

Transportation sustainability on a university campus

Transportation
sustainability

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Abstract

Purpose – This paper aims to show the present level of sustainable transportation, mainly walking and bicycling, on a large campus in the US Midwest and then analyzes some of the opportunities and impediments in increasing the modal share.

Design/methodology/approach – Three types of analysis are used. First, current level of walking and bicycling around the campus are measured during select mornings and afternoons. Second, a survey questionnaire completed by 668 students is tabulated and reported. Third, the campus and environs are inventoried to note those aspects of infrastructure which either facilitate or block walking or cycling.

Findings – This paper records generally low existing levels of sustainable transportation among students around a campus. There is a particularly low level of bicycling activity. Reasons have to do with time and convenience (especially among students who work), but also that many students do not enjoy bicycle access. Finally, student attitudes and an inventory of campus indicate that existing infrastructure discourages sustainable transportation activity around campus.

Research limitations/implications – This may be biased towards specific circumstances in the one institution we studied. However, there are several important implications on the factors spurring or impeding walking and bicycling which may be applied to other campus communities.

Practical implications – Understanding the campus impediments to walking and bicycling may help universities design more attractive and useful facilities.

Social implications – Great attention to bicycling and walking can improve the social environment on campus, as well as spur greater health among students and staff.

Originality/value – Several methods of measuring existing transportation patterns are applied, canvassing student attitudes towards sustainable transportation and then inventorying and mapping those campus features which could affect walking and bicycling activity.

Keywords Universities, Infrastructure, Bicycles, Sustainable transport, Walking, Cycling

Paper type Research paper

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Introduction

Universities have paid a great deal of attention to sustainability, yet they too often disregard issues of transportation and land use (Norton *et al.*, 2007). Most campuses have been designed as pedestrian campuses but are caught by a culture that encourages driving at every opportunity. This puts more pressure on campus officials to develop parking lots, increase the size and number of roadways, and neglect the type of infrastructure that would encourage non-motorized transportation (Toor and Havlick, 2004).



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Universities are uniquely capable of influencing travel behavior (Millard-Ball *et al.*, 2004). They shape the campus and the surrounding community (Larkham, 2000). They frequently generate most of the traffic in their communities (Delmelle and Delmelle, 2012). They often decide land use, infrastructure and facility siting which may promote walking or bicycling (Ellis, 2003; Tolley, 1996). While it is true that “college campuses are privileged places to communicate sustainability” (Balsas, 2003, p. 36), these actions are not easy because they require tearing down many attitudinal and physical barriers to sustainable transportation on campus. So, it is vital to understand the attitudes of university stakeholders and to identify the infrastructural impediments that may hamper non-motorized activity. This paper seeks to develop an empirical understanding of the current situation in a larger university campus and to uncover ways more non-motorized traffic can be encouraged within campus and between the campus and the surrounding community.

This study is conducted at Kent State University, the second largest university (after Ohio State) in Ohio with approximately 28,000 students on the main campus. It is located in the town of Kent with approximately 25,000 residents (Figure 1). This study examines what exists as the “state of play” right now in regard to Kent State’s non-motorized transportation. This analysis consists of three parts:

- (1) the real-time observation of bicycling and walking activity in key points around the campus;
- (2) the behavior and attitudes of students in regard to walking or bicycling; and
- (3) finally an examination of the infrastructure which can facilitate or impede non-motorized transportation.

The value of this study lies in linking observed behavior, attitudes and the built environment. While this study also looked at behavior and attitudes towards buses, in the interests of space, this aspect is not explicitly examined here. These observations

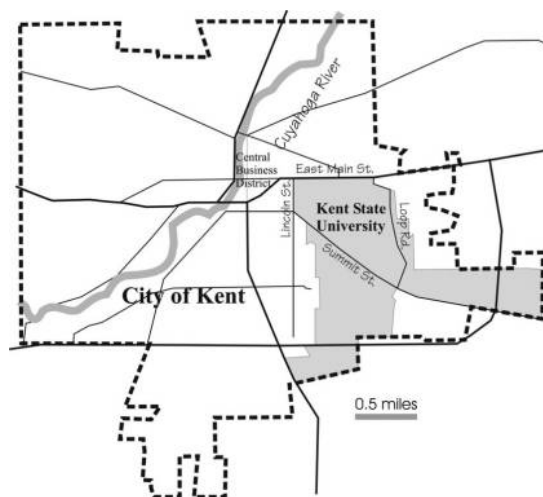


Figure 1.
Kent State University
and Kent, Ohio

provide some concrete suggestions of how to better improve the practice of sustainable transportation on this campus and on other university campuses by extension.

