A LONGITUDINAL ANALYSIS OF THE EFFECT OF BICYCLE FACILITIES ON COMMUTE MODE SHARE

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ABSTRACT

This paper uses census data to describe changes in bicycle commute mode shares between 1990 and 2000 in the Minneapolis-St. Paul, MN area, and specifically the impact of new bicycle facilities that were created during this decade. Previous efforts to understand the impact of facilities on bicycling rates have compared different locations; however, with this method it is not possible to determine the extent to which differences may have already existed before the facilities were built. This study addresses this problem by comparing the same locations before and after facilities were built, using a number of different ways of measuring facility impact.

We find that the locations where facilities were built did in fact already have very high bicycle commute mode shares relative to the rest of the region; but also that these differences became even larger after the facilities were built. The areas within our facility buffers showed mode share increasing from 1.7% to 2.0%, while the remainder of the region remained constant at 0.2%. All individual facilities showed statistically significant increases in bicycle mode share. Central city trips crossing the Mississippi River showed a much larger increase than trips that did not; this reflects a number of significant improvements to bicycle accommodation on bridges during this decade. Finally, downtown Minneapolis and the University of Minnesota, where most of the facilities were concentrated, showed large increases in bicycle mode share, while downtown St. Paul, which had few improvements, had no increase.

INTRODUCTION

Planning agencies and bicycle advocacy groups have long searched for ways to quantify the effects of building new bicycle facilities. Before funding bicycle facility projects, funding agencies often want to know, "if we build it, will they come?" This question is difficult to answer. Many factors affect how many people bicycle, for what purpose, and how often.

There is a great deal of variation in bicycling rates across different metropolitan areas, and often even within different parts of the same city (*1*). It is tempting to ascribe these differences to variations in the bicycling environment in general, and specifically to the presence or absence of special bicycling facilities. Some studies have attempted to compare bicycling rates and facilities across cities (*2, 3, 4*); at least one has tried to explain intra-city differences this way (*5*). These studies have limited success, in part because of the difficulty of acquiring comparable bicycling data from different cities, and of developing consistent definitions of facilities.

A more substantial issue with these types of studies is the indeterminacy of the causality. That is, rather than bicycle facilities inducing higher bicycling rates, it could be that existing high densities of bicyclists created the political climate and perhaps safety justification for building the facilities in the first place (*2*). Nonetheless, facilities are very heavily used compared with ordinary streets (*6*), and there is evidence that commuters are willing to divert out of their way to use facilities (*7, 8*). From these indications of the value that bicyclists place on facilities, it seems logical to deduce that their presence will induce at least some people to commute by bicycle who wouldn't have otherwise. Separating the effects of pre-existing bicycle commuting from the effects of the facility itself would be a key advance in this regard.

One way around this problem is to compare the same location at two different points in time. While local populations still do not remain completely constant over time, they should at least be more comparable than populations from two different cities, or even two parts of the same city.

This paper uses such a longitudinal method for determining the effect of bicycle facility construction in Minneapolis-St. Paul, MN, on journey to work bicycle mode share. During the 1990s a number of new facilities were created in the two central cities; many of them focused on the bicycle commuting hotspots of the University of Minnesota and nearby downtown Minneapolis, and on connecting existing facilities. The U.S. census in both 1990 and 2000 counted bicycle commuters; we believe that this is the first time that such comparable data from two different surveys has been available in this country. The analysis that follows is fairly simple, comparing bicycling commute rates over various parts of the city, and between specific origins and destinations, depending on proximity to the new facilities.

The first part of the paper describes the facilities and the areas they serve and offers a few intuitive hypotheses regarding how they might be expected to be used. This section also describes two buffering methods that we used to characterize the area of influence of the facilities. The next section describes the rate of bicycle commuting over a variety of different ways of defining the area and its commuting patterns vis-à-vis the new facilities, and discusses some implications of these findings. The final section concludes and offers suggestions for further research.

THE FACILITIES

Seven new bicycle facilities in the cities of Minneapolis and St. Paul were selected for the buffer analysis method. Three comprise on-street bicycle lanes; the remaining four are off-street bicycle trails. This list does not necessarily represent a comprehensive list of all new facilities created during the 1990s, but it is of are of particular interest for this study because all the facilities are located in areas where they could reasonably be expected to impact the rate of bicycle commuting through providing improved access to the major employment centers of downtown Minneapolis and the University of Minnesota, which are about one mile apart.

