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The Effect of Innovative Pavement Markings to Facilitate Bicycle Travel

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1 INTRODUCTION

Two types of pavement markings that are relatively new in the US are the bike box, a space for bicycles to stop ahead of the motor-vehicle stop bar at the intersection approach, and the two-stage turn box, a space where turning bicyclists can wait before making the second stage of a two-stage (typically left) turn [1]. This study evaluated the effects of two bike boxes and two turn boxes at an intersection in a small city in Virginia.

1.1 Purpose of Bicycle Pavement Markings

Stated purposes of bike boxes include relieving bicyclists from breathing motor vehicle exhaust, making bicyclists more visible to motorists at the beginning of the green phrase, and allowing bicyclists to position themselves for turns and merges [2,3]. The National Association of City Transportation Officials listed several benefits of two-stage turn boxes, including improving bicyclists' ability to safely and comfortably make left turns, providing a formal queuing space, and reducing turning conflicts between bicyclists and motor vehicles [4].

1.2 Study Site

The study site in Charlottesville is surrounded by the campus of the University of Virginia. It is a signalized T-intersection with a side road on the leg of the T and a spur diverging from the cap of the T (Figure 1). Prior to the changes, bicycle infrastructure included bike lanes on the leg of the T and an eastbound climbing bike lane approaching the intersection. Westbound left turns onto the spur were prohibited at the signal, diverting the movement to an unsignalized intersection 350 feet to the west. Right turns on red were prohibited from the leg of the T and from the spur.

In August 2014, bike boxes were installed westbound and southbound, and two two-stage left-turn queue boxes were installed eastbound and westbound (Figure 1). Other intersection changes included restriping; a westbound ingress bike lane into the bike box; use of green-colored pavement for bike facilities; a westbound right-turn-on-red prohibition (required because of the bike box); and additional signs.

