Bicycle Cordon Count Pilot Study

Performed for the Kentucky Transportation Cabinet
Division of Multimodal Programs

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By
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Final Report

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1.0 INTRODUCTION

The Kentucky State Bicycle Coordinator is tasked with a difficult problem: planning for and supporting the needs of Kentucky cyclists. Unfortunately, very little quantitative information on the number of cyclists or their travel patterns has been collected in Kentucky. There is a pressing need to develop an efficient and low cost means to collect broad and useful data to support the bicycle program in Kentucky. Although some other jurisdictions include bicycles as vehicles in their traffic counting programs, Kentucky does not. Several complications make counting bicycles difficult: they cannot easily be detected by automatic counting devices, they travel in different locations, make unpredictable shortcuts and are simply a very uncommon vehicle in most of Kentucky. The objective of this project was to develop and test a bicycle count methodology that could be used in the locations in Kentucky where bicycle traffic is significant. This test of the count procedure should provide KYTC with information to consider the inclusion of bicycles as one element in the traffic counting programs. For planning purposes, more than just counts are desirable for bicycles. An understanding of the number, age, gender, travel infrastructure preferences (road vs path vs sidewalk), and origin/destination patterns for cyclists is needed to better plan for bicycling as a mode of transportation as well as to consider safety issues.

This report outlines the methodology and pilot test of such a bicycle count and data collection procedure. The assumed largest regular bicycle trip generator in Kentucky, the University of Kentucky Lexington campus was the location of the pilot study. Student counters were stationed around the perimeter of campus forming a complete cordon in shifts from 7 AM to 7 PM on Tuesday September 22, 1998. Counters recorded the following data: time of observation, gender, approximate age, helmet usage, location of bicycle (road versus sidewalk), travel direction (inbound versus outbound), and travel direction (with or against traffic). Despite the non-ideal weather conditions for biking (cool, overcast with some drizzle) a total of 3628 bicycle trips were counted. A total of 79% of the cyclists were male and only 11% were wearing helmets. Only 14% of the cyclists traveling on the road were traveling against traffic (the wrong way), while 44% of those on the sidewalk were. Certain points around the campus handled the bulk of the bicycle traffic which suggests possible locations or routes for specific bicycle infrastructure improvements. Several dangerous bicycle travel patterns were noted suggesting the need for safety education.

This next section of this report describes the count methodology and execution of the survey. The subsequent section provides comprehensive quantitative results, while the following section describes results which are of local value relating to bicycle transportation planning at the University of Kentucky. Finally, conclusions and recommendations are presented.

2.0 BICYCLE CORDON COUNT PROCEDURE

Discussions with the Kentucky Bikeway and Bicycle Commission, the State Bicycle Coordinator and the research team at the University of Kentucky, resulted in the decision that human counters could best record the information required (times, cyclist characteristics and travel patterns) on a one page survey form with one line per cyclist. Other methods such as automatic counters for bicycle paths or video recording were considered in conjunction with KYTC during proposal development but were considered ineffective given the nature of bicycle travel. A portion of the survey page used by the human counters is shown in Figure 1. The information recorded and the categories used were drafted and sent to members of the community, cycling groups and local planners for input. The form was designed for ease of use by the field counters. Only one data item required the counter to write, all other data was collected via the student circling the appropriate response. Only where bicycle volumes exceeded 60 bicycles per hour did the student workers have trouble keeping up with data collection.

