Accident Analysis and Prevention 120 (2018) 74–82

Contents lists available at ScienceDirect

Accident Analysis and Prevention

journal homepage: www.elsevier.com/locate/aap

Bike lanes next to on-street parallel parking

Paul Schimek

Effective Data Associates, 50 Saint Rose Street, Boston, MA, 02130, United States

ARTICLE INFO

Keywords:
Bicycle
Bicycling
Bike lanes
Separated bike lanes
Cycle tracks
On-street parking

ABSTRACT

For decades it has been the conventional wisdom that crashes involving bicyclists and opening car doors are rare. This belief is based on motor vehicle crash reports, but these reports generally exclude this crash type by definition. More complete sources show that dooring crashes are one of the most common causes of urban bicycle-motor vehicle collisions, accounting for 12%–27% of the total.

This paper reviews all available studies of bicyclist position in bike lanes adjacent to on-street parking. With bike lanes meeting current minimum standards, almost all bicyclists were observed riding within range of opening doors. However, when an additional three or four feet is provided between the bike lane and parked cars, hardly any bicyclists are observed in the door zone.

All of the design guides recently developed in North America for *separated* bike lanes include a buffer to account for the door zone when the bike lane is placed between on-street parallel parking and the curb. However, only the Ontario design guide has a similar requirement for *standard* bike lanes. The buffer requirement for standard bike lanes adjacent to on-street parking should be incorporated into all design guidance.

When there is not room for this necessary buffer, an alternative is to place a shared lane marking in the center of the travel lane, which encourages bicyclists to ride outside the door zone. Increasing the number of bicyclists who ride outside of the door zone may require lowering speed limits and repealing laws that create a presumption that bicyclists must always keep to the right of the travel lane.

1. Introduction

There has been a large increase in the number of marked bike lanes in North American cities in the past two decades. Many of these lanes have been added in older urban areas, where arterials often have on-street parking. One of the motivations for marking bike lanes is to make bicyclists feel welcome on city streets. However, government agencies and bicyclist organizations routinely warn bicyclists about the danger of suddenly opened door of a parked car – a problem known as "dooring" – even when bicyclists are using bicycle lanes.

How frequently do bicyclists strike the opened door of a parked car? A recent paper argues that "past studies have shown that dooring crashes are a rare form of bicycle crash and are not relatively dangerous" (Ferenchak and Marshall, 2016). Is this contention supported by available data? This article reviews (a) the available data on dooring crashes to determine their prevalence; (b) studies that include observational data on bicyclist position with respect to on-street parking in the presence of different lane widths and markings; and (c) design guidance for separated and ordinary bike lanes to determine how they account for the "door zone." (This article is concerned only with *parallel* on-street parking. *Angle* on-street parking does not present a dooring hazard for bicyclists, although it does present a backing hazard, particularly with the more common back-out design.)

2. Prevalence of collisions with car doors

The main source of U.S. data on bicyclist crashes is the National Highway Traffic Safety Administration, which provides both a nationally representative sample of police-reported crashes and a complete inventory of road fatalities. However, both databases are restricted to crashes involving a *motor vehicle in transport*. Bicycles are not "motor vehicles" and parked motor vehicles are not "in transport." Therefore, dooring collisions are excluded by definition from these national databases, as well as from U.S. state crash databases. This exclusion may not be clear to data users, since in some datasets a few of these crash types are included, possibly inadvertently. For example, the NHTSA General Estimates System includes the Pedestrian and Bicycle Crash Analysis Tool (PBCAT) code for "Bicyclist Overtaking - Extended Door", and two out of the 3437 bicycle-car collisions in the 2015 sample (less than 0.1%) were assigned this code (Harkey et al., 1996). North Carolina is the only U.S. state that routinely codes police-reported crashes using the PBCAT system. Of the more than 17,000 North Carolina

E-mail address: paul.schimek@effectivedataassociates.com.

https://doi.org/10.1016/j.aap.2018.08.002
Received 5 April 2018; Received in revised form 2 August 2018; Accepted 2 August 2018

bicycle-car collisions between 1997 and 2014, only 36 were coded as Extended Door, or 0.2% (North Carolina DOT, 2018). A Wisconsin study coded officially-recorded motor vehicle crashes involving bicyclists for the year 2003 using the PBCAT system (Amsden and Huber, 2006). Only four out of the 1112 incidents were Extended Door, or 0.4%. These sources give the misleading impression that dooring crashes are exceedingly rare, but in fact they are excluded by definition from the sample universe and are only accidentally included. There is no warning in these sources that dooring crashes are undercounted.

Denver, Colorado conducted a bicyclist crash study using data from state crash forms that found that only 1.7% of bicycle-motor vehicle (BMV) collisions involved dooring (Denver Public Works, 2016). However, the Colorado state crash reporting form specifically says that "A bicycle accident is not a traffic accident unless it involves a motor vehicle in motion, regardless of injury. When a cyclist is involved in an accident on a bicycle only, and is injured, it is not a traffic accident.. . . When a cyclist collides with a parked vehicle, it is not a traffic accident" (Colorado State Traffic Records Traffic Advisory Committee, 2006). Therefore as with the U.S. national and North Carolina data, this does not accurately represent the true prevalence of this crash type.

