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REMARKS TO TOWN OF CHAPEL HILL REGARDING BICYCLE LANES VERSUS WIDE CURB LANES

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Introduction

My intent is to provide a brief review of a study performed for the Federal Highway Administration, an arm of the US DOT, by the University of North Carolina Highway Safety Research Center (HSRC) during 1995-1998. The study was focused on a comparison of bicycle lanes (BLs) versus wide curb lanes (WCLs), and I was the principal investigator. I would also like to add some further thoughts on the subject of BLs versus WCLs, and these should be considered as my personal thoughts, but they are certainly reflective of the conclusions of the report and research done by others.

A long standing issue in the bicycling community centers on whether BLs or WCLs are preferable. Many bicyclists report feeling safer when riding on BLs, while BL opponents venture that these facilities make it difficult for bicyclists to handle turning maneuvers at intersections, especially left turns. WCL advocates feel that these wider lanes encourage cyclists to operate more like motor vehicles and thus lead to more correct maneuvering at intersections. Both perspectives have merit and should be addressed in any evaluation of these facilities.

Project Overview

Bicyclists riding in either a BL or WCL were videotaped as they approached and proceeded through eight BL and eight WCL intersections with varying speed and traffic conditions in the cities of Gainesville, FL; Austin, TX; and Santa Barbara, CA. Approximately 4,600 bicyclists were videotaped in the three cities (2,700 riding in BLs and 1,900 in WCLs). The videotapes were coded to learn about **operational characteristics** (e.g., intersection approach position and subsequent maneuvers) and **conflicts** with motor vehicles, other bicycles, or pedestrians. A conflict was defined as an interaction between a bicycle and motor vehicle, pedestrian, or other bicycle such that at least one of the parties had to change speed or direction to avoid the other. Both bicyclist and motorist maneuvers in conflict situations were coded and analyzed. This would cover maneuvers such as a bicyclist moving incorrectly from the bicycle lane into the traffic lane prior to making a left turn, or conversely, a motor vehicle passing a bicyclist and then abruptly turning right across its path.

Within these 3 cities, the objective was to achieve a group of sites which varied by width of BL or WCL (2 levels), motor vehicle traffic volume (2 levels), and speed limit (2 levels). Such a matrix yields a total of eight sites. Thus, eight BL and eight WCL sites were selected for videotaping in each city. Selected breakpoint values were:

BL width - 5 feet or less, > 5 feet
WCL width - 14 feet or less, > 14 feet
Speed limit - 30 mi/h or less, > 30 mi/h
Traffic volume - Low volume up to 7,500 vpd for 2 lanes; 15,000 vpd for 4 lanes, etc.
High volume greater than 7,500 vpd for 2 lanes; 15,000 vpd for 4 lanes, etc.

As potential sites were selected in each city, we attempted to develop a mix based on the variable parameters shown above, as well as attempting to have variety in the sites that is representative of real-world conditions (e.g., BL and WCL sites with and without parking, BL sites with a weaving area and a bike pocket, BL sites with and without the stripe carried all the way to the intersection, BL and WCL sites where turning lanes were added at the intersection). We also tried to satisfy an objective of having 20-30 bicyclists per hour riding through the selected intersections. In all three cities, however, the preliminary site list of top candidates had to be altered, usually due to a small number of riders available for videotaping. BL sites were generally popular and tended to have a reasonably high number of bicyclists available. It was difficult to find eight suitable WCL sites in any of the selected cities due to low numbers of cyclists on these facilities.

In Gainesville and Austin, the selected sites were quite close to the university campuses, because this is where the majority of the bicyclists were located, and data could be collected in an efficient manner. In Santa Barbara, the university campus was remote, and student bicyclists were a much smaller part of the mix. Not surprisingly, BL sites tended to concentrate at low motor vehicle speed and traffic volume locations, while WCL sites tended to concentrate at high motor vehicle traffic volume locations. Overall, the matrices of final sites indicate a reasonable mix of variation, but the way the sites distributed likely lead to some observed differences in behaviors.

Besides the items mentioned above, a variety of other descriptive data items were collected at each site. These included type of area, pavement marking (striping) information for the BLs and WCLs, traffic control device present, number of lanes, estimated driving speed, presence of parking, motor vehicle traffic volume, and others.