Measuring non-motorized traffic

In 2008, the exact volume of walking and bicycling traffic was measured over the course of two semesters, both spring and fall. The measurements took place later in the semesters, when traffic patterns had been established, and avoided Fridays and bad weather days when it was rainy, snowy or below freezing. Essentially the study followed customary practice when making pedestrian counts (see [Cottrell and Pal, 2003](#)) of physically counting the numbers with a hand clicker. While tedious, this method allowed for ancillary observations about the type of pedestrian and biker, the weather conditions, traffic and the state of roads, sidewalks and crosswalks. One issue concerned the separation of commuting from recreation. Clear notes were taken for joggers and others who would appear to be simply exercising (this was not possible in regard to bicycle traffic). In addition, intersections were counted so as to avoid counting people walking to and from their parked automobiles. The objective was to get as accurate a picture as possible. Unfortunately, there was no way to distinguish students from other university personnel in this exercise. [Figures 2 and 3](#) show the generalized counts for both AM and PM traffic.

[Figure 2](#) demonstrates that bicycle activity is a minuscule part of campus commuting. Only 40 bicycles were observed during the 18 hours of counting. It should be noted that, except for one day, all of these counts were conducted in reasonable but not ideal biking weather where there was no snow and the temperatures were above freezing. Bicycle traffic ranged from a low of zero bicycles observed (for seven of the counting sessions) to a high of eight and six bicycles observed for two periods at the same intersection. Most bicycles come from the south with negligible amounts of