Figure 1: Survey Form Page

University of Kentucky   **Name of Surveyor**_______________   **Location**__________________________

Bicycle Cordon Count Pilot Study

AM   **PM**   **Date**____________   **Road conditions**______________________

Time	Direction	Gender	Age	Helmet	Traffic	Location	Comments
	In Out	M F	0-10 11-17 18-30 31+	Y N	with traffic wrongway	S R	
	In Out	M F	0-10 11-17 18-30 31+	Y N	with traffic wrongway	S R	
	In Out	M F	0-10 11-17 18-30 31+	Y N	with traffic wrongway	S R	
	In Out	M F	0-10 11-17 18-30 31+	Y N	with traffic wrongway	S R	
	In Out	M F	0-10 11-17 18-30 31+	Y N	with traffic wrongway	S R	
	In Out	M F	0-10 11-17 18-30 31+	Y N	with traffic wrongway	S R	
	In Out	M F	0-10 11-17 18-30 31+	Y N	with traffic wrongway	S R	

Creating the cordon around the University campus such that all bicycles entering or leaving campus would be counted proved difficult. The final cordon is shown in Figures 2 and 3. Site inspection indicated that bicycles could only enter or leave campus by crossing the solid lines in Figure 3. Therefore, a student counter was placed at each location. Locations 1, 2, 4, 7, 8, 14, 15, and 16 required students to watch more than one entry/exit point at a time. In some cases students watched a whole continuous section, such as a field, for bicycles entering across it. In locations with multiple entry locations the students recorded the location of the bicycle in the comments section of the survey form.

The cordon did not include the Lexington Community College which is also a major bicycle destination. Most of the university student residences were within the cordon and therefore the counts presented in this report do not include the number of bicycle trips between residences and classroom buildings. University transportation and parking managers consider these volumes significant although no magnitude is known. The cordon line along Nicholasville Road / Limestone Avenue was considered to be the inside edge of the sidewalk along the east side of the road. In this way cyclists passing a student counter while traveling along Nicholasville Road or its sidewalks were not counted. They were only counted at the point where they entered the cordon (ie crossed the line) and entered campus. In this way, double counting was minimized and only bicycle trips destined for the University were counted.

There were several bicycle trips (139) where the cyclists crossed in and out of the cordon at one count location (such as location 2 on Figure 3 for example). These observations were removed from the bicycle trip count totals. There was also the possibility that cyclists crossing the cordon were not going to or coming from the university but rather traveling across the campus to and from other origins or destinations. Given the nature of bicycling in Lexington, the magnitude of this possible over counting is assumed negligible.

The count locations were observed from 7AM through 7PM in primarily two shifts. Several extra counters and the State Bicycle Coordinator provided relief for breaks and students who could not complete a whole 6 hour shift. The logistics of coordinating the counters was significant. If similar bicycle cordon counts were to be conducted at other locations a maximum of 8 count stations would be desirable. The reason for these logistic problems at this location was primarily the permeability (multiple nearly unlimited access points) along the Nicholasville Road boundary of Campus. This area simply required a significant number of workers. This would not be the case at other typical bicycle destinations such as hospitals, large campus type work places, smaller university campuses, recreation centers or parks.