Videotaping of Bicyclists

Intersections and the approaches to intersections were the focus of the data collection effort. Bicyclists were videotaped in the oncoming direction as they approached the selected intersections. The two-person data collection team usually mounted the camera on a 10 foot stepladder set up approximately 100-150 feet on the far side of the intersection. The location was such that the oncoming bicyclists generally were not aware of the camera until close to the intersection. The stepladder was quite beneficial in providing a viewing angle above traffic. Normally the camera position allowed for a view of more than 500 feet back from the intersection. Approaching bicyclists were usually captured 400-500 feet back from the intersection and followed through the intersection. The data collector would zoom in on the bicyclist to enable a better view of any kinds of bicycle-motor vehicle interactions. Each intersection was videotaped twice for two hours at each session. We attempted to videotape on both weekdays and weekends if there was enough bicycle traffic. Generally all 16 sites were videotaped once before the second round of taping began. As stated earlier, approximately 4,600 bicyclists were videotaped in the three cities (2,700 riding in BLs and 1,900 in WCLs).

Coding of Videotape Data

The objective was to code actions associated both with a "midblock" (the intersection approach) and an intersection area. Midblock was thus defined as the area on the approach leg 300-500 feet from the intersection stop bar location. The intersection was defined as the area covered by the 300 feet back from the stop bar location.

Here are some of the types of variables that were coded:

- Bicyclist riding wrong way
- Bicyclist demographics and helmet use
- Midblock positions and movements
- Bicyclist midblock behaviors (e.g., turning across a lane of traffic)
- Midblock conflict information
- Intersection positions and movements
- Bicyclist straight, left turn, and right turn methods
- Bicyclist straight, left turn, and right turn conflict information

Main Results

Operational Data - Significant differences in operational behaviors and conflicts were found between BLs and WCLs but varied depending on the behavior being analyzed. Operational behavior differences were examined through contingency table analysis, looking at how a variable distributed on BLs or WCLs. Some of these results likely reflect the motor vehicle speed limit and traffic volume characteristics at the locations, keeping in mind that BLs tended to be more associated with lower motor vehicle speed and traffic volume locations and WCLs more associated with higher motor vehicle traffic volume locations. We did not perform statistical modeling in this analysis to control for these factors because we wanted to examine all of the operational variables individually.

Selected operational results include:

- Wrong way riding and sidewalk riding were more prevalent at WCL sites.

- Significantly more motor vehicles passing bicycles on the left encroached into the adjacent traffic lane under WCL situations.
- Proportionally more bicyclists obeyed stop signs at BL sites: however, when a stop sign was disobeyed, the proportion of bicyclists with both "somewhat unsafe" and "definitely unsafe" movements was higher at BL sites.

Conflict Data - In regard to the conflicts analysis, raw frequency bike-motor vehicle conflict rates per entering cyclist were slightly higher at BL sites than WCL sites when both midblock and intersection conflict data were combined (6.7 bike-motor vehicle conflicts per 100 entering bicyclists at BL sites versus 5.1 conflicts at WCL sites). In addition,

- The rate of **midblock** bike-motor vehicle conflicts associated with BLs was considerably higher than the rate for WCLs, although the rates were small. Generalized linear models fitted to the data showed that both the presence of a BL and the BL width, along with motor vehicle traffic volume and the presence of driveways, were significant variables in the midblock conflict rate models. The practical effect of such models was that the midblock bike/motor vehicle conflict rate was higher at sites with BLs than at WCL sites. However, a closer examination of the data revealed that the higher midblock BL conflict rates were attributable to only a few sites. The midblock conflicts at the 10 highest rate sites were thus examined clinically. Part of the reason for the higher conflict rates at these sites appeared to pertain to the provision of turn lanes at some of the intersections.
- An initial model fitted to the **intersection** conflicts showed no differences in the conflict rate by type of bicycle facility, but higher conflict rates for left turn movements. A subsequent model was developed that included different intersection types based on the type of BL striping (e.g., solid stripe to the intersection, dashed stripe to the intersection) and whether the typical WCL cross section was maintained through the intersection (or narrowed due to the provision of turn lanes). This model showed *lower* conflict rates for straight through and right turning bicycles where the BL stripe continued all the way to the intersection and the WCL was not narrowed at the intersection. This is perhaps not surprising, in that bicycles would have more space in these configurations. As before, a

closer study of the data showed that the findings from this model were mainly attributable to a few sites. The difficulty of statistically interpreting outcomes that seemed so dependent on site-specific characteristics led to a clinical analysis of higher conflict rate sites, both at midblock and intersection locations.