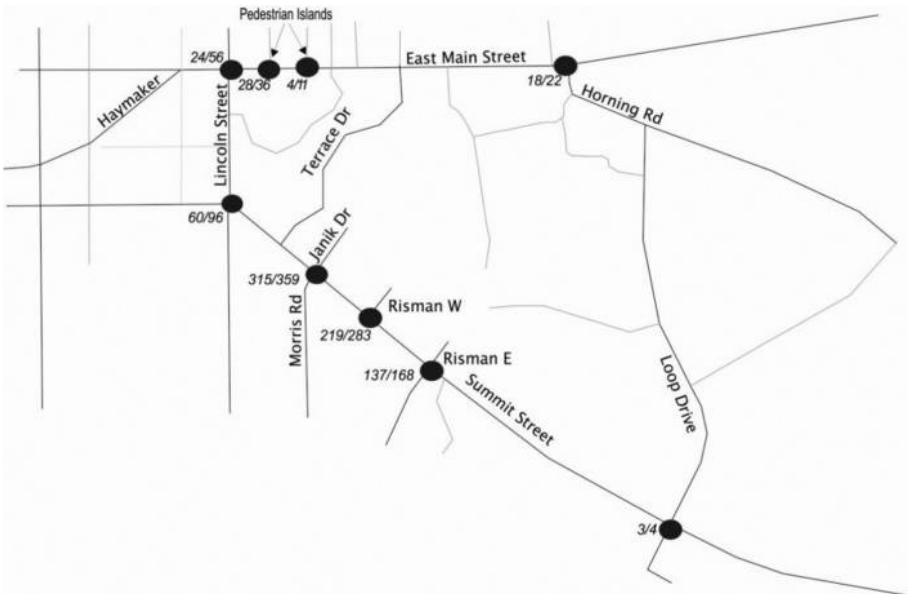


Figure 2.
Pedestrian
intersection counts

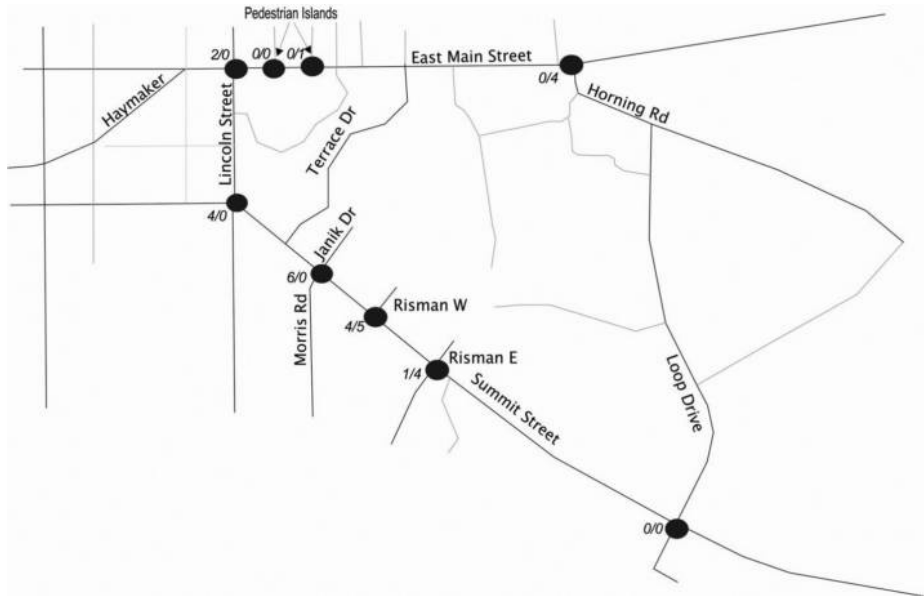


Figure 3.
Bicycling
intersection counts

bicycle traffic observed coming from the north or the east. This could reflect safety concerns about these particular parts of campus.

As seen in Figure 3, pedestrian activity was far more robust. Overall, 1,853 pedestrians were counted over the 18 hours, with an average of 103 per hour or nearly two per minute. The variations between places were high, ranging from 3 or 4 walkers in an hour to well over 300 per hour at one intersection. The volume of walkers varied significantly between intersections but not so much by time of day at the same intersections. Intersections with heavy traffic in the morning also demonstrated heavy traffic in the afternoon. Very few recreational joggers were observed.

At two intersections, at the corners of Summit Street and Risman East and Risman West, a great deal of the foot traffic was likely made up of people crossing over from commuter lots. Elsewhere, parking lots did not seem to have such a heavy influence. The intersection with the heaviest pedestrian activity, on the corner of Summit and Morris, is likely impacted by the proximity of a major apartment complex. Many students in this complex choose to walk to the university and save on parking permits. Other research activities also suggest the importance of nearby residences as a way to promote non-motorized traffic. Likewise, the corner of Lincoln and Summit exhibited more pedestrian traffic, mostly between classes. The map demonstrates very low levels of pedestrian activity at the intersection of Loop and Summit. This intersection is close to some apartments and to other places where some traffic might be expected. Yet, while automobile traffic in this area is robust, pedestrian traffic is rare and bicycle traffic is non-existent. The day that the counts were taken was a mild one, but the field notes show that the intersection is on a busy road that could discourage anything but car travel. There were twice as many cars witnessed leaving the apartments, almost always with a single occupant. Also observed were poor sidewalks and a lack of good crosswalks.

Further north, on the corner of East Main (SR 59) and Horning, there is more pedestrian traffic, but it is still quite low given the proximity of this intersection to apartment complexes, university buildings and restaurants. The field notes indicate that most people crossing Horning probably come from the apartment complexes and restaurants down the street. The quality of the sidewalk at this point is quite poor, and tends to be blocked by snow during the wintertime.

Across East Main Street and north of the campus are a number of nice residences, some apartments and several fast food restaurants, a bar and a coffee shop. This would seem to be a prime area for pedestrian activity. But East Main is a difficult street to cross. It has five lanes and the auto traffic is faster than the posted speed limit of 35 miles per hour (already quite fast for an urban street). A few years ago, three pedestrian islands were built in the central lane. These have made it easier for people to cross. This is important since the field notes indicate that “traffic does not stop for pedestrians”. This leads many walkers to cross in the middle of the street, between crosswalks. Most do not cross at all and decide to drive instead. There is more foot traffic at the intersection of Lincoln and East Main, especially in the early afternoon. Still it is lower than what might be expected. One aspect to note: the weather during this day was cold, snowy and windy, which could dampen traffic. The higher counts at Lincoln and Summit took place during better weather.

