THE RELATIONSHIP BETWEEN
BICYCLING FACILITIES AND BICYCLE TRAVEL:

A COMPARATIVE STUDY IN THE UNITED STATES AND THE NETHERLANDS

by

ZACHARY DAVID SHAHAN

A Master's Project submitted to the faculty
of the University of North Carolina at Chapel Hill
in partial fulfillment of the requirements
for the degree of Master of Regional Planning
in the Department of City and Regional Planning.

Chapel Hill

2007

Approved by:

Daniel Rodriguez

Acknowledgements

Table of Contents

Abstract

This research project examined the relationship between bicycle facilities and bicycle travel in two locations—Montgomery County, Maryland and the city of Delft in the Netherlands. Data regarding personal characteristics of respondents, neighborhood environments, travel mode options, travel distances, and bicycle facilities were collected from residents of both locations. In Montgomery County, 293 residents of five neighborhoods (ranging from urban to suburban to exurban) were interviewed. In Delft, 249 mail surveys were collected from a stratified random sample of 1121 residents. The data collected in these interviews and surveys were used in regression analyses that examined the relationship between perceived availability of various bicycle facilities and bicycle travel. The Delft portion of the study also examined the relationship between the *quality* of bicycle facilities and bicycle travel. Results indicate that various bicycle facilities (especially higher quality facilities) located in one's home neighborhood are significantly associated with bicycle travel, cross-culturally. Results also demonstrate, however, that many bicycle facilities are not significantly associated with higher levels of bicycle travel. The results help to suggest which bicycle facilities (and which design aspects of those facilities) are critical in order to effectively encourage bicycle travel.

Chapter 1

Introduction: Why Encourage Bicycle Travel?

The Benefits of Bicycle Travel

The following subsections present and briefly discuss several of the key benefits of bicycle travel. Critical problems confronting the United States, auto-oriented civilizations, and, in some cases, inhabitants of the entire planet, guide this introductory discussion. The main issues discussed regard the environment, the physical and mental health of humans, and social justice. The topic of other alternative modes of transportation and the topic of urban form are also briefly discussed.

Environmental Responsibility

Worldwide, acknowledgement that we need to identify and promote environmentally responsible alternatives to automobile travel is becoming more and more prevalent. Global climate change, a potential environmental problem of considerable concern, is gaining attention on both public and academic radars. The negative environmental effects of increasing global warming are many, including sea level rise and flooding of coastal areas, increases in natural disasters, development and spread of vector-borne diseases, and large-scale species loss (Scheraga and Grambsch, 1998; Parry et al., 2001; Smith et al., 2003; Hurd et al., 2004; White, 2004). Strong evidence of unique and abrupt global warming is already documented (North, 2003), and greenhouse gas emissions are now known to be a significant predictor of climate variability (Watson, 2001). Automobile travel is a major cause of greenhouse gas emissions (U.S. Environmental Protection Agency, 2006). The automobile is also a leading cause of other types of air pollution and urban smog, related environmental problems plaguing increasingly urban and auto-dependent countries such as the United States (U.S. Environmental Protection Agency, 2006; Welch, 2006).

Efforts to develop more environmentally benign versions of the automobile are in progress, but viable and effective solutions are yet to materialize. A more immediate solution to these problems is to get travelers to move from the automobile to more environmentally friendly modes of travel, such as the bicycle. Traveling via bicycle, arguably the most environmentally friendly mode of travel, does not emit any critical air pollutants. The U.S. Congress (1978) and others (Exploratorium, 2007; Lowe, 1988; Schinnerer, 1997; Whitt & Wilson, 1982; Wikipedia, 2007) consider bicycling to be the most efficient transportation mode.

In addition to the air pollution issues mentioned above, there are also water and land issues that increased bicycle travel could help to address. Bicycles require much less transportation infrastructure than other modes of travel (Figure 1.1). "For a bridge of a given size to accommodate 40,000 people in one hour would require twelve lanes for cars, four lanes for buses, two for trains and one for bicycles," (Lowe, 1988). Less transportation infrastructure means that more natural areas, farmlands and open spaces can be preserved. In a related manner, less paving of land also produces less impervious surface, reducing stormwater runoff, soil erosion and sedimentation. Water resources all over the world, and especially in the developed world, are impaired and ruined by pollution from excessive stormwater runoff, erosion and sedimentation. Water pollution from stormwater runoff may actually *exceed* water pollution from factories and sewage facilities (Marsh, 2005; Natural Resources Defense Council, 2000). Thus, accommodating more bicycles and fewer cars could considerably improve water quality in many a place.

Figure 1.1: Approximately 20 bicyclists at a traffic light take up less space than three or four small cars.

Bicycles also require far fewer resources for their production. "One hundred bicycles can be manufactured with the materials it takes to build a medium-sized car," (Lowe, 1988).

Lastly, increasing bicycle travel in place of automobile travel would result in considerable reductions in noise levels. This is not an issue that came to mind until I was living and studying in the Netherlands and noticed how quiet a city of 185,000 could be. The noise created by ten or by fifty bicycles is considerably less than the noise created by the same number of cars, or even *one tenth* the number of cars.

Largely as a result of these various environmental issues, bicycling has been gaining an increasing amount of support on international, national, state, county and municipal levels (Feske, 1994; Pucher et al., 1999; Betsill, 2001; Betsill and Bulkeley, 2004; ICLEI, 2005). Some countries, such as the Netherlands, Denmark and Germany, have developed and implemented extensive plans, policies and programs for promoting bicycle travel. Other countries, less advanced with regards to this topic, are more recently awakening to the value of bicycling as a central mode of travel in daily life. Nonetheless, they too are beginning to put more attention into planning for bicycles. Such countries include Canada, Great Britain, and the United States of America.

Physical and Mental Health

Making bicycling a legitimate mode of travel is seen not only as a way to improve environmental responsibility, but also as a way to improve the health of excessively sedentary and auto-dependent urban residents (Frank and Engelke, 2001; McCann, 2005). In the United States, according to the Centers for Disease Control and Prevention, almost two-thirds of adults are either obese or overweight, and the rates of overweight children more than tripled between the years 1980 and 2005, going from 5% to 17% (Segal, 2006). Laura Segal states, "According to a new report from Trust for America's Health (TFAH), adult obesity rates continued to rise in 31 states over the past year while government policy efforts have consistently failed to provide viable solutions to the growing obesity crisis," (2006). A key factor considered by health professionals to cause obesity is an excessively sedentary lifestyle (*Causes of Obesity*, n.d.). Making more of our regular trips – to work, the store, a friend's house, etc. – via bicycle could appreciably counter this obesity epidemic.

In addition to obesity, the psychological toll of auto-dependency and excessive driving is another important issue affecting large numbers of people in highly developed countries. Residents of highly populated but highly auto-dependent urban areas, such as Los Angeles, Houston, Atlanta, Tampa, and other metropolitan areas in the western and southern United States, are especially likely to suffer from the negative psychological effects of long and congested daily commutes. Although it is more difficult to examine the degree and ramifications of this less tangible health topic, stress, rage (i.e. road rage), isolation, and depression are commonly conjectured results of this lifestyle (Burden, 2001; Calthorpe, 1993; Duany, et al., 2001; Giles-Corti, 2006; Morris, 2004).

Social Justice

Socioeconomic inequality and the continually increasing gap between the rich and the poor are huge issues facing American society (Blank, 1997; Danzinger and Gottschalk, 1995; Fishman, 2000; Harrison and Bluestone, 1990; Levy and Murnane, 1992; Wyly, et al., 1998). Efforts to get to the roots of these issues are critical if we are to consider our society to be evolving for the better. Increasing access to jobs and to the educational settings that allow the less advantaged to improve their socioeconomic status must be a part of any effective attempts at balancing the socioeconomic status of people in this country. This includes (but is definitely not limited to) better *physical* access to such places. Improving access through more affordable means of travel than the automobile, such as the bicycle, is an important way of doing this. Making bicycling a more viable way to traverse the territory in which one must find economic, educational and social support could significantly improve equity in many a place.

In addition to digging at the roots of socioeconomic inequality, making the bicycle a more legitimate mode of travel may also make the quality of life of the less advantaged substantially better. Generally, there seem to be two groups of people who bicycle for utilitarian purposes in the United States – (1) bicycle enthusiasts (those people who wear tight and colorful cyclist suits, who ride bikes worth approximately $1000 or more, and who ride at about the speed limit of a residential street), and (2) those who cannot afford an automobile and do not have good access to public transit. As much as driving long distances on congested highways may be unpleasant, bicycling on them is in many ways more so. Improving the bicycle facilities for those who *have* to bicycle would improve the quality of life of our society's more choice-constrained residents. It may also improve the bicycling option enough that those constrained to riding less than satisfactory public transit or those struggling to afford the luxury of a low-quality car, or even those who are simply tired of commuting via car, would benefit from being able to switch their main mode of transport to the bicycle.

Figure 1.2: Bicyclists have a separate waiting area in front of cars at a major intersection in the city of Groningen in the Netherlands.

Figure 1.3: A bicycle lane going towards town turns into a separate path and stays flat as it and the roadway go under a bridge.

Other Alternative Modes of Travel

Many of the most critical issues discussed above are the result of excessive dependence on the automobile. Addressing this issue, it is advised that we decrease such dependence through a variety of means and through a variety of travel modes. Diversity in most cases is the best solution, in process and product. This topic does not present an exception to the rule. Increasing the viability of various forms of public transit and of walking is not in conflict with the aim to increase cycling, and doing so may even be complementary to the actual viability and attractiveness of cycling. For example, transit often better serves the purpose of long-distance travel, while bicycling better serves the purpose of relatively short-distance travel, with overlap somewhere in the middle. By increasing the attractiveness and viability of transit, the attractiveness and viability of combined bicycle/transit travel could be improved (Figures 1.4, 1.5, & 1.6).

Figure 1.4, 1.5 & 1.6: A small portion of the bicycle parking at train stations in Groningen and Delft (Netherlands).

Walking and bicycling are more comparable in their advantages and disadvantages than other common modes of travel, and, thus, walking and bicycling are often grouped together in discussions regarding travel modes. Improving the walking environment may, even more significantly than improving the bicycling environment, improve the situation of some of the dilemmas discussed above. However, it is more difficult to improve the walking environment of large areas than it is to improve that place's bicycling environment. Walking is inherently more sensitive than bicycling to travel distances and, hence, to density (or compactness) and land use mix, factors that normally take a very long time to change. However, because they are relatively similar, improving the environment for one will in many cases improve the environment for the other. Making *bicycling* safer and more convenient will in many cases make *walking* safer and more convenient. Off-road bicycle paths and trails are often

Figure 1.7: Off-road path for cyclists and pedestrians.

Figure 1.8: Bicycle lanes help to buffer sidewalks from the roadway.

bicycle/pedestrian paths and trails (Figure 1.7). On-road bicycle lanes help to buffer sidewalks from automobile traffic (Figure 1.8). Additionally, although I do not think that this has been studied, it seems likely that the presence of more pedestrians would make bicycling a more interesting and enjoyable experience, (until a certain very large level of scale were reached in which there was actual pedestrian/cyclist congestion and conflict).

Bicycle travel is the specific topic of interest in this study, but its relationship to other modes of travel, and the mutual nature of the goals that promotion of these various alternative modes of travel are trying to achieve, are not issues that should be left unacknowledged.

Urban Form

Although this paper is not comprehensively addressing or examining the relationship between urban form and bicycle travel, there are some things to note with regards to this subject. It is rather conclusive that more compact, mixed-use and traditionally designed urban places significantly relate to higher levels of bicycle travel (1000 Friends of Oregon, 1997; 1000 Friends of Oregon, 2003; Handy, 1996; Handy, et al., 2002; Hoehner, et al., 2005; Krizek, 2003). Access and proximity to common destinations is presumably a key factor in this relationship. When studying the relationship between bicycle facilities and bicycle travel, the relative utility of these facilities due to the spatial proximity of different key places (i.e. home, work, stores, restaurants, friends' houses) is an important factor that is sure to play an underlying role in the nature of that relationship. This is addressed, somewhat, through the survey questions and research design used in this study, but, truthfully, urban form is a very complex matter involving a host of different issues that may underlie a relationship between bicycle facilities and bicycle travel. Furthermore, it is the nature of these more compact, traditionally designed places to *automatically* provide more bicycle facilities – maybe not specific bicycle lanes and bicycle paths, but a higher number of low volume and low speed roads and a higher number of sidewalks, all of which act as very satisfactory bicycle facilities (Figures 1.9 & 1.10). In all, the relationship between urban form and bicycle travel is intricate and complex, and although this study strives to control for key factors concerning that relationship in itself, its complexity and possible influence on this study is an important caveat to keep in mind.

Figure 1.9 & 1.10: Narrow roads and compact development support cycling. Pictures from the cities of Delft and Groningen in the Netherlands.

General Description of the Research Study

The research study that this paper is centered around thoroughly examined the relationship between bicycle facilities and bicycle travel in five cities in Montgomery County (Maryland) and in the City of Delft in the Netherlands. The study involved the use of survey data to examine perceived accessibility to bicycle facilities and the relationship between such perceptions and bicycle travel.

For the Montgomery County portion of the study, the data from a survey that included several questions regarding perceived access to various bicycle facilities (i.e. off-road bicycle paths, bicycle lanes, bicycle storage facilities, showers for cyclists) in or near various key places (i.e. home neighborhood, work neighborhood, most common destinations) were collected. A mail-in mail-back survey using some of these same questions (ensuring comparability) as well as additional questions regarding other facilities and more qualitative information regarding bicycle facilities was then developed and used to survey a stratified random sample of Delft residents. The data from the two surveys were statistically analyzed using linear regression, controlling for such factors as age, gender, personal values, automobile ownership/access, and travel distances, among a host of other things (see Chapter 3 for more detail).

By surveying residents in two countries, it was possible to identify factors that were cross-culturally related to bicycle travel, as well as factors that were more culturally relevant. Findings are presented in Chapter 4 and more thoroughly discussed in Chapter 5.

Chapter 2

Accumulated Knowledge: Review of Bicycle Facility and Bicycle Travel Literature

Introduction

The majority of this chapter involves the review of various studies that have (1) examined people's preferences for different bicycling facilities, and (2) examined the relationship between the existence of such facilities and bicycle travel behavior. Studies include stated preference surveys, aggregate studies of large-scale investments in bicycling facilities and concurrent increases in bicycle travel, and studies that relate perceived and objective measures of bicycling facilities to bicycle travel behavior. The basic hypothesis is that all bicycling facilities would be wanted and would encourage bicycle travel, but that some facilities would be much more preferred and would consistently show a much stronger relationship to bicycle travel behavior. With a limited number of studies performed, and limitations in research designs, the only strong conclusions that can be made at this point are that survey respondents consistently state a preference for off-road bicycle paths and bicycle travel is higher in countries with more bicycle facilities.

Potential Reasons Why Bicycle Facilities Would Influence Bicycle Travel

Theoretically, special bicycling facilities, such as bike paths, bike lanes, or even sidewalks, are considered to be important factors influencing people's decisions whether or not to travel via bicycle. The underlying idea is that such facilities (1) make bicycling safer, or at least make it seem safer; (2) make bicycling more convenient; and (3) make bicycling more aesthetically enjoyable. These more basic topics are not thoroughly discussed in this paper, but, generally, they are considered to be the fundamental factors underlying the importance of bicycling facilities in promoting bicycle travel. A considerable percentage of the trips people make are within a relatively short distance of their home (Malone, 1996). It is hypothesized that if bicycling were better planned for—particularly, through the planning and construction of satisfactory bicycle facilities—many of these trips could and would be made via bicycle.

Counter to some of these assumptions, Forester (2001) has argued against the building of bicycle paths and any travel facilities specifically for bicyclists, considering them needless and even dangerous. This argument has been strongly contended by Pucher (2001) who presents data showing that the countries and places where bicycling is safest and most popular are also where provision of such facilities is most extensive, as well as data from stated-preference surveys that show that people prefer separate facilities and that a major reason for that preference is because they feel that they are safer. Preferences for bicycling facilities, and their association with bicycle travel, are more thoroughly discussed in the following sections through an extensive review of relevant studies and literature.

Desirability of Bicycle Facilities

The desirability of different bicycling facilities and the influence they may have on bicycle travel behavior have been studied through several stated-preference surveys in various cities, metropolitan areas, and countries. There is fairly strong consistency in the findings as to which facilities are preferred in general, but there are limitations concerning the populations studied, the specific

relationship between preferences and actual use, and the relationship between preferences and trip purposes.

Stated-Preference Surveys

The 2002 National Survey of Pedestrian and Bicyclist Attitudes and Behaviors identified that almost one half (49.8%) of all adults age 16 or older are not satisfied with the design of their community with regards to bicycling safety (Levy and Russell, 2002). Of the recommended changes solicited to improve the design of their communities for bicyclists, 73% recommended providing more bicycling facilities (i.e. bicycles trails, paths, lanes, racks, traffic signals, lighting, or crosswalks), and another 7.8% recommended improving existing bicycle facilities (Levy and Russell, 2002). However, proportions of the specific facilities recommended, facilities respondents considered most lacking, were not presented. The survey also found that, of the bicycle trips taken, the largest percentage of them (48.1%) were taken on paved roads, 13.6% were taken on sidewalks, 13.1% were taken on bicycle paths, walking paths, or trails, 12.8% were taken on the shoulders of paved roads, and 5.2% were taken on bicycle lanes on roads (Levy and Russell, 2002). Although this information is interesting, and shows that a considerable amount of bicycle trips are taken on specific bicycling facilities, it does not compare the trips taken with *availability* of the various facilities. Also, this information was not further separated according to trip purpose, such as whether the bicycle trips taken were for recreation or for transportation purposes.

Jackson and Ruehr (1998) found that people in San Diego County who bicycled preferred bicycle paths separated from the road as their number one choice of bikeway facility. Again, a limitation of this study is that this information was not distinguished according to people who bicycled for transportation purposes versus people who bicycled for recreation. It was found generally, however, that only 15% of the respondents who had ridden a bicycle at least once in the last year had done so for transportation purposes. The City of Philadelphia (1990) captured the importance of such paths to Philadelphians for a decent portion of utilitarian trips – trips to work – in a citywide transportation survey. In this survey it was found that 35% of respondents would *require* exclusive bicycle paths as a necessary element that must be present for them to bicycle to work.

In a study in Germany, in which cyclists were interviewed as to their preferred bicycle travel facilities, again separate bicycle paths (or "tracks" as they are called in the report) were the preferred facilities, slightly more attractive than bicycle lanes, more attractive than low volume roads, and much more attractive than medium or high volume roads (Bohle, 2000). A little more generally, in an internet-conducted survey of bicycle commuters, it was found that the presence of bicycle lanes and separate bicycle paths strongly influence the routes chosen, and that the level of automobile traffic, the quality of the riding surface, and the presence of a bicycling facility on a bridge also influence the travel routes chosen (Stinson and Bhat, 2003). The limitation of these studies is that they only concerns existing bicyclists and not *potential* bicyclists who might have different preferences or degrees of preference.

Through an adaptive stated-preference survey, Krizek, Tilahun, and Levinson (n.d.) examined preferences for different types of bicycle and roadway facilities, as well as increases in the travel time a person would expend to use a more desired facility, in order to determine not only which facilities were preferred but also by how much they were preferred. They found that people were willing to travel up to twenty minutes more to travel on the most desired option – an off-road bicycle trail – rather than the least desired option – an unmarked on-road facility with side parking. The overall ranking of the facilities, from most preferred to least preferred, were off-road bicycle trails, roads with a bike lane and

no side street parking, roads with a bike lane and side street parking, roads with no bike lane and no side street parking, and roads with no bike lane but with side street parking.

Krizek, Johnson, and Tilahun (2004) took an initial step in studying the issue of gender differences in bicycling through a careful review of several existing stated-preference surveys. They came to a few interesting observations regarding *differences* between the two genders. First of all, however, they did find that women and men had similar overall preferences for different facilities. "Women and men cyclists were relatively similar in the proportion who value specific types of bicycle facilities such as on-road bicycle lanes, separate bicycle paths, and a connected system of bicycle routes as well as those who value amenities such as secure storage facilities at work or school. They were also relatively similar with respect to the lower proportions of those who value showers at work or bicycle racks on buses" (2004, p.36). They also found that of the respondents who did not consider Minnesota to be "very safe" for cycling, women were more likely to say this was due to a lack of bicycle paths and poor road conditions, whereas men were more likely to say that this was due to unsafe behaviors of drivers and unsafe behaviors of cyclists. Lastly, they found that *for all facilities* women were more willing to travel further for a better bicycle facility than men, demonstrating that women seem to have a stronger preference for safer bicycle travel routes.

Discussion

People do value bicycling facilities, and have been shown to require them if they are to bicycle. Bicycle paths separate from the roadway consistently are found to be the most preferred facility. However, studies often have not distinguished between recreational cyclists and utilitarian cyclists, or they only examine one of the study groups. Additionally, in these studies, preferences are neither compared to availability of different facilities nor to the bicycle travel behavior of respondents.

Figure 2.1: Bicycle paths separate from the roadway consistently found to be most preferred bicycle facility in stated-preference surveys.

Relationship between the Existence of Bicycle Facilities and Decisions to Bicycle

The actual relationship between bicycling facilities and bicycle travel behavior has been studied by a handful of researchers through a few different means. Aggregate studies of increased funding and construction of facilities and correlated increases in bicycle travel have demonstrated the general importance of such facilities. Cross-sectional studies, concerning *perceptions* of bicycle facility

availability and *actual* bicycle facility availability, have begun to examine the relationship between specific types of facilities and bicycle travel behavior, showing some consistency in their conclusions but also some dissimilarity. Variations in the specific facilities examined in these separate studies, and lack of a comprehensive study of potential bicycle facilities, as well as limitations due to methodology, areas of study, and study populations, limit the conclusiveness of the overall results concerning this topic.

Aggregate Studies

Through a study of 43 major cities in the United States, Dill and Carr (2003) found that cities with a higher provision of bicycle facilities, such as bike paths and bike lanes, have higher percentages of bicycle commuters. This study makes findings concerning a portion of the people who bicycle for transportation purposes, not including findings concerning those who travel via bicycle for other utilitarian purposes or for recreational purposes, nor the importance of such facilities to those people who do not bicycle at all.

Pucher (1997) found that bicycle travel increased considerably concurrent with and following considerable expansion of Germany's bicycle facilities and bicycle route network. Similarly, Pucher and Buehler (2005) identify a relationship between large increases in spending on bicycle facilities and large increases in bicycle travel in Canadian cities and provinces. They discuss the production of great amounts of bicycle paths and bicycle lanes in Quebec (Quebec City and Montreal), the extensive provision of bicycle parking and bicycle traffic signals in Ontario (Toronto and Ottawa), as well as other efforts to encourage bicycle travel. The limitation of these studies is that the results are very broad, and the significance of the relationship between facilities (in general) and bicycle travel behavior is not isolated and tested while controlling for other factors that might have had a significant influence on such behavior.