Figure 2: Study Area in Lexington, KY

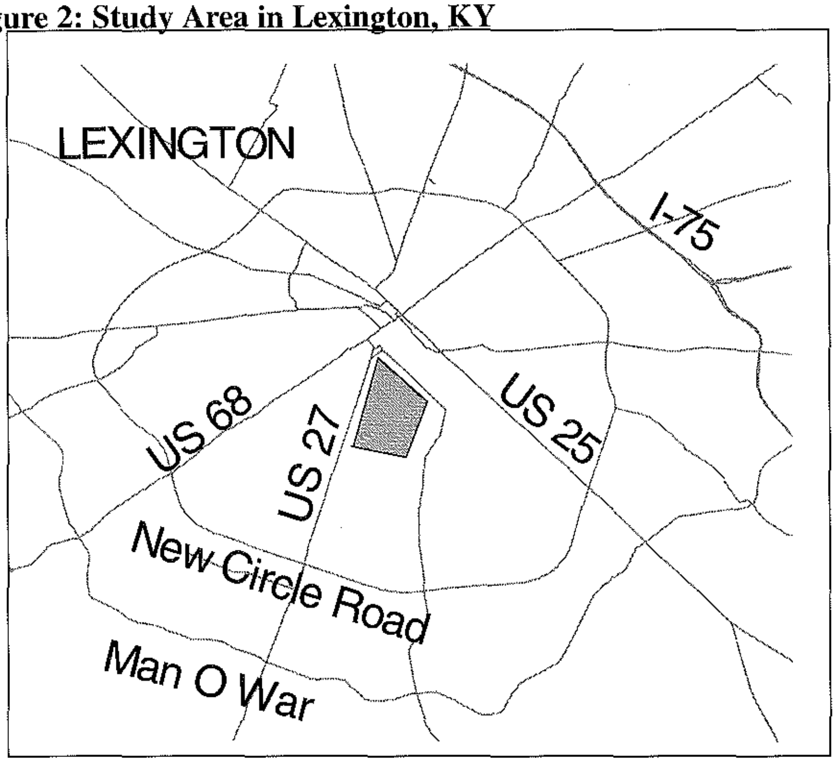
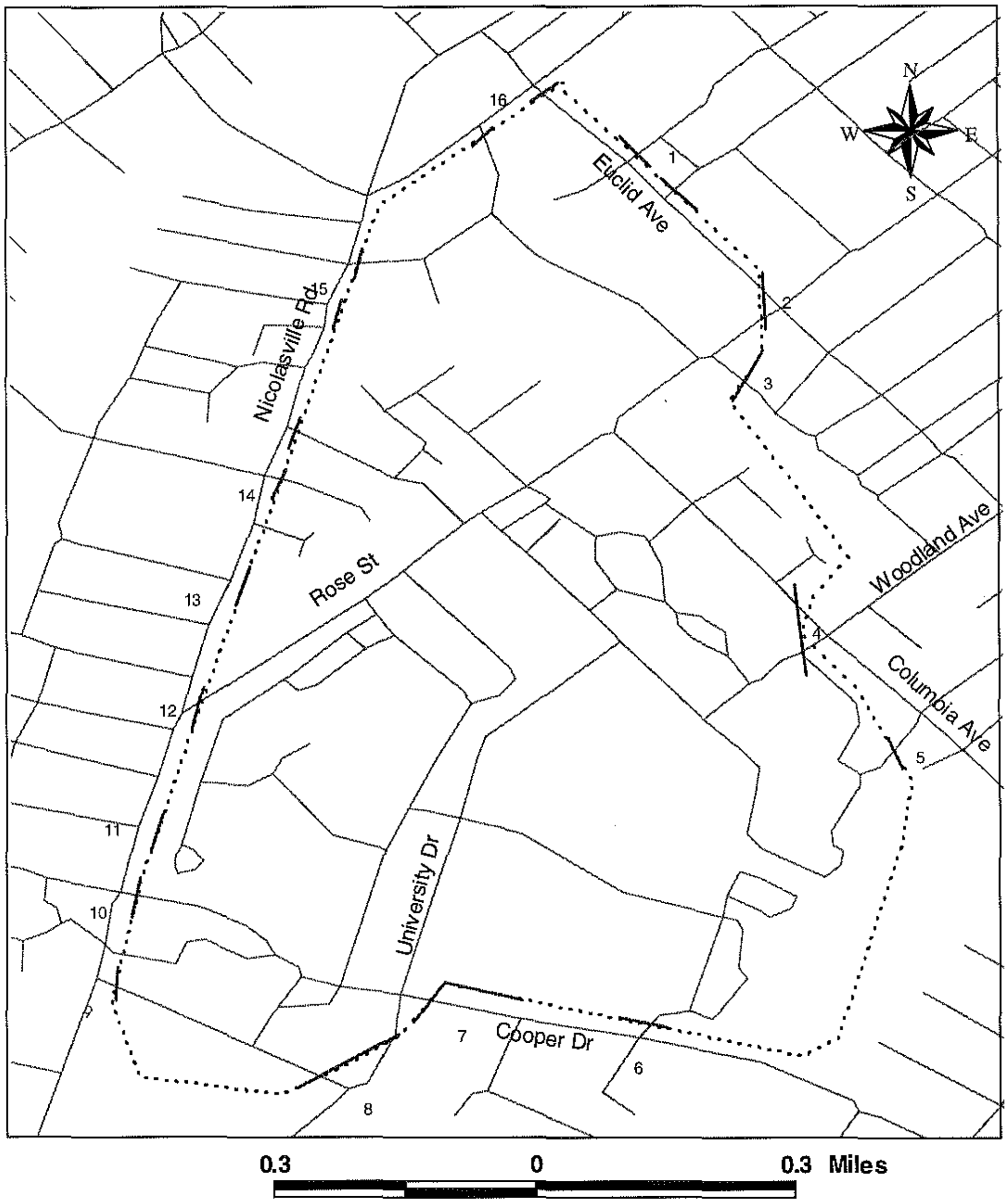