Student transportation behaviors

This project sought to understand student behavior and attitudes towards sustainable transportation. When school is in session, the city of Kent roughly doubles in size and the university operates as the largest generator of traffic. This traffic can be divided between traffic that would be there regardless of the university; traffic generated by faculty and staff which tends to follow more regular workplace rhythms; traffic generated by students who are commuting between school, work and home and internal traffic of students moving from class to class or to eat, shop and recreate.

Students are by far the largest population group at Kent State. Previous research demonstrated that each additional student enrolled increases daily traffic along the key corridor of Summit Street by 0.4 automobiles (Kaplan, 2004). A Web-based survey with a total of 668 student respondents was conducted in April 2008, broken down pretty evenly by class although graduate students are underrepresented. The survey questions were pilot tested on a number of students ahead of time in order to make sure that the questions were clear. There was no possibility in the survey for students to be double counted since each student has a unique academic e-mail. The division by age is also sound, and while women are overrepresented in the survey – covering two-thirds of respondents – they are also about 60 per cent of the Kent State University student body. This was followed up by a focus group consisting of 12 students in total. The participants were able to provide some additional depth to the survey questions themselves.

Kent State University is primarily a residential university, but one that draws most of its students from within a 100-mile radius. A large number (some 45 per cent) of surveyed students live in residence halls. A smaller proportion, about one of seven, live with their parents in Kent or a nearby town. Of the rest, most live in apartments in Kent. A little over one-third of students live outside of Kent, either by themselves or with their parents. Of these, none live within 5 miles and about two-thirds live between 6 and 15

miles of the university. This latter group would not be expected to walk or bicycle to campus.

Students were asked which modes they used at various times, and which mode was their primary form of transportation (see Table I). Other surveys have asked students to indicate their chosen transportation mode on the last day they went to school (Páez and Whalen, 2010) or the number of times a given mode was chosen throughout the year (Delmelle and Delmelle, 2012). In this survey, students were allowed to state their modal choice in a more general way. Single occupancy automobiles are clearly the main mode of transportation, used primarily by nearly 60 per cent of all students. This is followed by walkers, students taking the bus, students who car pool and bikers. At the same, many more students report taking the bus occasionally and nearly half of all students walk at times.

Eighty six per cent of students reported having some access to vehicles and so are not reliant on other forms of transportation. Among these students, most own some form of parking permit. Only 14 per cent of the surveyed students with cars had no parking permits. This information demonstrates the difficulties involved with promoting non-motorized transportation. While student may complain about parking on campus, most can park somewhere and so do not have to bicycle or walk. Sustainable transportation is a matter of choice for them.

The choice of mode depends on where students live. A simple distinction was made between those living on campus, those living in town (all within about 3 miles) and those living out of town (more than 5 miles away). Students who live on campus were included because many live fairly far from their classrooms, upwards of a mile. So walking may not always be the most feasible option. A few key observations can be made based on the survey results. First, walking is the most popular mode among students who live in the residence halls. Except for commuters, all freshmen live in residence halls, and many residence halls are located fairly close to classrooms. Students in residence halls are also more willing to take the bus. Yet, based on follow-up survey questions and focus groups, this behavior only persists for travel to classes. Whenever they go off campus, students in residence halls prefer to drive. Focus group attendees indicated that while the campus itself is perceived as a good place for walking, they do not think that off-campus access is easy because of the sidewalk conditions and the lack of crosswalks. Therefore, even students living in residence halls drive whenever they go off campus.

Location	Bus (%)	SOV (%)	Passenger (%)	Walk (%)	Bike (%)	Total responses
<i>Main mode</i>						
Residence hall	10	37	10	42	1	293
Kent	11	54	7	23	4	166
Outside Kent	4	90	3	4	0	199
Total	9	57	7	26	2	658
<i>Mode</i>						
Residence hall	52	49	23	67	6	293
Kent	34	69	30	52	13	166
Outside Kent	19	95	10	17	1	199
Total	37	68	20	48	6	658

Table I.
Mode of
transportation to
classes

Second, for students who live out of town, driving is the norm. Solo driving accounts for about 90 per cent of all student traffic among this group. In many cases, it is fairly necessary because the bus service does not cover most of the places where students live. For students who live off campus in Kent, the survey findings showed that half of them walk sometimes and nearly one-third take the bus.