Despite the exclusion of dooring crashes from motor vehicle crash data, there are other sources on its prevalence, which are summarized in Table 1. Dooring was the first, second, or third largest crash type in the sources that provided detailed analysis of crash type. Dooring should therefore be viewed as a highly significant BMV crash type, at least in areas with on-street parking.

3. Severity of injury due to opening doors

There are several ways in which a suddenly opening door can cause injuries. The bicyclist could come into contact with the door, which presents a sharp edge that could produce a cutting injury. If the bicyclist hits the center of the door with force, he or she could break the window glass. Contact with the door is almost certain to cause a fall, which can produce injuries via a collision with the asphalt. A bicyclist who falls can end up suddenly in the path of an approaching motor vehicle, with no time for the driver to stop; these incidents can be fatal. Even a small overlap between the end of the bicycle handlebars and the open door can cause the front wheel to turn suddenly to the right, which will immediately send the bicycle and rider to the left, into the path of approaching traffic.

With regard to injury severity, the Toronto study observed that for dooring crashes, "the injuries sustained were often more severe than average" and concluded that, combined with its frequency, "this type of crash would appear to be a very serious concern for urban cyclists" (City of Toronto Works and Emergency Services Department, 2003). Transport for London reports that cyclists hit by car doors (or swerving to avoid them) tied for the second largest category of *serious* bicyclist injuries in London, representing about twice as many serious injuries as cases of bicyclists hit from the rear (Transport for London. Surface Transport, 2011). The University of British Columbia Cycling in Cities study of hospitalized bicyclists in Toronto and Vancouver found a 60% greater odds of serious injury when bicyclists were using roads with on-street parking compared to roads without[1] (Teschke et al., 2012). More than one out of four bicycle-motor vehicle collisions in the study were dooring collisions.

[1] Calculated by the author based on data reported in Table 4 of the paper. There was a reported safety benefit of bike lanes only when comparing streets with bike lanes but *without on-street parking* to streets without bike lanes but *with on-street parking*. The presence or lack of on-street parking explains all of their finding that bike lanes were safer.

4. Preventing collisions with car doors

There are several ways dooring collisions can be prevented. Automobile occupants should look before opening a door: 41 of 50 U. S. states and eight of 10 Canadian provinces prohibit the opening of a door of a motor vehicle if it is unsafe to do so. Between 2013 and 2016, Virginia became the 41st U.S. state to adopt this rule and Quebec, British Columbia, and Ontario and the City of Chicago increased the fine for violating this rule, with the aim of reducing dooring collisions. However, after dark an approaching bicyclist failing to use a required headlight can be difficult to see. Based on the prevalence of dooring, it appears that even if most motorists look before opening a door, sufficient numbers do not, despite a legal requirement to do so.

It is sometimes argued that the bicyclist should be responsible for stopping in time. When a door opens, stopping sight distance is a function of the bicyclist's speed and the distance between the bicyclist and an open door. Since a door can be opened very quickly, there is no speed at which a bicyclist can be sure to avoid a suddenly opened door that is within range of any part of the bicycle or rider. If the bicyclist can see that a car is unoccupied, he or she can be sure that there is no dooring hazard. But seeing inside vehicles is not reliable at night nor with vehicles that have tinted glass. In one case, a bicyclist was struck when a driver lying on his side kicked open the car door (Edelman, 2014).

Almost all bicycle safety materials produced by states, cities, and advocacy groups recommend that bicyclists *always* stay a door's width away from parked cars, often specifying a distance of three or four feet. However, 44 U.S. states and six Canadian provinces require bicyclists to keep as close to the right edge of the roadway as "practicable" or "safe" (depending on the specific wording). Many of these statutes include an exception that permits bicyclists to leave the right edge "when reasonably necessary to avoid conditions including, but not limited to, fixed or moving objects, parked or moving vehicles, bicycles, pedestrians, animals, surface hazards, or substandard width lanes that make it unsafe to continue along the right hand curb or edge." While it is obvious that an open door constitutes a "condition" under this exemption, it is less obvious that the exemption applies to the *possibility* of a suddenly opening door. For example, when Long Beach (Calif.) sought permission from the California Traffic Control Devices Committee to experiment with an enhanced shared lane marking designed to encourage bicyclists to ride outside the door zone, "committee members had concerns over a California Vehicle Code provision that requires bicyclists to ride as far to the right as is reasonably safe" (KOA Corporation, 2010).

Five U.S. states, including three of the largest (California, New York, and Florida) have statutes explicitly requiring bicyclists to use bike lanes. Although these statutes generally have exceptions similar to those of the right edge of the roadway statutes, they may amplify the social pressure, sometimes backed up by police actions, for bicyclists to stay in the bike lane even if that means riding within range of open doors.

5. Bicyclist position with on-street parking

How does the presence of bike lanes or other pavement markings affect the position of bicyclists? Are there changes that can be made to keep bicyclists out of the door zone? There are a number of studies that have examined how bicyclist position in relation to parked cars is affected by bike lanes of various dimensions and by shared lane markings placed at various distances from the curb. Before reviewing these studies, it is necessary to determine where bicyclists must operate to be clear of opening doors.

5.1. Extent of the door zone

To determine if the bicyclist is outside the door zone one must know