Figure 3: University of Kentucky Bicycle Cordon



Count Screenline
Count Cordon

3.0 PILOT TEST RESULTS

3.1 Volume Results

A total of 3628 bicycle trips crossed the cordon line between 7AM and 7PM. A total of 1950 (54% of these trips were inbound while 1678 (46%) were outbound. The bicycle trips had an interesting distribution over time and space. Figure 4 illustrates the 5 minute bicycle volumes over the 12 hour count period. A dramatic peaking pattern was found particularly for the morning hours. These peaks correspond to the time just before classes start. The bicycle count location with the highest number of trips (#4) at the intersection of Columbia Avenue and Woodland Avenue shows a similar peaking pattern (Figure 5). At that location during the peak hour an average of 2.5 bicycles per minute were counted.

The peak bicycle volumes may have safety implications. More bicycles than hourly averages might suggest are concentrated during peak times increasing the potential for conflict. Furthermore, these times are also peak pedestrian times making enforcing rules concerning sidewalk cycling more critical. These peak volumes also have implications for planning where pedestrians and bicyclists share facilities (or facilities that intersect). Peak bicycle volumes also have an effect on traffic signal capacity. These peaking patterns are surely to be found at other Kentucky educational institutions where bicycle transportation is a common mode.

Bicycle counts also varied significantly over space. Table 1 indicates the total and peak counts for the 16 locations shown in Figure 3. The entrance points to the north east and at a main entrance on Limestone have the greatest bicycle volume. These locations of high bicycle counts suggest corridors for future off-campus bicycle facilities. Bicycle lanes or bicycle routes leading away from campus in the north east direction should be considered. Other cities have found one-way streets with contra-flow bicycle lanes a successful means to make accommodation for bicycles where limited right of way is an issue such as along Rose Lane. This and other approaches could be considered in these highly traveled corridors. Finally, the magnitude of these counts confirm that bicycle transportation does make a contribution to traffic and parking management at UK.

Figure 4: Time Series of 5 minute Bicycle Counts (All Locations)

