

Best Bicycle Driving Practices and North Carolina Law

North Carolina’s existing traffic laws for drivers of vehicles are well aligned with best bicycling practices. This article describes how our existing laws support defensive bicycle driving as recognized by road cycling safety experts and taught by certified traffic bicycling instructors in North Carolina and throughout North America.

Safety Strategy

Examination of bicyclist behaviors and the types, frequency and causes real-world bicycling crashes (failure mode analysis) allows identification of the most successful practices for bicycle travel, as well as behaviors to avoid. This knowledge has been incorporated into our state traffic laws to promote safety, efficiency and fair access to public ways. The basic rules of movement for all drivers of vehicles were designed and perfected over time to minimize collisions between vehicle operators while providing reasonable efficiency of movement. We apply this process (Figure 1) to evaluation of bicycle laws.

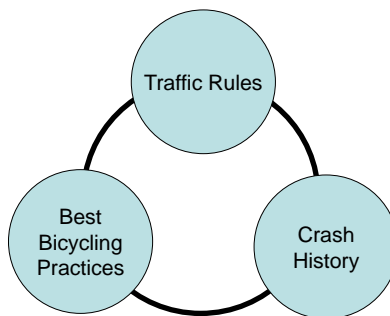


Figure 1: Evaluation and improvement of best practices and traffic laws

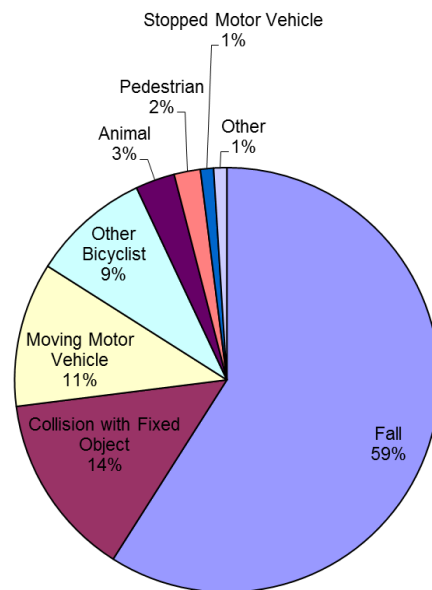


Figure 2: Types of bicycling crashes nationwide [Data from Moritz, 1998]

Most bicyclist injury crashes are single-vehicle incidents (see Figure 2). 73% of adult bicyclist crashes are either falls (59%) or collisions with fixed objects (14%) according to a nationwide survey of cyclists¹. Per mile of bicycling, falls are more likely to occur off-road, on paths, and on sidewalks than on roadways, which are designed for travel by wheeled vehicles. Falls are also more common at the edge of the roadway than away from the edge.

Most bicyclist collisions with motor vehicles in North Carolina occur at intersections, driveways, and other crossing locations². This is especially true in urban areas of NC, where most bicycle trips occur. Figure 3 shows the relative frequency of different bicycle-motor vehicle collision types in urban areas of NC.

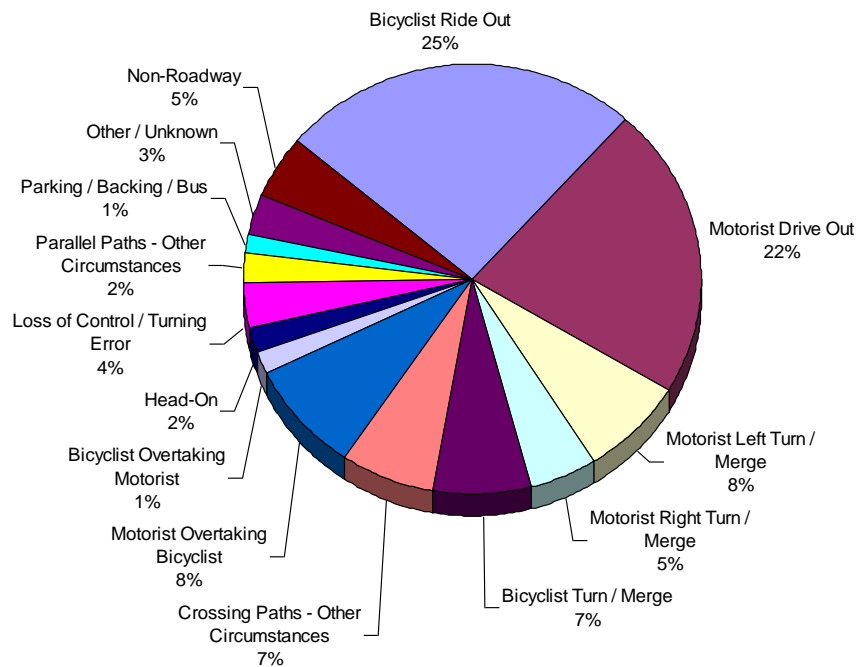


Figure 3: Urban bicycle-motor vehicle collisions in NC [from NCDOT PBCAT database query]

Rural areas feature fewer junctions per mile, higher posted maximum speed limits, and narrower roads than urban areas. As a result, the percentage of bicycle collisions that involve same-direction motorists overtaking is greater in rural areas (29%) than in urban areas (8%). Most overtaking-type car-bike collisions in North Carolina happen in rural areas.