Similar to Pucher's studies, Grimshaw (2002) discusses a massive expansion of the bicycle network in the UK in the mid and late 1990s, and shows initial increases in bicycle travel between 1998 and 2001. However, Grimshaw (2002) notes that the increases must continue to rise, even more considerably than they have so far, for the investments' goal to realize (which would be a quadrupling of cycling trips by 2012). This brings up another important question, how much must investments increase bicycle travel for them to be considered successful? It is generally assumed that building bicycle facilities will induce bicycle travel, but to what degree should they do so? This topic is addressed partly by Krizek (n.d.) through a review of literature regarding efforts to evaluate the economic benefits of bicycling and bicycle facilities. Other than the work reviewed in that essay, however, the questions asked above are often answered more qualitatively according to people's individual values and range of knowledge.

Looking at the topic of bicycle parking and storage facilities, Holladay (2002), Beatley (2000), Pucher and Dijkstra (2003), and Noland and Kunreuther (1995) each discuss the general, intuitive importance of good bicycle parking and storage facilities for enhancing and encouraging bicycle travel. Holladay (2002) claims that at rail stations where bike lockers are available for a fee, lockers are often over-subscribed and waiting lists are being employed. Beatley (2000) and Pucher and Dijkstra (2003) discuss extensive and innovative efforts to provide good bicycle parking and storage facilities in the top bicycling cities in Europe and the United States. Beyond general discussions such as these, which mostly concern facilities in high bicycle travel environments, this topic has not really been looked at.

The limitations of all of these aggregate studies are that they can only make general connections between the provision of bicycle facilities and bicycle use. Additionally, given the range of efforts used to encourage cycling in many of the cited cases, it is not definite that an increase in availability of facilities is the key factor influencing increases in bicycle travel. None of these studies soundly tests the significance of such factors or the relative importance of the different facilities. As Pucher, Komanoff, and Schimek (1999) stated:

> Unquestionably, separate bike lanes and paths for cyclists, together with better parking facilities, make cycling more attractive to non-cyclists. However, we are not aware of any rigorous statistical studies of their actual impact on increasing cycling levels; to some extent, such facilities may be a response to increased cycling instead of its cause. Nevertheless, every European city with high cycling levels has an extensive route system, including separate bike paths and lanes as well as general street use in traffic-calmed neighborhoods.

The following section reviews several studies, mostly very recent, that more soundly examine the significance of the relationship between different facilities and decisions to bicycle.

Bicycle Travel and Perceived & Objective Factors Concerning Bicycling Facilities

Everett (1990) found that in order for mass bicycling (10% or more of trips) to occur in an area, separate bicycle paths, or, in some rare examples, sidewalks with curb cuts and low speed-volume traffic levels, must be available. However, Everett also suggested that such mass bicycling is probably dependent on other factors as well, such as the cost of trips (including time costs). He also acknowledged that this study used a somewhat crude regression model and that more research needed to be conducted on the relative importance of such bicycle paths and bicycle routes in order to determine their potential for influencing bicycle travel.

Moudon, et al. (2005) found, through objective measures, that proximity to bicycle trails is significantly related to the likelihood that a person will bicycle, and that people are more likely to use these trails for recreation than for transportation purposes. They also found, through objective measures, that bicycle lanes and traffic speed and volume do not significantly affect the likelihood that a person will bicycle. The *perceived* presence of bicycle lanes, as well as bicycle trails, however, was significantly correlated with bicycle travel. The overall result demonstrates the importance of bicycle paths but is less conclusive about the importance of bicycle lanes for encouraging bicycle travel. "This study highlights the significant positive role of trails measured objectively, as distance to the closest trail, and subjectively, as the combined trails and bike lanes in the neighborhood" (2005, p.257). A limitation of this specific study, as admitted by the authors, is that bicycle facilities are not very abundant in the study area. "The role of these objectively measured variables (including bike lanes) may be downplayed because of the limited bicycle transportation infrastructure in the sample" (2005, p.259). Additionally, the study does not distinguish between the effect such facilities have on bicyclists traveling for recreation versus transportation purposes.

Hoehner, et al. (2005) came to the same conclusions regarding bicycle lanes, but did not study bicycle paths. Again, they found that there was no relationship between objective measures of the presence of bicycle lanes and the likelihood that a person would travel via bicycle, but they did find that the *perception* of the availability of bicycle lanes was significantly correlated with the decision to travel via bicycle. These results were true for both transportation and recreation related bicycle activity. Because this study was focused on the topic of bicycling for public health reasons, the authors measured bicycling-related physical activity rather than the likelihood that a person would travel via bicycle.

Nonetheless, they come to the same basic conclusion regarding the relevance of bicycle lanes for increasing bicycling.

Krizek and Johnson (2006) in a very recent study of residents in the Twin Cities in Minnesota came to contrary findings from those above. They found that proximity to an off-road bicycle path is not significantly related to bicycle use, but that residents living within 400 meters of an on-street bicycle lane had significantly higher odds of bicycling than residents living more than 1600 meters from such a facility.

Also rather contrary to the findings of Everett (1990) and Moudon, et al. (2005), Rodriguez and Joo (2004) found that a higher level of travel time savings resulting from the use of bicycle/pedestrian paths was negatively associated with the probability that a person would make a trip via bicycle. This suggested that the building of more paths near a person's home, or the building of more utilitarian-oriented paths, would decrease the probability that a person would travel via bicycle. As the authors noted, this result could be a proxy for factors not studied, such as perceptions of safety or the aesthetic quality of these paths. This issue of the design of facilities will be addressed a little further in the next part of this paper. Rodriguez and Joo (2004) also found that the availability of sidewalks does not have a significant effect on bicycle travel.

Studying a specific portion of the population, Boarnet, et al. (2005) found that Safe Routes to School projects, and, in particular, the building of sidewalks, increased the proportion of children who bicycled to school in areas where the children passed by such projects. Compared to children who did not pass by such projects on their normal route to school, this increase was found to be statistically significant.

Moving away from the topic of bicycle travel facilities, Noland and Kunreuther (1995) found that bicycle parking is an important factor related to bicycle travel behavior. They found that bicycle parking is significantly related to perceptions of bicycling convenience. "Those respondents with safe bicycle parking available have a statistically significant higher mean perception of bicycling convenience than those without parking available" (1995, p.73). Supporting the importance of this finding, they also found that perceptions of bicycling convenience are significantly related to a person's decision whether or not to travel via bicycle. This study by Noland and Kunreuther appears to be the only study that actually tests the significance of the relationship between bicycle parking of any sort and bicycle travel, although it does so somewhat indirectly and it does not distinguish between different types of bicycle parking, such as racks versus lockers.

A handful of additional studies (Troped, et al., 2001; Pikora, et al., 2003; Wendel-Vos, et al., 2004) and some of the findings of the studies discussed above have examined the association between trails, low volume roads, or sidewalks and non-motorized travel, but since these studies and findings do not distinguish between factors related to bicycling and factors related to walking, they have not been included in this discussion.

Discussion

The more statistically rigorous studies discussed in this section come to mixed conclusions regarding the relationship between different types of bicycle facilities and bicycle travel behavior. Some studies suggested that there is a significant relationship between bicycle travel and the perceived and objective presence of bicycle paths, and that there is a significant relationship between bicycle travel and the perceived presence of bicycle lanes but not the objectively measured presence of bicycle lanes.

However, another study showed the opposite results regarding the objectively measured presence of bicycle paths and lanes. The studies differ in their findings regarding the relevance of low volume roads and sidewalks as well. Additionally, most of these studies still do not distinguish between people bicycling for transportation purposes and people bicycling for recreation purposes, and none of them study the relevance of a full range of potential bicycling facilities. Their study populations and their areas of study, which range considerably in their *provision* of facilities, also inherently limit these studies. In all, this topic has hardly been studied through rigorous statistical analyses, and differences in results *as well as* variations in populations studied, areas of study, variables used, and assumptions employed regarding objective measures, make the results anything but conclusive.

Importance of Facility Design and Aesthetics

The issue of facility design is discussed by McClintock (1992), who argues that this is a critical issue affecting travel behavior. For example, he states, "the value of even basically well-designed cycle paths can be marred by poor detail" (p.26). Despite this appealing theoretical argument, the relevance of bicycle facility design and aesthetics has been studied even less than the relevance of facilities in general. A few studies have begun to look into the topic of preferences for and effects of aesthetics of the surrounding environment and facility design and quality. For the most part, however, this topic has barely been broached, despite its intuitive importance to facility use.

Very generally, Troped, et al. (2003) found that the perceived environmental variable "enjoyable scenery in the neighborhood" was significantly related to transportation-related physical activity. This finding hints at the idea that the scenic and aesthetic quality of a bicycle route, and of bicycle facilities of any kind, would increase the likelihood that a person would use it for transportation purposes. However, this is still a very general finding and does not even distinguish between the association such a factor has with bicycling rather than walking.

In a study of shared use trails in Texas, Shafer, et al. (1999) identified associations between different trail attributes and both user satisfaction and actual trail use. They found adequate separation from motor vehicles, trail surface quality, and trail width to be important factors influencing satisfaction and use. They also found "scenery" to be the factor that was liked by the largest proportion of users, and "having natural areas present" was overall the most important quality of life item tested. The large majority of the users in this study (73.8%) were using the trail for recreation/fitness purposes rather than commuting purposes, but importance of the above issues were essentially the same for both purposes. Again, differences in the importance of the above factors were not presented according to differences in activity type (i.e. bicycling versus walking).

Hunter (1999) studied the difference in feelings of safety and of distance between cyclists and passing vehicles when paved road shoulders were painted red on a portion of a roadway in Florida. They found that with the shoulders painted red, 79% of respondents felt safer, 17.9% felt it made no difference, and 3.2% felt less safe. They also found that 85.9% of the responding cyclists felt that there was more space between cyclists and passing vehicles.

Discussion

There is a definite deficiency in studies that have evaluated preferences for and importance of different design attributes of bicycling facilities. The few studies that have initiated such evaluations were not focused on that topic (they only touched on it), did not distinguish between people using the trails for

bicycling versus walking, or were not very statistically rigorous. Additionally, each of these three studies only interviewed users of the facilities and not *potential* users.

Conclusions

From stated preference surveys it is clear that people do value bicycle facilities, and especially bicycle paths. Unfortunately, these studies do not compare preferences for facilities to *availability* of different facilities, or to the bicycle travel behavior of respondents. Another key finding, from the results of large-scale aggregate studies, is that more facilities are associated with more bicycle travel. Limitations of these studies, however, include the fact that they can only make very general conclusions regarding correlations between the provision of bicycle facilities and bicycle use. They are not statistically rigorous and do not signify a definite relationship between bicycle facilities and bicycle travel, especially since other important factors are not controlled for.

Studies more rigorously examining the relationship between bicycle travel and perceived and objective factors concerning bicycling facilities have been low in number and have come to mixed conclusions regarding such relationships. Two studies have found that the perceived and objective presence of bicycle paths is associated with significantly higher amounts of bicycle travel, but another study found no significant relationship between these factors. Two studies have also found that the perceived presence of bicycle lanes is significantly associated with higher amounts of bicycle travel, but they found no significant relationship between the objectively measured presence of bicycle lanes and amounts of bicycle travel. Again, another study came to a contrary finding, that the objectively measured presence of bicycle lanes *is* significantly associated with amounts of bicycle travel. Similarly, there have been inconclusive and mixed findings regarding the relevance of low volume roads and sidewalks.

These studies also have several limitations. Most studies do not distinguish between people bicycling for transportation purposes and people bicycling for recreation purposes. None of the studies examine the relevance of a full range of potential bicycle facilities. Study populations and areas of study, which range considerably in their *provision* of facilities, inherently limit the general relevance of these studies. The variables used, and assumptions employed regarding objective measures, which can considerably affect the results obtained, were different in all studies and have not been standardized. Additionally, because these are all cross-sectional studies, they cannot make conclusive claims with regards to cause and effect.

In all, at this point no strong conclusions can be made concerning the importance of various bicycle facilities in generating bicycle travel. In addition, the relevance of facility design and aesthetics, and of bicycle parking and storage facilities, have hardly been addressed. Distinguishing differences in the preferences of different groups of people (i.e. males and females, Caucasians and minorities, rich and poor, recreational cyclists and utilitarian cyclists) also has seldom been done. Understanding these preferences is important when a potential policy is being considered because (1) there are equity concerns that may not be addressed without this information, and (2) policies are considered for different reasons and, for example, a policy to promote bicycle transportation should be guided by information regarding preferences for utilitarian cycling. Lastly, many of these studies only produce findings concerning *existing* cyclists, when it is often the importance of different cycling facilities for *potential* cyclists that policy makers need to know about. Therefore, there is room for a great deal more research on this topic.

Chapter 3

Examining the Relationship Between Bicycle Facilities and Bicycle Travel: Research Design and Methodology

The basic research question of this study is: "What is the relationship between various bicycle facilities and bicycle travel?" This chapter discusses the process used in this study to help answer the research question. This includes a discussion of the research design and methodology used for each of the two study areas—Montgomery County (Maryland) and Delft (Netherlands)—as well as a thorough description of the data analysis procedures.

Montgomery County, Maryland

Montgomery County borders the northern edge of Washington, D.C., political capital of the United States with a population of approximately 515,000 (US Census Bureau, 2000). Residents from Bethesda, Forest Glen, Four Corners, Layhill, and Olney were invited to participate in the study (as

Figure 3.1: Map of counties around Washington, D.C.—Montgomery County on the north border

discussed in further detail below). Bethesda, the largest of the study cities in Montgomery County has a population of approximately 55,000. It is approximately 8 miles from DC. As discussed below, Bethesda is comparable to the Netherlands study city—Delft.

Traditionally, Montgomery County is well known for its coordination between transportation and land development in support of modes of travel other than the private automobile (Godschalk et al., 1978). This integrated and progressive approach to land use and transportation planning is still prominent today. "The county … has adopted land-use policies that have led to the creation of transit-friendly, pedestrian-oriented projects.… The county continues to lead the U.S. in the implementation of planning and growth management tools." (Rodriguez, et al., 2007). In relation to other places in the United States, Montgomery County has a fairly extensive system of bicycle facilities. As a result of these factors, Montgomery County was deemed a good U.S. site for this study.

The Montgomery County portion of the study was led by a team of University of North Carolina and University of Maryland researchers. Participants were recruited using a two-stage clustered sampling research design. Residents from five community analysis zones (CAZ) in Montgomery County—Bethesda (urban), Forest Glen (suburban), Four Corners (suburban), Layhill (exurban), and Olney (exurban)—were invited to participate in the study. The selected neighborhoods represented clusters of a continuum between exurban and urban built environments. Inclusion criteria were age (>17 years) and ability to move unaided for 20 minutes or more. Participants were recruited through a variety of methods: mail invitations, telephone calls, door-to-door recruitment, newspaper announcements, and television newscasts. In the end, 293 residents were interviewed (between 2005 and 2006). Forty-

seven participants were enrolled from Bethesda, 44 from Forest Glen, 67 from Four Corners, 62 from Layhill, and 73 from Olney. For additional details regarding this portion of the study, see http://www.planning.unc.edu/ALR/. (Demissie, 2007, Protocal Participation Methods)

Figure 3.2 & 3.3: Bicycle paths in the city of Bethesda in Montgomery County, Maryland . (Esparolini, 2004)

The interview questionnaire used in Montgomery County collected self-reported physical activity, personal and household socio-demographic information, social support for physical activity, perceptions of various neighborhood environments (i.e. home, work), and information regarding parking, transit, and bicycle facilities, among other things (Appendix I). Most of the survey questions were obtained from other studies—the National Household Travel Survey, the National Quality of Life Survey, and the Southern Village Study. More details on the questionnaires are presented after introducing the Delft study area. (Demissie, 2007, Survey Methods)

Delft, Netherlands

The Netherlands is considered by many to be one of the best countries in the developed world for bicycle facilities, if not the best. Beatley (2000) states: "Few developed nations place as much emphasis on bicycles as does the Netherlands… and from this country much can be learned… Among European nations, the Netherlands has the highest proportion of bike lanes and paths" (p.168). The Netherlands was deemed an ideal country for this study.

Figure 3.4: Map of Delft in relation to nearby cities (RB-Deskkart & Schirmer Medienservice, 2005)

Delft, located in "South Holland" (a southwestern region of the Netherlands), was chosen as the study city in the Netherlands. In Delft, 35% of all commutes are by bicycle, a little higher than the modal share of 28% for all trips in the Netherlands (Sommer, 2003). Delft was chosen as the Netherlands study city because of its similarities with Bethesda, MA, the largest of the five Montgomery County cities studied. Delft has a population of approximately 94,000, while Bethesda is slightly smaller, with a population of

approximately 55,000. Delft is approximately 9 miles from Den Haag (The Hague), political capital of the Netherlands with a population of approximately 444,000 (Planetware, 2007). As mentioned above, Bethesda is almost the same distance from D.C., and D.C. is highly comparable to Den Haag in population and in its role as a political capital. These similarities are important because they help to control for intercity commutes and travel.

Figure 3.5, 3.6 & 3.7: Bicycle bridges and bicycle lanes in the city of Delft.

For the Delft portion of the study, a stratified random sample of residents was used as the sample population. 1121 residents were randomly selected from the Delft phone listings (Nationale telefoongids, 2006) and were stratified according to whether or not they lived in the inner city of Delft. Participants were surveyed through a mail-in mail-back questionnaire that was developed specifically for this study (Appendix II & III). Residents under the age of 18 were excluded from the study, since the intent of the study was primarily to examine the travel behavior of adults and since acquiring parental consent for underage respondents in the Netherlands would have been complicated and cumbersome. Full-time college students were also excluded from the study because they receive free transit passes in the Netherlands (either weekday or weekend, depending on their preference) and that issue is likely to have skewed results. In the end, 249 completed surveys were collected from the sampled residents and used in the regression analyses.

The Delft questionnaire included some of the same questions as were used in the Montgomery County interviews (ensuring comparability), as well as additional questions regarding other bicycle facilities and more qualitative information regarding facilities (i.e. design, connectivity, contiguousness, and the surrounding environment). The Delft questionnaire also included more questions regarding personal values of respondents (i.e. how much they valued bicycling for environmental, personal health, and social or cultural reasons). Dr. Paul van Steen of the University of Groningen translated the original questionnaire from English to Dutch.

Survey Questionnaires

This section presents the questions used in this study from the Montgomery County and Delft questionnaires. The exact questions, possible answers and the way the answers were scored are presented for each question. Additionally, when applicable, the variable name used in the regression analyses is also presented.

Tables 3.1-3.4 show questions from the Montgomery County questionnaire and Tables 3.5-3.9 show questions from the Delft questionnaire. Before each table is a brief explanation as to why the selected questions were considered important for this study. The questions are grouped according to general topics or categories. Most questions were combined into scales of these same categories and used in that format in the regression analyses. This process is described in more detail in the final section of this chapter.

Montgomery County Questionnaire

Bicycle Facilities

Bicycle facility availability, in general, is the main independent variable being examined in this study (for the reasons discussed in previous chapters). Available bicycle facilities in Montgomery County, as in most places in the United States, include bicycle/pedestrian pathways or trails, bicycle lanes and sidewalks. Additional non-travel facilities include showers for cyclists, lockers for clothes and bicycle storage or parking. Parked car buffers and grass or dirt strip buffers between sidewalks and roadways are also included in this section, because it is presumed that if bicyclists use sidewalks as bicycle facilities these buffers help to make them feel safer. Traditionally, it is considered that on-street parking discourages bicycling, but this argument is debatable for the reason just presented, and results from this study do show a positive relationship between such buffers and bicycle travel.

Table 3.1: Bicycle Facilities Questions (Montgomery County)

Question (as on questionnaire)	Type of Answer	Possible Score	Name of Variable in Analyses
I1. There are sidewalks on most of the streets in your neighborhood.	Likert Scale	1 to 4	Sidewlks_HomeNeigh
I3. There are bicycle or pedestrian pathways or trails in or near your neighborhood that are easy to get to.	Likert Scale	1 to 4	BikePedPathways_HomeNeigh
I4. Sidewalks are separated from the road/traffic in your neighborhood by parked cars.	Likert Scale	1 to 4	ParkedCarBuffer_HomeNeigh
I5. There is a grass/dirt strip that separates the streets from the sidewalks in your neighborhood.	Likert Scale	1 to 4	GrassDirtBuffer_HomeNeigh
I7. There are facilities to bicycle in or near your neighborhood, such as bicycle lanes, separate paths or trails, shared used paths for pedestrians and cycles.	Likert Scale	1 to 4	BikeFacilities_HomeNeigh
U3. There are sidewalks on most of the streets in your workplace neighborhood.	Likert Scale	1 to 4	Sidewlks_WorkNeigh
U4. There are bicycle or pedestrian trails in or near your workplace neighborhood that are easily accessible.	Likert Scale	1 to 4	BikePedPathways_WorkNeigh

Are you aware of any of the following at your
work or from your employer?

Question	Type of Answer	Possible Score	Variable
T8B. Shower facilities that you can use	Yes or No	1=Yes or 0=No	Showers_Workplace
T9B. Lockers for clothes	Yes or No	1=Yes or 0=No	Lockers_Workplace
T10B. Safe bicycle storage	Yes or No	1=Yes or 0=No	BikeStorage_Workplace
Sum of T8B-T10B			ShowersLockersStorage_Work

Are any of the following items available at
this place (self-specified common
destination)?

Question	Type of Answer	Possible Score	Variable
BB14. Shower facilities	Yes or No	1=Yes or 0=No	Showers_CommonDest
BB15. Safe bike storage.	Yes or No	1=Yes or 0=No	BikeStorage_CommonDest
BB16. Locker facilities.	Yes or No	1=Yes or 0=No	Lockers_CommonDest

Aesthetics/Attractiveness of Surrounding Neighborhoods

Factors measured through the following questions were believed to be important to this study because
they concern the quality of the neighborhoods in which one travels and, presumably, more aesthetically
pleasing neighborhoods would encourage bicycle travel. Factors examined include the presence of
street trees, interesting and pleasant visual attractions, litter, traffic, and other people.

Table 3.2: Aesthetics/Attractiveness of Surrounding Neighborhoods (Montgomery County)

Question (as on questionnaire)	Type of Answer	Possible Score
J1. There are trees along the streets in your neighborhood.	Likert Scale	1 to 4
J2. Trees give shade for the sidewalks in your neighborhood.	Likert Scale	1 to 4
J3. There are many interesting things to look at while walking in your neighborhood.	Likert Scale	1 to 4
J4. Your neighborhood is generally free from litter.	Likert Scale	1 to 4
J5. There are many attractive natural sights in your neighborhood (such as landscaping, views).	Likert Scale	1 to 4
J6. There are attractive buildings/homes in your neighborhood.	Likert Scale	1 to 4
K1. There is so much traffic along the street you live on that it makes it difficult or unpleasant to walk in your neighborhood.	Likert Scale	1 to 4
K2. There is so much traffic along nearby streets that it makes it difficult or unpleasant to walk in your neighborhood.	Likert Scale	1 to 4
K3. The speed of traffic on the street I live on is usually slow (30mph or less).	Likert Scale	1 to 4
K4. The speed of traffic on most nearby streets is usually slow (30 mph or less).	Likert Scale	1 to 4
K6. Your neighborhood streets are well lit at night.	Likert Scale	1 to 4

Question	Type of Answer	Possible Score
I6. Considering traffic and road conditions, it is safe to ride a bike in or near your neighborhood.	Likert Scale	1 to 4
U7. Your workplace neighborhood is generally free from litter.	Likert Scale	1 to 4
U8. There is so much traffic along the streets that it makes it difficult or un-pleasant to walk in your workplace neighborhood.	Likert Scale	1 to 4
U10. You see a lot of other people when you are walking in your workplace neighborhood.	Likert Scale	1 to 4

Other Travel Mode Options

Table 3.3 shows questions regarding modes of travel other than the bicycle. Increased availability of other travel modes is likely to have a negative effect on a person's propensity to travel via bicycle, especially when such options are of a high quality. Thus, questions include the availability and the quality of automobile parking, automobile travel and transit, as well as the viability of walking.