Third, reported bicycle usage is extremely low across the board. Very few Kent State University students use bicycles even occasionally. Students who live off campus in Kent are the most likely to use bicycles sometimes (13 per cent), but less than 4 per cent of local students list bicycles as the main mode of transportation. Of all students who lived out of town, only one respondent, who lived in the adjoining town of Stow, reported bicycling into school.

Fourth, there was an interesting difference by gender. Women are more likely to walk, whereas men are twice as likely to bicycle sometimes (and three times as likely to bicycle as a main mode of transportation). Much of this could be because far fewer women than men have access to bicycles. Overall, the survey showed that one-half of all men own a working bicycle, but just one-third of all women. Gender differences go beyond ownership. [Delmelle and Delmelle \(2012\)](#) found that women were less receptive to bicycling around the University of Idaho, although they reported similar levels of bicycle ownership. [Akar et al. \(2013\)](#) demonstrated that women at Ohio State University are less likely to feel safe on a bicycle.

Student transportation attitudes

There are many reasons accounting for the use or avoidance of non-motorized transportation. [Table II](#) asks those students who live within a mile why they do not walk to school. Inclement or cold weather is cited as the most significant factor, and indeed [Aultman-Hall et al. \(2012\)](#) estimated that weather conditions account for about 30 per cent of pedestrian volumes. There is also a perception that walking requires more time. Since it takes less than 20 minutes to walk a mile, this may or may not be true, depending on how long it takes to park a car and walk from there. Inconvenience can cover the fact that many students work, and several have children, and so walking is not seen to be a practical option. “Physical limitations” is self-explanatory and many of the “other” responses come from students who live beyond a mile or who do indeed walk. Most interesting is the number of students who cite infrastructural factors that make walking unpleasant. About one of six mention the absence of sidewalks and/or streets that are too busy for comfortable walking.

Turning now to bicycle usage, the survey asked about conditions or attitudes that might prevent students at a middle distance (3-5 miles) from biking to school. [Handy and Xing \(2011\)](#) mention a number of factors which can impede bicycle usage, among these

Gender	Weather (%)	Time (%)	Walking impediments			Other (%)	Total
			Lack of walkways (%)	Physical limits (%)	Inconvenience (%)		
Female	54	43	18	5	24	14	462
Male	45	44	16	3	32	16	206
Total	51	43	17	4	27	15	668

Table II. If you are within a mile or so of campus, what prevents you from walking to school?

the quality of the physical environment. They also focus on the intangible quality of a bike culture which can lead to changing attitudes towards biking.

As seen in Table III, of all the things that prevent students from biking, weather emerged as the key factor (see also Akar *et al.*, 2012). It remains an article of faith among many students that Northern Ohio's colder climate makes bicycling more difficult. This contradicts the fact that many more wintry cities such as Boulder, Colorado, and Madison, Wisconsin, enjoy a vigorous biking culture (Toor and Havlick, 2004; Balsas, 2003). Many students also cited not having enough time, similar to Shannon *et al.* (2006), who found that perceived longer travel times were the most significant obstacle to active commuting. This was particularly true of residence hall students and students who lived in Kent. Inconvenience, likely for many of the same concerns as with walking, occupied an important place. As with walking, physical limitations also played a role among some students.

In regard to how the physical environment seemed to impede biking, one of five students brought up a lack of good bikeways and streets that are too busy for biking. One out of six students mentioned safety concerns, which could be taken to mean fear of getting into an accident on a busy street without bicycle lanes. Alternatively, it could refer to personal safety (the lack of a significant male/female difference in this response could point to the former explanation). Whannell *et al.*'s (2012) recent study demonstrates that route safety comes just after distance as a concern of college aged students. Bicyclists encounter a lot of difficulty in trying to navigate regular city streets. Many of these are simply not set up to include bike traffic on the side of the road. As part of this concern, students mentioned the attitudes of motorists, who may question whether bicyclists belong on the street at all.

The open-ended responses which fit within the "other" category are also quite revealing. Mostly women cited the fact that they did not own a bike, a point mentioned above. Beyond this, a few mentioned general laziness or having too much to carry. Others complained about not being able to dress nicely and bicycle, or about looking "dorky". These are all valid concerns that are difficult to change.

