Bicyclist Lateral Roadway Position versus Motorist Overtaking Distance

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ABSTRACT

A novel data collection method using bicycle helmet mounted video cameras has been applied to a case study of bicyclist lateral roadway position versus motorist overtaking distance. A 0.3 mile stretch of a multilane roadway in suburban Los Angeles with narrow outside lanes and no driveways or intersections was selected for the study. The bicyclists made multiple runs along this stretch of roadway, varying their lateral roadway position each time. The bicyclist lateral position in the outside travel lane and the overtaking clearance provided by the motorist were measured using still images extracted from the video clips.

When the bicyclists rode near the gutter, the motorists exhibited the full distribution of overtaking behaviors ranging from in-lane passes, to a number of straddle passes, and a group of lane change passes. However, when the bicyclists were left of the center of the lane, the closer motorist passes (the in-lane and straddle passes) were consistently replaced by full lane change passes. While the number of data points was insufficient to establish a quantitative relationship, the data seem to indicate that bicyclist lateral position has a significant influence on motorist overtaking distance.

BACKGROUND

A novel data collection method using bicycle helmet mounted video cameras has been developed. Two bicyclists ride single file, with a distance of approximately one bicycle length between them. The bicyclist in the rear wears a front-facing camera, and the bicyclist in the front wears a rear-facing camera, as shown in the figure below.

FIGURE 1 Dual Camera View

Unlike previous methods of on-bike video, this method allows for post-ride observation of roadway and traffic conditions around both bicyclists. In addition, the presence of a bicyclist in the video frame provides more opportunities for data collection compared to a "bare" camera view of a roadway without seeing a bicyclist in the video. This data collection method has been applied to a case study of bicyclist lateral roadway position versus motorist overtaking distance.

METHODOLOGY

A 0.3 mile section of southbound Lakewood Boulevard between Ashworth and Hedda Streets in Lakewood, CA was selected for the study. This section of Lakewood has six lanes, three in each direction, and is flat and straight with a 40 mph speed limit and no sightline obstructions. The outside lane width is 12'-8" (+/- 1") including the 1'-0" gutter pan, and there are no driveways and intersections in this section, eliminating the potential complication of motorist turning and crossing maneuvers. A satellite image is shown in the figure below.

FIGURE 2 Overhead View

In order to consistently ensure an adequate number of overtaking vehicles in the rightmost lane for each run, the following procedure was used. The two bicyclists waited at eastbound Ashworth in preparation for a right turn onto southbound Lakewood, a movement controlled by a stop sign. The bicyclists had a clear line of sight northbound to the traffic signal 0.1 mile away at Lakewood and Rose. They waited an entire light cycle so that southbound Lakewood traffic would be stopped, and immediately after a

fresh green for southbound Lakewood traffic, the bicyclists would then make the right turn onto southbound Lakewood. The gap between Rose and Ashworth gave the bicyclists adequate time to establish the desired lane position for that run. Then the bicyclists would turn right on Hedda and head back to Ashworth via the northbound frontage road in preparation for the next run.

The study data were collected on two consecutive weekend Saturdays in the summer of 2006. The road was dry and the weather was sunny with calm winds on both days. Early afternoon on both days was chosen for the data collection in order to ensure similar traffic volumes, as well as to provide the best video quality when the sun is high in the sky. The bicyclists rode the course at an approximate speed of 15 mph twelve times on July 28, 2006 and two times on August 4, 2006, using the following three typical bicyclist lane positions:

- Near gutter – Runs 1-5 on July 28 (Run 6 had no passes)
- Motorist right tire track – Runs 7, 8, 10, 11, 12 on July 28; Run 1 on August 4
- Left of the center portion of the travel lane – Run 9 on July 28; Run 2 on August 4

RESULTS

A total of 50 motorist overtaking maneuvers, in which a motorist whose original path of travel was in the rightmost lane, were recorded over the two days. Overtaking maneuvers by motorists whose path of travel originated in either of the left two lanes were excluded from the analysis. The video clips of each overtaking maneuver, as well as still images that have been extracted of the closest overtaking point, are here: <http://www.cyclistview.com/overtaking/>. Two examples of the use of video frames to make measurements are provided in the figures below. Since the lane width is known, the motorist overtaking distance as well as the bicyclist distance from the edge were scaled from the still images.

FIGURE 3 Example Still Image of Overtaking Maneuver with Measurements

FIGURE 4 Example Still Image of Overtaking Maneuver with Measurements

Three types of motorist overtaking behaviors were observed:

- In-Lane Pass: The motorist overtook the cyclist while completely staying in the rightmost lane.
- Straddle Pass: The motorist partially encroached in the adjacent lane.
- Lane Change Pass: The motorist performed a complete lane change to the adjacent lane.

A plot of motorist overtaking clearance versus bicycle lateral position is provided in the figure below.