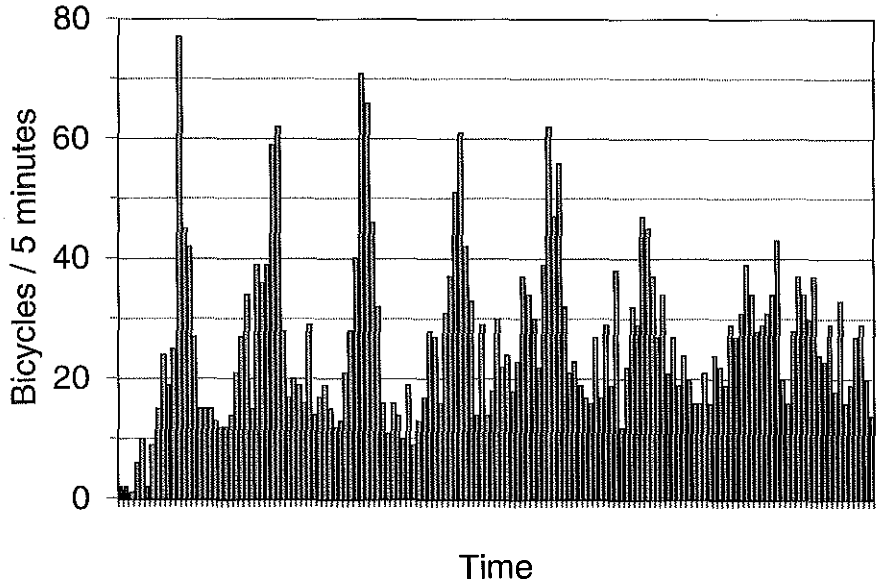


Figure 5: Times Series of 5 Minute Bicycle Counts (Woodland and Columbia)

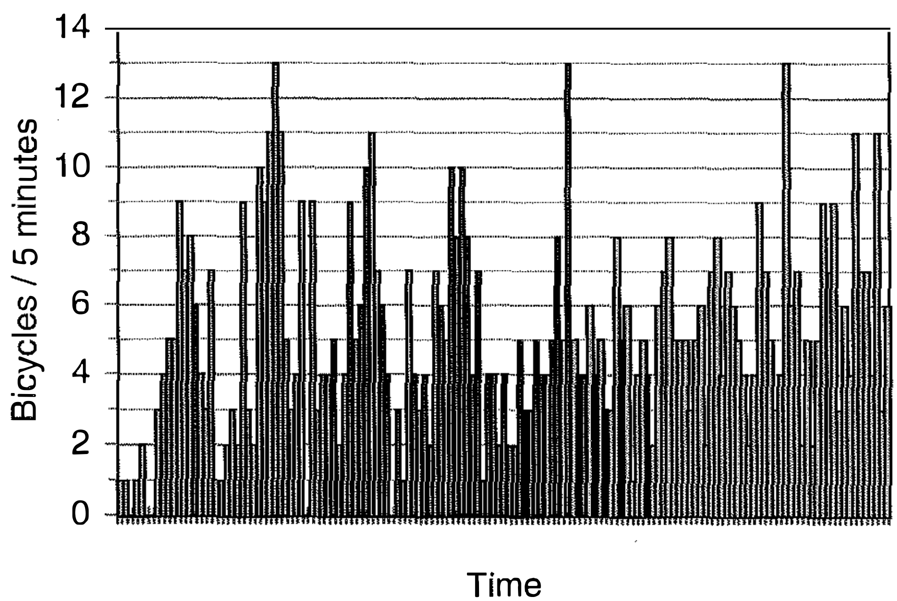


Table 1: Bicycle Counts by Location

Location*	12hr. In Trips	12 hr. Out Trips	AM Peak In	AM Peak Out	PM Peak In	PM Peak Out
1	60	43	22	0	11	15
2	281	199	85	15	52	63
3	221	212	93	12	28	49
4	396	334	141	30	69	136
5	33	28	11	4	5	12
6	61	54	19	8	12	20
7	105	107	17	20	33	22
8	127	105	69	8	14	39
9	22	15	8	1	5	7
10	44	36	22	6	5	8
11	42	48	14	4	8	24
12	129	107	53	7	13	48
13	15	4	6	0	3	1
14	72	86	27	10	11	21
15	201	134	66	16	25	34
16	141	166	27	20	36	52
Total	**1950**	**1678**	**680**	**161**	**330**	**551**

*See Figure 3

There was some concern that the less than ideal weather conditions (cool and drizzling rain at times) on the day of the bicycle count could impact the overall count totals. In order to consider this possibility counts were made for a 2.5 hour period between 7:45 AM and 10:15 AM the following Tuesday September 29 at count location 8. On the original count day September 22 during this time period a total of 76 inbound and 9 outbound bicycles were counted. One week later on the clear but cooler day a total of 83 bicycles were counted (63 inbound and 20 outbound). Therefore, we conclude that the weather did not have a significant effect on the overall number of bicycles counted on September 22.