Table 3.3: Other Travel Mode Options (Montgomery County)

Question (as on questionnaire)	Type of Answer	Possible Score
G3. Parking is difficult in local shopping areas.	Likert Scale	1 to 5
G4. There are many places to go within easy walking distance of your home.	Likert Scale	1 to 5
G5. It is easy to walk to a transit stop (bus, train) from your home.	Likert Scale	1 to 5
L1. How satisfied are you with the highway access from your home?	Likert Scale	1 to 5
T14a. Does your employer offer incentives not to drive to work?	Yes or No	0=Yes or 1=No
EE1. Parking is always an issue in your neighborhood.	Likert Scale	1 to 4
EE4. The cost for parking in your neighborhood, on- or off-street, seems reasonable to you.	Likert Scale	1 to 4
EE5. You are satisfied with the transit frequency in your neighborhood.	Likert Scale	1 to 4
EE6. Transit takes you where you want or need to go.	Likert Scale	1 to 4
EE7. It is easy to get to the bus or rail transit from your neighborhood.	Likert Scale	1 to 4

Personal Characteristics and Values

The remaining questions include a variety of questions regarding more personal and unique topics that may be related to bicycle travel. Such topics concern issues such as health, age, gender, race, education, income, whether or not a person has children, and proximity to work, among other things.

Table 3.4: Personal Characteristics and Values (Montgomery County)

Question (as on questionnaire)	Type of Answer	Possible Score	Name of Variable in Analyses
A_A2. In general, you would say that your health is:	7 Specified Options	Scale from 1-5	Health
AA5. What is Your Age?	Open-Ended	Continuous #	Age
AA6. What is Your Gender?	Male or Female	2=Male or 1=Female	Gender
AA9. Are you of Hispanic or Latino origin?	Yes or No	1=Yes or 0=No	Race

Question	Type of Answer	Possible Score	Name of Variable
AA11. Please Tell Me the Highest Education Degree You Have Completed:	8 Specified Options	Scale from 1-6	Education
AA13. Are you a parent, foster parent, or legal guardian of children that live with you?	Yes or No	1=Yes or 0=No	Children
AA33N. I am going to read several annual income categories, please tell me which category best matches your annual household income:	13 Specified Options	Scale from 1-11	Income
PW_DV1. How many minutes did it usually take you to get from home to work last week?	Open-Ended	Continuous #	Proximity_to_Work
M2. Please tell me if you have the following in your home, yard, or apartment complex: Bicycle	Yes or No	1=Yes or 0=No	OwnBicycle
Q7. You think that environmental protection is an important issue.	Likert Scale	1 to 5	EnvironmentalProtection
Q10. I enjoy bicycling.	Likert Scale	1 to 5	EnjoyBicycling
W1. You enjoy doing vigorous physical activities.	Likert Scale	1 to 5	
W2. You enjoy the feeling you get while doing vigorous activities.	Likert Scale	1 to 5	
W3. You enjoy the feeling you get after doing vigorous activities.	Likert Scale	1 to 5	
W4. You enjoy doing moderate physical activities.	Likert Scale	1 to 5	
W5. You enjoy the feeling you get while doing moderate physical activities	Likert Scale	1 to 5	
W6. You enjoy the feeling you get after doing moderate physical activities.	Likert Scale	1 to 5	
Average of W1-W6.	Likert Scale	1 to 5	EnjoyPhysicalActivity

Delft Questionnaire

Bicycle Facilities

Many of the same bicycle facilities as were examined in the Montgomery County questionnaire are examined in this one as well. Due to the greater variety and availability of bicycle facilities, however, some additional facilities (bicycle-oriented roads, bicycle traffic lights) are examined and sidewalks are not considered to be bicycle facilities and are not examined.

Table 3.5: Bicycle Facilities Questions (Delft)

Question (as on questionnaire)	Type of Answer	Possible Score	Name of Variable in Analyses
4. Are you aware of any of the following in or near your home neighborhood? (Please mark all that apply)			
a. Bicycle lanes	Yes or No	1=Yes or 0=No	BikeLanes_HomeNeigh
b. Paths or trails, separated from the roadway, for cyclists or pedestrians/cyclists (not including sidewalks)	Yes or No	1=Yes or 0=No	BikePaths_HomeNeigh
c. Roads in which cyclists have priority/bicycle boulevards	Yes or No	1=Yes or 0=No	BikeRoads_HomeNeigh
d. Traffic signals that are exclusively for cyclists	Yes or No	1=Yes or 0=No	BikeLights_HomeNeigh

7. Are you aware of any of the following in or near your workplace neighborhood? (Please mark all that apply)			
a. Bicycle lanes	Yes or No	1=Yes or 0=No	BikeLanes_WorkNeigh
b. Paths or trails, separated from the roadway, for cyclists or pedestrians/cyclists (not including sidewalks)	Yes or No	1=Yes or 0=No	BikePaths_WorkNeigh
c. Roads in which cyclists have priority/bicycle boulevards	Yes or No	1=Yes or 0=No	BikeRoads_WorkNeigh
d. Traffic signals that are exclusively for cyclists	Yes or No	1=Yes or 0=No	BikeLights_WorkNeigh
9. Are any of the following available at your workplace or from your employer?			
a. Shower facilities that you can use	Yes or No	1=Yes or 0=No	Showers_Work
b. Lockers for clothes	Yes or No	1=Yes or 0=No	Lockers_Work
c. Safe bicycle storage	Yes or No	1=Yes or 0=No	BikeStorage_Work
18. Are any of the following available at this place (self-specified common destination)?			
a. Shower facilities that you can use	Yes or No	1=Yes or 0=No	Showers_CommonDest
b. Lockers for clothes	Yes or No	1=Yes or 0=No	Lockers_CommonDest
c. Safe bicycle storage	Yes or No	1=Yes or 0=No	BikeStorage_CommonDest
19. Are you aware of any of the following in or near the neighborhood in which this place (self-specified common destination) is located?			
a. Bicycle lanes	Yes or No	1=Yes or 0=No	BikeLanes_CommonDest
b. Paths or trails, separated from the roadway, for cyclists or pedestrians/cyclists (not including sidewalks)	Yes or No	1=Yes or 0=No	BikePaths_CommonDest
c. Roads in which cyclists have priority/bicycle boulevards	Yes or No	1=Yes or 0=No	BikeRoads_CommonDest
d. Traffic signals that are exclusively for cyclists	Yes or No	1=Yes or 0=No	BikeLights_CommonDest

Design and Quality of Available Bicycle Facilities

Design and quality of bicycle facilities is another key factor this study is examining. The questions included in the Delft questionnaire regarding this topic relate to the utility, design, condition, and integration of bicycle facilities, as well as the quality of the environments through which bicycle travel facilities pass.

Table 3.6: Design and Quality of Bicycle Facilities (Delft)

Question #	Type of Answer	Possible Score	Name of Variable in Analyses
21. On-road bicycle lanes in/near the places discussed are well-designed and in good condition.	Likert Scale	1 to 5	GoodConditionDesign_BikeLanes
22. Off-road bicycle paths and trails in/near the places discussed are well-designed and in good condition.	Likert Scale	1 to 5	GoodConditionDesign_BikePaths
23. Bicycle travel facilities – lanes, paths and trails, and bicycle-oriented roads – are well connected, allowing for continual travel on a bicycle friendly travel route.	Likert Scale	1 to 5	FacilitiesWellConnected
24. Bicycle travel facilities – lanes, paths and trails, and bicycle-oriented roads – provide direct (not roundabout) access to key places, allowing for the shortest possible travel time from place to place.	Likert Scale	1 to 5	FacilitiesProvideDirectAccess

25. The natural and urban scenery along most bicycle travel routes is pleasant, enhancing the quality of bicycle travel.	Likert Scale	1 to 5	SceneryAlongBikeRoutes

Aesthetics/Attractiveness of Surrounding Neighborhoods

Again, factors concerning the quality of neighborhoods are examined. Due to limitations regarding the amount of questions that could be included on the Delft questionnaire, only the presence of street trees and traffic are examined in this portion of the study. As will be mentioned when discussing the results of the analyses, however, it is believed that these factors acted as a proxy for lower density, more suburban development, causing the examined relationship to be counter to what was initially expected.

Table 3.7: Aesthetics/Attractiveness of Surrounding Neighborhoods (Delft)

Question #	Type of Answer	Possible Score
1. The speed of traffic on the street I live on is relatively slow.	Likert Scale	1 to 5
2. The speed of traffic on most nearby streets is relatively slow.	Likert Scale	1 to 5
3. There are trees along the streets in my neighborhood.	Likert Scale	1 to 5
5. The speed of traffic on the street I work on is relatively slow.	Likert Scale	1 to 5
6. There are trees along the streets in my workplace neighborhood.	Likert Scale	1 to 5

Other Travel Mode Options

Again, due to limitations regarding the amount of questions that could be included on the Delft qeustionnaire, this topic is not as thoroughly examined as in the Montgomery County portion of the study. Questions focus on factors regarding automobile travel since that is considered to be the main travel mode competing with bicycle travel.

Table 3.8: Other Travel Mode Options (Delft)

Question #	Type of Answer	Possible Score	Name of Variable in Analyses
8. Is automobile parking limited or costly near your workplace neighborhood?	Yes or No	0=Yes or 1=No	AutoParking_Work
10. How long would it take you to bicycle to work?	Open-Ended	Continuous #	Time_to_Work
13. Of the following, what transportation options do you normally have available to you to get to work? (Please mark all that apply)			
a. Drive an Automobile (by yourself)	Yes or No	1=Yes or 0=No	AutoAvail_to_Work
b. Carpool	Yes or No	1=Yes or 0=No	CarpoolAvail_to_Work
c. Fairly good and direct public transit	Yes or No	1=Yes or 0=No	TransitAvail_to_Work
d. Walk	Yes or No	1=Yes or 0=No	WalkAvail_to_Work
e. Other _____	Yes or No	1=Yes or 0=No	OtherModeAvail_to_Work
f. Not Applicable			
33. Are you a licensed driver?	Yes or No	1=Yes or 0=No	DriversLicense
34. Do you own an automobile?	Yes or No	1=Yes or 0=No	OwnAutomobile
36. Can you easily find automobile parking in your home neighborhood? (Only applied to respondents who owned an automobile)	Yes or No	1=Yes or 0=No	AutoParking_HomeNeigh

Personal Characteristics and Values
Many of the factors examined in Montgomery County regarding personal characteristics and values of respondents were examined in Delft as well (i.e. health, age, gender, education, whether or not a person has children, and proximity to work). Additional factors regarding whether or not respondents declared

bicycle facilities to be key to their deceision whether or not to bicycle, whether or not respondents had ever lived in an area with considerably more or considerably fewer bicycle facilities, whether or not respondents lived in the innercity of Delft, proximity to common destinations, and the degree to which respondents valued bicycling (for environmental, personal health, and social or cultural reasons) were included as well.

Table 3.9: Personal Characteristics and Values (Delft)

Question #	Type of Answer	Possible Score	Name of Variable in Analyses
26. Are the bicycle facilities present (or not present) in/near the places discussed a key factor in your decision whether or not to bicycle?	Yes or No	1=Yes or 0=No	BikeFacilitiesImportant
27b. Have you ever lived and bicycled in an area with considerably more bicycle facilities?	Yes or No	1=Yes or 0=No	History_MoreFacilities
27c. Have you ever lived and bicycled in an area with considerably fewer bicycle facilities?	Yes or No	1=Yes or 0=No	History_FewerFacilities
28. What is Your Age?	Open-Ended	Continuous #	Age
29. Please Indicate Your Sex:	Male or Female	2=Male or 1=Female	Gender
30. In general, you would say that your health is:	6 Specified Options	Scale from 1-5	Health
31. Are you a parent, foster parent, or legal guardian of children that live with you?	Yes or No	1=Yes or 0=No	Children
32. What is the one-way distance from your home to your primary workplace?	Open-Ended	Continuous #	Proximity_to_Work
16. b) From the starting place just mentioned, how long would it take you to bicycle to this place?	Open-Ended	Continuous #	Proximity_to_CommonDest
35. Do you own a bicycle?	Yes or No	1=Yes or 0=No	OwnBicycle
37. Do you live in the inner city of Delft?	Yes or No	1=Yes or 0=No	Live_in_Innercity
38. Please Indicate the Highest Education Degree You Have Completed:	6 Specified Options	Scale from 1-5	Education
41. I enjoy bicycling.	Likert Scale	1 to 5	EnjoyBicycling
42. I think bicycling is important for environmental reasons.	Likert Scale	1 to 5	BicyclingImportant_Environment
43. I think bicycling is important for its health benefits.	Likert Scale	1 to 5	BicyclingImportant_Health
44. I think bicycling is important for social or cultural reasons.	Likert Scale	1 to 5	BicyclingImportant_Culture
Average of 42, 43 and 44.			ValueBicycling

Analysis

Data collected from the above questionnaires were analyzed using linear regression. For both study areas, three dependent variables were used: (1) the number of days in the previous month a respondent traveled to their workplace via bicycle; (2) the number of days in the previous week a respondent traveled to a self-specified "common destination" via bicycle; and (3) the number of times per week a respondent bicycled in or from their home neighborhood. These variables were deemed appropriate for this study because they examine key utilitarian trips (variables 1 and 2) as well as an approximate total amount of bicycle trips (variable 3).

For the Delft analyses, one additional variation on each of the three main dependent variables was also used. For bicycling to work, in addition to the *number* of times a person bicycled to work in the previous month, the *proportion* of times a person bicycled to work in the previous month was included. For bicycling to a common destination, in addition to the *number* of times a person bicycled to their self-specified common destination in the previous week, the *proportion* of times the person bicycled to their self-specified common destination in the previous week was included. For bicycling in or from one's home neighborhood, in addition to the *number* of times per week a person bicycled in or from their neighborhood, the total approximate *distance* they bicycled was also included.

The key independent variables being tested in these analyses were availability of various bicycle facilities and (in the Delft study only) design and quality of available bicycle facilities. Due to limitations that resulted from the relatively small sample size of both study areas, and due to potential colinearity among variables, the various independent variables addressed in the questionnaires were collapsed under the following broader categories: Availability of Bicycle Facilities, Design and Quality of Available Bicycle Facilities, Aesthetics/Attractiveness of Surrounding Neighborhoods, and Availability/Feasibility of Other Travel Modes (for more details, see Tables 3.10 & 3.11). The variables within each of these categories were combined to create a single score for each category. The composite scores for each category were then used as the independent variables in the regression analyses. Various personal characteristics and values of respondents were used in the analyses as well, but these variables were generally input separately (as individual variables) because of their uniqueness and inability to be combined with one another.

Merging the different questions within the broader categories just discussed required standardizing the way in which the original questions were scored and then combining the original scores to create a single score for the entire category. Often times, a category would only have Likert Response Scales, in which case an average of the different scores was used in the regression analyses. Most of the remaining categories only had "Yes/No" responses. For these, a numerical value was given to "Yes" and a numerical value was given to "No" (1 or 0, depending on what was appropriate for that specific question). The values were then summed and the sum was used in the regression analyses. A small number of times, in the Montgomery County analyses, Likert Response Scales had to be combined with responses giving a certain numerical value. In these cases, the Likert Response Scales were divided in half, giving either "Strongly Agree" and "Moderately Agree," or "Strongly Disagree" and "Moderately Disagree" (depending on what was appropriate for that specific question) a score of 1 and the rest of the possible answers a score of 0. This allowed the Likert Scale questions to be combined with the numerical value questions.

Some of the specific questions used in the separate analyses were different, due to differences in the questionnaires, but many of the questions were exactly the same. Additionally, the general categories in which the original questions were eventually combined were the same for both analyses, (with the exception of the "Design and Quality of Available Facilities" category, which was only used in the Delft study).

In both of the analyses, not *all* of the questions were used in examining *each* of the different dependent variables (see Tables 3.10 & 3.11). Only questions appropriate to the dependent variable being tested were used in that variable's statistical models. For example, the availability of bicycle lanes in or near a respondent's workplace neighborhood (question #7 on the Delft questionnaire) was not used in models for variable #2 (the number of days in the past week a respondent traveled to a self-specified "common destination" via bicycle), since those two variables are not presumed to be directly related.

Questions regarding a person's home neighborhood were used in all analyses, because it was presumed that the initial starting point of any trip was from the person's home neighborhood.

Finally, in the interest of testing the influence of *specific* bicycle facilities that were expected to be especially important for inducing bicycle travel, questions regarding these specific variables were taken out of their broader category ("Availability of Bicycle Facilities") for additional regression analyses. These specific bicycle facilities included bicycle lanes, off-road bicycle paths or trails, bicycle-oriented roads, and (in the Montgomery County analyses only) sidewalks. These individual analyses are useful to provide guidance to planners about specific improvements that appear correlated with behavior. Basic summary statistics were also examined, in order to identify additional salient information not directly captured in the regression analyses.

In the end, results from the Delft analyses were compared with results from the Montgomery County analyses in order to identify factors that were cross-culturally related to bicycle travel as well as factors that were more culturally relevant.

Table 3.10: Scales Used in Regression Analyses of the Montgomery County Data

Availability of Bicycle Facilities

Name (as used in regression analyses)	Questions Included in Scale	Relevant Dependent Variable
FacilityAvail_DV1	I1, I3, I7, U3, U4, T8B, T9B, T10B	1
FacilityAvail_DV2	I1, I3, I4, I5, I7, BB14, BB15, BB16	2
FacilityAvail_DV3	I1, I3, I4, I5, I7	3

Aesthetics/Attractiveness of Surrounding Neighborhoods

Name (as used in regression analyses)	Questions Included in Scale	Relevant Dependent Variable
AttractiveSurroundingNeigh_DV1	J1-J6, K1-K4, K6, I6, U5, U7, U8, U10	1
AttractiveSurroundingNeigh_DV2_3	J1-J6, K1-K4, K6, I6	2 & 3

Availability/Feasibility of Other Travel Modes

Name (as used in regression analyses)	Questions Included in Scale	Relevant Dependent Variable
OtherModes_DV1	G5, L1, T14a, EE1, EE4, EE5, EE6	1
OtherModes_DV3	G3, G4, G5, L1, T14a, EE1, EE4, EE5, EE6	3

Table 3.11: Scales Used in Regression Analyses of the Delft Data

Availability of Bicycle Facilities

Name (as used in regression analyses)	Questions Included in Scale	Relevant Dependent Variable
FacilityAvail_DV1	4a-4d, 7a-7d, 9a-9c	1
FacilityAvail_DV2	4a-4d, 18a-18c, 19a-19d	2
FacilityAvail_DV3	4a-4d	3

Design and Quality of Available Bicycle Facilities

Name (as used in regression analyses)	Questions Included in Scale	Relevant Dependent Variable
FacilityDesign	21-25	1,2,3

Aesthetics/Attractiveness of Surrounding Neighborhoods

Name (as used in regression analyses)	Questions Included in Scale	Relevant Dependent Variable
AttractiveSurroundingNeigh_DV1	1, 2, 3, 5, 6	1
AttractiveSurroundingNeigh_DV2_3	1,2,3	2 & 3

Availability/Feasibility of Other Travel Modes

OtherModes_DV1	8, 13a-13e, 33, 34, 36	1
OtherModes_DV2_3	33, 34, 36	2 & 3

Chapter 4

Results

Montgomery County Study Area

A total of 293 residents of five community analysis zones (CAZ) in Montgomery County were interviewed for this portion of the study—47 (16%) from Bethesda, 44 (15%) from Forest Glen, 67 (23%) from Four Corners, 62 (21%) from Layhill, and 73 (25%) from Olney. This corresponds to 3%, 4.3%, 7.3%, 7%, and 3.6% of the housing units in the CAZ, respectively. (Demissie, 2007, Protocal Participation Methods)

Summary Statistics

Table 4.1 shows summary statistics for the main variables used in the Montgomery County study area analyses. It is important to note that the average number of minutes it took a respondent to get to work in the previous week was 32.5, considerably higher than the national average of 25.1. Additionally, respondents were highly educated, with 128 (53%) of the respondents having at least obtained a college or university degree (compared with 27% for the United States as a whole). (US Census Bureau, 2000)

Additional factors of considerable relevance to this study include that 70% of respondents had a bicycle at their home and the average respondent was almost neutral with regards to how much they enjoyed cycling. These issues will be further discussed when comparing the Montgomery County results with the Delft results. Also, the median for all three dependent variables is 0, already indicating a very low amount of bicycling.

Table 4.1 Summary Statistics of the Montgomery County Variables

	N	Mean	Median	Std. Deviation	Range
Dependent Variables					
DV1	184	0,21	0,00	1,34	12
DV2	109	0,07	0,00	0,52	5
DV3	293	0,62	0,00	0,86	3
Independent Variables					
FacilityAvail_DV1	293	4,00	4,00	2,08	9
FacilityAvail_DV2	93	4,47	4,00	1,59	7
FacilityAvail_DV3	293	2,98	3,00	0,58	2,6
Sidewlks_HomeNeigh	293	3,05	3,00	1,05	3
ParkedCarBuffer_HomeNeigh	285	2,78	3,00	1,09	3
GrassDirtBuffer_HomeNeigh	285	3,21	4,00	0,97	3
BikePedPthways_HomeNeigh	291	0,77	1,00	0,42	1
BikePedPthways_WorkNeigh	168	0,34	0,00	0,47	1
ShowersLockersStorage_Work	183	1,27	1,00	1,20	3
AttractiveSurroundingNeigh_DV1	293	3,20	3,25	0,38	2,625
AttractiveSurroundingNeigh_DV2_3	293	3,25	3,25	0,41	2,833
Proximity_to_Work	180	32,47	30,00	20,27	120
OtherModes_DV1	153	5,29	6,00	1,17	5
OtherModes_DV3	152	6,38	6,00	1,40	7
EnjoyPhysicalActivity	293	4,18	4,50	0,80	4
Health	293	1,97	2,00	0,81	3
Age	293	50,37	51,00	14,51	72

Gender	293	1,32	1,00	0,47	1
Race	275	0,04	0,00	0,20	1
Education	292	5,11	5,00	1,10	5
Children	291	0,43	0,00	0,50	1
Income	288	3,20	3,00	0,90	3
OwnBicycle	293	0,70	1,00	0,46	1
EnvironmentalProtection	293	4,53	5,00	0,72	4
EnjoyBicycling	289	3,32	4,00	1,32	4

A very limited number of respondents bicycled to work and even fewer bicycled to their self-specified common destination. Only six respondents (out of 184) answered that they had traveled to work via bicycle at least once in the previous month (Table 4.2). This gives a lot of importance to what might be odd characteristics of those six respondents. For bicycle travel to a common destination, only *three* respondents traveled to their self-specified common destination via bicycle at least once in the previous week (Table 4.3). Due to these limitations, results for these dependent variables are not very reliable and have a low explanatory value, as presented in the following subsections.