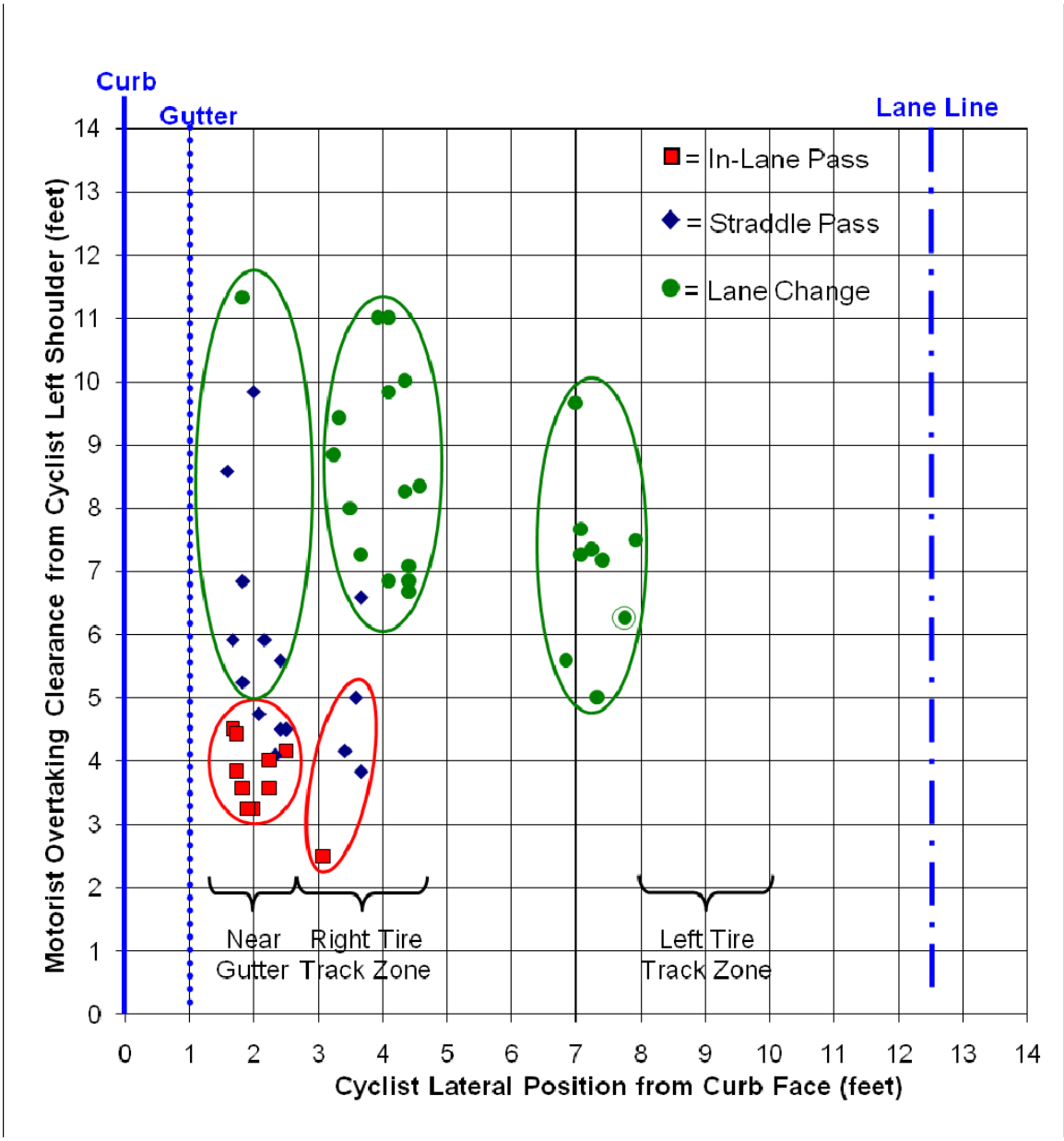

FIGURE 5 Plot of Motorist Overtaking Clearance and Bicyclist Lateral Position

Another representation of the data is provided in the figure below (the indicated three foot law minimum overtaking clearance is typical for some states, although not for California). The colored bars show the distance between the edge of the motor vehicle and the cyclist's left shoulder. The bicyclist wheel track, which is one foot to the right of the cyclist's left shoulder, is also shown. For ease of presentation, the data have been sorted in increasing cyclist distance from the curb.