Of course, one large concern that affects a great many students is the need to balance their campus life with their working life. In fact, 422 members of the sample worked at least some of the time (159 worked more than 20 hours a week) and the overwhelming

Gender	Time (%)	Safety concerns (%)	Physical limits (%)	Busy streets (%)	Inconvenience (%)	No parking (%)	Other (%)	Weather (%)	Total (%)
Female	28	20	6	19	19	13	28	39	462
Male	33	18	5	24	24	16	20	41	206
Total	30	19	6	21	21	14	25	40	668

In Good Weather

Table III.
If you are within 3-5 miles of campus, what prevents you from biking to school?

	Time (%)	Safety concerns (%)	Physical limits (%)	Busy streets (%)	Inconvenience (%)	No parking (%)	Other (%)	Total
Female	27	17	6	19	21	14	30	462
Male	34	17	3	23	30	15	22	206
Total	30	17	6	21	24	14	28	668

majority worked more than 5 miles away. Table IV shows a fairly monotonic relationship between working and using single-occupancy vehicles (SOVs). The more the students work, the more likely they are to just use a car for transportation.

Table V reports on an open-ended question which asked students to comment on what the city and university could do to facilitate walking and biking. Infrastructure topped the list: sidewalks, bike paths, street lights and crosswalks. Several people also pointed out the problems of snow removal, especially because bikers often feel they have to travel on sidewalks for safety. The issue of storage was also raised. While there are many bike racks, sometimes they are not available where students want them to be. For some students, they are worried about their expensive bikes being stolen. Improving bike facilities could mean better storage, but students also mentioned bike maintenance facilities and a place to get bikes at little or no cost. Some campuses have initiated these types of programs with success (see Walton, 2011 for a recent comparison of seven large universities).

The infrastructure of sustainable transportation

Previous research on pedestrian and bicycling activity has highlighted the importance of the built environment (see Pucher *et al.*, 2010; Peers, 1998) and it can be a useful exercise to witness how often facilities or infrastructure falls short in providing easy paths to walking and biking. Most transportation modal decisions are made by choice.

Do you have a job?	Mode					Responses
	Bus (%)	SOV (%)	Passenger (%)	Walk (%)	Bike (%)	
No	41	58	24	56	5	245
Part time under 10 hours a week	53	65	19	59	5	80
Part time 10-20 hours a week	39	67	17	49	7	183
More than 20 hours a week	22	85	18	31	7	159
Total	37	68	20	48	6	667
	Main Mode					
No	9	46	12	32	1	245
Part time under 10 hours a week	11	51	6	31	0	80
Part time 10-20 hours a week	8	59	3	29	1	183
More than 20 hours a week	7	76	3	10	4	159
Total	9	57	7	26	1	667

Table IV.
Employment by commuter status

Possible improvements	No. of mentions
More/better sidewalks	102
More bike paths/lanes	74
Better snow/ice removal	49
Street lights and crossing	42
Improve bike facilities	40
Beautify campus/city	16
Incentives	12

Table V.
What can Kent and Kent State do to make it attractive for students to walk or bicycle to campus?

If they are difficult for whatever reason, people choose to take the easier or more comfortable mode, which more often than not is to take an automobile. Some of these factors cannot be easily controlled, such as the weather, but other factors are based on how transportation resources are provided. To that end, the facilities and infrastructure responsible for sustainable transportation were inventoried. Certain elements that may improve or detract from the comfort level for walkers and bikers alike were examined (Moudon *et al.*, 1997; Sarkar *et al.*, 1997). Facilities refer to bike racks and bus stops whereas infrastructure refers to sidewalks, bicycle paths, crosswalks, median islands and bus routes. This inventory was conducted within the boundaries of Kent State's main campus at Kent, the parts of Kent adjacent to campus and an area of land stretching from the west of campus to the downtown and bounded by the Cuyahoga River. Much of the transportation information was gathered over several months through field observation.