These crash statistics indicate the importance of the role that intersection and crossing movements play in bicyclist safety, and the attention they warrant in evaluation of the rules of movement. The challenges presented by intersection and crossing movements are similar for drivers of bicycles, motorcycles, automobiles and other wheeled vehicles, because they share similar perceptual, cognitive and kinematic constraints. The basic rules of the road that have been shown to minimize these crashes for drivers of other vehicles have the same benefits for bicyclists. This is why

¹ Moritz, W. Adult Bicyclists in the United States: Characteristics and Riding Experience in 1996. Transportation Research Record 1636: pp. 1-7, 1998

² http://www.pedbikeinfo.org/pbcat_nc/_bikequery.cfm

bicyclists are assigned the rights and duties of drivers of vehicles in all 50 states and in most of the developed world.

Bicyclists are not pedestrians, who have superior maneuverability and near zero stopping distance. The crash rate for sidewalk cycling is several times higher, per mile, than cycling in the roadway^{3 4}. Although state law requires other drivers to yield to bicyclists on sidewalks as they would to pedestrians, sidewalk cyclists often surprise motorists at intersections and are less able than pedestrians to stop quickly when conflicts arise at street corners and crosswalks. Some municipalities have local ordinances that prohibit bicycling on sidewalks.

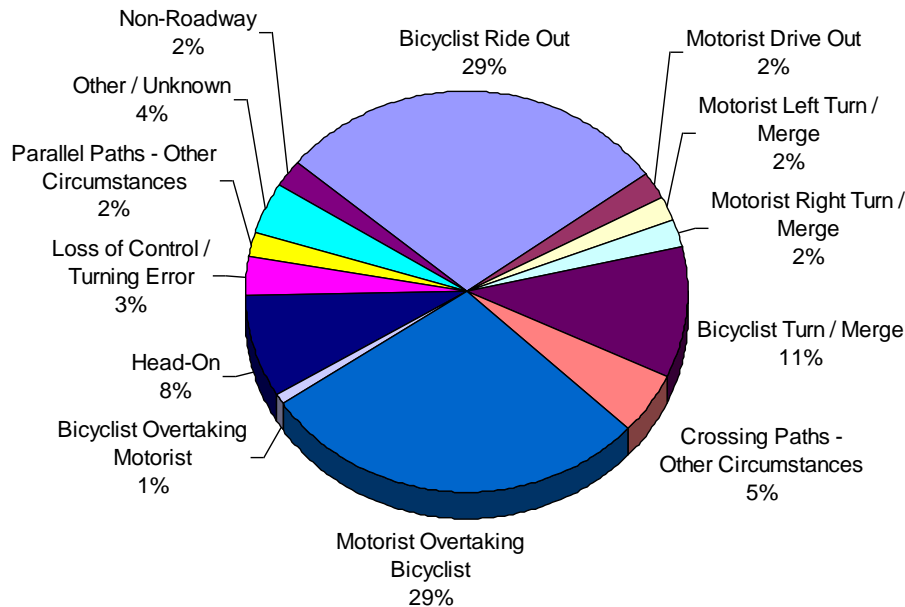


Figure 4: Rural bicycle-motor vehicle collisions in NC [from NCDOT PBCAT database query]

Legal Definitions

Existing state law clearly defines bicycles as vehicles, and defines bicyclists as having the responsibilities of drivers of vehicles. State law separately defines a motor vehicle as being self-propelled, i.e. motorized. “Motor vehicles” are by definition a subset of “vehicles.”

§ 20-4.01(49) Vehicle. – ...for the purposes of this Chapter bicycles shall be deemed vehicles and every rider of a bicycle upon a highway shall be subject to the provisions of this Chapter applicable to the driver of a vehicle except those which by their nature can have no application.

§ 20-4.01(23) Motor Vehicle. – Every vehicle which is self-propelled and every vehicle designed to run upon the highways which is pulled by a self-propelled vehicle.

³ Wachtel, A. and Lewiston, D. Risk Factors for Bicycle-Motor Vehicle Collisions at Intersections; ITE Journal, September, 1994

⁴ Moritz, W. Adult Bicyclists in the United States: Characteristics and Riding Experience in 1996. Transportation Research Record 1636: pp. 1-7, 1998

Determination of whether or not a state law applies to bicyclists is straightforward. If the law says “motor vehicle” then it does not apply to bicyclists or bicycles. If the law only says “vehicle” then it applies to all vehicles including bicycles and animal-drawn vehicles. The basic rules of movement aka “rules of the road” for drivers generally apply to all vehicles including bicycles. Some special laws are written to apply only to motor vehicles, typically due to their greater inherent danger to the public.