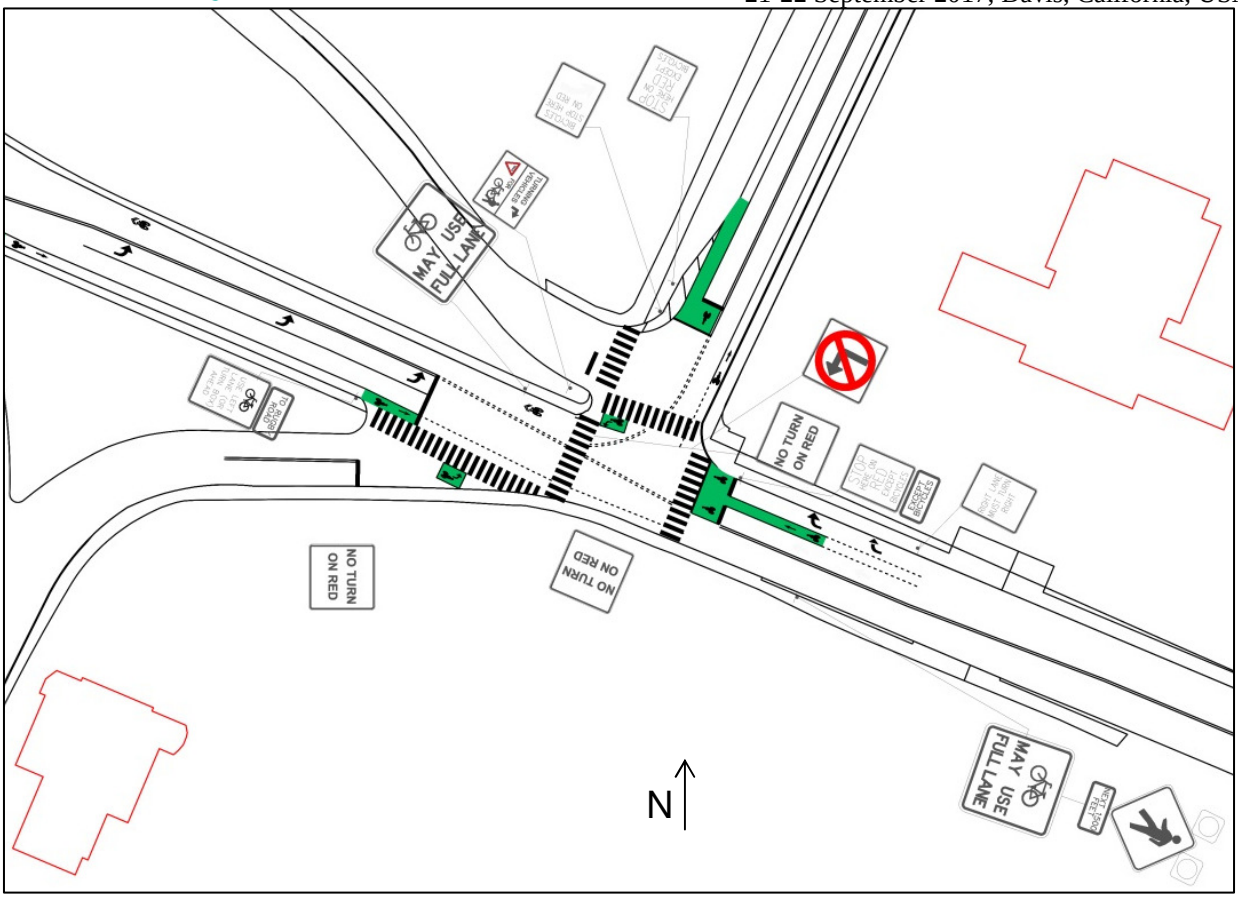

Figure 1: Intersection improvements as constructed included two bike boxes and two turn boxes along with striping and signage (figure provided by the City of Charlottesville).

2 METHODS

Three video cameras were used to collect automated multimodal traffic counts and to obtain footage that researchers later reviewed to identify behaviors of interest. To classify all bicycle-related traffic interactions at the intersection, reviewers watched all three cameras' footage for the same recorded period. Before and after video footage was reviewed to collect data on bicycle-related conflicts, motorists and bicyclists traffic infractions, and bicyclists' proper and improper use of bike boxes and turn boxes.

Bicycle-related conflicts were coded as minor or major. The classification of bicycle-related conflicts followed the two-tiered classification used in previous related studies [2,5,6,7] but with revised nomenclature to improve clarity. Conflicts that might have been described in other studies as "major" were termed Observed Near Misses and defined as emergency/panic braking, or, for pedestrians, stopping short, to avoid a collision – often when both parties seemed unaware of each other until the last second. Conflicts that might have been described as "minor" in other studies were termed Forced Yielding to Avoid a Near Miss and defined as controlled precautionary braking or change of direction, typically by the road user with the right-of-way and often forced by a road user without the right-of-way.

Events were classified by the status of the traffic signal controlling the approach: red, the first five seconds of green, and the rest of the green phase. Each violation, not each violator, was counted.

3 RESULTS AND DISCUSSION

Initial results were mixed and indicated that:

- Rates of traffic infractions decreased for some types of infractions and for some intersection approaches but went up for others.
- Rates of conflicts involving bicyclists went up, per bicyclist.
- Although the potential for right-hook conflicts exists on one approach, it is mitigated by vertical and horizontal geometry that naturally slows speeds.
- Some bicyclists used the new markings properly, but some used them improperly or failed to use them.

Initial results also suggested a potential problem with inter-rater reliability among video reviewers, so the lead researcher re-reviewed a subset of the video footage to address this concern. The results of this re-review are pending (and will be complete well in advance of the ICSC).

Conclusions cannot be developed until after analysis is complete, but one likely conclusion is that, at this particular site, the bicycle pavement markings by themselves were not sufficient to address all the issues observed, particularly red-light running by bicyclists. That is, additional treatments such as bicycle signals might address site-specific challenges that the bike box and turn box pavement markings are not intended to overcome while enhancing proper use of the bicycle pavement markings.

REFERENCES

[1] Monsere, C., Dill, J., McNeil, N., Clifton, K. J., Foster, N., Goddard, T., and Parks, J. (2014). *Lessons from the Green Lanes: Evaluating protected bike lanes in the US.* Published by National Institute for Transportation and Communities, Portland, Oregon, 2014.

[2] Dill, J., Monsere, C., and McNeil, N. *Evaluation of Bike Boxes at Signalized Intersections*, 2011. http://www.otrec.us/project/227. Accessed July 27, 2016.

[3] Hamer, M. Go by Bike-Holland Shows the Way. In *New Scientist*, Vol. 90, Issue 1256. 1981, pp. 612-615.

[4] National Association of City Transportation Officials. Two-Stage Turn Queue Boxes. http://nacto.org/publication/urban-bikeway-design-guide/intersection-treatments/two-stage-turn-queue-boxes/. Accessed June 9, 2016.

[5] Allen, D., S. Bygrave, and H. Harper. Behavior at Cycle Advanced Stop Lines. Report No. PPR240. Transport *for* London, London Road Safety Unit, London, 2005.

[6] Atkins Services. *Advanced Stop Line Variations*. Research Study Report No. 5031271. Transport for London, London, 2005.

[7] Hunter, W. Evaluation of innovative bike-box application in Eugene, Oregon. *Transportation Research Record: Journal of the Transportation Research Board, No. 1705*, Washington, D.C., 2000, pp. 99-106.