There were also a number of major bridge improvements during the 1990s. Both downtowns and the University are located on the Mississippi River. Two new bicycle bridges were constructed near the University, and wide bicycle lanes were added as part of the general rebuilding of several other road bridges in the area. Thus it could be expected that there would be more cross-river commuting by bicycle in 2000 than in 1990. We examine this possibility as part of our analysis, but without trying to define spheres of influence for specific bridges, as we do for linear facilities.

On-Street Bicycle Lanes

A) Park/Portland Striping Park and Portland Avenues are parallel one-way thoroughfares running into and out of downtown Minneapolis, respectively. The bicycle lane on Portland Avenue is 4.22 miles (6.79 km) long, while the lane on Park Avenue is 4 miles (6.44 km) long. South of downtown Minneapolis, the lanes pass through the residential heart of Minneapolis. Both lanes terminate at 46th St., half a mile north of the Minnehaha Creek bicycle path, a popular recreational route. Both Park and Portland Avenues experience heavy vehicle traffic traveling at speeds around 35 mph (56 kph). As such, the existence of bicycle lanes on these streets significantly enhances conditions for bicyclists.

B) Summit Striping Summit Avenue is a boulevard traversing central west St. Paul from the Mississippi River to just outside of downtown St. Paul. Bi-directional bicycle lanes traverse 4.58 miles (7.37 km) of its length. The western end of the boulevard intersects with the East Mississippi River Parkway, which has recreational walking and off-street bicycling paths. The character of the surrounding neighborhoods is primarily residential. Because Summit Avenue is wide and relatively lightly traveled, it is unlikely that adding bicycle lanes in the 1990s dramatically improved conditions for bicyclists.

C) University/4th Striping University Avenue and 4th Street SE are parallel one-way thoroughfares near the University of Minnesota Twin Cities Campus in Minneapolis. The southeast-bound facility on University is 1.56 mi (2.51 km), while the northwest bound lane on 4th St SE is just .84 mi (1.36 km) split into two segments. The two segments are interrupted by a 0.16 mi (0.26 km) stretch with no lane striping. As with Park and Portland Avenues, University Avenue and 4th Street SE experience heavy, high speed vehicle traffic. Consequently, the bicycle lanes improve travel conditions for bicyclists.

Off-Street Bicycle Paths

D) Cedar Lake Trail The Cedar Lake Trail is an off-street bicycle path that runs 7.79 miles (12.54 km) through a former rail corridor from the northwest side of downtown Minneapolis to the southwest Minneapolis suburb of Hopkins. Access to the path is limited to occasional entry/exit points, much like a limited access highway. As such, it is possible to live in close proximity to the trail without having similarly proximate trail access. In this analysis, only the 2.73 mi (4.40 km) portion of the trail within the city of Minneapolis is included.

E) Kenilworth Trail The Kenilworth Trail is a 1.78 mi (2.87 km) path connecting the Cedar Lake Trail in the north and to the Midtown Greenway, an off-street bicycle path completed in 2000, in the south. The trail runs through a small Minneapolis neighborhood nestled between Lake of the Isles and Cedar Lake. As with the Cedar Lake Trail, access to the path is limited to a few entry/exit points.

F) West River Parkway Minneapolis and St. Paul both have nearly continuous off-street bicycle paths along the Mississippi River. Portions of the path along the downtown Minneapolis riverfront were completed during the 1990s, from Plymouth Avenue in the north to the Washington Avenue bridge (on the University of Minnesota campus) in the south. This portion of the path is 7.96 mi long (12.81 km). Completing this portion provided a direct route into downtown for commuters coming from the already extant southern part of the West River Parkway.

G) U of MN Transitway The University of Minnesota Transitway is a transit-only connection between the University's Minneapolis and St. Paul campus. During the 1990s a parallel bicycle path was established along part of the route, from the Minneapolis campus east to Energy Park Drive. The facility is 1.86 mi (3.00 km) long. There are multiple access points on the western end of the facility, but in the eastern half it is not possible to enter or exit the path except from its termination point at Energy Park Drive. The land uses surrounding the facility are primarily industrial in nature. A consequence of these two characteristics is that the facility is likely used for trips whose routes include its entire length.

