments about how you view cycling and the road in the Twin Cities?

Appendix B: List of Sources for Survey Distribution

Twin Cities Bike Advocacy Non-Profit Organizations, Online Forums, and Group List-serves

Non-profit Organizations

Sibley Bike Depot

St. Paul Smart Trips

St. Paul Bicycle Coalition

Midtown Greenway Coalition

Minneapolis Bicycle Coalition

Macalester Sustainability Office

Online Forums

Minneapolis Bike Love

Grease Rag Blog

MacBike

Bicycle and Gender-Related Email List-Serves

Twin Cities Action Group

Radical Feminist Google Group

Personal blog

Macalester Faculty & Staff Bike List-serve

Grease Rag Google Group

Dames on Frames List-Serve

Appendix C: Full Survey Results

1. How many times do you travel by bicycle for the following purposes in a typical week? How many miles do you travel for ea purpose?

Times per Week

Answer Options	0	1	2	3	4	5	6	7	Response Count
Commuting to Work	43	12	15	25	28	72	7	3	214
Commuting to School	101	3	11	13	3	16	3	2	159
Errands/ Shopping	25	34	51	48	27	15	2	10	225
Recreation	13	70	52	43	12	11	3	7	215
Other	35	27	13	7	5	2	1	1	93

Distance (miles) for each trip, one-way

Answer Options	Less than 1	1 - 3	4 - 6	6 - 9	10 or more	Response Count
Commuting to Work	14	60	51	32	19	176
Commuting to School	23	24	12	7	0	66
Errands/ Shopping	24	102	60	10	2	198
Recreation	1	25	39	28	101	194
Other	5	20	17	6	14	62

Question Totals	
Answered	238
Skipped	0

2. Do you make more than one stop on the same journey while bicycling?

Answer Options	Response Percent	Response Count
Always	5.5%	13
Sometimes	88.6%	210
Never	5.9%	14
	Answered	237
	Skipped	1

3. On a scale of 1 to 5, 1 = not at all important and 5 = extremely important, please rank the following factors in order of their importance to your decision to bike.

Answer Options	Not at all important - 1	2	3	4	Extremely Important - 5	Rating Average	Response Count
Exercise, staying healthy	1	5	28	88	116	4.3	238
Being outdoors, fresh air	1	5	21	73	138	4.4	238
Bicycling is fun and enjoyable	2	4	21	57	154	4.5	238
It saves money	18	26	45	59	90	3.7	238
It is fast and efficient	8	13	55	86	76	3.9	238
It is good for the environment	8	9	37	74	110	4.1	238
Lack of access to a car	130	25	24	18	40	2.2	237
Lack of access to good public transit options	94	75	41	15	12	2.1	237
To socialize with family and friends	37	55	54	55	37	3.0	238
It is empowering	22	16	50	62	87	3.7	237
						Answered	*238*
						Skipped	*0*

4. Which street and route options would you PREFER (if they were all available options) to travel on for each type of bicycle trip? Check all that apply.

% in Favor	Off-Street/ Separated Bike Path	On-street Bike Lane	Cycle-track	Bike Blvd	Buffered Bike Lane	Main Road	Side Street	Response Count
Work	70.1	52.8	33.8	31.6	38.5	12.1	24.7	231
School	39.0	28.6	18.1	18.1	21.9	6.7	11.0	210
Errands	55.5	52.4	33.2	38.0	43.7	15.3	33.2	229
Recreation	86.1	36.1	30.0	26.1	23.0	13.9	27.8	230
							Answered	234
							Skipped	4

5. Which type of street or route option do you TYPICALLY ride your bicycle on for each type of bicycle trip? Check all that apply.

%	Off-Street/ Separated Bike Path	On-Street Bike Lane	Cycle-track	Bike Blvd	Buffered Bike Lane	Main Street	Side Street	Response Count
Work	37.8	53.2	6.8	7.7	4.1	43.2	46.4	222
School	10.8	21	3.1	1.5	2.1	16.9	18.5	195
Errands	32.9	59.5	8.6	9	10.4	59.9	62.6	222
Recreation	84.7	50.9	17.1	12.6	10.4	37.8	50.5	222
							Answered	228
							Skipped	10

6. Which characteristics and facilities of a road do you value MOST for each type of bicycle trip? Check all that apply.

Answer Options	Fast and Efficient	Well-Lit	Connected to Public Transit	Car-Free	Scenic; greenery	Quiet, separated from traffic	Around other cyclists	Response Count
Work	186	106	40	56	38	66	48	216
School	88	52	20	24	16	26	27	113
Errands	172	103	36	52	44	58	29	217
Recreation	62	70	14	131	186	138	78	225
						Answered		230
						Skipped		8

7. When bicycling on a street with no bicycle infrastructure, where do you position yourself in the lane?

Answer Options	Response Percent	Response Count
As far to the right as possible	43.9%	100
Within the shoulder - if there is one	31.6%	72
In the middle, traveling with traffic	20.6%	47
On the sidewalk	3.5%	8
I do not bike on roads without bicycle infrastructure	0.4%	1
	Answered	228
	Skipped	10

8. Do you wear a helmet when you cycle?

Answer Options	Response Percent	Response Count
Always	73.2%	167
Sometimes	18.4%	42
Never	8.3%	19
	Answered	228
	Skipped	10

9. Do you ever carry children along with you on your bicycle while commuting somewhere other than for recreational purposes?

