

Research Report Summary



SAFER-SIM University Transportation Center, 69A3551747131

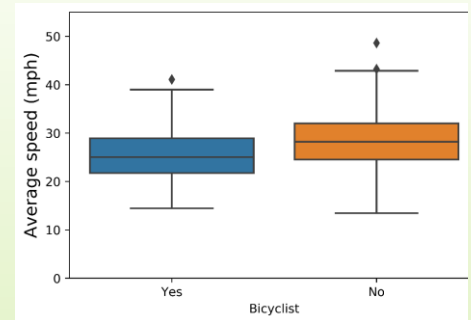
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Dissecting the Safety Benefits of Protected Intersection Design Features

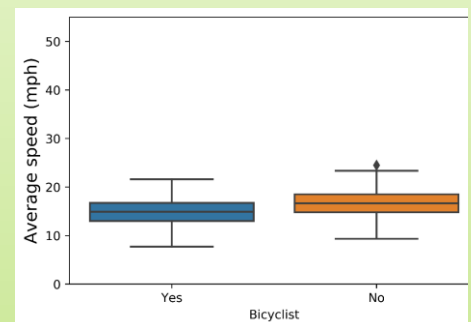
Protected intersections are used to facilitate safe crossings for bicyclists and pedestrians at intersections. Their placement after segments with protected bike lanes can increase driver awareness of and attentiveness to bicyclist presence. Protected intersections also reduce the number of conflict points between right-turning vehicles and bicyclists going through the intersection. Therefore, they have the potential to reduce right-hook crashes.

Given that protected intersections are still rare in North America, there is a need to understand how their different design elements, e.g., turning radius and intersection crossing pavement markings, impact interactions between drivers and bicyclists.

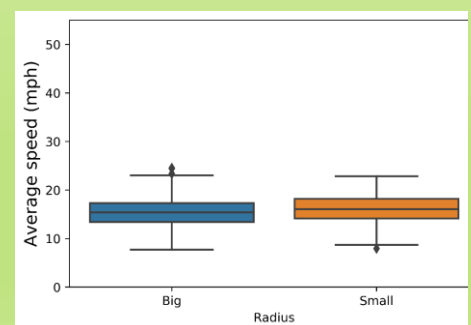
In particular, the objective of this study was to examine the effects of protected intersection elements and bicyclist presence on the behavior of right-turning drivers. A driving simulator experiment was designed for this purpose and was used to analyze right-turning vehicle speeds at protected intersections with different turning radii and bicycle crossing pavement markings with and without the presence of a bicyclist.



Boxplot of average approaching speed with and without the presence of a bicyclist



Boxplot of average turning speed with and without the presence of a bicyclist



Boxplot of average turning speed under different radii sizes

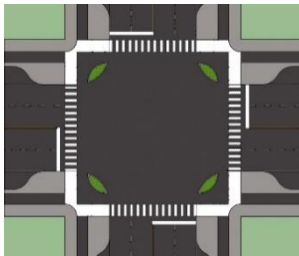
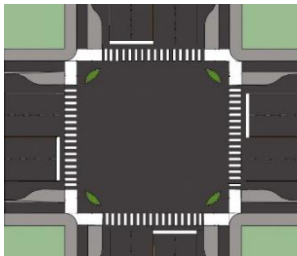
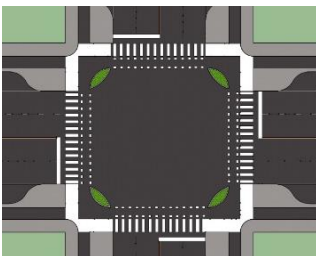
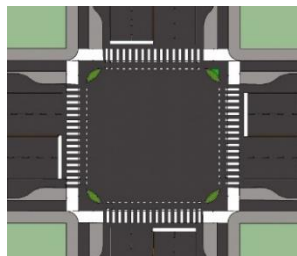
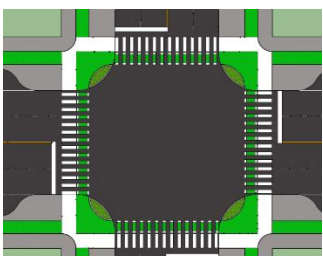
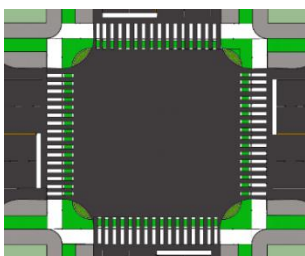
The hypotheses tested were (1) that larger turning radii and more visible bicycle crossing pavement markings reduce driver speed, thereby increasing safety at protected intersections, and (2) that the presence of a bicyclist at the intersection would significantly reduce the driver's speed through the intersection.

Six protected intersection designs were created with varying turning radius (small or big) and types of intersection crossing pavement markings (no markings, simple markings, and green-colored markings). Each of these represents a scenario in the driving simulator. The presence of a bicyclist crossing the intersection was also considered for a total of 12 scenarios, half with a bicyclist crossing the intersection while making the turn and half with no bicyclist present.

Average speeds were collected for two segments of each turn: (1) while the participant was entering (approaching speed), and (2) while the participant was traveling within the intersection (turning speed).

Participants' demographics and bicycling history were collected and considered in the analysis.

The results indicate that the presence of a bicyclist at the protected intersection significantly reduces speeds for drivers performing a right turn through that intersection. Larger intersection radii were found to reduce turning speeds as they are accompanied by larger corner islands and bigger curb extensions. Bicycle crossing pavement markings influenced only approaching speeds prior to the actual turn because that was when they were the most visible. Demographics (i.e., age and gender) and bicycling history also affected turning speeds, indicating that design elements alone cannot determine the safety effectiveness of a protected intersection.

Big Radius (16.4 feet)	Small Radius (9.8 feet)
	
(a) No intersection crossing pavement markings	
	
(b) Simple intersection crossing pavement markings	
	
(c) Green-colored intersection crossing pavement markings	

Protected intersection designs tested