Table 4.2 Dependent Variable #1 Frequencies

Number of times in the previous month the respondent bicycled to work	Response Frequency
0	178
1	1
2	1
5	1
8	1
10	1
12	1

Table 4.3 Dependent Variable #2 Frequencies

Number of times in the previous week respondent bicycled to common destination	Response Frequency
0	106
1	1
2	1
3	1

The data for bicycle travel in or from one's home neighborhood was much more adequate for rigorous statistical analysis, and the results make more sense and are more robust as a result. According to the data, 128 of the respondents bicycle in or from their neighborhood at least occasionally (Table 4.4).

Table 4.4 Dependent Variable #3 Frequencies

Number of times in the previous month respondent bicycled in or from their home neighborhood	Response Frequency
Never	165
Less than Once a Week	91
1-2 times week	19
3-6 times a week	18

Bicycle Travel to Work

For the first dependent variable—number of days in the previous month a respondent traveled to her/his workplace via bicycle—three statistical models are presented (Table 4.5). The three models include an initial model, a more refined model that doesn't include highly insignificant variables in the

equation (<50%), and a final model that is the same as the second model except that it replaces the bicycle facilities index with specific bicycle facilities questions.

The respondent's self-perception of their personal health was found to be significant at the 95% confidence level in all models. Age became significant at the 90% confidence level in the second and the final models. Whether or not the respondent had a bicycle at their home and whether or not sidewalks were separated from the road by a grass or dirt strip became significant at the 90% level in the final model. And the presence of sidewalks and "bicycle or pedestrian pathways or trails" in one's neighborhood became significant at the 95% confidence level in the final model. The existence of bicycle or pedestrian trails in or near the respondents' workplace neighborhoods, however, was not found to be significant, and facilities such as showers, lockers and safe bicycle storage at or near respondents' workplaces also did not show a significant association.

The direction of the relationships was as expected for some of the significant variables but was in the opposite direction as expected for others. The younger a person was, the more likely they were to bicycle; the presence of bicycle or pedestrian pathways or trails in or near one's home neighborhood was positively associated with bicycle travel to work; and the presence of grass or dirt buffers between roads and sidewalks were positively associated with bicycle travel. However, counterintuitive results include that the healthier a person thought themself to be, the less likely they were to bicycle to work; if a person had a bicycle at their home, they were less likely to bicycle to work; and the presence of sidewalks in one's home neighborhood was negatively associated with bicycle travel.

As discussed above, data limitations concerning the number of respondents who bicycled to work at least once in the previous month make the statistical analyses and results for this dependent variable very unreliable.

Table 4.5 Regression Analysis for Bicycle Travel to Work

	Model 1			Model 2			Final Model		
	Coeff.		t-stat	Coeff.		t-stat	Coeff.		t-stat
Constant	-1,01		-0,42	0,11		0,06	0,48		0,23
FacilityAvail_DV1	0,12		1,52	0,09		1,4			
Sidewlks_HomeNeigh							-0,33	**	-2,04
ParkedCarBuffer_HomeNeigh							-0,18		-1,29
GrassDirtBuffer_HomeNeigh							0,31	*	1,69
BikePedPthways_HomeNeigh							0,87	**	2,38
BikePedPthways_WorkNeigh							-0,37		-1,11
ShowersLockersStorage_Work							0,10		0,76
AttractiveSurroundingNeigh_DV1	-0,52		-1,22	-0,47		-1,24	-0,63		-1,53
Proximity_to_Work	0,01		0,69	0,00		0,71	0,00		0,55
OtherModes_DV1	0,15		1,06	0,09		0,73	0,15		1,14
Health	0,54	**	2,36	0,37	**	2,03	0,41	**	2,17
Age	-0,02		-1,57	-0,02	*	-1,7	-0,02	*	-1,87
Gender	0,00		-0,01						
Race	-0,50		-0,63						
Education	0,03		0,15						
Children	0,06		0,15						
Income	-0,14		-0,63						
EnvironmentalProtection	0,25		1,04	0,22		1,05	0,31		1,29
OwnBicycle	-0,47		-0,94	-0,34		-0,98	-0,66	*	-1,72

	Coeff.	t-stat
EnjoyCycling	0,08	0,54
EnjoyPhysicalActivity	0,13	0,65
Summary Statistics		
N	82	88	80
F-statistic	1,09	1,71	2,07
R^2	0,199	0,148	0,290
Adjusted R^2	0,017	0,062	0,150

Note: ***, **, * Significant at the 99, 95, and 90% level of confidence, respectively.

Bicycle Travel to a "Common Destination"

The same three regression analyses as were used above were used for the second dependent variable—an initial one including all potentially relevant variables, a more refined one that did not include highly insignificant variables, and variation on the second one that replaced the bicycle facilities index with specific bicycle facilities questions.

The second dependent variable did not generate very salient results. Two independent variables were significantly associated with bicycle travel to a "common destination" in the second model—a respondent's self-perception of their personal health and the degree to which they enjoyed bicycling (significant at the 90% confidence level)—but no variables were found to be significantly associated in the initial or final models (Table 4.6). Again, my assumption is that there were not enough respondents who traveled to their self-specified common destination via bicycle to produce informative statistical results.

In this case, counter to the finding regarding travel to work, the healthier a person thought themself to be, the more likely they were travel via bicycle. Additionally, the more they enjoyed bicycling, the more likely they were to bicycle to their common destination. Both of these findings are related to bicycle travel in the direction that was expected.

Table 4.6 Regression Analysis for Bicycle Travel to a Common Destination

	Model 1		Model 2		Final Model	
	Coeff.	t-stat	Coeff.	t-stat	Coeff.	t-stat
Constant	-0,55	-0,55	-0,10	-0,29	-0,15	-0,34
FacilityAvail_DV2	0,01	0,16	0,01	0,19		
Sidewlks_HomeNeigh					-0,02	-0,36
ParkedCarBuffer_HomeNeigh					0,07	1,3
GrassDirtBuffer_HomeNeigh					-0,03	-0,54
BikePedPthways_HomeNeigh					0,03	0,25
AttractiveSurroundingNeigh_DV2_3	-0,07	-0,35				
EnjoyPhysicalActivity	0,06	0,55				
Health	-0,11	-1,21	-0,13 *	-1,76	-0,11	-1,62
Age	0,00	0,65				
Gender	0,13	0,82	0,15	1,19	0,16	1,44
Education	0,02	0,27				
Children	0,02	0,14				
Income	0,03	0,37				
EnvironmentalProtection	0,01	0,14				
OwnBicycle	0,03	0,2				
EnjoyBicycling	0,07	1,17	0,07 *	1,71	0,06	1,45

Summary Statistics

N	87	91	103
F-statistic	0,74	2,22	1,57
R^2	0,107	0,093	0,103
Adjusted R^2	-0,037	0,051	0,037

Note: ***, **, * Significant at the 99, 95, and 90% level of confidence, respectively.

Bicycling In or From One's Home Neighborhood

For the third dependent variable—the number of times per week a respondent bicycled in or from her/his home neighborhood—the same three statistical models are presented (Table 4.7). Again, the three models include an initial model, a more refined model that doesn't include highly insignificant variables (<50% confidence level), and a final model that is the same as the second model except that it replaces the bicycle facilities index with specific bicycle facilities questions.

The data and results are more robust for this variable. Gender, whether or not the respondent is a parent or guardian of a child/children, whether or not the respondent has a bicycle at their home, and the degree to which the respondent enjoys bicycling were found to be significant in all models. The bicycle facilities index became significant (at the 95% confidence level) in the second model, and in the third model the presence of sidewalks and buffers by parked cars between the road and the sidewalk were found to be significantly related to bicycle travel (at the 99% confidence level and 95% confidence level, respectively). More specific bicycle facilities such as bicycle paths/trails were not found to be significantly associated with bicycle travel.

The direction of the relationships was as expected for all of the significant variables. Males, respondents who had bicycles at their home, respondents who enjoyed bicycling, and those who lived in neighborhoods with sidewalks and parked car buffers between sidewalks and roads were all more likely to bicycle. Parents/guardians of children, on the other hand, were less likely to bicycle.

Table 4.7 Regression Analysis for Bicycle Travel in or from One's Home Neighborhood

	Model 1			Model 2			Final Model		
	Coeff.		*t-stat*	Coeff.		*t-stat*	Coeff.		*t-stat*
Constant	-2,94		-3,35	-2,66425		-4,33	-2,59443		-4,23
FacilityAvail_DV3	0,18		1,56	0,200562	**	2,17		**	
Sidewlks_HomeNeigh							0,151677	*	2,67
ParkedCarBuffer_HomeNeigh							0,137634	**	2,59
GrassDirtBuffer_HomeNeigh							-0,08241		-1,43
BikePedPthways_HomeNeigh							-0,07518		-0,57
AttractiveSurroundingNeigh_DV2_3	0,09		0,54						
OtherModes_DV3	0,03		0,74	0,030163		0,77	0,042783		1,1
EnjoyPhysicalActivity	0,01		0,1						
Health	0,00		-0,04						
Age	0,00		0,2						
Gender	0,26	**	2,03	0,247938	**	2,13	0,21234	*	1,84
Race	0,32		0,9	0,33348		1	0,343248		1,05

	Coef.		t	Coef.		t	Coef.		t
Education	0,05		0,87	0,044278		0,77	0,023292		0,39
Children	-0,38	***	-2,84	-0,36218	***	-2,9	-0,28518		-2,23
Income	0,00		0,05						
OwnBicycle	0,77	***	4,87	0,760912	***	5,27	0,824342	***	5,66
EnvironmentalProtection	0,11		1,29	0,113536		1,41	0,110877		1,39
EnjoyBicycling	0,31	***	5,43	0,31773	***	6,8	0,324858	***	6,91

Summary Statistics

N	139	139	135
F-statistic	9,21	14,81	12,45
R^2	0,510	0,508	0,551
Adjusted R^2	0,454	0,474	0,506

Note: ***, **, * Significant at the 99, 95, and 90% level of confidence, respectively.

Delft Study Area

Of the 1121 surveys that were mailed to residents of Delft, 249 completed surveys were received back in time to include them in the following analyses. Thus, the response rate for this portion of the study was approximately 22.2%, representing 2.6% of the population of Delft. Of the 249 respondents, 52 (21%) were from the innercity of Delft and 185 (74%) were not from the innercity. Twelve respondents (5%) did not answer this question.

Summary Statistics

Table 4.8 shows summary statistics for variables used in the regression analyses of the Delft data. Before delving into the results of the regression analyses, there are several things to point out from this initial information. Unlike the Montgomery County respondents, almost all of the Delft respondents (96%) owned a bicycle, and distance to work was much lower (a median of 7.5 miles in Delft versus a median of 30 miles in Montgomery County). Still, automobile ownership and accessibility were fairly high—91% of respondents stated that they have a driver's license and 84% stated that they own an automobile. Of respondents who completed the travel to work section, 77% stated that they had the option to drive alone to work. It is also noted that most respondents enjoyed bicycling and they thought it was important for environmental and personal health reasons.

Summary statistics of the dependent variables show that Delft respondents do travel via bicycle. The average employed respondent bicycled to work 6.3 times in four weeks (38% of the time), the average respondent bicycled to their common destination 1.7 times per week (46% of the time), and the average respondent bicycled in or from their home neighborhood approximately 4 times per week.

Table 4.8 Summary Statistics of the Delft Variables

	N	Mean	Median	Std. Deviation	Range
Dependent Variables					
DV1B	175	6,30	0,00	7,96	21
DV1C	175	0,38	0,00	0,46	1
DV2B	232	1,68	1,00	2,01	10
DV2C	231	0,46	0,50	0,44	1
DV3A	245	3,74	4,50	2,58	7

DV3C	232	33,23	18,00	50,01	490
Independent Variables					
AttractiveSurroundingNeigh_DV1	175	3,44	3,40	0,70	3,6
AttractiveSurroundingNeigh_DV2_3	249	3,61	3,67	0,89	3,67
BikeLanes_HomeNeigh	247	0,59	1,00	0,49	1
BikePaths_HomeNeigh	247	0,35	0,00	0,48	1
BikeRoads_HomeNeigh	247	0,32	0,00	0,47	1
BikeLights_HomeNeigh	247	0,30	0,00	0,46	1
FacilityAvail_DV3	247	1,56	1,00	1,33	4
Proximity_to_Work	171	18,23	12,00	22,31	150
BikeLanes_WorkNeigh	175	0,54	1,00	0,50	1
BikePaths_WorkNeigh	175	0,52	1,00	0,50	1
BikeRoads_WorkNeigh	175	0,50	0,00	0,50	1
BikeLights_WorkNeigh	175	0,42	0,00	0,50	1
Showers_Work	174	0,43	0,00	0,50	1
Lockers_Work	174	0,28	0,00	0,45	1
BikeStorage_Work	174	0,64	1,00	0,48	1
FacilityAvail_DV1	176	4,94	5,00	2,30	11
AutoParking_Work	142	0,44	0,00	0,50	1
Time_to_Work	164	52,22	35,00	75,52	599
AutoAvail_to_Work	176	0,77	1,00	0,42	1
CarpoolAvail_to_Work	176	0,05	0,00	0,21	1
TransitAvail_to_Work	176	0,39	0,00	0,49	1
WalkAvail_to_Work	176	0,19	0,00	0,39	1
OtherModeAvail_to_Work	176	0,03	0,00	0,17	1
DriversLicense	245	0,91	1,00	0,29	1
OwnAutomobile	245	0,84	1,00	0,37	1
AutoParking_HomeNeigh	214	0,80	1,00	0,40	1
OtherModes_DV1	174	4,30	5,00	1,20	7
OtherModes_DV2_3	245	2,44	3,00	0,92	3
Proximity_to_CommonDest	217	26,00	12,50	44,62	360
BikeLanes_CommonDest	225	0,61	1,00	0,49	1
BikePaths_CommonDest	225	0,43	0,00	0,50	1
BikeRoads_CommonDest	225	0,42	0,00	0,49	1
BikeLights_CommonDest	225	0,34	0,00	0,48	1
Showers_CommonDest	220	0,19	0,00	0,39	1
Lockers_CommonDest	220	0,09	0,00	0,28	1
BikeStorage_CommonDest	220	0,28	0,00	0,45	1
FacilityAvail_DV2	224	3,90	4,00	2,50	10
GoodConditionDesign_BikeLanes	232	3,56	4,00	1,04	4
GoodConditionDesign_BikePaths	226	3,55	4,00	1,07	4
FacilitiesWellConnected	233	3,38	3,00	0,99	4
FacilitiesProvideDirectAccess	235	3,52	4,00	1,07	4
SceneryAlongBikeRoutes	235	3,26	3,00	0,99	4
FacilityDesign	237	3,45	3,40	0,74	4
BikeFacilitiesImportant	229	0,32	0,00	0,47	3,4
History_MoreFacilities	237	0,16	0,00	0,37	1
History_LessFacilities	237	0,32	0,00	0,47	1
Age	242	52,39	53,00	14,90	73
Gender	245	1,65	2,00	0,48	1
Health	243	2,51	3,00	1,00	4
Children	242	0,28	0,00	0,45	1

OwnBicycle	245	0,96	1,00	0,19	1
Live_in_Innercity	238	0,22	0,00	0,42	1
Education	243	3,92	5,00	1,30	4
EnjoyBicycling	244	4,15	4,00	1,01	4
BicyclingImportant_Environment	244	4,18	5,00	1,01	4
BicyclingImportant_Health	244	4,28	5,00	0,90	4
BicyclingImportant_Culture	242	3,14	3,00	1,15	4
ValueBicycling	242	3,87	4,00	0,80	4

Bicycle Travel to Work

Similar to before, for each dependent variable regarding bicycle travel to work, four statistical models are presented (Table 4.9 and Table 4.10). The four models include an initial model, a more refined model that doesn't include highly insignificant variables in the equation (<60%), a third model that is the same as the second model except that it includes variables regarding specific bicycle facilities available in the respondent's home neighborhood, and a fourth model that is the same as the second model except that it includes the variable 'SceneryAlongBikeRoutes' (the attractiveness of natural and urban scenery along most bicycle travel routes) individually rather than in the scale for design and quality of available facilities.

For DV1B (*number* of times the respondent bicycled to work), distance to work was the only variable that was significant in the initial model. It was significant at the 99% confidence level. In the second model, the degree to which the respondent enjoys cycling became significant at the 95% confidence level. In the third model, the presence of bicycle lanes in or near one's home neighborhood, the presence of bicycle paths in or near one's home neighborhood, and the presence of bicycle-only roads in or near one's home neighborhood became significant—the presence of bicycle paths and the presence of bicycle-only roads at the 95% confidence level and the presence of bicycle lanes at the 90% confidence level. Everything else remained the same as in the second model. In the fourth model, the results were the same as in the second model.

The direction of the significant relationships was in the expected direction for all but one of the variables. The greater the distance to work, the less likely the respondent was to bicycle; the more the respondent enjoyed bicycling, the more likely she/he was to bicycle; and the presence of bicycle lanes or bicycle-only roads increased the likelihood that a respondent would travel to work via bicycle. The presence of bicycle paths, however, *decreased* the likelihood that a respondent would travel to work via bicycle, counter to what was assumed. This issue comes up in later analyses as well and is discussed in the following chapter when discussing overall conclusions.

For DV1C (*proportion* of times the respondent bicycled to work), the results are very similar but not entirely the same. Again, only distance to work was significant in the initial model, at the 99% confidence level. In the second model, however, the degree to which the respondent enjoys bicycling became significant at the 95% confidence level and whether or not the respondent had ever lived in an area with considerably more bicycle facilities became significant at the 90% confidence level. In the third model, the presence of bicycle paths in or near the respondent's home neighborhood became significant at the 95% confidence level, the presence of bicycle-only roads in or near the respondent's home neighborhood became significant at the 90% confidence level, and everything else remained the same as in the second model. In the fourth model, results were the same as in the second model except that the quality of the natural and urban scenery along most bicycle routes became significant at the 95% confidence level.

As was the case with DV1A, the direction of the significant relationships was in the expected direction for all but one of the variables. The greater the distance to work, the less likely the respondent was to bicycle; the more the respondent enjoyed bicycling, the more likely they were to bicycle; whether or not the respondent had ever lived in an area with considerably more bicycle facilities was associated with more bicycle travel; the more the respondent valued bicycling, the more likely they were to bicycle; the presence of bicycle-only roads increased the likelihood that a respondent would bicycle; and the more pleasant the natural and urban scenery along most bicycle routes, the more likely the respondent was to bicycle. Again, however, the presence of bicycle paths *decreased* the likelihood that the respondent would bicycle to work.

Table 4.9 Regression Analysis for Bicycle Travel to Work (# of bicycle trips)

	Model 1			Model 2			Model 3			Model 4		
	Coeff		t-stat	Coeff		t-stat	Coeff		t-stat	Coeff		t-stat
Constant	-9,52		-1,10	-1,44		-0,31	-3,48		-0,74	-1,95		-0,45
FacilityAvail_DV1	0,11		0,39									
AttractiveSurroundingNeigh_DV1	0,73		0,80									
OtherModes_DV1	-0,84		-1,47	-0,73		-1,41	-0,73		-1,39	-0,72		-1,41
FacilityDesign	0,84		0,85	0,61		0,70	0,80		0,93			
BikeFacilitiesImportant	1,65		1,26	1,27		1,03	1,21		0,99	1,11		0,89
History_MoreFacilities	1,74		1,04	1,65		1,06	2,05		1,32	1,70		1,10
History_FewerFacilities	0,55		0,40									
Age	0,03		0,43									
Gender	0,98		0,68									
Health	-0,24		-0,33									
Children	-1,18		-0,94	-1,26		-1,04	-1,42		-1,19	-1,37		-1,14
Proximity_to_Work	-0,12	***	-3,76	-0,13	***	-4,26	-0,12	***	-4,19	-0,12	***	-4,15
OwnBicycle	1,27		0,34									
Live_in_Innercity	-0,66		-0,45									
Education	0,26		0,41									
EnjoyBicycling	1,29		1,63	1,59	**	2,13	1,67	**	2,28	1,65	**	2,23
ValueBicycling	1,18		1,14	1,05		1,11	1,14		1,22	0,87		0,92
BikeLanes_HomeNeigh							2,18	*	1,70			
BikePaths_HomeNeigh							-2,92	**	-2,25			
BikeRoads_HomeNeigh							2,77	**	1,99			
BikeLights_HomeNeigh							-1,08		0,45			
SceneryAlongBikeRoutes										0,97		1,62
Summary Statistics												
N		150			157			155			156	
F-statistic												
R²		0,255			0,228			0,288			0,236	
Adjusted R²		0,159			0,186			0,228			0,194	

Note: ***, **, * Significant at the 99, 95, and 90% level of confidence, respectively.

Table 4.10 Regression Analysis for Bicycle Travel to Work (proportion of trips)

	Model 1			Model 2			Model 3			Model 4		
	Coeff		t-stat	Coeff		t-stat	Coeff		t-stat	Coeff		t-stat
Constant	-0,60		-1,23	-0,33		-1,14	-0,41		-1,37	-0,37		-1,35

	Model 1			Model 2			Model 3			Model 4		
FacilityAvail_DV1	0,00		-0,22									
AttractiveSurroundingNeigh_DV1	0,04		0,81									
OtherModes_DV1	-0,04		-1,28	-0,04		-1,46	-0,04		-1,36	-0,04		-1,47
FacilityDesign	0,05		0,91	0,05		0,92	0,06		1,12			
BikeFacilitiesImportant	0,11		1,45	0,09		1,21	0,09		1,29	0,07		1,02
History_MoreFacilities	0,14		1,44	0,14		1,65	0,16	*	1,82	0,15	*	1,74
History_FewerFacilities	0,06		0,83									
Age	0,00		0,93	0,00		1,20	0,00		1,15	0,00		1,12
Gender	0,01		0,14									
Health	0,00		-0,06									
Children	-0,06		-0,86	-0,08		-1,15	-0,08		-1,23	-0,09		-1,34
Proximity_to_Work	-0,01	***	-4,08	-0,01	***	-4,46	-0,01	***	-4,31	-0,01	***	-4,35
OwnBicycle	0,09		0,42									
Live_in_Innercity	-0,05		-0,64									
Education	0,02		0,57									
EnjoyBicycling	0,07		1,49	0,08	**	1,97	0,09	**	2,12	0,09	**	2,10
ValueBicycling	0,08		1,32	0,08		1,52	0,08		1,50	0,07		1,32
BikeLanes_HomeNeigh							0,10		1,40			
BikePaths_HomeNeigh							-0,17	**	-2,23			
BikeRoads_HomeNeigh							0,14	*	1,71			
BikeLights_HomeNeigh							-0,07		-0,85			
SceneryAlongBikeRoutes										0,08	**	2,24
Summary Statistics												
N		150			155			153			154	
F-statistic												
R^2		0,287			0,280			0,322			0,297	
Adjusted R^2		0,195			0,235			0,259			0,253	

Note: ***, **, * Significant at the 99, 95, and 90% level of confidence, respectively.