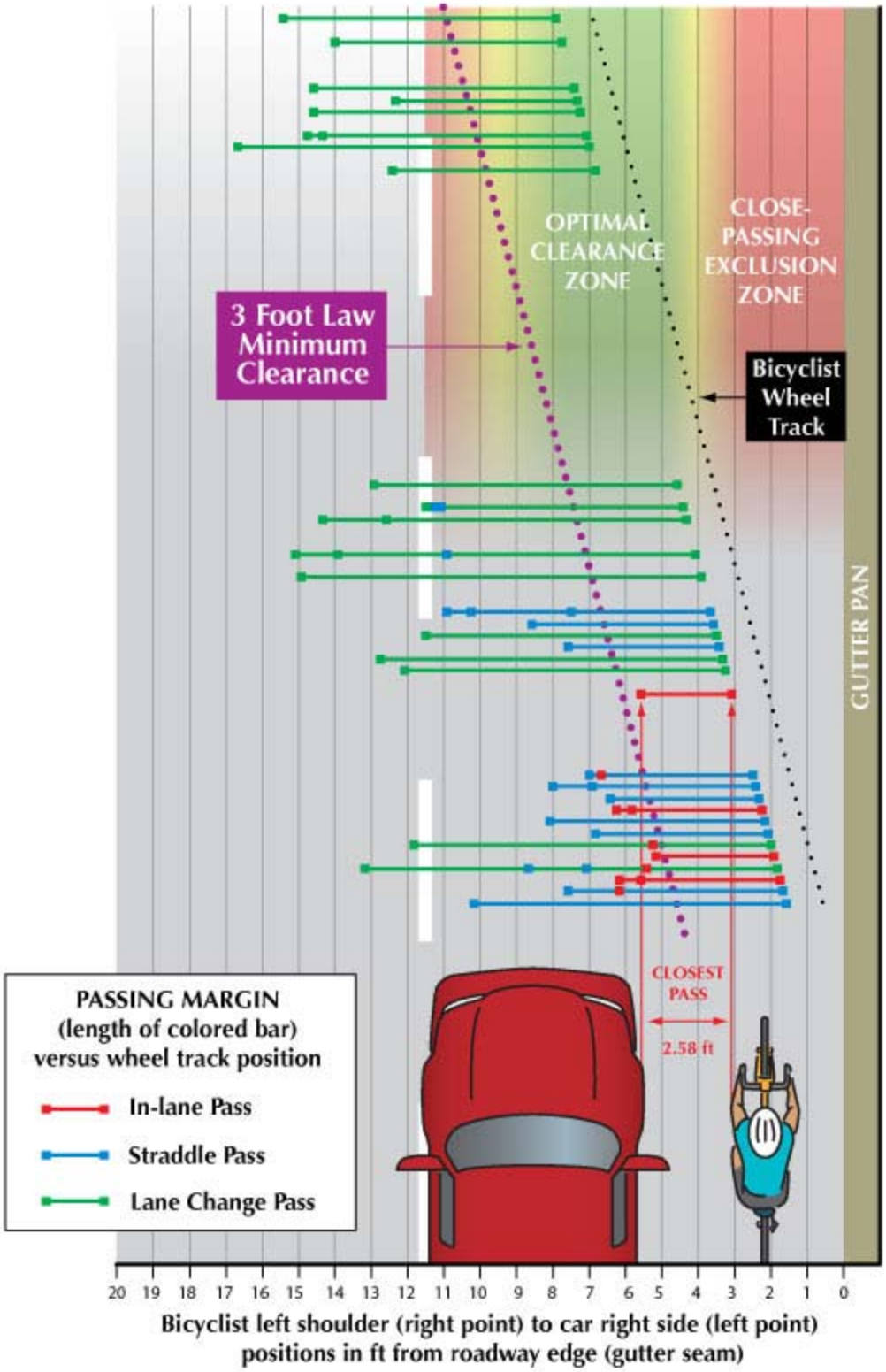

FIGURE 6 Alternate Plot of Motorist Overtaking Clearance and Bicyclist Lateral Position

FINDINGS

The use of bicyclist helmet camera video shows great promise as a data collection tool. Due to the small size of the equipment and the motorist/bicyclist speed differential, it appears that the motorists did not notice the video equipment, allowing real world data to be obtained without the presence of the videotaping influencing the results.

The interesting qualitative findings in the plots above show when the bicyclists rode near the gutter, the motorists exhibited the full distribution of overtaking behaviors ranging from in-lane passes, to a number of straddle passes, and a group of lane change passes. Even for the case of the bicyclists riding in the right tire track, there were still a few straddle passes and one close in-lane pass. This suggests that other factors, such as the presence or absence of traffic in the adjacent lane, are at play. However, when the bicyclists were left of the center of the lane, the closer motorist passes (the in-lane and straddle passes) were consistently replaced by full lane change passes.

Another interesting qualitative finding was the motorists initiated lateral movements needed for overtaking much earlier when the bicyclists used a left of center position, compared to the more rightward bicyclist lane positions. Although this effect was not quantified as part of this study, it can be seen in the video clips of the individual overtaking maneuvers. One possible explanation for this effect is that the more leftward bicyclist lane position allows motorists to much more easily discern that the lane is not wide enough for safe motorist/bicyclist sharing, versus a more rightward bicyclist lane position that leaves a large enough gap for the motorist to perceive that there is adequate room to overtake the cyclist without having to make a lateral move into the adjacent lane.

While the number of data points was insufficient to establish a quantitative relationship, as described above the data seem to indicate that bicyclist lateral position has a significant influence on motorist overtaking distance. This is worthy of further study to quantify the effect.