3.2 Cyclist Related Results

In order to consider the personal characteristics of the cyclists only the inbound bicycle counts were used. Use of both the in and outbound cyclists would potentially involve double counting of some cyclists. The majority of the cyclists (79%) were male as indicated in Table 2. This is consistent with other studies of commuter cyclists. As indicated in Table 2 very few cyclists observed around the UK campus were estimated to be under 18 years of age. The majority of male and female cyclists (90%) were estimated to be between 18 and 30 years of age. This would be expected around a college campus. There was no significant difference between the age of male and female cyclists.

Table 2:Cyclists by Gender

Male	Female
1637 (79%)	436(21%)

Table 3: Age Distribution

Age Range	**1-10**	**11-17**	**18-30**	**31+**
Male	2(0.1%)*	13(0.8%)	1461(90%)	147(9%)
Female	0(0%)	8(2%)	388(89%)	38(9%)
All	2(0.1%)	21(1%)	1856(90%)	186(9%)

*Percent of males or females

Overall only 11% of the cyclists were wearing bicycle helmets. As indicated in Table 4 there was no significant difference between the portion of males and females that were wearing helmets. However, age (shown in Table 5) did affect helmet usage. While only 7.5% of the people estimated to be between 18 and 30 years old were wearing helmets, 41.3% of the people over 30 were. This suggests a need to target helmet safety education programs at college age individuals.

Table 4: Helmet Usage by Gender

	Wears Helmet	**No Helmet**
Male	174 (11%)	1445 (89%)
Female	44 (10%)	392 (90%)

Table 5: Helmet Usage by Age

Age Range	1-10	11-17	18-30	>30
Wears Helmet	1(50%)*	2(9.5%)	139(7.5%)	76(41.3%)
No Helmet	1(50%)	19(90.5%)	1711(92.5%)	108(58.7%)

*Percent of age group

Wrong way riding (a cyclist traveling on the side of a road in the opposite direction relative to the vehicular traffic) is a serious safety concern. Previous research (discussed in section 4.0) has found wrong way riding, especially sidewalk wrong way riding, has a higher risk of collision. Table 6 illustrates the overall number of bicycle trips observed to be with and against vehicular traffic for bicycles on roads and sidewalks. Although 14% of road cyclists traveled against traffic, 43% of the sidewalk cyclists did. Where ever their riding location, cyclists riding the wrong way are not a predicable or expected vehicle in the transportation network which results in increased risk.

Table 6: Direction of Travel

	% With Traffic	% Against Traffic
On Sidewalk	57.0	43.0
On Road	85.8	14.2

4.0 BICYCLE TRAVEL OBSERVATIONS AT THE UNIVERSITY OF KENTUCKY

Several observations made during the study are of value specifically for those who are involved with planning bicycle facilities, enforcement and routes around the UK campus. Those observations are described in this section.

At point 3 (see Figure 3) many cyclists were observed crossing to the wrong side of Rose Lane in advance of its intersection with Rose Street and turning to travel the wrong way in the bike lane on Rose Street. A total of 26% of inbound cyclists at this location were traveling on the wrong side of the road. It seems plausible to target this area for enforcement of proper direction riding in bicycles lanes. A large section of Rose Street has a raised median in the center. Engineers might also considering making "breaks" in the median of Rose Street for bicycles so that cyclists would not be inclined to ride the wrong way in order to be on the right side of the street when they reach their destination. This wrong way riding is a serious enforcement and safety issue.

Along Limestone Avenue (and Nicholasville Road) many cyclists were also observed traveling in ways which are not consistent with proper operation for a vehicle. For example, cyclists were regularly on the sidewalk and entered the roadway at mid-block points. Many bicyclists crossed the wide arterial road by riding down the center lanes or area waiting for a gap. While not illegal, per say, such unpredictable behavior certainly impacts safety for cyclists, pedestrians and vehicles. The counts suggest the need to accommodate bicycle entries to campus in the vicinity of the gatehouse on Limestone (count location 15 in Figure 3).