These seven facilities comprise a comprehensive list of major facilities constructed in the central cities during the 1990s. Each is viable for commuting. One other major new central city facility, the Gateway Trail, originates in St. Paul and radiates to the countryside to the northeast. We omitted it from this analysis because, while it is very heavily used as a recreational trail, it does not seem suitable for commuting, as it does not pass near or even aim toward any major employment centers. Our own analysis confirmed that there are virtually no bicycle commuters in this corridor.

There were also facilities, both on- and off-street, created in the suburban Twin Cities during the 1990s. Again, however, we omitted these for purposes of this study, both because bicycle commuting rates are relatively low in the suburbs, and because the facilities tend to not serve major employment concentrations.

Two different buffering techniques were employed for trails and lanes. In the first technique, Traffic Analysis Zones (TAZs) were selected if their centroids lay within one mile (1.61 km) of the facility (referred to as buffer 1). This method assumes that the importance of a residential or employment location's proximity to the facility remains constant for the entire length of the facility. In the second technique, the endpoints of the facility were buffered to a distance of 1.5 miles (2.43 km), and if these two buffers did not intersect, the remainder of the facility was buffered to a distance of one mile (referred to as buffer 2). This method allows for the possibility that the ends of the facility attract riders from a greater distance. Again, TAZs were selected if their centroids lay within the buffer.

In the case of paired bicycle lanes, the most extreme endpoints of each set of lanes were used for this analysis. For example, the Portland Avenue bicycle lane is a few hundred meters longer than the Park Avenue bicycle lane, so the endpoints of the former were buffered. In the case of the Cedar Lake Trail, which extends beyond the Minneapolis city limits, only the endpoint located within the central city was buffered to 1.5 miles. The reasoning for this is that while the other endpoint of the trail for purposes of this analysis is at the city limits, this is not the true endpoint for the facility and therefore should not be analyzed as such. Overall, the buffers covered a majority of the city of Minneapolis, but considerably less of St. Paul (Figure 1).