- Identifiable situations leading to conflicts from this clinical analysis were **presence of parked motor vehicles (either entering/exiting legal parking or illegal parking/stopping) in the BL or WCL, presence of driveways or intersecting streets, and provision of turn lanes at intersections that typically (but not always) resulted in a narrowing of the BL or WCL at the intersection proper (normally in the last 100-150 feet before the stop bar). These situations did not appear to be related to whether a BL or WCL was present.** In other words, the conflicts that resulted were site-specific and likely would have occurred whether a BL or WCL was present.
- Serious conflicts were also examined clinically, and again there appeared to be no differences between BL and WCL serious conflicts.

Overall Conclusion

The overall conclusion from this study is that *both* BL and WCL facilities can and should be used to improve riding conditions for bicyclists. The differences in operations and conflicts that we saw appeared to be related to the specific destination patterns of bicyclists riding through the intersection areas and not to whether a BL or WCL was present.

Personal Commentary

I have always believed in balance in all phases of life, so it should come as no surprise that I believe in, as much as possible, a balanced transportation system. Admittedly this is difficult given our dependence and bias toward the automobile. However, Chapel Hill (and Carrboro for that matter) have a sizable number of bicyclists compared to most NC communities, primarily due to the presence of the university. It would be beneficial in many respects to increase the number of cyclists and the corresponding mode share for bicycling. My feeling is that more bicyclists on the roads leads to improved safety for this group, primarily due to motorists being more attuned to their presence and their movements.

So how do we get more bicyclists on the streets? For a long time bicyclists have stated that they want bicycle facilities, and the facilities they state as their preference are separate bike paths and BLs. This is particularly the case for women, who are in the vast minority when it comes to numbers of cyclists, and who are more concerned with higher motor vehicle speeds and traffic volumes than men (research by Nancy Smith Lea). Another of our projects at HSRC found that bicyclists had an increased comfort level on bike lanes when compared to other on-road facilities. What this implies is that bicyclists want their own space. Somehow BLs seem to have a sense of "verticality" (i.e., the stripe extends vertically like a wall), and bicyclists feel that the BL stripe will not be violated by motor vehicles. Separate paths feel safe because no motor vehicles are present.

This is not to say that separate paths and BLs are without problems. There certainly can be risky situations where these facilities intersect other roadways or driveways, and bicyclists need awareness or training about these situations.

A word about WCLs. These are bicycle facilities, in my mind, but I think the vast majority of bicyclists do not know what WCLs are, because they are not marked or identified on the street. And these facilities also require good knowledge about how to bicycle in traffic. Depending on the destination of the bicyclist, risky maneuvers can take place on these facilities, just as they can on bike lanes.

A conclusion in the earlier study was that both BLs and WCLs are viable bicycle facilities, and both can and should be used in communities. However, in my opinion, BLs will generate more bicycling, as evidenced by surveys and our difficulty in finding cyclists on WCL facilities in our earlier study, and I am for promoting bicycling. As we move forward, I think our community should look to provide BLs along our major bicycling corridors. WCLs could be an alternative if inadequate space for BLs is available.

To cite an example, the City of Phoenix has added a large number of BLs in recent years and now have approximately 225 miles of on-street BLs. While many of the BLs are on collector streets, BLs are also provided on arterial streets. In addition, the standard cross-section for *new* arterial streets was modified to include on-street BLs. They examined their bicycle-motor vehicle crash data and found that the addition of these BLs did not lead to an increase in crashes. In fact, 95% of the crashes took place on streets with no bike facilities. Less than 2% of the bicyclists were struck while riding in an on-street BL, and a smaller percentage of bicyclists were struck while riding in a striped shoulder area (similar to, but not striped as a BL). These cyclists were mostly either riding the wrong way or at night without proper lights. There was also concern that the additions of the BLs on collector and arterial streets would lead to more crashes involving children trying to ride in a higher motor vehicle speed, higher traffic volume condition. An examination of the latest year of data for this study, the year 2000, showed that with the exception of one 16-year-old cyclist, all other bicyclists struck in BLs were adults.

The debate over whether BLs or WCLs are preferable has been heated for many years. The debate has sometimes forced decision makers to choose which facility type they prefer, to the exclusion of the other. More bicycle facilities might be in place in this country except for this long-standing division of opinion.