A total of 955 bicycle trips crossed the cordon line along the two-way section of Nicholasville Road / Limestone Avenue. This is a large number of bicycles. The high vehicular traffic volume, narrow lanes and high activity sidewalks along this road segment make it inappropriate for bicycling. The difficulty in crossing Nicholasville Road may lead to cyclists choosing to ride on the sidewalk more often than they would in other locations.

It was also unfortunate that the cordon count placement did not allow for a bicycle volume count at any location along Nicholasville Road. The cordon was placed on the inside edge of the sidewalk on the east side of Nicholasville Road with the result that bicyclists along Nicholasville Road were counted together with those who simply cross Nicholasville Road at different points. In order to consider cyclists traveling along Nicholasville Road an additional 2.5 hour morning peak bicycle count was conducted at location 13 between 7:40 AM and 10:10 AM on Tuesday October 13, 1998. By this time the weather had cooled and bicycle volumes were expected to be lower than at other times of the year including September when the main counts in this study were undertaken. This road is a concern for bicycle planning around the University of Kentucky because its high traffic volumes and narrow lanes are undesirable from a cycling point of view. Sidewalk cycling causes a hindrance to relatively high pedestrian traffic. No continuous nearby parallel route alternative exists for cyclists.

In the 2.5 hour period on October 13, 1998 a total of 31 cyclists cross the screenline on Nicholasville Road at point 13. Twenty six of the cyclists were on the sidewalk. All 5 of the road cyclists were traveling with (in the same direction) vehicular traffic, however, 15 (more than half) of the sidewalk cyclists were traveling against vehicular traffic. Aultman-Hall and Hall (1998) and Moritz (1997) have found that sidewalk cycling has higher event rates than cycling on either paths or roads. However, Aultman-Hall and Adams (1999) showed that people who cycle on the sidewalk have higher events rates on the road than those who do not suggesting sidewalk cyclists are perhaps less skilled or less comfortable with vehicular traffic. Wachtel and Lewiston (1994) worked with data from a corridor in Palo Alto, California over a four year period. They found the risk of bicycle - motor vehicle collision was 4.5 times higher for sidewalk cyclists who were traveling against traffic. Given these previous findings and the portion of Nicholasville Road cyclists traveling on the sidewalk and against traffic further investigation of the Nicholasville Road / Limestone Avenue bicycle transportation cooridor is warranted.

At the intersection of University Drive and Cooper Drive as well as other locations a large number of cyclists were observed running red lights. This suggests that cyclists do not know or choose not to follow the rules of the road which apply to cyclists as vehicles. Education and enforcement are typical countermeasures for this problem.

Finally, many cyclists were observed removing their bicycles from car bike racks or the backs of trucks after parking in the large parking lots surrounding the football stadium south of Cooper Drive. These cyclists then proceeded to bike in the direction of the main campus. This makes the football stadium parking lot a unique type of intermodal facility. It also suggests a latent demand for bicycling. If conditions for bicycles beyond campus were improved, more people might cycle to the UK campus from home.

5.0 CONCLUSIONS AND RECOMMENDATIONS

This study has found a significant number of bicycles trips are undertaken to and from the University of Kentucky main campus (over 3600 trips over 12 hours). These trips access the campus at several peak locations suggesting bicycle facilities or accommodation from these points would be used by cyclists. Significant numbers of cyclists were bicycling the wrong way against traffic, on sidewalks and without helmets. These cyclists represent a safety concern and suggest a need for bicycle education and enforcement.

The pilot count procedure used for this study was labor intensive and coordination of the large number of student counters was complicated. However, given the difficulty in capturing cyclist counts, personal characteristics, and travel patterns with automatic counters, an adapted form of this procedure might prove useful at selected locations within the state's traffic count program.

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