While there is not enough space to go into all of the details, a few examples shown in Figure 4 may give the reader a sense of the challenges present. One of the largest problems in regard to both walking and bicycling is the presence or lack of bicycle lanes, sidewalks and adequate crossings. In this regard, the eastern boundary of Kent State displays some of the more significant impediments to sustainable transportation. Loop Road divides the campus from the community and just to the east there are several large apartment complexes where many students reside. There is a sidewalk along only one side but with several interruptions. There is no pedestrian access from the nearby Holly Park complex. A bicycle lane does exist, but this is interrupted near the southern corner of Summit Street and does not extend around completely. One of the biggest issues is the lack of crosswalks. Because these are so far between, the pedestrian must make considerable detours to cross safely. The northern boundary of campus (East Main Street) is a five-lane state highway and is a little better. The portion of East Main Street within Kent City limits does include sidewalks, but these are narrow, directly adjacent to fast moving traffic, and are not well shoveled in the wintertime. There are often huge snow piles from businesses shoveling out their parking lots and driveways. Beyond Kent, in the neighboring unincorporated community of Franklin Township, there are no sidewalks at all. Bicycling of any sort is dangerous here.

Conclusions and recommendations

The research presented here indicates that levels of sustainable, "active" commuting remain fairly low for students in this medium-large Midwestern university. This is borne out by measurements of pedestrian and bicycling activity during the spring and fall semesters. Based on a survey questionnaire, only those students who live on campus walk as a principal mode of transportation to classes and even in this case there are more students who use private vehicles. For students living off campus, automobiles are by far the principal choice of transportation. Buses are used by many students but bicycling is still fairly rare as a means of commuting.

The reasons behind the decision not to walk or bicycle are not complex. Students find that pressures of time, discomfort of weather conditions and the inconvenience of not having a car for further errands inhibit active commuting. Many students also mention the problem of busy streets, safety concerns and a lack of places to park their bikes. Many of the complaints could be met with improvements in the sustainability infrastructure – especially walking and biking paths. Better snow removal and lighting