Bicycle Travel to a "Common Destination"

The same four models as were used for bicycle travel to work were also used for bicycle travel to a common destination (Table 4.11 and Table 4.12).

For DV2B (*number* of times the respondent bicycled to their self-specified common destination), distance to the destination, age, and the degree to which the respondent enjoyed bicycling were each significant at the 99% confidence level and gender was significant at the 90% confidence level in the initial model. In the second model, gender lost significance but everything else remained the same. The third model and the fourth model showed the same results as the second model.

The direction of each of the relationships is very logical, but not necessarily what was expected. The greater the distance to the destination, the less likely the respondent was to bicycle; the more the respondent enjoyed bicycling, the more likely they were to bicycle to the destination; the older the respondent was, the more likely they were to bicycle to the destination; and if the respondent was female they were more likely to bicycle to their destination. The result regarding gender is counter to common knowledge in the U.S., where men are consistently found to be more likely to bicycle. I would assume that this was not the case in this portion of the study because women are probably less likely to own a car or to have access to a car (especially in a country where it is very uncommon for a household

to own two cars). That factor should have been controlled for through the variable OtherModes_DV2_3, however, so it does not irrefutably explain the atypical result.

The results for DV2C were very similar to the results for DV2B, but they did introduce a couple of significant differences. In the initial model, distance to the respondent-specified destination and age were, again, significant at the 99% confidence level, the degree to which the respondent enjoys bicycling was significant at the 95% confidence level, gender was significant at the 90% confidence level, and the scale for aesthetics and attractiveness of the surrounding neighborhood was significant at the 90% confidence level. In the second model, everything remained the same except that the degree to which the respondent enjoys bicycling increased in significance from the 95% confidence level to the 99% confidence level and gender increased in significance from the 90% confidence level to the 95% confidence level. In the third model, the scale for aesthetics and attractiveness of the surrounding neighborhood increased in significance from the 90% confidence level to the 95% confidence level, gender reverted back to the 90% confidence level, and the presence of bicycle-only roads in or near the respondent's home neighborhood became significant at the 90% confidence level. Otherwise, everything remained the same as in the second model. In the fourth model, the scale for aesthetics and attractiveness of the surrounding neighborhood lost significance and gender reverted back to the 90% confidence level. Otherwise, everything remained the same as in the second model.

The direction of the significant relationships was in the expected direction for all of the significant variables except gender (as was discussed above) and the scale for aesthetics and attractiveness of the surrounding neighborhood. It was presumed that people living in an attractive neighborhood would be more likely to bicycle, but the opposite relationship was identified. Perhaps, this variable acts as a proxy for income or for lower-density development, and that is why the relationship was negative. Otherwise, no explanation for this relationship comes to mind.

Table 4.11 Regression Analysis for Bicycle Travel to Common Destination (# of bicycle trips)

	Model 1			Model 2			Model 3			Model 4		
	Coeff		t-stat	Coeff		t-stat	Coeff		t-stat	Coeff		t-stat
Constant	0,53		0,26	-0,97		-0,73	-1,33		-0,96	-0,39		-0,31
FacilityAvail_DV2	-0,02		-0,37									
AttractiveSurroundingNeigh _DV2_3	-0,08		-0,53									
OtherModes_DV2_3	-0,14		-0,88	-0,10		-0,65	-0,10		-0,61	-0,13		-0,85
Proximity_to_CommonDest	-0,01	***	-2,98	-0,01	***	-3,14	-0,01	***	-3,02	-0,01	***	-3,36
FacilityDesign	0,31		1,54	0,25		1,35	0,26		1,35			
BikeFacilitiesImportant	0,27		0,95	0,32		1,22	0,31		1,14	0,20		0,75
History_MoreFacilities	0,46		1,18	0,38		1,05	0,40		1,07	0,34		0,96
History_FewerFacilities	0,25		0,86	0,17		0,61	0,16		0,55	0,23		0,83
Age	0,04	***	3,09	0,04	***	3,40	0,04	***	3,38	0,03	***	2,78
Gender	-0,52	*	-1,73	-0,45		-1,57	-0,42		-1,42	-0,41		-1,46
Health	-0,23		-1,52	-0,21		-1,47	-0,18		-1,21	-0,17		-1,20
Children	0,16		0,54									
OwnBicycle	-0,54		-0,41									
Live_in_Innercity	-0,18		-0,53									
Education	-0,18		-1,48	-0,14		-1,22	-0,13		-1,11	-0,18		-1,62
EnjoyBicycling	0,54	***	3,06	0,47	***	3,29	0,49	***	3,36	0,50	***	3,58
ValueBicycling	-0,16		-0,72									
BikeLanes_HomeNeigh							0,03		0,10			
BikePaths_HomeNeigh							-0,27		-0,86			

	Coeff	t-stat	Coeff	t-stat	Coeff	t-stat	Coeff	t-stat
BikeRoads_HomeNeigh					0,23	0,70		
BikeLights_HomeNeigh					0,25	0,75		
SceneryAlongBikeRoutes							0,20	1,45
Summary Statistics								
N	182		189		187		190	
F-statistic								
R^2	0,267		0,260		0,268		0,262	
Adjusted R^2	0,191		0,214		0,203		0,217	

Note: ***, **, * Significant at the 99, 95, and 90% level of confidence, respectively.

Table 4.12 Regression Analysis for Bicycle Travel to Common Destination (proportion of trips)

	Model 1		Model 2		Model 3		Model 4	
	Coeff	*t*-stat	Coeff	*t*-stat	Coeff	*t*-stat	Coeff	*t*-stat
Constant	0,24	0,51	0,16	0,66	0,22	0,87	0,11	0,47
FacilityAvail_DV3	0,00	0,11						
AttractiveSurroundingNeigh _DV2_3	-0,06 *	-1,78	-0,06 *	-1,86	-0,07 **	-2,00	-0,06	-1,63
OtherModes_DV2_3	-0,02	-0,44						
Proximity_to_CommonDest	0,00 ***	-4,31	0,00 ***	-0,49	0,00 ***	-4,69	0,00 ***	-5,09
FacilityDesign	0,05	1,01	0,03	0,79	0,03	0,71		
BikeFacilitiesImportant	-0,06	-0,98	-0,04	-0,64	-0,03	-0,44	-0,05	-0,81
History_MoreFacilities	0,05	0,55						
History_FewerFacilities	0,02	0,32						
Age	0,01 ***	2,88	0,01 ***	3,57	0,01 ***	3,33	0,01 ***	2,98
Gender	-0,13 *	-1,81	-0,13 **	-2,09	-0,11 *	-1,71	-0,11 *	-1,89
Health	-0,05	-1,34	-0,04	-1,39	-0,05	-1,60	-0,03	-0,97
Children	0,03	0,40						
OwnBicycle	-0,08	-0,25						
Live_in_Innercity	-0,04	-0,48						
Education	0,00	-0,15						
EnjoyBicycling	0,09 **	2,16	0,11 ***	3,38	0,10 ***	3,28	0,11 ***	3,60
ValueBicycling	0,02	0,45						
BikeLanes_HomeNeigh					-0,07	-1,04		
BikePaths_HomeNeigh					-0,09	-1,34		
BikeRoads_HomeNeigh					0,12 *	1,68		
BikeLights_HomeNeigh					0,03	0,40		
SceneryAlongBikeRoutes							0,04	1,26
Summary Statistics								
N	182		190		188		191	
F-statistic								
R^2	0,261		0,264		0,282		0,260	
Adjusted R^2	0,184		0,232		0,233		0,228	

Note: ***, **, * Significant at the 99, 95, and 90% level of confidence, respectively.

Bicycling In or From One's Home Neighborhood

Again, the same four models as were used for the dependent variables regarding bicycle travel to work and bicycle travel to a common destination were also used for the dependent variables regarding bicycling in or from one's home neighborhood (Table 4.13 and Table 4.14).

For DV3A (number of times per week a respondent bicycled in or from their home neighborhood), the scale for design and quality of available bicycle facilities, the degree to which the respondent enjoys bicycling, and whether or not the respondent owns a bicycle were each significant at the 99% confidence level in the initial model. Additionally, the scale for aesthetics and attractiveness of the surrounding neighborhood and the scale for the degree to which the respondent values bicycling (for environmental, personal health, and social or cultural reasons) were each significant at the 95% confidence level. In the second model, the scale for design and quality of available bicycle facilities dropped in significance from the 99% confidence level to the 95% confidence level, and the scale for the degree to which the respondent values bicycling dropped from the 95% confidence level to the 90% confidence level. All other results remained the same. In the third model, everything remained the same as in the second model except that the presence of bicycle paths in or near the respondent's home neighborhood became significant at the 95% confidence level. In the fourth model, the only significant relationship that remained the same as in the second model was that regarding the degree to which the respondent enjoys bicycling. The scale for the availability of other modes of travel became significant at the 95% confidence level, the scale for aesthetics and attractiveness of the surrounding neighborhood decreased in significance from the 95% confidence level to the 90% confidence level, the scale for the degree to which the respondent values bicycling lost significance completely, and the attractiveness of urban and natural scenery along bicycle travel routes replaced the scale for design and quality of available bicycle facilities at the 95% confidence level.

The direction of relationships for significant variables was in the expected direction for all variables except, as in previous cases, the scale for aesthetics and attractiveness of the surrounding neighborhood and the presence of bicycle paths in or near the respondent's home neighborhood. Better design and quality of bicycle facilities, the ownership of a bicycle, the more the respondent enjoyed bicycling, the more the respondent valued bicycling, and the more pleasant the urban and natural scenery along bicycle travel routes, the more likely a respondent was to bicycle in or from their home neighborhood. Increased availability of other travel modes (particularly, an automobile) decreased the likelihood that a respondent would bicycle.

For DV3C (the estimated *distance* a respondent bicycled in a week), the results were quite different. In the initial model, the scale for availability of other travel modes and whether or not the bicycle facilities present were a key factor in the respondent's decision to bicycle (or not) were each significantly associated with bicycle travel at the 99% confidence level. Age was significant at the 90% confidence level. In the second model, age lost significance and the degree to which the respondent valued bicycling became significant at the 95% confidence level. Everything else remained the same. In the third model, the scale for design and quality of available bicycle facilities, whether or not the respondent had ever lived in an area with considerably fewer bicycle facilities, and age each became significant at the 90% confidence level. Otherwise, everything remained the same as in the second model. In the fourth model, everything remained the same as in the second model except that whether or not the respondent had ever lived in an area with considerably fewer bicycle facilities became significant at the 90% confidence level.

Table 4.13 Regression Analysis for Bicycle Travel in or from Home Neighborhood (# of bicycle trips)

	Model 1			Model 2			Model 3			Model 4		
	Coeff		t-stat	Coeff		t-stat	Coeff		t-stat	Coeff		t-stat
Constant	-2,74		-1,26	-2,17		-1,23	-2,95		-1,66	-1,68		-0,91
FacilityAvail_DV3	-0,18		-1,44	-0,17		-1,40				-0,15		-1,24
AttractiveSurroundingNei	-0,47	**	-2,45	-0,42	**	-2,21	-0,41	**	-2,21	-0,32	*	-1,71

	Model 1			Model 2			Model 3			Model 4		
	Coeff		t-stat	Coeff		t-stat	Coeff		t-stat	Coeff		t-stat
gh_DV2_3												
OtherModes_DV2_3	-0,28		-1,34	-0,30		-1,56	-0,26		-1,34	-0,41	**	-2,12
FacilityDesign	0,69	***	2,79	0,51	**	2,21	0,56	**	2,41			
BikeFacilitiesImportant	0,49		1,41	0,44		1,29	0,44		1,31	0,42		1,22
History_MoreFacilities	0,69		1,44	0,47		1,05	0,59		1,32	0,33		0,73
History_FewerFacilities	0,13		0,36									
Age	0,00		-0,12									
Gender	-0,46		-1,23	-0,43		-1,24	-0,36		-1,04	-0,31		-0,88
Health	-0,09		-0,47									
Children	0,40		1,10	0,53		1,52	0,42		1,18	0,57		1,59
OwnBicycle	3,03	***	2,58	3,11	***	2,66	3,18	***	2,73	2,95	**	2,13
Live_in_Innercity	-0,21		-0,51									
Education	0,09		0,56									
EnjoyBicycling	0,55	***	2,50	0,61	***	2,89	0,65	***	3,09	0,64	***	3,04
ValueBicycling	0,52	**	1,94	0,43	*	1,65	0,44	*	1,68	0,38		1,43
BikeLanes_HomeNeigh							0,40		1,16			
BikePaths_HomeNeigh							-0,89	**	-2,39			
BikeRoads_HomeNeigh							-0,24		-0,60			
BikeLights_HomeNeigh							0,15		0,36			
SceneryAlongBikeRoutes										0,35	**	2,03
Summary Statistics												
N			202			210			210			213
F-statistic												
R²			0,278			0,250			0,275			0,231
Adjusted R²			0,216			0,209			0,223			0,189

Note: ***, **, * Significant at the 99, 95, and 90% level of confidence, respectively.

Table 4.14 Regression Analysis for Bicycle Travel in or from Home Neighborhood (total distance per week)

	Model 1			Model 2			Model 3			Model 4		
	Coeff		t-stat	Coeff		t-stat	Coeff		t-stat	Coeff		t-stat
Constant	-59,53		-1,30	-45,97		-1,45	-50,62		-1,54	-23,9		-0,83
FacilityAvail_DV3	0,13		0,05									
AttractiveSurroundingNeigh_DV2_3	-0,73		-0,18									
OtherModes_DV2_3	-12,75	***	-2,89	-11,53	***	-2,95	-12,68	***	-3,13	-11,3	***	-2,98
FacilityDesign	8,58		1,59	7,45		1,54	8,32	*	1,68			
BikeFacilitiesImportant	19,01	***	2,57	19,00	***	2,72	18,92	***	2,65	17,88	***	2,57
History_MoreFacilities	10,71		1,04	6,93		0,74	7,73		0,81	5,71		0,53
History_FewerFacilities	12,35		1,62	10,66		1,46	12,42	*	1,64	12,99	*	1,79
Age	0,50	*	1,69	0,43		1,63	0,45	*	1,64	0,33		1,25
Gender	-1,29		-0,16									
Health	-2,98		-0,76									
Children	-3,04		-0,40									
OwnBicycle	17,23		0,70									
Live_in_Innercity	2,03		0,24									
Education	4,48		1,38	3,78		1,28	4,38		1,46	3,12		1,08
EnjoyBicycling	1,86		0,40									
ValueBicycling	7,50		1,32	9,22	**	2,06	9,36	**	2,04	9,12	**	2,08
BikeLanes_HomeNeigh							3,73		0,51			
BikePaths_HomeNeigh							-6,20		-0,78			

BikeRoads_HomeNeigh			2,94	0,36	
BikeLights_HomeNeigh			-1,09	-0,13	
SceneryAlongBikeRoutes				3,30	0,91
Summary Statistics					
N	194	201	199	204	
F-statistic					
R^2	0,198	0,170	0,183	0,164	
Adjusted R^2	0,125	0,135	0,131	0,129	

Note: ***, **, * Significant at the 99, 95, and 90% level of confidence, respectively.

Limitations

A basic limitation of this study is that it is a cross-sectional study. More telling findings may be identified if this study or some variation of it is repeated at a later point in time. Additionally, this study only examined the *perceptions* of respondents. No outside, objective measurements of any of the variables were included (e.g., GIS or street audits). This study could be enhanced by incorporating objective measures as well as the subjective measures collected from respondents. One final limitation of both portions of this study is that it would be much better to perform the regression analyses using count models rather than linear regression models. The regression estimates obtained using the linear regression models are likely to be biased. Additional limitations, unique to the two separate portions of the study, are discussed below.

For the Montgomery County portion of the study, one clear limitation is the infrequent use of cycling to get to destinations. The results for the first two dependent variables, in particular, are very weak as a result of the low number of cases in which respondents bicycled to get to their destinations. Additionally, in relation to other places in the United States, Montgomery County has a fairly good bicycle infrastructure network, but there is still much to be desired there. The lack of a truly satisfactory bicycle facility network in the county may make this study a little premature for this location. Similarly, bicycling is not a real transportation option for most people in the United States. Until bicycling becomes a truly viable transportation option in the collective consciousness of the United States, testing the relevance of environmental factors for influencing bicycle travel may not produce very salient results.

Time limitations required that the Delft portion of the study be done at a reasonable scale. This meant a one-page (two-sided) mail survey. Research design drawbacks of this are that some of the variables could not be very comprehensively measured (i.e. aesthetics/attractiveness of surrounding neighborhoods, density and neighborhood type, employment situation and lifestyle of respondents, and design and quality of available bicycle facilities). Additionally, although a mail survey is a decent approach, one-on-one interviews would have been better for ensuring that the respondents understood the questions and the possible answers. Additionally, although an adequate typology of bicycle facilities was used for this portion of the study, it would have been best to first identify (through preliminary studies with the residents of Delft) how *they* categorized bicycle facilities. This would have helped to clarify which facilities were available to respondents and, subsequently, which of those were significantly related to bicycle travel. Whether or not bicycle facilities were a key factor in a respondent's decision whether or not to bicycle showed up as a significant factor in the regression analysis of the third dependent variable, but the perceived *presence* of bicycle facilities did not show a significant correlation with bicycle travel in that case. This may have been captured correctly, or it may be the result of a less than ideal bicycle facility typology for the sample population.

Despite the above limitations, this study brings to light and examines a number of topics that have not been studied thus far regarding bicycle travel behavior, and it contributes greatly to nascent knowledge of the relationship between various bicycle facilities and bicycle travel. The next chapter concludes this paper with a more thorough discussion of the key findings obtained through this study and their lessons for planners and policy makers.

Chapter 5

Conclusions and Discussion

Montgomery County

As was expected at the commencement of this study, bicycle facilities did show some relationship to bicycle travel in Montgomery County, Maryland. The existence of bicycle paths/trails in one's home neighborhood was significantly correlated with bicycle travel from home to work, and the existence of sidewalks in one's home neighborhood was significantly correlated with bicycling in or from one's neighborhood. Sidewalks protected from the roadway by a buffer of parked cars had a particularly strong association with bicycling in or from one's home neighborhood.

However, in many cases, the association between bicycle facilities and bicycle travel was not discovered. Bicycle paths/trails, bicycle lanes, bicycle storage, and lockers and showers for cyclists at or near one's workplace were not associated with more bicycle travel to work. Additionally, bicycle paths/trails and bicycle lanes in or near one's home neighborhood were not associated with more bicycle travel in or from one's neighborhood.

From these results, there is the positive indication that building travel infrastructure for cyclists would, to some degree, encourage and facilitate bicycle travel. However, the results imply that such facilities are not the key factor influencing bicycle travel among residents of Montgomery County, Maryland. The study shows that factors such as age, gender, whether or not a person has children, physical health, the degree to which a person enjoys cycling, and whether or not a respondent has a bicycle, as well as other factors not captured in this study, are also strongly related to bicycle travel behavior.

As discussed previously, these results are generalizable to U.S. locations with a similarly mediocre bicycle facility network, but they do not necessarily show the impact such facilities would have if they were part of a more complete and holistic bicycling system.

Delft

The city of Delft does have a very holistic and fairly complete bicycle facility network. Although not located in the U.S., the results from this portion of the study do help to examine the potential influence of bicycle facilities on bicycle travel behavior in general.

The presence of certain bicycle facilities and issues regarding their design were found to be significantly associated with bicycle travel in a number of instances. Bicycle-only roads—the largest and presumably most preferred type of bicycle infrastructure that was examined—in or near one's home neighborhood was significantly and positively associated with the highest number of dependent variables of any bicycle facility variable—the number of times a respondent bicycled to work, the proportion of times they bicycled to work, and the proportion of times they bicycled to their common destination. This indicates that the better the bicycle facility, the more likely it is to influence bicycle travel. Bicycle lanes were also significantly and positively related to the number of times a respondent bicycled to work, indicating the importance of support travel facilities in auto-dominant urban environments.

The quality of the urban and natural scenery along bicycle travel routes (*where they are located*) was significantly related to the proportion of times a person traveled to work via bicycle and the number of times they traveled in or from their home neighborhood. Additionally, the entire scale for "design and quality of available bicycle facilities" was significantly associated with the number of times per week a respondent bicycled in or from their home neighborhood, as well as the total distance they bicycled in or from their home neighborhood. This implies that design and quality of bicycle facilities, and, in particular, the environments through which bicycle facilities pass, are very important to their effectiveness in attracting bicyclists and inducing bicycle travel.

Whether or not a person had ever lived in an area with considerably more bicycle facilities was significantly correlated with the proportion of times they bicycled to work, indicating a possible carry-over effect of a habit that had been developed in a more bicycle friendly environment. Anecdotally, I do know of an elderly man from the Netherlands who lives in a very bicycle-unfriendly environment in south Florida who still bicycles everywhere he goes because he says that it is ingrained in him from living in the Netherlands in his youth.

Lastly, whether or not the bicycle facilities present were a key factor in a respondent's decision to bicycle (or not) was very significantly associated with the total distance that a respondent bicycled in or from her/his home neighborhood. In a less objective way, this also indicates the importance of bicycle facilities for inducing bicycle travel.

Despite the results that affirm my hypotheses, however, it was again found that most bicycle facilities were not significantly associated with more bicycle travel. None of the bicycle facilities in or near respondents' workplace neighborhoods nor those in or near the neighborhoods of their self-specified common destinations were significantly associated with bicycle travel. Traffic lights for cyclists and the entire scales for available bicycle facilities were not significantly associated with any of the dependent variables. Bicycle lanes were significantly associated with only one of the six dependent variables. The quality of the urban and natural scenery along most bicycle travel routes and the scale for design and quality of available bicycle facilities were each significantly related to only two of the six dependent variables.

As was noted in the previous chapter, bicycle paths separate from the roadway were found to be significantly and *negatively* associated with bicycle travel in a number of instances—when examining the number of times a respondent bicycled to work, the proportion of times a respondent bicycled to work, and the number of times a person bicycled in or from their home neighborhood. One of my hypotheses regarding these very counterintuitive results is that bicycle paths were more common in lower density, primarily homogenous residential environments, whereas bicycle-only roads were more common in more urban and mixed-use environments. Thus, other factors in the places where bicycle paths existed discouraged bicycle travel. This was also my main supposition as to why neighborhoods with more trees and less traffic (more aesthetically pleasing neighborhoods) were significantly associated with *less* bicycle travel. Another possibility, however, is that the typology of bicycle facilities I created was not ideal and many respondents were lumping together bicycle paths and bicycle roads under bicycle roads only (especially in places that had both). Unfortunately, the actual cause of these results cannot be verified.

Aside from bicycle facilities, it is important to note that distance was a very significant factor in all of the analyses where it was incorporated. Shorter distances were positively related to bicycle travel to work and to respondent-specified common destinations, implying that compact urban form and

effective mixing of land uses (in a way that decreases distances between homes and key destinations) are critical to higher levels of bicycle travel. Also, personal factors such as the degree to which respondents enjoy bicycling and the degree to which they value bicycling were consistently significant factors related to bicycle travel, indicating the importance of public education, public outreach campaigns, and 'bicycle marketing' for inducing bicycle travel.