Answer Options	Response Percent	Response Count	% for whom applicable
Yes	11.4%	26	27.4
No	30.1%	69	72.6
Not Applicable	58.5%	134	/
	Answered	229	100.0
	Skipped	9	

10. Do you ever travel with saddle bags/ panniers on your bicycle or haul a trailer with you to carry items?

Answer Options	Response Percent	Response Count
Yes	59.6%	136
No	40.4%	92
	Answered	228
	Skipped	10

11. How important are the following factors of the road in determining your cycling route or whether you will even bike at all? Please rate on a scale from 1 to 5. 1 = Not at all important, "Of course I will still bike!" and 5 = Extremely Important, "I will not bike in these conditions."

Answer Options	Not at all important - 1	2	3	4	Extremely Important - 5	Rating Average	Response Count
Distance is too far	45	61	59	47	15	2.7	227
Weather is not suitable (too wet/hot/cold)	42	49	48	53	35	3.0	227
High car traffic volume	25	59	51	54	39	3.1	228
They don't clear the ice and snow from the bikeways	12	18	40	63	93	3.9	226
Roads are too narrow	43	68	56	42	18	2.7	227
I don't like riding next to parked cars	79	83	35	22	8	2.1	227
Too many potholes	23	59	68	58	21	3.0	229
						Answered	229
						Skipped	9

12. How important are the following factors of the built environment in determining your cycling route or whether you will even bike at all? Please rate on a scale from 1 to 5. 1 = Not at all important, "Of course I will still bike!" and 5 = Extremely Important, "I will not bike in these conditions."

Answer Options	Not at all important - 1	2	3	4	Extremely Important - 5	Rating Average	Response Count
The bike paths or lanes are not convenient or direct enough	74	72	40	34	6	2.2	226
Not enough street lights to ride after dark	71	51	52	30	21	2.5	225

I do not live near a bike path	136	52	22	8	4	1.6	222
There are not enough connections between bike paths	95	63	37	23	5	2.0	223
There are not enough safe bike parking places at my destinations	72	70	43	27	13	2.3	225
						Answered	227
						Skipped	11

13. How important are the following lifestyle factors in determining your cycling route or whether you will even bike at all? Please rate on a scale from 1 to 5. 1 = Not at all important, "Of course I will still bike!" and 5 = Extremely Important, "I will not bike in these conditions."

Answer Options	Not at all important - 1	2	3	4	Extremely Important - 5	Rating Average	Response Count
I have too many things to carry	70	49	55	37	14	2.5	225
I have to transport my children	143	8	28	7	11	1.7	197
I make too many different stops and errands	131	47	34	7	2	1.7	221
I do not like to arrive sweaty at my destinations	93	56	42	25	10	2.1	226
I do not have many mechanical skills	135	44	23	16	1	1.7	219
I do not have enough time	75	53	52	30	14	2.4	224
I do not trust my bike enough - it never works quite right	145	39	26	4	5	1.6	219
						Answered	227
						Skipped	11

14. Do you identify as:

Answer Options	Response Percent	Response Count
Male	36.8%	84
Female	62.3%	142
Other (please specify)	0.9%	2
	Answered	228
	Skipped	10

14. Age

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Under 20	6	2.5	2.7	2.7
	20 - 30	115	48.3	50.9	53.5
	31 - 40	51	21.4	22.6	76.1
	41 - 50	31	13.0	13.7	89.8
	51 - 60	18	7.6	8.0	97.8
	61 - 70	5	2.1	2.2	100.0
	Total	226	95.0	100.0	
Missing	System	12	5.0		
Total		238	100.0		

16. What is your race/ ethnicity? Select all that apply.

Answer Options	Response Percent	Response Count
American Indian and Alaska Native	0.4%	1
Asian	4.5%	10
Black or African American	1.3%	3
Hispanic or Latino	3.1%	7
Native Hawaiian and Other Pacific Islander	0.9%	2
White	91.1%	204
Other (please specify)	3.6%	8
	Answered	224
	Skipped	14

17. What is your employment status?

Answer Options	Response Percent	Response Count
Work away from home	86.2%	193
Work at home	6.7%	15
Unemployed	12.1%	27
	Answered	224
	Skipped	14

18. City/ State

	Percent	Count
St. Paul	34.3	74
Minneapolis	57.4	124
TC Metro Area	8.3	18
Answered	100.0	216
Skipped		22
Total		238