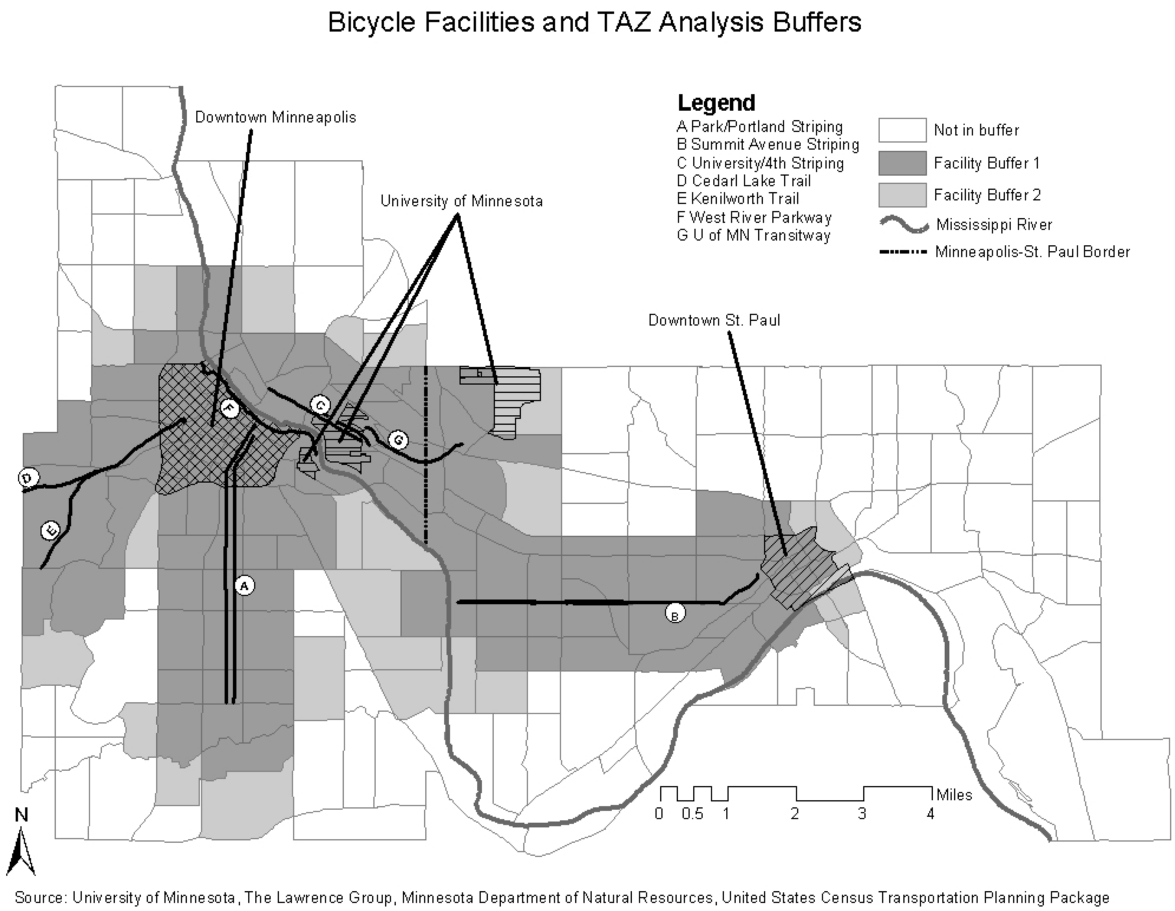

FIGURE 1 Bicycle Facilities and TAZ Analysis Buffers

ANALYSIS

Our analysis examined changes in a variety of measures of bicycle commute shares in the central cities of Minneapolis and St. Paul. We focus on residential measures, that is, the bicycle commute rate for people who live in a given area. We looked also at the mode share for people who work in a given area, but the results were so similar to the residential measures that it seemed redundant to include both, with one exception noted in the bullets below. We consider a sequence of measures that represent different ways of specifying commuting patterns, in each case comparing 1990 to 2000:

- Overall mode shares for different parts of the metro region,
- Shares for TAZs in facility buffers versus those that are not,
- Point to point shares for trips that are within facility buffers,
- Shares for the areas around individual facilities,
- Share for trips that cross the Mississippi River,
- Shares for trips terminating in downtown Minneapolis, downtown St. Paul, and the Minneapolis campus of the University of Minnesota.

Examining river crossings was prompted by the observation, noted earlier, that there were many bridge improvements including the addition of bicycle lanes to existing road bridges. We look at point to point data to determine if trips crossing the river gained a significant number of bicycle commuters as a result. The study of the three trip destinations derived from the fact that many of the major improvements were concentrated around providing access to the University of Minnesota and downtown Minneapolis, and in particular the connection between them, while there were few or no improvements of similar magnitude around downtown St. Paul.

Overall Bicycle Mode Share

Calculating the percentage of all commute trips completed by bicycle is straightforward enough. A small complication arises because the numbers that are reported in the Census Transportation Planning Package (CTPP) are scaled up based on the results of a smaller sample. Furthermore, the scaled-up counts by mode are rounded off to multiples of five; this could introduce bias since there are often very few bicyclists in a given TAZ. However, in calculating the mode share based on the reported (scaled-up) totals, and an estimate of the actual samples, there was virtually no difference in the bicycle mode share. We concluded from this that using the scaled-up numbers will not introduce any major errors.

A related issue stems from calculating the statistical significance of increases in bicycle mode share. A person is either a bicycle commuter or not; the characteristics of a sample of commuters can thus be represented as a binomial distribution. The probability that a person commutes by bike is represented by the sample mean: the number of bicyclists divided by the total number of commuters. The standard deviation of this distribution is given by Equation 1.

Standard deviation = $(N*p*(1/p))^{(1/2)}$ (1)

Where N is the total sample size,

p is the probability of the outcome of interest.

In determining the significance of changes in bicycle commute share, we calculate the number of standard deviations by which the observed number of bicycle commuters in 2000 exceeds the number that would be expected based on the sample mean in 1990. We represent this in the tables in this paper in its own column; a “2” means that the observed number exceeds the 1990 rate by at least two standard deviations, “1” exceeds by at least one standard deviation, and “0” is less than one standard deviation. Note that the sample size in this calculation is based on the actual long form sample size, not the total number of commuters as scaled up by the census bureau.