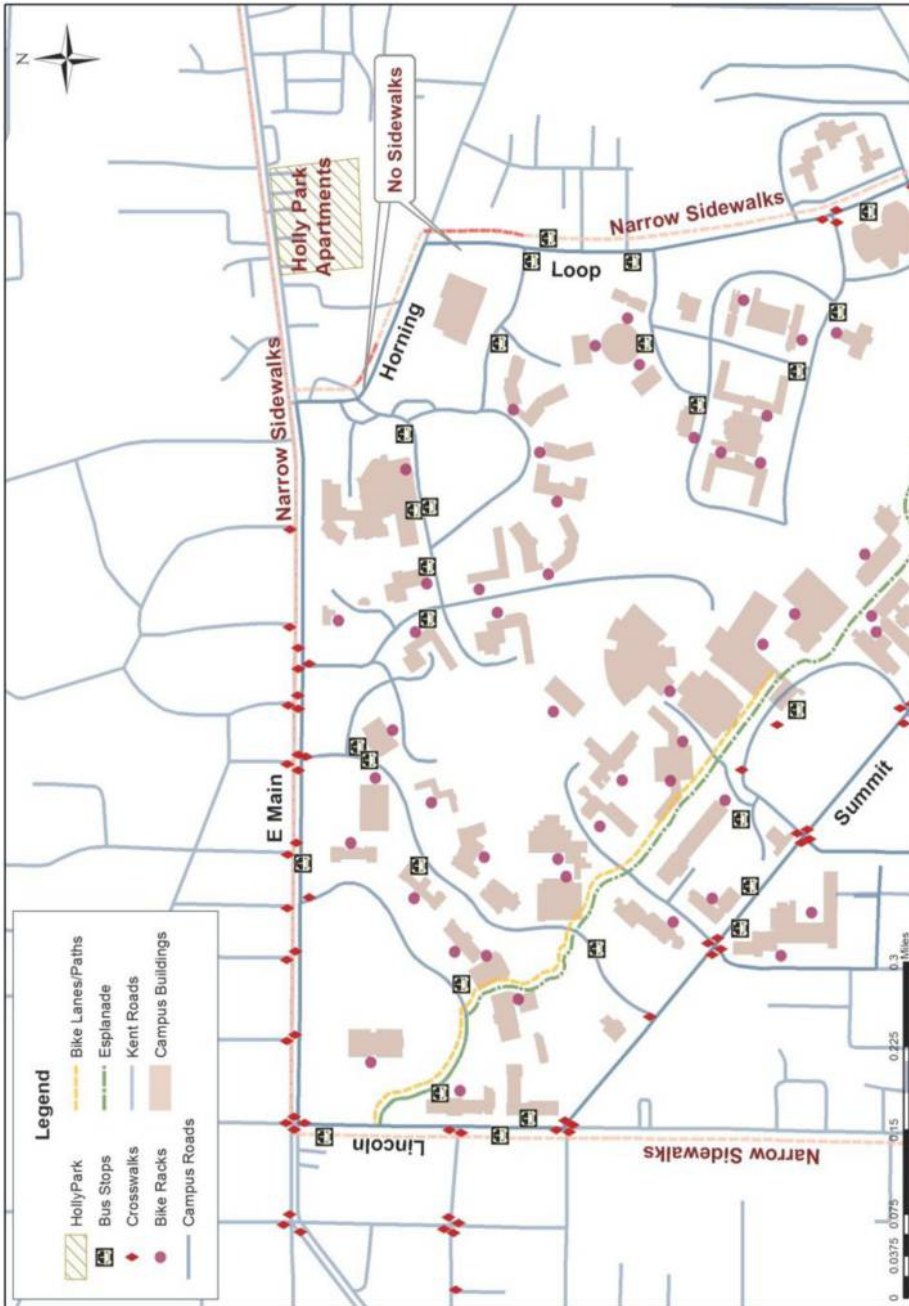


Figure 4. Impediments to non-vehicular transportation

would improve the pedestrian and bicycling experience, as could the provision of facilities, notably, bike racks.

An inventory of Kent State's infrastructure affirms the student complaints. Most of the facilities and infrastructure promote walking and bicycling within the core campus area itself, but do not link well to the outside. There are many areas where bicycling or walking is uncomfortable and potentially dangerous. Perimeter roadways are more often than not unfriendly to bicycles. There are generally sidewalks available, but with a number of blocked access points between where students live and campus buildings. Moreover, crossings are not easily available, forcing the student to make a significant detour or jaywalk. Incidentally, there have been a number of collisions between pedestrians and vehicles in the past few years. The infrastructure for bicycling needs a lot of improvement as well. A more thorough bicycle network is being developed, but it is still incomplete and cannot cover the places where commuting bikers would need to go. More secure, covered bike shelters have also been proposed, although these are fairly expensive.

Shifting from automobile usage to active commuting can occur through either making driving more difficult or by making biking and walking easier. This paper has focused primarily on the latter issue, but is cognizant of factors like parking fees that might affect student behavior (Handy and Xing, 2011). While this was not addressed here, students indicated in the survey that increases in parking fees could spur many of them to change their transportation mode. Like other universities, Kent State does limit the amount of parking available for undergraduate students, especially underclassmen. More parking limits and higher expenses could be imposed, but that is not being considered at this point.

Conversely, there have been some efforts at infrastructure improvements and these fit in well with two broad recommendations. First, more linkages between the campus and the surrounding apartment buildings and commercial areas would help make bicycling and walking more pleasant. One major improvement had to do with the reconstruction of the sidewalk on the southern side of East Main Street. It is now wider and further from the flow of traffic. Bicycling traffic can also use this walk as well. Another change was the aforementioned construction of the three pedestrian islands in the center lane of East Main Street. This has made crossing this street much easier. The construction of the Esplanade, a walking and bicycling trail which runs roughly east and west across campus, has helped to connect the campus and it was just recently extended straight into the city of Kent's downtown.

Second, more bicycling facilities, especially bike racks, bike maintenance facilities and a bike share program, could be helpful. There have been some new bike racks installed but not enough to meet increasing demand. Promoting a greater culture of bicycling by increasing access to bicycles could increase its modal share. To that end, the university has offered a pilot bike sharing system for two years and is embarking on a possible "third generation" bicycling system, which would allow students to check out bikes at one site and return them to another.

Major changes in traffic patterns can be made with only small changes in the proportion of students who walk or bicycle. There exists potential to shift at least some of the commuting population towards walking and bicycling by providing better infrastructure and facilities. Those students who live in Kent but outside of Kent State University could be a more practical population to convert to sustainable transportation

than students from out of town. There would also seem to be some potential in increasing the number of women who feel comfortable riding a bicycle as a means to enhancing their mobility. By making a few simple adjustments, many universities can significantly increase their population of active commuters.

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