Contrasts and Comparisons

In both of the above studies, the best possible bicycle travel facilities in respondents' home neighborhoods were significantly associated higher levels of bicycle travel, strongly affirming initial hypotheses. However, bicycle travel facilities near workplaces and respondent-specified common destinations were not associated with more bicycle travel in *any* of the analyses, implying that bicycle facilities near destinations are not nearly as critical. Additionally, showers, lockers, safe bicycle storage and traffic lights for cyclists were not significantly associated with bicycle travel in any of the analyses, again suggesting that these facilities do not induce bicycle travel to any significant degree.

In Montgomery County but not in Delft, whether or not respondents had children and respondents' self-perceptions of their personal health were consistent factors related to bicycle travel, implying that personal and lifestyle issues are more important in the U.S. than in the Netherlands.

It is interesting that distance was only significant in the Delft analyses, (to a very large degree). However, it should be noted that distance was not included in the Montgomery County analyses for travel to a common destination and there were considerable data limitations for the analyses for bicycle travel to work (as discussed previously).

Lastly, the degree to which respondents enjoy bicycling was significant in many of the analyses (for both studies), and in the Delft study it was added that the degree to which respondents value bicycling is in many cases significant. As mentioned above, this suggests that efforts and events that increase public knowledge of the benefits of bicycling or that make it a more appealing activity would significantly increase bicycle travel. When I visited Delft, I actually walked past an elementary school where the students were playing some sort of game on their bicycles, supervised by teachers. This is just one instance of how bicycling is promoted and encouraged in the Netherlands, making it a more valued and more enjoyable activity.

My general conclusion from performing this research project is that bicycle facilities (especially higher quality facilities) are important for promoting bicycle travel, cross-culturally, but that public education, bicycle marketing and bicycle-oriented entertainment events are extremely important as well. In addition, as has been verified through previous studies, the built environment and urban spatial structure also appear to be very important factors related to bicycle travel. Lastly, higher quality bicycle facilities in home neighborhoods and aesthetically pleasing bicycle travel routes are very important factors related to bicycle travel.

References

1000 Friends of Oregon. (1997). *Making the Connections: A Summary of the LUTRAQ Project: Integrating Land-Use and Transportation Planning for Livable Communities*. Portland, OR: 1000 Friends of Oregon.

1000 Friends of Oregon. (2003). *The Pedestrian Environment*. Portland, OR: 1000 Friends of Oregon.

Beatley, T. (2000). *Green Urbanism: Learning from European Cities*. Covelo, CA: Island Press.

Betsill, M. (2001). Mitigating Climate Change in U.S. Cities: Opportunities and obstacles. *Local Environment* 4(4): 393-406.

Betsill, M. and H. Bulkeley. (2004). Transnational Networks and Global Environmental Governance: The cities for climate protection program. *International Studies Quarterly* 48(2): 471-493.

Blank, R. (1997). *It Takes a Nation: A New Agenda to Fight Poverty*. Princeton, NJ: Princeton University Press.

Boarnet, M., C. Anderson, K. Day, T. McMillan, and M. Alfonzo. (2005). Evaluation of the California Safe Routes to School legislation. *American Journal of Preventive Medicine*, 28(2S2): 134-140.

Bohle, W. (2000). Attractiveness of bicycle-facilities for the users and evaluation of measures for the cycle-traffic. *Traffic Safety on Two Continents Conference*, Report VTI knferens 13A(part 5): 89-94.

Burden, D. (2001). *Building Communities with Transportation*, Distinguished Lecture Presentation at the 2001 Transportation Research Board Annual Conference. Retrieved on February 11, 2007 from: Distinguished Lecture Presentation

Calthorpe, P. (1993). *The Next American Metropolis: Ecology, Community, and the American Dream*. New York, NY: Princeton Architectural Press.

Causes of Obesity. (n.d.). Retrieved on October 24, 2006 from: http://www.obesityinamerica.org/causes.html

Danziger, S. and P. Gottschalk. (1995). *America Unequal*. New York and Cambridge, MA: Russel Sage Foundation and Harvard University Press.

Dill, J. and T. Carr. (2003). Bicycle commuting and facilities in major U.S. cities: If you build them, commuters will use them. *Transportation Research Record*, Issue#1828, ISBN#0309085616: 116-123.

Esparolini, J. (2004). A Spring Bike Ride with BURP. Retrieved on February 3, 2007 from: http://www.pbase.com/sloopjohne/biking_with_burp

Everett, M. (1990). The Determinants of Mass Bicycle Commuting Revisited. *Journal of the Transportation Research Forum*, 30: 360-366.

Exploratorium. (1997). *Human Power*. Retrieved on February 11, 2007 from:
  http://www.exploratorium.com/cycling/humanpower1.html

Feske, D. (1994). Life in the Bike Lane: A recent report points out how cities and counties can help
  make wheels and feet viable forms of alternative transportation. *American City & County*,
  109(11): 64-68.

Fishman, R. (2000). The American Metropolis at Century's End: Past and Future Influences. *Housing
  Policy Debate*, 11(1): 199-213.

Forester, J. (2001). The bicycle transportation controversy. *Transportation Quarterly*, 55(2): 7-17.

Frank, L. and P. Engelke. (2001). The Built Environment and Human Activity Patterns: Exploring the
  Impacts of Urban Form on Public Health. *Journal of Planning Literature*, 16(2): 202-218.

Duany, A, E. Plater-Zyberk and J. Speck. (2001). *Suburban Nation: The rise of sprawl and the decline
  of the American dream*. New York, NY: North Point Press.

Giles-Corti, B. (2006). *The Impact of Urban Form on Public Health*, paper prepared for the 2006
  Australian State of the Environment Committee, Department of the Environment and Heritage,
  Canberra. Retrieved on February 11, 2007 from:
  http://www.environment.gov.au/soe/2006/publications/emerging/public-health/index.html

Godschalk, D., D. Brower, D. Herr, and B. Vestal. (1978). *Responsible Growth Management: Cases
  and materials*. Chapel Hill, NC: Center for Urban and Regional Studies.

Grimshaw, J. (2002). The UK national cycle network: a millennium project. In H. McClintock (Ed.)
  Planning for Cycling: Principles, Practice and Solutions for Urban Planners (pp.100-109).
  Cambridge, England: Woodhead Publishing Limited.

Handy, S. (1996). Understanding the Link between Urban Form and Non-work Travel Behavior.
  Journal of Planning Education and Research, 15(3): 183-198.

Handy, S., Boarnet, M., Ewing, R., and R. Killingsworth. (2002). How the Built Environment Affects
  Physical Activity: Views from Urban Planning. *American Journal of Preventive Medicine*,
  23(2S): 64-73.

Harrison, B. and B. Bluestone. (1990). *The Great U-Turn: Restructuring and the Polarizing of
  America*. New York, NY: Basic Books.

Hoehner, C., Ramirez, L.B., Elliot, M., Handy, S. and R. Brownson. (2005). Perceived and Objective
  Environmental Measures and Physical Activity Among Urban Adults. *American Journal of
  Preventive Medicine*, 28: 105-116.

Holladay, D. (2002). Cycling with public transport: combined in partnership, not conflict. In H.
  McClintock (Ed.) *Planning for Cycling: Principles, Practice and Solutions for Urban Planners*
  (pp.110-142). Cambridge, England: Woodhead Publishing Limited.

Hunter, W. (1999). An evaluation of red shoulders as a bicycle and pedestrian facility. *Association for the Advancement of Automotive Medicine Proceedings*, ISSN#08926484: 29-43.

Hurd, B., J. Callaway, J. Smith, and P. Kirshen. (2004). Climatic Change and U.S. Water Resources: From modeled watershed impacts to national estimates. *Journal of the American Water Resources Association* 40(1): 129-148.

International Council for Local Environmental Initiatives (ICLEI). (2005). *Local Governments for Sustainability*. Retrieved on July, 2006 from: http://www.iclei.org

Jackson, M. and E. Ruehr. (1998). Let the people be heard: San Diego County bicycle use and attitude survey. *Transportation Research Record*, Issue#1636, ISBN#0309065089: 8-12.

Krizek, K. (n.d.). Estimating the economic benefits of bicycling and bicycle facilities: An interpretive review and proposed methods. Retrieved on April 24, 2006 from: http://www.hhh.umn.edu/people/kkrizek/writings.html

Krizek, K. (2003). Residential Relocation and Changes in Urban Travel: Does Neighborhood-Scale Urban Form Matter? *Journal of the American Planning Association*, 69(3): 265-281.

Krizek, K. and P. Johnson. (2006). Proximity to trails and retail: Effects on urban cycling and walking. *Journal of the American Planning Association*. 72(1): 33-43.

Krizek, K., P. Johnson, and N. Tilahun. (2004). Gender differences in bicycling behavior and facility preferences. *Conference on Research on Women's Issues in Transportation, Conference Proceedings Issue 35*: 31-40.

Krizek, K., D. Levinson, and N. Tilahun. (n.d.). Trails, lanes, or traffic: The value of different bicycle facilities using an adaptive stated preference survey. Retrieved on April 28, 2006 from: http://www.hhh.umn.edu/people/kkrizek/writings.html

Levy, H. and R. Murnane. (1992). U.S. Earnings Levels and Earnings Inequality: A review of recent trends and proposed explanations. *Journal of Economic Literature*, 30: 1333-1381.

Levy, M. and N. Russell. (2002). National Survey of Pedestrian & Bicyclist Attitudes and Behaviors: Highlights Report. Retrieved on April 24, 2006 from: http://trisonline.bts.gov/detail.cfm?ANNUMBER=00942303&STARTROW=41&CFID=3322373&CFTOKEN=9237568

Lowe, M. (1988). Pedaling Into the Future: Bicycles are the transportation alternative that can relieve the congestion and pollution brought on by automobiles. *World Watch*, 1: 10-16.

Marsh, W. (2005). *Landscape Planning: Environmental Applications, 4th Ed.* Hoboken, NJ: John Wiley & Sons, Inc.

McCann, B. (2005). *Active Living Research: Designing for Active Recreation*. San Diego: San Diego State University.

McClintock, H. (1992). Post-war traffic planning and special provision for the bicycle. In H. McClintock (Ed.) *The Bicycle and City Traffic* (pp.19-39). London, England: Belhaven Press.

Morris, M. (2004). *Planning and Public Health Reunited: New opportunities for collaboration*. Retrieved on February 11, 2007 from: http://www.sfdph.org/phes/enchia/orient_APAmemo.pdf

Moudon, A., C. Lee, A. Cheadle, C. Collier, D. Johnson, T. Schmid, and R. Weather. (2005). Cycling and the built environment, a U.S. perspective. *Transportation Research Part D*, 10: 245-261.

Nationale telefoongids. (2006). White pages. Retrieved on January 18, 2007 from: http://whitepages.goudengids.nl/decodesearch.ds

Natural Resources Defense Council. (2000). *The Problem of Urban Stormwater Pollution*. Retrieved on October 29, 2006 from: http://www.nrdc.org/water/pollution/fstorm.asp.

Noland, R. and H. Kunreuther. (1995). Short-run and long-run policies for increasing bicycle transportation for daily commuter trips. *Transport Policy*, 2(1): 67-79.

North, G. (2003). Climate change over the next century. In J. Griffin (Ed.) *Global Climate Change: The Science, Economic, and Politics* (pp.45-66). Northampton, MA: Edward Eglar Publishing.

Parry, M., N. Arnell, T. McMichael, R. Nicholls, P. Martens, S. Kovats, M. Livermore, C. Rosenweig, A. Iglesias, and G. Fischer. (2001). Millions at Risk: Defining critical climate change threats and targets. *Global Environmental Change* 11(3): 181-183.

Peterson, R., Hanna, J., and D. Ross. (1995). Adoption of the Bicycle as an Urban Commuter Vehicle. *Journal of Nonprofit and Public Sector Marketing* 3(3/4): 25-36.

Pikora, T., B. Giles-Corti, at al. (2003). Developing a framework for assesment of the environmental determinants of walking and cycling. *Social Science and Medicine*, 56: 1693-1703.

Planetware. (2007). The Hague. Retrieved on January 20, 2007 from: http://www.planetware.com/netherlands/the-hague-nl-zh-hague.htm

Pucher, J. (1997). Bicycling Boom in Germany: A Revival Engineered by Public Policy. *Transportation Quarterly*, 51(4): 31-46.

Pucher, J. (2001). Cycling safety on bikeways vs. roads. *Transportation Quarterly*, 55(4): 9-11.

Pucher, J. and R. Buehler. (2005). Cycling Trends and Policies in Canadian Cities. *World Transport Policy and Practice*, 11(1): 43-61.

Pucher, J. and L. Dijkstra. (2000). Making walking and cycling safer: Lessons from Europe. *Transportation Quarterly*, 54(3): 25-50.

Pucher, J. and L. Dijkstra. (2003). Promoting Safe Walking and Cycling to Improve Public Health: Lessons from the Netherlands and Germany. *American Journal of Public Health*, 93(9): 1509-1516.

Pucher, J., C. Komanoff, and P. Schimek. (1999). Bicycling renaissance in North America? Recent trends and alternative policies to promote bicycling. *Transportation Research Part A*, 33(7/8): 625-654.

Rodriguez, D. and J. Joonwon. (2004). The Relationship Between Non-Motorized Mode Choice and the Local Physical Environment. *Transportation Research Part D*: 151-173.

Rodriguez, D. and J. Valentine. (n.d.) *Planning and Physical Activity*. Retrieved on October 29, 2006 from: http://www.planning.unc.edu/ALR/.

Scheraga J. and A. Grambsch. (1998). Risks, Opportunities, and Adaptation to Climate Change. *Climate Research* 10(Dec): 85-95.

Schinnerer, J. (1997). *The Most Efficient Engine*. Retrieved on February 11, 2007 from: http://www.eco-living.net/writings/transport/effengine.html

Segal, L. (2005). America's Obesity Epidemic Getting Worse; New Report Finds Adult Obesity Rates Up in 31 States; the South is the "Biggest Belt." Retrieved on October 24, 2006 from: http://healthyamericans.org/newsroom/releases/release082906.pdf

Shafer, C., B. Lee, S. Turner, and M. Hughart. (1999). Evaluation of bicycle and pedestrian facilities: User satisfaction and perceptions on three shared use trails in Texas. *Southwest Region University Transportation Center*, Report SWUTC/99/472840-00021-1: 89.

Smith J., J. Lazo, B. Hurd. (2003). The difficulties of estimating global non-market damages from climate change. In J. Griffin (Ed.) *Global Climate Change: The Science, Economic, and Politics* (pp.114-139).

Sommer, E. (2003). *A Fair Modal Share for Cycling: Twenty percent by 2020 in Orlando*. Retrieved on January 21, 2007 from: http://www.environment.ucf.edu/bikepath/Supporting%20Files/cycling_proposal%20-%205%20May%202003.pdf

Stinson, M. and C. Bhat. (2003). Commuter bicyclist route choice: Analysis using a stated preference survey. *Transportation Research Record*, Issue#1828, ISBN#0309085616: 107-115.

Troped, P., R. Saunders, R. Pate, B. Reininger, J. Ureda, and S. Thompson. (2001). Associations between self-reported and objective physical environmental factors and use of a community rail-trail. *Preventive Medicine*, 32: 191-200.

Troped, P., R. Saunders, R. Pate, B. Reininger, and C. Addy. (2003). Correlates of recreational and transportation physical activity among adults in a New England community. *Preventive Medicine*, 37: 304-310.

U.S. Census Bureau. (2000). *American FactFinder*. Retrieved on October 28, 2006 from: http://factfinder.census.gov/home/saff/main.html?_lang=en.

U.S. Congress. (1978). *National Energy Conservation Policy Act of 1978. PL 95-619. S. 682*.

U.S. Environmental Protection Agency. (2006). *Transportation and Air Quality*. Retrieved on October 28, 2006 from: http://www.epa.gov/otaq/.

Watson, R. (2001). *Climate change 2001: Synthesis report. Working Groups I, II and III to the Third Assessment Report of the Intergovernmental Panel on Climate Change*. Cambridge, U.K.: Cambridge University Press.

Welch, C. (2006). *Pollution*. Retrieved on October 28, 2006 from: http://www.solcomhouse.com/Pollution.htm.

Wendel-Vos, G., A. Schuit, et al. (2004). Factors of the physical environment associated with walking and bicycling. *Official Journal of the American College of Sports Medicine*: 725-730.

White, R. (2004). Managing and Interpreting Uncertainty for Climate Change Risk. *Building Research and Information*. 32(5): 438-448.

Whitt, F. and D. Wilson. (1982). *Bicycling Science*. Cambridge, Massachusetts: Massachusetts Institute of Technology.

Wikipedia. (2007). *Bicycle*. Retrieved on February 11, 2007 from: http://en.wikipedia.org/wiki/Bicycle

Wyly, E., N. Glickman, and M. Lahr. (1998). A Top 10 List of Things to Know About American Cities. *Cityscape: A Journal of Policy Development and Research*, 3(3): 7-32.

Appendix I:
Montgomery County
Physical Activity and Built Environment Survey

In just a minute we will begin the survey. As a reminder, please feel free to ask any questions at any point. Also, you may notice that a few of the questions seem to repeat in different sections of the survey. Be assured that they are different and that any similarities between questions are intentional.

FORM 0
Table A

These first questions are general information questions.

Participant ID				
[A1]	Do you currently have a job or do any unpaid work outside your home?	Yes =1	No=2	Refused to Answer= 999
[A2]	In general, you would say that your health is:	1= excellent 2= very good 3= good 4= fair 5= poor 998 = Doesn't know/Not sure 999 = Refused to answer		

FORM 1
Table C

For the next questions, please tell me how much you agree or disagree with the following statements:

		Strongly Disagree 1	Somewhat Disagree 1	Neutral 3	Somewhat Agree 4	Strongly Agree 5	Doesn't Know/Not Sure 998	Refused to Answer 999
[C1]	People around your neighborhood are willing to help their neighbors.							
[C2]	Your neighborhood is close-knit.							
[C3]	People in your neighborhood can be trusted.							
[C4]	People in your neighborhood generally don't get along with each other.							
[C5]	People in your neighborhood do not share the same values.							
[C6]	You and your neighbors want the same thing from your neighborhood.							
[C7]	You feel at home on your block.							
[C8]	Very few of your neighbors know you.							
[C9]	You care about what your neighbors think of your actions							
[C10]	You have no influence over what your block is like.							
[C11]	If there is a problem on your block, the people who live there get it solved.							
[C12]	It is very important to you to live on your block.							
[C13]	You expect to live on your block a long time.							

FORM 2
Table E

We would like to find out more information about the way that you perceive or think about your neighborhood. The following questions are about your neighborhood and yourself, please tell me the answer that best applies to you and your neighborhood.

		None 1	A Few 2	Some 3	Most 4	All 5	Doesn't Know/ Not Sure 998	Refused to Answer 999
[E1]	How common are detached single-family residences in your immediate neighborhood?							
[E2]	How common are townhouses or row houses of 1-3 stories in your immediate neighborhood?							
[E3]	How common are apartments or condos 1-3 stories in your immediate neighborhood?							
[E4]	How common are apartments or condos 4-6 stories in your immediate neighborhood?							
[E5]	How common are apartments or condos 7-12 stories in your immediate neighborhood?							
[E6]	How common are apartments or condos with 13 or more stories in your immediate neighborhood?							

Table F

For the next set of questions, please tell me about how long would it take to get from your home to the nearest businesses or facilities listed below if you WALKED to them at your normal walking pace?

		5 mins or less 1	6-10 mins 2	11-20 mins 3	21-30 mins 4	30 + mins 5	Doesn't Know/Not Sure 998	Refused to Answer 999
F1	Convenience/small grocery store							
F2	Supermarket							
F3	Hardware Store							
F5	Laundry/Dry Cleaners							
F6	Clothing Store							
F7	Post Office							
F8	Library							
F9	Elementary School							
F10	Other Schools							
F11	Bookstore							
F12	Fast Food Restaurant							
F14	Bank/Credit Union							
F15	Non-Fast Food Restaurant							
F16	Video Store							
F17	Pharmacy/Drug Store							

		Salon/Barber Shop							
F18	Salon/Barber Shop								
F19b	Your Main Job (not applicable is also an option here)								
F20	Bus or Train Stop								
F21	Park								
F22	Recreation Center								
F23	Gym or Fitness Center								

Table G

For the next seven questions, please tell me how much you agree or disagree with following statements.

		Strongly Disagree 1	Somewhat Disagree 2	Neutral 3	Somewhat Agree 4	Strongly Agree 5	Doesn't Know/Not Sure 998	Refused to Answer 999
G1	You can do most of your shopping at stores within a 10-15 minute walk from your home.							
G2	Stores are within easy walking distance of your home.							
G3	Parking is difficult in local shopping areas.							
G4	There are many places to go within easy walking distance of your home.							
G5	It is easy to walk to a transit stop (bus, train) from your home.							
G6	The streets in your neighborhood are hilly, making your neighborhood difficult to walk in.							
G7	There are many canyons/hillsides in your neighborhood that limit the number of routes for getting from place to place.							

Form 3
Table H

Please tell me how much you agree or disagree with the following five statements.

		Strongly Disagree 1	Somewhat Disagree 2	Somewhat Agree 3	Strongly Agree 4	Doesn't Know/Not Sure 998	Refused to Answer 999	Not Applicable 997
H1	The streets in your neighborhood do not have many cul-de-sacs or other dead-end streets.							
H2	There are walkways in your neighborhood that connect cul-de-sacs to streets, trails, or other cul-de-sacs.							
H3	The distance between intersections in your neighborhood is usually short (100 yards or less; the length of a football field or less).							
H4	There are many four-way intersections in your neighborhood.							
H5	There are many alternative routes for getting from place to place in your neighborhood. (I don't have to go the same way every time.)							

Table I

Please tell me how much you agree or disagree with the following seven statements.

		Strongly Disagree 1	Somewhat Disagree 2	Somewhat Agree 3	Strongly Agree 4	Doesn't Know/Not Sure 998	Refused to Answer 999	Not Applicable 997
I1	There are sidewalks on most of the streets in your neighborhood.							
I2	The sidewalks in your neighborhood are well maintained (paved, even, and not a lot of cracks).							
I3	There are bicycle or pedestrian pathways or trails in or near your neighborhood that are easy to get to.							
I4	Sidewalks are separated from the road/traffic in your neighborhood by parked cars.							
I5	There is a grass/dirt strip that separates the streets from the sidewalks in your neighborhood.							
I6	Considering traffic and road conditions, It is safe to ride a bike in or near your neighborhood.							
I7	There are facilities to bicycle in or near your neighborhood, such as bicycle lanes, separate paths or trails, shared used paths for							

		Strongly Disagree 1	Somewhat Disagree 2	Somewhat Agree 3	Strongly Agree 4	Doesn't Know/Not Sure 998	Refused to Answer 999	Not Applicable 997
	pedestrians and cycles.							

Table J

Please tell me how much you agree or disagree with the following eight statements.