The Twin Cities metropolitan area overall had a very small increase in bicycle mode share during the 1990s. However, this increase was all concentrated in the two central cities; the suburbs actually showed a slight decline from an already low level. The increases in the central cities were relatively concentrated in the areas around facilities; while all areas showed a statistically significant increase in bicycle mode share, the areas in the facility buffers showed a larger increase (Table 1).

TABLE 1 Twin Cities Metro Area Bicycle Commute Share, 1990-2000

	1990 Bicycle Mode Share (%)	2000 Bicycle Mode Share (%)	Significance
All Metro	0.442	0.462	1
Non-central city TAZs	0.187	0.164	-2
Central city TAZs	1.153	1.386	2
TAZs in buffer 1	1.859	2.051	2
TAZs in buffer 2	1.701	2.000	2
TAZs outside buffers	0.428	0.535	2

Viewing the two cities separately, similar results emerge. Minneapolis has a much higher bicycle mode share than St. Paul, probably due to a large extent to the large University of Minnesota campus located there. All parts of both cities showed increased bicycle mode share, with the areas in facility buffers showing generally larger increases (Table 2). An interesting point is that in Minneapolis, the larger buffers showed increases where the smaller buffers did not, indicating that all the increase in the larger buffers was in the outermost TAZs that were not included in the smaller buffers. This is somewhat puzzling, especially in light of the fact that the zones that were outside the buffers entirely did not show such large increases. It does hint at the possibility that one effect of facilities is to make longer commutes more viable, while the impact may be less significant on shorter commutes.

TABLE 2 Minneapolis and St. Paul Bicycle Commute Share, 1990-2000

	1990 Bicycle Mode Share (%)	2000 Bicycle Mode Share (%)	Significance
St. Paul	0.528	0.681	2
TAZs in buffer 1	0.855	1.125	2
TAZs in buffer 2	0.828	1.090	2
Zones outside buffers	0.332	0.415	1
Minneapolis	1.596	1.876	2
TAZs in buffer 1	2.423	2.557	1
TAZs in buffer 2	2.127	2.439	2
Zones outside buffers	0.530	0.664	1

Trips in Facility Buffers

One concern with this analysis is that it may be capturing trips that originate near a facility, but go in directions other than those provided by the facilities. To control for this, we further confined the mode share calculations to trips that both began and ended within facility buffers, using the census part 3 data to consider both origins and destinations. To simplify the analysis we considered just the larger buffers. We also eliminated all trips that were less than one mile (0.62 km); since our buffers extended a mile (0.62 km) or more away from the facilities, this reduced the possibility of counting trips that could begin and end in the buffer but never get to the facility. For comparison, we considered other trips that began and ended in the central cities, but where at least one end was not in a buffer (and which were at least one mile long).

These results again show that trips within the facility buffers show a larger increase in bicycle mode share that do trips that leave the buffers; however, all trips in the central city show an increase (Table 3).

TABLE 3. Minneapolis and St. Paul Bicycle Commute Share For Commutes Longer than One Mile, 1990-2000

	1990 Bicycle Mode Share (%)	2000 Bicycle Mode Share (%)	Significance
St. Paul	0.696	1.068	2
TAZs in buffers 1 & 2	1.202	1.649	1
TAZs outside buffers	0.453	0.678	1
Minneapolis	2.337	3.267	2
TAZs in buffers 1 & 2	3.157	4.283	2
TAZs outside buffers	0.942	1.173	1

An interesting side note on this table is that in our early calculations we restricted the trips to those less than five miles long on the theory that this focuses the analysis more directly on bicycle-length trips. We arrived at the puzzling result that the facility-based trips in St. Paul showed no increase in bicycle mode share, although Table 2 had shown that the full set of trips originating near these facilities showed a significant increase. In attempting to solve this riddle, we found that a substantial fraction of the trips originating near St. Paul facilities were in fact more than five miles in length, and that these long trips were in fact responsible for almost all the increase in total bicycle commuting around these facilities. This may be due to increased commuting to the University of Minnesota campus, to which these facilities provide key links; this again indicates that a major effect of facilities may be to make long-distance commuting more viable.

