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Pedestrian and Bicycle Safety Research Brief

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BICYCLE INFRASTRUCTURE SAFETY

As cities around the country adopt initiatives like Vision Zero to eliminate traffic deaths and serious injuries, they are faced with the question of how effective different types of interventions are. For example, do protected bike lanes or painted sharrows reduce the risk of severe injury to cyclists? A group of researchers from the New York University School of Medicine examined this question by studying where cyclists admitted to the hospital crashed and how severe their injuries were.[1]

Stephen P. Wall and his colleagues gathered data from 839 cyclists who collided with a motor vehicle and were admitted to Bellevue Hospital, a Level-1 trauma center located on Manhattan's East Side. They classified the cyclists' injuries into two categories using a standard injury severity score scale: mild or less, and moderate or more. They geocoded the bicycle crash locations and matched them to NYC DOT bicycle infrastructure shapefiles to find out where cyclists were riding.

Cycling on routes with dedicated infrastructure appeared to be safer. The risk of injury to a cyclist was 90 percent less if they were traveling on a bicycle lane compared to traveling on a route without any signs, lanes, or barriers. Risk also declined if they traveled on a protected bike path, but not to a statistically significant degree. While this was the good news, the bad news was that cycling on streets with bicycle infrastructure was associated with an increase in the *severity* of injury compared to cycling on an unmarked street. Odds of sustaining at least a moderate injury were 94 percent greater on routes with sharrows, 52 percent greater in bicycle lanes, and 66 percent greater on protected bicycle paths.

The study results were mixed: there were fewer injuries on streets with bicycle infrastructure compared to other streets. However, when there were injuries, they were more severe. So what's the lesson for safety? "In our study, some physically protected paths lacked any injuries at all," Wall and his research team wrote. "Their designs and use may be informative to improve bicycle route infrastructure in other locations where injury risk and severity are greater than expected." In other words, cities should look at where injuries haven't occurred to prevent where they do.

Figure 1. A cyclist navigates along a sharrow in New York City. Photograph by Wall et al.

If the type of bicycle infrastructure influences the severity of injuries, what other characteristics might also contribute? Morteza Asgarzadeh of Harvard's T.H. Chan School of Public Health and four other Boston-area researchers studied the association between intersection geometry and the severity of bicycle–vehicle crashes.[2] They obtained data from 3,266 police-reported crashes in New York City, which included collision locations and the severity of the bicyclists' injuries.

The researchers found that most crashes occurred at intersections—a finding that matches results from studies of other cities. They also found that the geometry of the intersection significantly predicted injury severity.

The odds of a bicyclist sustaining a severe injury were 37 percent greater at odd-angled intersections compared to right-angled intersections. The researchers attributed the increased odds of injury to limited sight distances at those types of intersections, particularly where the approaches formed an acute angle. The takeaway: "Safety interventions and design modifications at non-orthogonal intersections, such as installing a bicycle traffic light, may reduce risk of severe injuries," Asgarzadeh and his collaborators concluded.

But the biggest dangers to cyclists the research team found had little to do with design features. Bicycle collisions with a bus or truck doubled the odds of a severe injury over collisions with a car (Figure 1), and cyclists riding at night were 54 percent more likely to sustain a severe injury than at other times of the day. Shielding cyclists from the dangers of large vehicles and improving lighting could achieve the greatest benefit in terms of reducing major injuries.

PEDESTRIAN AND CROSSWALK SAFETY

One out of every two pedestrian-vehicle collisions in California in 2013 occurred when the pedestrian was in a crosswalk. In nearly two-thirds of those cases, drivers did not yield the right-of-way; in other words, they simply did not stop when they were supposed to. These figures are not unique to our state; Oregon, for example, has similar rates of driver non-compliance at crosswalks. But even when police set up traffic enforcement actions and announce them ahead of time, too many drivers illegally encroach on crosswalks when pedestrians are crossing legally. Miguel Figliozzi and his student Chawalit Tipagornwong at Portland State University sought to understand what explains why drivers violate pedestrians' rights-of-way so frequently.[3]

The researchers identified an uncontrolled intersection within the city of Portland that had a high number of crosswalk law violations where they could easily place video equipment to record vehicle behavior (see Figure 2). The SW 4th Avenue and SW College Street intersection is near the university and a popular lunch spot, two blocks from the Interstate 405 off-ramp. SW 4th Avenue is a one-way street, and there is a traffic signal at the intersection prior to SW College St. Using their video system, the research team measured the speed of every vehicle along 4th Avenue in the study area. Each time there was a pedestrian–vehicle interaction, they recorded the vehicle's trajectory, traffic conditions, and pedestrian behavior. They only analyzed interactions when the pedestrian crossed fully within the crosswalk and the approaching vehicle was outside the dilemma zone; that is, when the driver could reasonably stop in time after the pedestrian entered the intersection.