		Strongly Disagree 1	Somewhat Disagree 2	Somewhat Agree 3	Strongly Agree 4	Doesn't Know/Not Sure 998	Refused to Answer 999	Not Applicable 997
J1	There are trees along the streets in your neighborhood.							
J2	Trees give shade for the sidewalks in your neighborhood.							
J3	There are many interesting things to look at while walking in your neighborhood.							
J4	Your neighborhood is generally free from litter.							
J5	There are many attractive natural sights in your neighborhood (such as landscaping, views).							
J6	There are attractive buildings/homes in your neighborhood.							
J7	Your neighborhood has several free or low cost recreation facilities, such as parks, walking trails, bike paths, recreation centers, playgrounds, public swimming pools, etc.							
J8	Hills, or steep slopes, are common in your neighborhood.							

Table K

For the next set of questions please tell me how much you agree or disagree with the following statements.

		Strongly Disagree 1	Somewhat Disagree 2	Somewhat Agree 3	Strongly Agree 4	Doesn't Know/Not Sure 998	Refused to Answer 999	Not Applicable 997
K1	There is so much traffic along the street you live on that it makes it difficult or unpleasant to walk in your neighborhood.							
K2	There is so much traffic along nearby streets that it makes it difficult or unpleasant to walk in your neighborhood.							
K3	The speed of traffic on the street you live on is usually slow (30 mph or less).							
K4	The speed of traffic on most nearby streets is usually slow (30 mph or less).							

K5	Most drivers exceed the posted speed limits while driving in your neighborhood.						
K6	Your neighborhood streets are well lit at night.						
K7	Walkers and bikers on the streets in your neighborhood can be easily seen by people in their homes.						
K8	There are crosswalks and pedestrian signals to help walkers cross busy streets in your neighborhood.						
K9	The crosswalks in your neighborhood help walkers feel safe crossing busy streets.						
K10	When walking in your neighborhood there are a lot of exhaust fumes (such as from cars, buses).						
K11	You see and speak to other people when you are walking in your neighborhood.						
K12	There is a high crime rate in your neighborhood.						
K13	The crime rate in your neighborhood makes it unsafe to go on walks during the day.						
K14	The crime rate in your neighborhood makes it unsafe to go on walks at night.						
K15	Your neighborhood is safe enough so that you would let a 10-year-old child walk around your block alone in the daytime.						
K16	There are unattended or stray dogs in your neighborhood.						

Form 4
Survey Section L

Next are things about your neighborhood with which you may or may not be satisfied. Using the scale that I will read to you, tell me your satisfaction with each item.

		Strongly Dissatisfied 1	Somewhat Dissatisfied 2	Neither Satisfied or Dissatisfied 3	Somewhat Satisfied 4	Strongly Satisfied 5	Doesn't Know/Not Sure 998	Refused to Answer 999
L1	the highway access from your home							
L2	the access to public transportation in your neighborhood.							
L3a	your commuting time to work [not applicable =997]							
L3b	your access to school [not applicable =997]							
L4	the access to shopping in your neighborhood.							
L5	the number of friends you have in your neighborhood.							
L6	the number of people you know in your neighborhood.							
L7	how easy and pleasant it is to walk in your neighborhood.							
L8	how easy and pleasant it is to bicycle in your neighborhood.							
L9	the quality of schools in your neighborhood							
L10	access to entertainment in your neighborhood (restaurants, movies, clubs, etc)							
L11	the safety from the threat of crime in your neighborhood.							
L12	the amount and speed of traffic in your neighborhood.							
L13	the noise from traffic in your neighborhood.							
L14	the number and quality of food stores in your neighborhood.							
L15	the number and quality of restaurants in your neighborhood.							
L16	your neighborhood as a good place to raise children.							
L17	your neighborhood as a good place to live.							
L18	Overall, how satisfied are you with your neighborhood?							

Table M

Please tell me if you have the following in your home, yard, or apartment complex.

		Yes 1	No 0	Doesn't Know/Not Sure 998	Refused to Answer 999
M1	stationary aerobic equipment (e.g. treadmill, cycle)				
M2	bicycle				
M4	trampoline for jogging in place				
M5	running shoes				
M6	swimming pool				
M7	weight lifting equipment (e.g. free weights, Nautilius Universal)				
M8	skis (snow or water)				
M9	toning devices (e.g. exercise balls, ankweights, Dynabands, Thighmaster)				
M10	exercise DVD, video or audiotapes				
M11	step aerobics, slide aerobics				
M12	skates (roller, in-line, or ice)				
M13	sports equipment (balls, racquets)				
M14	surf board, boogie board, windsurf board				
M15	canoe, row boat, kayak				

Form 5
Table N

Now I am going to read you a list of places where you can exercise. Please let me know if the place is on a frequently traveled route or within a 5-minute drive or 10-minute walk from your work or home.

		Yes 1	No 0	Doesn't Know/Not Sure 998	Refused to Answer 999
N1	aerobics studio				
N2	basketball court				
N3	beach, lake, river, or creek				
N4	bike lane or trails				
N5	golf course				
N6	health spa/gym				
N7	martial arts studio				
N8	playing field (soccer, football, softball, etc.)				
N9	public park				
N10	public recreation center				
N11	racquetball/squash court				
N12	running track				
N13	skating rink				
N14	sporting goods store				
N15	swimming pool				
N16	walking/hiking trails				
N17	tennis courts				
N18	dance studio				

Private recreational facilities are places to be physically active which you have to join or pay a fee to use. Examples of private facilities include YMCA's, health clubs or gyms, martial arts studios, dance studios, or yoga studios.

N20	Would you say that the availability of recreational and exercise facilities in your community was . . .	Excellent = 1	Good = 2	Fair = 3	Poor = 4	Doesn't Know/Not Sure = 998	Refused to Answer = 999	Not Applicable = 997
N22	How often do you use the recreational and exercise facilities in your local area?	Very Often = 1	Often = 2	Sometimes = 3	Never = 4	Doesn't Know/Not Sure = 998	Refused to Answer = 999	Not Applicable = 997
N23	Would you say that the quality of the recreational and exercise facilities in your local area was...	Excellent = 1	Good = 2	Fair = 3	Poor = 4	Doesn't Know/Not Sure = 998	Refused to Answer = 999	Not Applicable = 997

Table O

Next I will read to you reasons for moving to your neighborhood. Please rate how important each of the following reasons was in your decision to move to your neighborhood. For each reason, please select a number between 1 and 5, with 1 being not at all important and 5 being very important.

		Not at all important = 1	Somewhat Important = 2	Somewhat Important = 3	Somewhat Important = 4	Very Important = 5	Doesn't Know/Not Sure = 998	Refused to Answer = 999
O1	Affordability/Value							
O2	Closeness to open space (for example, parks)							
O3	Closeness to job or school							
O4	Closeness to public transportation							
O5	Desire for nearby shops and services							
O6	Ease of walking							
O7	Sense of community							
O8	Safety from crime							
O9	Quality of schools							
O10	Closeness to recreational facilities							
O11	Access to freeways							

Form 6
Table Q

Please tell me how much you agree or disagree with the following statements.

		Strongly Disagree = 1	Somewhat Disagree = 2	Neutral = 3	Somewhat Agree = 4	Strongly Agree = 5	Doesn't Know/Not Sure = 998	Refused to Answer = 999
Q4	You would like to have more time for leisure							
Q6	You think that it's important for children to have a large backyard for playing							
Q7	You think that environmental protection is an important issue							
Q8	You enjoy a house close to the sidewalk so that you can see and interact with passersby							
Q9	You think that too much land is consumed for new housing, stores, and offices							
Q10	You enjoy bicycling							
Q11	You enjoy living in close proximity to your neighbors							
Q13	You prefer a lot of space between your home and the street.							
Q16	You think that children should have a large public play space within safe walking distance of their home.							
Q17	You think that having shops and services close by is important.							

		Less than 5	Between 5	Between	More than	Doesn't	Refused to	Not

		min =1	and 15 min = 2	15 and 30 min = 3	30 min =4	Know/Not Sure = 998	Answer = 999	Applicable = 997
Q18	Now, please tell me what would be your ideal one-way commuting time to work or school:							

		Less than 5 min = 1	Between 5 and 15 min = 2	Between 15 and 30 min = 3	Between 30 and 45 min = 4	Between 45 min and 1 hr = 5	More than 1 hour = 6	Doesn't Know/Not Sure = 998	Refused to Answer = 999	Not Applicable = 997
Q19	And please tell me what would be the longest acceptable time for you to commute one-way to work or school.									

Table R

Next, I am going to ask you about walking for transportation purposes. Please let me know how many days in the past month you have walked to a:

		Home	And/or fromWork
	market/retail store from home, from work	R2:HOME	R2:WORK
	school/day care center from home, from work	R3:HOME	R3:WORK
	bank/credit union from home, from work	R4:HOME	R4:WORK
	post office from home, from work	R5:HOME	R5:WORK
	restaurant/café from home, from work	R6:HOME	R6:WORK
	gym/health club/rec facility from home, from work	R7:HOME	R7:WORK
	park from home, from work	R8:HOME	R8:WORK
	public transportation/park and ride facility from home, from work	R9:HOME	R9:WORK
	work site/office from home, from work	R10:HOME	R10:WORK

Table S

For the questions below, please do not count stationary biking.

S5	If you were to bicycle in your neighborhood you would feel safe from cars while riding.	Strongly disagree 1	Somewhat disagree 2	Neutral 3	Somewhat agree 4	Strongly agree 5	Doesn't Know/Not Sure = 998	Refused to Answer = 999
S1	How often do you bicycle, either in your neighborhood or starting from your neighborhood?	Never = 0	Less than once a week = 1	1-2 times a week = 2	3-6 times a week = 3	Everyday = 4	Doesn't Know/Not Sure = 998	Refused to Answer = 999

S2	When you bicycle, how far do you normally ride?		Miles

S3	How often would you bike if you thought it was safe from cars?	Never = 0	Less than once a week = 1	1-2 times a week = 2	3-6 times a week = 3	Everyday = 4	Doesn't Know/Not Sure = 998	Refused to Answer = 999

Form 7
Table T

Now, I am going ask a number of questions about your workplace environment.

T2	Do you usually work at: (#of sites)	One site each day = 1	Multiple sites each day =2	Refuse to Answer =999	

T3	Is your primary work: (indoors/outdoors)	Indoors = 1	Outdoors =2	Mixed indoors and outdoors = 3	Refuse to Answer = 999

	How many days in the past month or so (20 work days) did you go to work by:	Days
T4a	Walking	
T4b	Biking	
T4c	Drive Alone	
T4d	Carpool Driver	
T4e	Carpool Passenger	
T4f	Vanpool	
T4g	Bus	
T4H	Taxi	
T4i	Train	

T5	How long does it take you to walk from your parking space, transit stop, or drop off location to your primary workplace? (in minutes)	Minutes

Are any of the following items available at your work or from your employer?

		Yes = 1	No = 0	Doesn't Know/Not Sure = 998	Refused to Answer =999
T6b	Exercise facilities (e.g. workout room/gym, exercise equipment, walking path /PAR course)				
T7b	Regular exercise programs (e.g. aerobic classes, team sports, walking groups, etc.)				
T8B	Shower facilities that you can use				
T9b	Lockers for clothes				
T10b	Safe bicycle storage				
T14a	Does your employer offer incentives not to drive to work?				

For each of the following programs, please tell me a) is it offered to you by your employer, and b) do you use it more than twice per month.

		Yes = 1	No = 0	Do you use it?	Yes = 1	No =0
T14b 1a,1b	An exercise specialist or activity coordinator available for employees.					
T14b 2a, 2b	Paid time for you to exercise.					
T14b 4a, 4b	The ability to work at home one or more days per week.					
T14b 5a, 5b	A guaranteed ride home.					
T14b 6a, 6b	Cash in lieu of using a parking space or a reduced transit pass.					
T14b 7a, 7b	Incentives for carpooling, such as a ridematching program or preferential parking.					

		Yes = 1	No = 0	Not Applicable = 997	Refused to Answer = 999
	Are the stairs at your work:				
T15a	available to use most of the time?				
T15b	safe?				
T15c	pleasant?				

		Answer
T16	What is the full address of your primary workplace? (please provide a street address, not a PO Box number)	
T17	What is the nearest intersection to your primary workplace?	
T18	How many days per week do you usually go to your primary workplace?	

Form 8
Table U
Please tell me how much you agree or disagree with the following statements.

		Strongly Disagree =1	Somewhat Disagree =2	Somewhat Agree =3	Strongly Agree = 4	Doesn't Know/Not Sure =998	Refused to Answer = 999
U1	The streets in your workplace neighborhood do not have many, or any, cul-de-sacs.						
U2	There are many four-way intersections in your workplace neighborhood.						
U3	There are sidewalks on most of the streets in your workplace neighborhood.						
U4	There are bicycle or pedestrian trails in or near your workplace neighborhood that are easily accessible.						
U5	There are many interesting things to look at while walking in your workplace neighborhood.						
6	There are trees along the streets in your workplace neighborhood.						
U7	Your workplace neighborhood is generally free from litter.						
U8	There is so much traffic along the streets that it makes it difficult or un-pleasant to walk in your workplace neighborhood.						
U9	There are crosswalks and pedestrian signals to help walkers cross streets in your workplace neighborhood.						
U10	You see a lot of other people when you are walking in your workplace neighborhood.						
U11	There is a high crime rate in your workplace neighborhood.						

Form 14
Table BB
Please think about the place that you most frequently visit during a typical week. This can be a friend or relative's house, a park, a library, a mall, etc... Now, I am going to ask you some questions about this place.

BB1	Is the place you most frequently visit:	Indoors = 1	Outdoors =2	Mixed indoors and outdoors =3	Refuse to Answer =999

	How many days in the past week did you go to this place by:	Days
BB2	Walking	
BB3	Biking	
BB4	Drive Alone	
BB5	Being a Carpool Driver	
BB10	Train	
BB6	Being a Carpool Passenger	
BB7	Riding in a Vanpool	
BB8	Bus	
BB9	Taxi	

B11	How long does it take you to walk from your parking space, transit stop, or drop off location to your most frequently visited place? (in minutes)	Minutes

Are any of the following items available at this place?

		Yes =1	No =0	Doesn't Know/Not Sure = 998
BB12	Exercise facilities.			
BB13	Exercise programs.			
BB15	Shower facilities.			
BB16	Safe bike storage.			
BB15	Locker facilities.			

		Yes = 1	No = 2	Not Applicable = 997	Refused to Answer = 999
	Are the stairs at this place:				
BB17	available?				
BB18	safe?				
BB19	pleasant?				

		Answer
BB20	What is the full address of this place? (please provides a street address, not a PO Box number)	
BB21	What is the nearest intersection to this place?	
BB22	How many days per week do you usually go to this place?	

Form 13
Table EE

		Strongly Disagree =1	Somewhat Disagree =2	Somewhat Agree =3	Strongly Agree = 4	Doesn't Know/Not Sure =998	Refused to Answer = 999
EE1	Parking is always an issue in your neighborhood						
EE2	There are an adequate number of off-street parking spaces in your neighborhood.						
EE3	There are an adequate number of on-street parking spaces in your neighborhood.						
EE4	The cost for parking in your neighborhood, on- or off-street, seem reasonable to you.						
EE5	You are satisfied with the transit frequency in your neighborhood.						
EE6	Transit takes you where you want or need to go.						
EE7	It is easy to get to the bus or rail transit from your neighborhood.						
EE8	I would like to have more stores and restaurants within walking distance of where I live.						

Table DD

		Yes =1	No = 0	Doesn't Know/Not Sure =998	Refused to Answer =999
DD22	Are there any trails or pathways in your neighborhood, not including state parks or national forests?				
DD23	Do you ever use the trails or pathways?				

DD24	Why don't you use the trails or pathways?	
DD25	How did you find out about the trails or pathways in your neighborhood?	
DD26	How do you get to the trails or pathways in your neighborhood?	
DD28	How often do you use the trails or pathways in your neighborhood?	Times per month

You are doing great and we are more than half way through the survey. Let's take a short break and measure your height, weight, and % body fat.

Form 9
Table V

V0a	We are interested in finding out about the kinds of physical activities that people do as part of their everyday lives. During the past month, did you participate in any physical activities or exercises such as running, calisthenics, golf, gardening, or walking for exercise?	Yes =1	No = 0	Doesn't Know/Not Sure =998	Refused to Answer =999			

V0b	During the past month, when you participated in physical activities, did you usually do it :	Near your home =1	At your home = 2	Near your workplace = 3	At your workplace = 4	Near both home and workplace =5	Some other place = 6	Doesn't Know/ Not Sure = 998	Refused to Answer = 999

The next questions are about all the physical activity you did in the last 7 days as part of your paid or unpaid work. This does not include traveling to and from work.

V2	During the last 7 days, on how many days did you do vigorous physical activities like heavy lifting, digging, heavy construction, or climbing up stairs as part of your work? Think about only those physical activities that you did for at least 10 minutes at a time.	Days
V3	How much time did you usually spend on ONE of those days doing vigorous physical activities as part of your work?	Hrs/Mins per day

V4	Again, think about only those physical activities that you did for at least 10 minutes at a time. During the last 7 days, on how many days did you do moderate physical activities like carrying light loads as part of your work? Please do not include walking.	Days

V5	How much time did you usually spend on ONE of those days doing moderate physical activities as part of your work?	Hrs/Mins per day

V6	During the last 7 days, on how many days did you walk for at least 10 minutes at a time as part of your work? Please do not count any walking you did to travel to or from work.	Days

V7	How much time did you usually spend on ONE of those days walking as part your work?	Hrs/Mins per day

These next questions are about how you traveled from place to place, including to places such as work, stores, movies and so on.

V8	During the last 7 days, on how many days did you travel in a motor vehicle like a train, bus or car?	Days

V9	How much time did you usually spend on ONE of those days traveling in a car, bus, train or other kind of motor vehicle?	Hrs/Mins per day

V10	During the last 7 days, on how many days did you bicycle for at least 10 minutes at a time to go from place to place?	Days

V11	How much time did you usually spend on ONE of those days to bicycle from place to place?	Hrs/Mins per day

V12	During the last 7 days, on how many days did you walk for at least 10 minutes at a time to go from place to place?	Days

V13	How much time did you usually spend on ONE of those days walking from place to place?	Hrs/Mins per day

This section is about some of the physical activities you might have done in the last 7 days in and around your home, like housework, gardening, yard work, general maintenance work, and caring for your family.

V14	Think about only those physical activities that you did for at least 10 minutes at a time. During the last 7 days, on how many days did you do vigorous physical activities like heavy lifting, chopping wood, shoveling snow, or digging in the garden or yard?	Days

V15	How much time did you usually spend on ONE of those days doing vigorous physical activities in the garden or yard?	Hrs/Mins per day

V16	Again, think about only those physical activities that you did for at least 10 minutes at a time. During the last 7 days, on how many days did you do moderate activities like carrying light loads, sweeping, washing windows, and raking in the garden or yard?	Days

V17	How much time did you usually spend on ONE of those days doing moderate physical activities in the garden or yard?	Hrs/Mins per day

V18	Once again, think about only those physical activities that you did for at least 10 minutes at a time. During the last 7 days, on how many days did you do moderate activities like carrying light loads, washing windows, scrubbing floors and sweeping inside your home?	Days

V19	How much time did you usually spend on ONE of those days doing moderate physical activities inside your home?	Hrs/Mins per day

This section is about all the physical activities that you did in the last 7 days solely for recreation, sport, exercise or leisure. Please do not include any activities you have already mentioned.

V20	Not counting any walking you have already mentioned, during the last 7 days, on how many days did you walk for at least 10 minutes at a time in your leisure time?	Days

V21	How much time did you usually spend on ONE of those days walking in your leisure time?	Hrs/Mins per day

V22	Think about only those physical activities that you did for at least 10 minutes at a time. During the last 7 days, on how many days did you do vigorous physical activities like aerobics, running, fast bicycling, or fast swimming in your leisure time?	Days

V23	How much time did you usually spend on ONE of those days doing vigorous physical activities in your leisure time?	Hrs/Mins per day

V24	Again, think about only those physical activities that you did for at least 10	Days

	minutes at a time. During the last 7 days, on how many days did you do moderate physical activities like bicycling at a regular pace, swimming at a regular pace, and doubles tennis in your leisure time?	

V25	How much time did you usually spend on ONE of those days doing moderate physical activities in your leisure time?	Hrs/Mins per day

The last questions are about the time you spend sitting while at work, at home, while doing course work and during leisure time. This may include time spent sitting at a desk, visiting friends, reading or sitting or lying down to watch television. Do not include any time spent sitting in a motor vehicle that you have already listed.

V26	During the last 7 days, how much time did you usually spend sitting on a weekday?	Hrs/Mins per day

V27	During the last 7 days, how much time did you usually spend sitting on a weekend day?	Hrs/Mins per day

Form 10
Table W

For the next six questions you will again need the following definition for "vigorous activity".

"Vigorous" exercise includes activities like jogging, running, fast cycling, aerobics classes, swimming laps, singles tennis, and racquetball. These types of activities usually increase your heart rate, make you sweat, and you get out of breath (do not count weight lifting).

Now, please tell me how much you agree or disagree with the following statements for vigorous activities.

		Strongly Disagree = 1	Somewhat Disagree =2	Neutral =3	Somewhat Agree =4	Strongly Agree =5	Doesn't Know/Not Sure =998	Refused to Answer = 999
W1	You enjoy doing vigorous physical activities.							
W2	You enjoy the feeling you get while doing vigorous activities.							
W3	You enjoy the feeling you get after doing vigorous activities.							

Table Y

Now, please tell me, on a scale of 1 to 5, how sure you are that you could exercise vigorously in each of the following situations.

		I'm sure I cannot =1	= 2	Maybe I can =3	= 4	I sure I can = 5	Doesn't Know/ Not Sure =998	Refused to Answer =999
Y1	Vigorous physical activity even though you're feeling sad or highly stressed.							
Y2	Stick with a program of vigorous physical activity even when family or social life takes a lot of time.							
Y3	You will set aside time for vigorous physical activity.							

Tables W&Y

Now, for the next six questions you will again need the following definition for "moderate physical activity".

"Moderate" physical activity includes activities like brisk walking, gardening, slow cycling, or dancing. A moderate physical activity is any activity that takes moderate physical effort and makes you breathe somewhat harder than normal.

Please tell me how much you agree or disagree with the following statements for moderate physical activities.

		Strongly Disagree = 1	Somewhat Disagree =2	Neutral =3	Somewhat Agree =4	Strongly Agree =5	Doesn't Know/Not Sure =998	Refused to Answer = 999
W4	You enjoy doing moderate physical activities							
W5	You enjoy the feeling you get while doing moderate physical activities							
W6	You enjoy the feeling you get after doing moderate physical activities							

Now, please tell me, on a scale of 1 to 5, how sure you are that you could exercise moderately in each of the following situations.

		I'm sure I cannot =1	= 2	Maybe I can =3	= 4	I sure I can = 5	Doesn't Know/ Not Sure =998	Refused to Answer =999
Y4	Do moderate physical activity even though you're feeling sad or highly stressed.							
Y5	Stick with a program of moderate physical activity even when family or social life takes a lot of time.							
Y6	You will set aside time for moderate physical activity.							

Table Z

Read the valid responses after each question.