Finally, we calculated the changes in bicycle mode share in the buffers around individual facilities. Here we counted trips that began in the buffer of a given facility but that ended in the buffer of any facility; this seemed appropriate since one of the important features of the facilities is their degree of interconnection. Again, almost all the facilities showed statistically significant increases in bicycle mode share; even in the three cases where small buffers showed no increase, the corresponding large buffer did (Table 4).

TABLE 4. Bicycle Commute Share in Buffer Analysis Areas, 1990-2000

Facility Buffer	1990 Bicycle Mode Share (%)	2000 Bicycle Mode Share (%)	Significance
A. Park/Portland			
Buffer 1	3.237	4.636	2
Buffer 2	3.494	4.540	2
B. Summit Avenue			
Buffer 1	0.833	1.926	2
Buffer 2	1.005	2.362	2
C. University/4th			
Buffer 1	7.030	9.320	2
Buffer 2	6.100	7.822	2
D. Cedar Lake Trail			
Buffer 1	1.698	1.270	0
Buffer 2	2.502	3.551	2
E. Kenilworth Trail			
Buffer 1	1.423	1.427	0
Buffer 2	1.727	3.039	2
F. West River Parkway			
Buffer 1	5.462	7.946	2
Buffer 1	5.480	7.175	2
G. U of MN Transitway			
Buffer 1	6.991	7.481	0
Buffer 2	6.367	7.829	2

River Crossings and Major Destinations

The Mississippi River divides the northern part of Minneapolis, skirts the downtown and the University of Minnesota, and then divides Minneapolis and St. Paul. Later it turns east and divides St. Paul from its southern suburbs and from a small portion of St. Paul that lies on the south side of the river (see Figure 1). On the east-flowing portion there were no bicycle-accessible crossings between the river bend and near downtown St. Paul, the one bridge in this stretch being an interstate highway; there were two crossings in downtown and one just outside. (A bicycle lane has since been added to the interstate bridge as part of a larger reconstruction.) On the south flowing part of the river there are a number of crossings; more closely spaced near downtown and the university, and much farther apart away from this area. There is the potential for a high level of cross-river commuting, especially since jobs and housing are both quite dense near the downtown.

During the 1990s two new bicycle bridges were built near the university, and bicycle lanes were added to two other road bridges in this area as part of their reconstruction. As a result the ease and safety of crossing the river by bicycle was greatly enhanced; the number of bridges with dedicated bicycle facilities went from two to six. This might be expected to impact the bicycle mode share for cross-river commutes. We again used CTPP part 3 data to identify the side of the river that central city commute trips began and ended. We compared the increase in bicycle mode share for trips that crossed the river to that for trips that stayed within the central cities but that did not cross (Table 5).

TABLE 5. Minneapolis and St. Paul River Crossing Bicycle Commute Share, 1990-2000

	1990 Bicycle Mode Share (%)	2000 Bicycle Mode Share (%)	Significance
Trips crossing south-flowing portion of Mississippi River	3.340	4.543	2
Trips originating and terminating west of the Mississippi River	2.264	2.607	1
Trips originating and terminating east of the Mississippi River	1.768	2.629	2

The trips that crossed the river already had a very high bicycle mode share, but this share increased substantially during the 1990s; much more than the increase for trips that remained on the same side of the river. The bridge improvements did seem to have a considerable effect on commuters' willingness to use bicycles to cross the river.

Our final analysis considers trip destinations. As noted earlier, most of the facilities provide improved access to the University of Minnesota and downtown Minneapolis. In addition to the facilities we analyze, there was a major program of striping bicycle lanes on streets in downtown Minneapolis. By contrast, there were few if any such improvements in and around downtown St. Paul. We hypothesized that as a result of this discrepancy in facility construction there should be a bigger increase in bicycle mode share for trips going to the Minneapolis destinations.

We identified sets of TAZs corresponding to each of the three destinations. Once again, we used CTPP part 3 data to identify trips that began in the central cities and that ended in one of the three destination areas (Table 6). We excluded trips that began outside the central cities because they rarely come by bicycle, and since they are becoming more prevalent over time, they tend to keep the overall bicycle mode share low; obscuring any changes that might be happening among shorter trips.

