Title: EVALUATION OF BIKE BOXES AT SIGNALIZED INTERSECTIONS IN PORTLAND, OREGON, USA

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Abstract:
Bicycle use as a primary means of commuting to work increased 145% (American Community Survey, US Census Bureau) from 1996 to 2006 in Portland, Oregon; however, recent surveys have found that more than half of Portland residents limit their bicycling due to traffic safety concerns. In Portland, 68% of bicycle crashes occur at intersections, (PDOT, 2004) which is consistent with national trends (Hunter et al., 1995), and a common crash pattern is the "right-hook" where right-turning motorists collide with through or stopped bicycles. To partially address these conflicts between bicycles and right-turning motor vehicles, the City of Portland installed 12 "bike boxes" at signalized urban intersections. The box is located in front of the stop line for motor vehicles and behind the pedestrian crosswalk, and the typical installation consisted of an advanced stop line, green textured thermoplastic marking with bicycle stencil, intersection striping, and regulatory signage (including no-turn-on-red). These installations also include colored bicycle lane markings in the intersection, which is unique. This combination of traffic control is hypothesized to reduce conflicts between motor vehicles and bicyclists and make motorists aware of a potential conflict, with a secondary outcome of encouraging more bicycling by enhancing safety and priority at an intersection.

Such an application of bike boxes in the U.S. is unprecedented. Bike boxes and similar advanced stop lines are used extensively in the United Kingdom, the Netherlands, and Denmark. Comprehensive evaluations of bike boxes are rare. The Eugene box was evaluated, however, that application was so unique that it has limited transferability (Hunter, 2000). The only other recent and thorough studies of the effects of such boxes found were two studies conducted in London (Allen et al, 2005; Wall et al, 2003). These studies looked at both the capacity implications and the behavior of motor vehicles and cyclists. The study examining the driver and cyclist behavior (Allen et al, 2005) compared 12 sites with advanced stop lines (ASL) and two without. All data were collected after installation of the advanced stop lines. That study found few conflicts with or without the ASLs. The study also found that the ASLs reduced the share of motor vehicles and bicycles encroaching on the pedestrian crosswalk.

This paper will present the results of a comprehensive, classical, observational before-after study of the effectiveness of the installed experimental traffic control devices and responses of all system users impacted by the installation of the bicycle boxes. The research questions addressed include:
1. Do the bike boxes reduce conflicts or the potential for conflict between motorized vehicles and bicycles?
2. Do the bike boxes create any new or potential conflicts between motorized vehicles and bicycles?
3. How does motor vehicle driver and bicyclist behavior differ with and without the bike boxes?
4. What design features affect behavior and conflicts?

5. Do the bike boxes affect pedestrian safety?
6. What are the impressions of the drivers and bicyclists using the intersections about how the bike boxes affect safety and operations?

Two primary methods were employed: (1) before and after video surveillance; and (2) cyclist and driver surveys. The video surveillance includes 11 treatment intersections and four control intersections. Data were collected on bicyclist and motorist positions relative to the bike box, bike lane, and the pedestrian crosswalk areas, in addition to signal phase, presence of pedestrians, stopping behavior, and bicycle and motor vehicle counts. Inter-rater reliability was also assessed. The survey of bicyclists who rode through the bike boxes collected information on user perceptions and behavior. The motorist survey collected information about motorists understanding of the markings, along with perceptions and behavior.

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