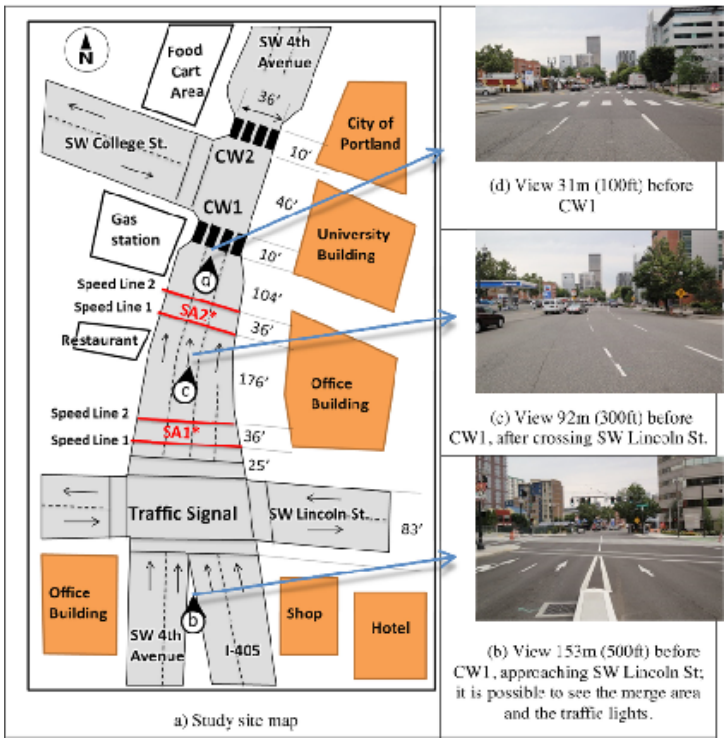

Figure 2. Study site at SW 4th Avenue and SW College Street in Portland, Oregon. Diagram by Figliozzi and Tipagornwong.

Drivers were least likely to stop for pedestrians if they accelerated in the block between the previous traffic signal and the crosswalk at the study intersection. They were more likely to stop if they increased their following distance from the car ahead, or if the pedestrian suddenly dashed across the crosswalk or stopped short to prevent a crash. The researchers

found that similar factors predicted how far drivers stopped prior to the crosswalk.

Even though they studied interactions at just one intersection with only law-abiding pedestrians, Figliozzi and Tipagornwong concluded that particular engineering measures would be helpful to improve the likelihood that vehicles would stop for pedestrians in the crosswalk. "Treatments or driver notifications that discourage accelerating—speeding up—towards the crosswalk would be most useful to increase compliance," they wrote.

They speculated that as cars become more intelligent, they might take the decision to comply with crosswalk laws out of the hands of drivers, enhancing safety for all.

CITATIONS

[1]Stephen P. Wall et al., "The Effect of Sharrows, Painted Bicycle Lanes and Physically Protected Paths on the Severity of Bicycle Injuries Caused by Motor Vehicles," *Safety* 2, no. 4 (2016): 26, doi:10.3390/safety2040026.

[2]Morteza Asgarzadeh et al., "The Role of Intersection and Street Design on Severity of Bicycle-Motor Vehicle Crashes," *Injury Prevention*, November 9, 2016, doi:10.1136/injuryprev-2016-042045.

[3]Miguel A. Figliozzi and Chawalit Tipagornwong, "Pedestrian Crosswalk Law: A Study of Traffic and Trajectory Factors That Affect Non-Compliance and Stopping Distance," *Accident Analysis & Prevention* 96 (2016): 169–79, doi:10.1016/j.aap.2016.08.011.

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