		Never = 0	Rarely = 1	Sometimes =2	Often =3	Vary Often = 4	Doesn't Know/Not Sure =998	Refused to Answer =999
Z1a	During the past three months your family did physical activity with you.							
Z1B	During the past three months your friends did physical activity with you							
Z2a	During the past three months your family offered to do physical activity with you.							
Z2b	During the past three months your friends offered to do physical activity with you.							
Z3a	During the past three months your family gave you encouragement to do physical activity.							
Z3b	During the past three months your friends gave you encouragement to do physical activity.							

Form 11
Table AA

Read the valid responses after each question.

		Detached single house 1	Duplex 2	Row house, town house 3	Apart. Or Condo. 4	Mobile home or trailer 5	Dorm room 6	Other 7	Doesn't Know/ Not Sure 998	Refused to Answer 999
AA1	Do you live in a:									

		Owned 1	Rented 2	Provided by job or military 3	Other 4	Doesn't Know/Not Sure 998	Refused to Answer 999
AA2	Do you own or rent your home?						

		Answer
AA3	Including yourself, how many people live in your household? Please do not include anyone who usually lives somewhere else or is just visiting, such as a college student away at school.	

		Yes 1	No 0	Doesn't Know/Not Sure 998	Refused to Answer 999
AA4	Are any of these people related to each other?				

		Age	Don't Know	Refuse to Answer
AA5	What is your age?			

		Male = 2	Female = 1	Refuse to Answer
AA6	What is your gender?			

		Yes 1	No 0	Doesn't Know/Not Sure 998	Refused to Answer 999
AA9	Are you of Hispanic or Latino origin?				

		White 1	African American 2	Asian 3	American Indian Alaskan Native 4	Native Hawaiian or Pacific Islander5	Multiracial 7	Other 8	Doesn't Know/ Not Sure 998	Refused to Answer 999
AA10	Please tell me which best describes your race									

		Less than high	Completed high	Vocational training	Some college	College/un iversity	Graduate or	Doesn't Know/ Not	Refused to Answer

		school diploma 1	school diploma (GED) 2	(beyond high school) 3	(less than four years) 4	degree 5	professional degree 6	Sure 998	999
AA11	Please tell me the highest education degree you have completed.								

		Never married 1	Married 2	Separated 3	Divorced 4	Widowed 5	Doesn't Know/ Not Sure 998	Refused to Answer 999
AA12	Please tell me what is your marital status.							

		Yes 1	No 0	Doesn't Know/Not Sure 998	Refused to Answer 999
AA13	Are you a parent, foster parent, or legal guardian of children that live with you?				

		Answer
AA14a	Please specify the number of children for whom you are a parent, foster, parent, or legal guardian.	

		Answer
AA14b	Please specify the ages of the children for whom you are a parent, foster, parent, or legal guardian.	

	These are Yes/No	Working	Homemaker	Looking for work	Going to school	Traveling	Retired	Temporarily absent from job/ business	Other	Doesn't Know/ Not Sure	Refused to Answer
	During most of last week you were... (please indicate all that apply)	AA15 a	AA15 b	AA15 c	AA15 d	AA15 e	AA15 f	AA15 g	AA15 h	AA15 i	AA15 j

		Yes 1	No 0	Doesn't Know/Not Sure 998	Refused to Answer 999
AA16	Last week, did you do any work for pay?				

		Full time 1	Part time one job 2	Part time multiple jobs 3	Doesn't Know/Not Sure 998	Refused to Answer 999
AA17	During most of last week you were working...					

		Yes 1	No 0	Doesn't Know/Not Sure 998	Refused to Answer 999
AA18	Do you have more than one job?				

		Sales or service 1	Clerical or administrative 2	Manufacturing, construction, maintenance, farming	Professional, managerial, technical 4	Other 5	Doesn't Know/ Not Sure 998	Refused to Answer 999

				3				
AA19	I am going to read four categories of occupations. Please tell me which one your primary job falls under.							

		Miles/ blocks	Doesn't Know/No t Sure	Refused to Answer	Not applicabl e
AA24	What is the one-way distance from your home to your primary workplace, in miles or blocks?				

		Minutes	Did not work in usual workplace	Did not work last week	Doesn't Know/Not Sure	Refused to Answer
AA25	How many minutes did it usually take you to get from home to work last week?					

		Vehicles	None	Doesn't Know/No t Sure	Refused to Answer
AA29	How many vehicles are owned, leased or available for regular use by the people who currently live in your household?				

I have a few questions about these vehicles:

	Starting with the newest vehicle:	Answer
30a1	What is the make of the vehicle? (for example: Honda, Volkswagen)	
30a2	What is the model of the vehicle? (for example: Accord, Jetta)	
30a3	What is the year of the vehicle?	
30a4	What is the type of the vehicle? (for example: car, van, SUV, truck)	

	Starting with the second newest vehicle:	Answer
30b1	What is the make of the vehicle? (for example: Honda, Volkswagen)	
30b2	What is the model of the vehicle? (for example: Accord, Jetta)	
30b3	What is the year of the vehicle?	
30b4	What is the type of the vehicle? (for example: car, van, SUV, truck)	

	Starting with the third newest vehicle:	Answer
30c1	What is the make of the vehicle? (for example: Honda, Volkswagen)	
30c2	What is the model of the vehicle? (for example: Accord, Jetta)	
30c3	What is the year of the vehicle?	
30c4	What is the type of the vehicle? (for example: car, van, SUV, truck)	

	Starting with the fourth newest vehicle:	Answer
30d1	What is the make of the vehicle? (for example: Honda, Volkswagen)	
30d2	What is the model of the vehicle? (for example: Accord, Jetta)	
30d3	What is the year of the vehicle?	
30d4	What is the type of the vehicle? (for example: car, van, SUV, truck)	

		Bicycles	Don't Know	Refuse to Answer

AA32	How many adult-sized bicycles does your household have in working order? Please include all bikes that are in working order and that are large enough to be used by an adult.			

		Yes 1	No 0	Refused to Answer 999
B12	Do you have a dog at home?			

		Times per day
B13	Approximately how many times per day do you walk your dog?	

		Minutes
B14	For each time, approximately how long do you spend walking your dog?	

I am going to read several annual income categories, please tell me which category best matches your annual household income:

	Less than $10,000 1	$10,000 - $19,000 2	$20,000 - $29,000 3	$30,000 - $39,000 4	$40,000 - $49,000 5	$50,000 - $59,000 6	$60,000 - $69,000 7	$70,000 - $79,000 8	$80,000 - $89,000 9	$90,000 - $99,000 10	More than $100,00 0 11	Refused to Answer 998	Refused to Answer 999
AA33													

For these last few questions, I am going to ask for your contact information. This is necessary in order to send you your participation check of $25.

		Answer
AA34	What is your home address?	

		Answer
AA35	What is the nearest street intersection to your home?	

		Answer
AA36	What is your email address?	

		Answer
AA37	What is your phone number?	

End of Survey

Appendix II: Delft Questionnaire (English)
ALL RESPONSES WILL BE KEPT STRICTLY **CONFIDENTIAL**.

QUESTIONS ABOUT YOUR HOME NEIGHBORHOOD

On a scale of 1 to 5, please express your level of agreement with the next three statements. 1= strongly disagree…. 5= strongly agree. [Circle a number for each statement]

1. The speed of traffic on the street I live on is relatively slow.

1	2	3	4	5
strongly disagree		neutral		strongly agree

2. The speed of traffic on most nearby streets is relatively slow.

1	2	3	4	5
strongly disagree		neutral		strongly agree

3. There are trees along the streets in my neighborhood.

1	2	3	4	5
strongly disagree		neutral		strongly agree

4. Are you aware of any of the following in or near your home neighborhood? (Please mark all that apply)
❑ Bicycle lanes (on the road, not protected by a buffer)
❑ Paths, protected or separated from the roadway, for cyclists or pedestrians/cyclists (not including sidewalks)
❑ Roads for cyclists only
❑ Traffic signals that are exclusively for cyclists

QUESTIONS ABOUT YOUR WORKPLACE NEIGHBORHOOD

On a scale of 1 to 5, please express your level of agreement with the next two statements. 1= strongly disagree…. 5= strongly agree. [Circle a number for each statement]

5. The speed of traffic on the street I work on is relatively slow.

1	2	3	4	5
strongly disagree		neutral		strongly agree

6. There are trees along the streets in my workplace neighborhood.

1	2	3	4	5
strongly disagree		neutral		strongly agree

7. Are you aware of any of the following in or near your workplace neighborhood? (Please mark all that apply)
❑ Bicycle lanes (on the road, not protected by a buffer)
❑ Paths, protected or separated from the roadway, for cyclists or pedestrians/cyclists (not including sidewalks)
❑ Roads for cyclists only
❑ Traffic signals that are exclusively for cyclists

8. Is automobile parking limited or costly near your workplace neighborhood? ❑ Yes ❑ No

9. Are any of the following available at your workplace or from your employer?
❑ Shower facilities that you can use
❑ Lockers for clothes
❑ Safe bicycle storage

10. How long would it take you to bicycle to work?
_____ minutes

11. How many days in the past month (4 weeks) did you go to work? _____

12. How many days in the past month (4 weeks) did you go to work by bicycle? _____

13. Of the following, what transportation options do you normally have available to you to get to work? (Please mark all that apply)
❑ Drive an Automobile (by yourself)
❑ Carpool
❑ Fairly good and direct public transit
❑ Walk
❑ Other _____
❑ Not Applicable

QUESTIONS ABOUT ANOTHER COMMON DESTINATION

For the following questions, please think about the place you most frequently visit during a typical week, other than your workplace. This can be a friend or relative's house, a park, a library, a mall, etc.

14. How many days in the past week did you go to this place? _____

15. How many days in the past week did you go to this place by bicycle? _____

16. a) Where do you normally travel to this place from? _____
**   b) From the starting point just mentioned, how long would it take you to bicycle to this place?**
_____ minutes

17. When you do not travel to this place by bicycle, what mode of travel do you normally use? (Please choose one of the options from the list in question #12)

_____

18. Are any of the following available at this place?
❑ Shower facilities that you can use
❑ Lockers for clothes
❑ Safe bicycle storage

19. Are you aware of any of the following in or near the neighborhood in which this place is located?
❑ Bicycle lanes (on the road, not protected by a buffer)
❑ Paths, protected or separated from the roadway, for cyclists or pedestrians/cyclists (not including sidewalks)
❑ Roads for cyclists only
❑ Traffic signals that are exclusively for cyclists

20. What is the full street address of this place?
_____
-_____

_____

QUESTIONS ABOUT BICYCLE FACILITIES IN THE THREE PLACES DISCUSSED ON THE PREVIOUS PAGE

On a scale of 1 to 5, please express your level of agreement with the next five statements. 1= strongly disagree…. 5= strongly agree. [Circle a number for each statement]

21. On-road bicycle lanes in/near the places discussed are well-designed and in good condition.

1	2	3	4	5
strongly disagree		neutral		strongly agree

22. Off-road bicycle paths and trails in/near the places discussed are well-designed and in good condition.

1	2	3	4	5
strongly disagree		neutral		strongly agree

23. Bicycle travel facilities – lanes, paths and trails, and bicycle-oriented roads – are well connected, allowing for continual travel on a bicycle friendly travel route.

1	2	3	4	5
strongly disagree		neutral		strongly agree

24. Bicycle travel facilities – lanes, paths and trails, and bicycle-oriented roads – provide direct (not roundabout) access to key places, allowing for the shortest possible travel time from place to place.

1	2	3	4	5
strongly disagree		neutral		strongly agree

25. The natural and urban scenery along most bicycle travel routes is pleasant, enhancing the quality of bicycle travel.

1	2	3	4	5
strongly disagree		neutral		strongly agree

26. Are the bicycle facilities present (or not present) in/near the places discussed a key factor in your decision whether or not to bicycle? ❑ Yes ❑ No

27. Have you ever lived and bicycled in an area with considerably more or considerably fewer bicycle facilities? (Check all that apply)
❑ No
❑ Considerably More
❑ Considerably Fewer

GENERAL QUESTIONS ABOUT YOU AND YOUR HOMEPLACE

28. What is Your Age? _____

29. Please Indicate Your Sex: ❑ Male ❑ Female

30. In general, you would say that your health is:
❑ Excellent
❑ Very Good
❑ Good
❑ Fair
❑ Poor
❑ Don't Know/Not Sure

31. Are you a parent, foster parent, or legal guardian of children that live with you? ❑ Yes ❑ No

32. What is the one-way distance from your home to your primary workplace?
_____ kilometers

33. Are you a licensed driver? ❑ Yes ❑ No

34. Do you own an automobile? ❑ Yes ❑ No

35. Do you own a bicycle? ❑ Yes ❑ No

36. Can you easily find automobile parking in your home neighborhood? ❑ Yes ❑ No

37. Do you live in the inner city of Delft? ❑ Yes ❑ No

38. Please Indicate the Highest Education Degree You Have Completed:
❑ Less than High School Diploma
❑ High School Diploma
❑ Vocational Training (beyond High School)
❑ Some College
❑ College or University Degree
❑ Don't Know/Not Sure

39. How often do you bicycle, either in your neighborhood or starting from your neighborhood?
❑ Never ❑ Less than once a week
❑ 1-2 times a week ❑ 3-6 times a week
❑ Everyday ❑ Don't Know/Not Sure

40. When you bicycle, how far do you normally ride?
_____

On a scale of 1 to 5, please express your level of agreement with the next four statements. 1= strongly disagree…. 5= strongly agree. [Circle a number for each statement]

41. I enjoy bicycling.

1	2	3	4	5
strongly disagree		neutral		strongly agree

42. I think bicycling is important for environmental reasons.

1	2	3	4	5
strongly disagree		neutral		strongly agree

43. I think bicycling is important because of its health benefits.

1	2	3	4	5
strongly disagree		neutral		strongly agree

44. I think bicycling is important for social or cultural reasons.

1	2	3	4	5
strongly disagree		neutral		strongly agree

THANK YOU AGAIN FOR YOUR TIME AND COOPERATION. IT IS MUCH APPRECIATED.

ALLE ANTWOORDEN ZULLEN STRIKT **VERTROUWELIJK** WORDEN VERWERKT

VRAGEN OVER UW WOONBUURT

Bent u het eens met de volgende drie stellingen? Geef uw mening op een schaal van 1 tot 5. 1= helemaal niet mee eens…. 5= helemaal mee eens [Omcirkel bij elke stelling uw mening]

1. De verkeerssnelheid in de straat waar ik woon is relatief langzaam.

1	2	3	4	5
helemaal mee oneens		neutraal		helemaal mee eens

2. De verkeerssnelheid in de meeste straten in de buurt is relatief langzaam.

1	2	3	4	5
helemaal mee oneens		neutraal		helemaal mee eens

3. Langs de straten in mijn woonbuurt staan bomen.

1	2	3	4	5
helemaal mee oneens		neutraal		helemaal mee eens

4. Zijn de volgende zaken in uw buurt aanwezig? (Kruis a.u.b. aan wat aanwezig is)
❑ Fietsstroken (op de weg, niet gescheiden van de weg)
❑ Paden, afgeschermd of gescheiden van de rijweg, voor fietsers of voetgangers (excl. troittoirs)
❑ Fietspaden uitsluitend voor fietsers
❑ Verkeerslichten exclusief voor fietsers

VRAGEN OVER DE OMGEVING VAN UW WERKADRES

Bent u het eens met de volgende twee stellingen? Geef uw mening op een schaal van 1 tot 5. 1= helemaal niet mee eens…. 5= helemaal mee eens [Omcirkel bij elke stelling uw mening]

5. De verkeerssnelheid in de straat waar ik werk is relatief langzaam.

1	2	3	4	5
helemaal mee oneens		neutraal		helemaal mee eens

6. Langs de straten in de buurt waar ik werk staan bomen.

1	2	3	4	5
helemaal mee oneens		neutraal		helemaal mee eens

7. Zijn de volgende zaken in de buurt/omgeving van uw werkadres aanwezig? (Kruis a.u.b. aan wat aanwezig is)
❑ Fietsstroken (op de weg, niet gescheiden van de weg)
❑ Paden, afgeschermd of gescheiden van de rijweg, voor fietsers of voetgangers (excl. troittoirs)
❑ Fietspaden uitsluitend voor fietsers
❑ Verkeerslichten exclusief voor fietsers

8. Is parkeren voor auto's in de buurt/omgeving van uw werkadres beperkt of kostbaar? ❑ Ja   ❑ Nee

9. Welke van de volgende voorzieningen zijn op uw werkadres aanwezig? (Kruis a.u.b. aan wat aanwezig is)
❑ Douchefaciliteiten
❑ Kluisjes voor kleren
❑ Veilige fietsenstalling

10. Hoe lang duurt een fietsrit naar uw werkadres?
_____ minuten

11. Hoeveel dagen in de afgelopen 4 weken ging u naar uw werk? _____

12. Hoeveel dagen in de afgelopen 4 weken ging u met de fiets naar uw werk? _____

13. Welke van de volgende vervoersmogelijkheden heeft u normaal ter beschikking om naar uw werk te gaan? (Kruis a.u.b. alles aan wat van toepassing is)
❑ Auto, als bestuurder
❑ Auto, carpool (meerijden met iemand anders)
❑ Redelijk goede en directe openbaar vervoer
❑ Lopen
❑ Anders, te weten: _____
❑ Niet van toepassing

VRAGEN OVER EEN ANDERE VEEL VOORKOMENDE BESTEMMING

Beantwoord de volgende vragen a.u.b. voor een andere bestemming dan uw werkadres, waar uw regelmatig naar toe gaat. Zoals het woonadres van familie of kennis, een park, een bibliotheek, een winkelcentrum, etc.

14. Hoeveel dagen in de afgelopen week ging u naar deze andere bestemming? _____

15. Hoeveel dagen in de afgelopen week ging u hier met de fiets naar toe? _____

16. a) Vanuit welke locatie/plek reist u meestal naar deze bestemming? _____

   b) Vanuit het zojuist genoemde vertrekpunt, hoe lang duurt de fietsrit er naar toe? _____ minuten

17. Als u niet met de fiets naar deze bestemming gaat, hoe gaat u dan? (Kies a.u.b. één van de mogelijkheden genoemd bij vraag 12)

_____

18. Welke van de volgende voorzieningen zijn op uw bestemming aanwezig?
❑ Douchefaciliteiten
❑ Kluisjes voor kleren
❑ Veilige fietsenstalling

19. Zijn de volgende zaken in de buurt/omgeving van uw andere bestemming aanwezig?
❑ Fietsstroken (op de weg, niet gescheiden van de weg)
❑ Paden, afgeschermd of gescheiden van de rijweg, voor fietsers of voetgangers (excl. troittoirs)
❑ Fietspaden uitsluitend voor fietsers
❑ Verkeerslichten exclusief voor fietsers

20. Wat is adres van deze andere bestemming?
_____

VRAGEN OVER FIETSVOORZIENINGEN IN DE DRIE LOCATIES GENOEMD OP DE VORIGE PAGINA

Bent u het eens met de volgende vijf stellingen? Geef uw mening op een schaal van 1 tot 5. 1= helemaal niet mee eens.... 5= helemaal mee eens [Omcirkel bij elke stelling uw mening]

21. Fietstroken (op de weg) in de buurten/locaties genoemd op de vorige pagina zijn goed ontworpen en in goede staat.

1	2	3	4	5
helemaal mee oneens		neutraal		helemaal mee eens

22. Fietspaden (gescheiden van de weg) in de buurten/locaties genoemd op de vorige pagina zijn goed ontworpen en in goede staat.

1	2	3	4	5
helemaal mee oneens		neutraal		helemaal mee eens

23. De fiets-infrastructuur (fietsstroken, fietspaden en wegen geschikt voor fietsverkeer) is onderling goed verbonden en op elkaar afgestemd, zonder beperkingen voor fietsers.

1	2	3	4	5
helemaal mee oneens		neutraal		helemaal mee eens

24. De fiets-infrastructuur (fietsstroken, fietspaden en wegen geschikt voor fietsverkeer) geeft de kortst mogelijke verbindingen naar bestemmingen.

1	2	3	4	5
helemaal mee oneens		neutraal		helemaal mee eens

25. De natuurlijke en bebouwde omgeving langs de meeste fietsroutes is aangenaam, wat de kwaliteit van het fietsen ten goede komt.

1	2	3	4	5
helemaal mee oneens		neutraal		helemaal mee eens

26. Is de aan- of afwezigheid van fietsvoorzieningen in de buurten/locaties genoemd op de vorige pagina een belangrijke reden voor u om te beslissen om wel of niet te fietsen? ❏ Ja   ❏ Nee

27. Heeft u ooit gewoond en gefietst in een buurt met aanzienlijk meer of aanzienlijk minder fietsvoorzieningen? (Kruis a.u.b. aan wat van toepassing is)
❏ Nee
❏ Ja, met aanzienlijk **meer** fietsvoorzieningen
❏ Ja, met aanzienlijk **minder** fietsvoorzieningen

GENERAL QUESTIONS ABOUT YOU AND YOUR HOMEPLACE

28. Hoe oud bent u? _____

29. Bent u man of vrouw? ❏ Man   ❏ Vrouw

30. Hoe is, door de bank genomen, uw gezondheid?
❏ Uitstekend
❏ Heel goed
❏ Goed
❏ Redelijk
❏ Slecht
❏ Weet niet / niet zeker

31. Bent u ouder of voogd van één of meer inwonende kinderen?   ❏ Ja   ❏ Nee

32. Wat is de enkele afstand van uw huis naar uw werkadres? _____ kilometer

33. Heeft u een rijbewijs? ❏ Ja   ❏ Nee

34. Heeft u een auto? ❏ Ja   ❏ Nee

35. Heeft u een fiets? ❏ Ja   ❏ Nee

36. Kunt u gemakkelijk een parkeerplaats voor uw auto in uw buurt vinden? ❏ Ja   ❏ Nee

37. Woont u in de binnenstad van Delft? ❏ Ja ❏ Nee

38. Wat is uw hoogste, afgeronde opleiding?
❏ Lager dan middelbare school
❏ Middelbare school
❏ Beroepsopleiding
❏ Enige jaren hogeschool
❏ Hogeschool of universiteit
❏ Weet niet / niet zeker

39. Hoe vaak fietst u (binnen uw buurt, of vanuit uw buurt?)
❏ Nooit   ❏ Minder dan eens per week
❏ 1-2 keer per week ❏ 3-6 keer per week
❏ Elke dag   ❏ Weet niet / niet zeker

40. Als u fietst, hoe ver fietst u dan meestal?
_____ kilometer

Bent u het eens met de volgende vier stellingen? Geef uw mening op een schaal van 1 tot 5. 1= helemaal niet mee eens.... 5= helemaal mee eens [Omcirkel bij elke stelling uw mening]

41. Ik vind fietsen leuk.

1	2	3	4	5
helemaal mee oneens		neutraal		helemaal mee eens

42. Ik vind fietsen belangrijk vanwege het milieu.

1	2	3	4	5
helemaal mee oneens		neutraal		helemaal mee eens

43. Ik vind fietsen belangrijk om gezondheids-redenen.

1	2	3	4	5
helemaal mee oneens		neutraal		helemaal mee eens

44. Ik vind fietsen belangrijk om sociale of culturele redenen.

1	2	3	4	5
helemaal mee oneens		neutraal		helemaal mee eens

NOGMAALS BEDANKT VOOR UW TIJD EN MEDEWERKING. HET WORDT ERG GEWAARDEERD.