TABLE 6. Minneapolis and St. Paul Major Destination Bicycle Commute Share, 1990-2000

Trips to Major Employment/ Activity Centers	1990 Bicycle Mode Share (%)	2000 Bicycle Mode Share (%)	Significance
U of MN—Minneapolis Campus	6.604	8.528	2
Downtown Minneapolis	2.266	2.583	1
Downtown St. Paul	0.643	0.591	0

Our hypothesis was supported by this analysis. There was a large increase in bicycle mode share to the University of Minnesota campus, and a smaller but still sizable increase to downtown Minneapolis. Downtown St. Paul, by contrast, showed a very slight decrease. This is especially surprising in light of the fact that bicycle commuting by residents of St. Paul increased substantially; apparently none of this increase was aimed at downtown. This indicates that the density of facilities in Minneapolis did likely substantially impact the use of bicycles for commuting in this area.

CONCLUSIONS

While the results are not entirely unambiguous, the preponderance of evidence seems to support the hypothesis that the major bicycle facilities constructed in the Twin Cities during the 1990s did in fact significantly impact the level of bicycle commuting. The suburban parts of the region showed a decline in bicycle commuting, contrasted with a sharp increase in both central cities. Within the central cities, areas near bicycle facilities tended to show more of an increase in bicycle mode share than areas farther away, although this trend is less sharply defined. Trips that crossed the Mississippi River showed a much larger increase than trips that did not, seemingly demonstrating the impact of several major bridge improvements. Finally, trips into downtown Minneapolis and the University of Minnesota, where improvements were concentrated, showed substantial increases, while trips into downtown St. Paul, where few improvements were made, showed a slight decline.

The results also provide considerable support for the alternative hypothesis that facilities are the effect, rather than the cause, of high bicycle use. In the Twin Cities, the areas where major facilities were built already had bicycle mode shares that ranged from twice the regional average up to nearly 15 times the regional average. While the facilities did increase the bicycle mode share in their buffers by about 17.5% overall (from 1.7% to 2.0%), this is far from the factor of ten difference that is observed between the facility and non-facility areas when considering the year 2000 in isolation (2.0% compared to 0.2%). This highlights the risks inherent in trying to deduce the impact of facilities by trying to compare two different places.

There are a number of further lines of work that could add more insight to this analysis. One would be experimenting with different buffering methods. We defined our buffers somewhat arbitrarily in order to simplify the analysis. But in some cases TAZs that fall into the buffer for a facility would not necessarily be expected to use it much, because there are physical barriers to access or because there is a more direct route to the most likely destinations. We believe that this may be what is happening with some of the buffers that showed no increase in bicycle mode share. Conversely, there may be TAZs that are outside our buffer but that fall within the zone of influence, because the facility falls on the route to a major destination or because it can be easily accessed using existing facilities. For example, both the West River Parkway in downtown Minneapolis and the Kenilworth Trail seem likely to derive much of their value by providing needed links or extensions to already existing facilities.

Another improvement would be a more careful reckoning of new facilities in the area. Our accounting of new facilities in Minneapolis was perhaps more thorough than those in St. Paul due to the sources we were able to access. The large increase in bicycle mode share outside of the facility buffers in St. Paul leads us to wonder if there are important facilities that we failed to include in our analysis. A related improvement would be to extend the analysis some distance into the suburbs, again being careful to identify major possible bicycle commuting facilities. There was one of our facilities that extended into the suburbs, and understanding the impact on bicycle commuting in this area compared with similar inner suburban areas without facilities would be interesting.

In this paper we did not control for demographic variables. The areas that we are studying seemed sufficiently large that major demographic shifts would unlikely in such a short time, although they certainly could have had an impact on specific locations. Generally variables such as age and income are not as important as they are often believed to be (*9*); the differences across ages and incomes are only a small fraction as large as the differences across geographic locations. However, there would be value in confirming this point within the specific context of this analysis.

While there are many possible improvements to be made, the fact that this simple analysis seems to show a clear impact of bicycle facilities on the level of bicycle commuting is of considerable interest. Comparing bicycling levels in different places is inherently subject to the criticism that no causality is implied by any observed relationship; facilities might have been built because many people already rode bikes, rather than the facilities causing the high levels of riding. This approach provides a method for demonstrating the effect that facilities have on the level of bicycling in an area in a much less ambiguous manner.

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