Basic Rules of the Road

The basic rules of movement for all drivers of vehicles are often summarized in bicycle driver safety courses (such as BikeWalk NC’s *Traffic Bicycling* class) as follows:

- 1. First come, first served**
- 2. Drive on the right half of the road**
- 3. Stop/yield before entering a more important roadway**
- 4. Yield before moving laterally**
- 5. Destination positioning at intersections**
- 6. Speed positioning between intersections**

The following are explanations of these basic rules and how they are specified in North Carolina’s traffic laws.

1. First Come, First Served

Each driver who is already on the road is entitled to the space their vehicle occupies, plus reasonable clearance behind and to each side, and reasonable stopping distance in front of them. Drivers must yield to other drivers already on the road in front of them, which requires them to limit their speed and be prepared to slow or stop for other traffic ahead.

§ 20-141. Speed restrictions. (a) No person shall drive a vehicle on a highway or in a public vehicular area at a speed greater than is reasonable and prudent under the conditions then existing. ... (m) The fact that the speed of a vehicle is lower than the foregoing limits shall not relieve the operator of a vehicle from the duty to decrease speed as may be necessary to avoid colliding with any person, vehicle or other conveyance on or entering the highway, and to avoid injury to any person or property.

§ 20-140. Reckless driving. (b) Any person who drives any vehicle upon a highway or any public vehicular area without due caution and circumspection and at a speed or in a manner so as to endanger or be likely to endanger any person or property shall be guilty of reckless driving.

Most drivers have no difficulty limiting their speed and seeing and slowing in time to avoid hitting vehicles traveling slowly ahead on the roadway. Impaired driving, reckless driving, distracted driving and bicycling at night without an adequate rear light or reflector are the primary contributing factors in car-bike collisions where motorists fail to slow in time to avoid rear-ending slower bicyclists.

2. Drive on Right Half of the Road

Driving on the right half of the road prevents head-on collisions and avoids surprising other drivers at junctions.

§ 20-146. Drive on right side of highway; exceptions. (a) Upon all highways of sufficient width a vehicle shall be driven upon the right half of the highway except as follows: (1) When overtaking and passing another vehicle proceeding in the same direction under the rules governing such movement; (2) When an obstruction exists making it necessary to drive to the left of the center of the highway; provided, any person so doing shall yield the right-of-way to all vehicles traveling in the proper direction upon the unobstructed portion of the highway within such distance as to constitute an immediate hazard; (3) Upon a highway divided into three marked lanes for traffic under the rules applicable thereon; or (4) Upon a highway designated and signposted for one-way traffic.

About 1/3 of bicycle-automobile collisions involve a bicyclist traveling on the left half of the road or otherwise opposite the expected direction of vehicle traffic.

3. Stop/Yield Before Entering a More Important Roadway

Drivers entering a roadway or crossing another roadway that has been assigned priority by a traffic control device must yield to the traffic that has priority. Stopping improves the reliability of the yield by increasing the amount of time that the driver has to see and recognize approaching traffic while in a position of superior vantage.

§ 20-158. Vehicle control signs and signals. (b) Control of Vehicles at Intersections. – (1) When a stop sign has been erected or installed at an intersection, it shall be unlawful for the driver of any vehicle to fail to stop in obedience thereto and yield the right-of-way to vehicles operating on the designated main-traveled or through highway. When stop signs have been erected at three or more entrances to an intersection, the driver, after stopping in obedience thereto, may proceed with caution. (2) a. When a traffic signal is emitting a steady red circular light controlling traffic approaching an intersection, an approaching vehicle facing the red light shall come to a stop and shall not enter the intersection. After coming to a complete stop and unless prohibited by an appropriate sign, that approaching vehicle may make a right turn. b. Any vehicle that turns right under this subdivision shall yield the right-of-way to: 1. Other traffic and pedestrians using the intersection; and 2. Pedestrians who are moving towards the intersection, who are in reasonably close proximity to the intersection, and who are preparing to cross in front of the traffic that is required to stop at the red light.

§ 20-156. Exceptions to the right-of-way rule. (a) The driver of a vehicle about to enter or cross a highway from an alley, building entrance, private road, or driveway shall yield the right-of-way to all vehicles approaching on the highway to be entered.

The most common types of bicycle-motor vehicle collisions are junction crashes are where (1) a motorist drives out in front of a through bicyclist (usually a bicyclist on a sidewalk) or (2) a bicyclist (usually a child bicyclist) rides out in front of a through motorist.

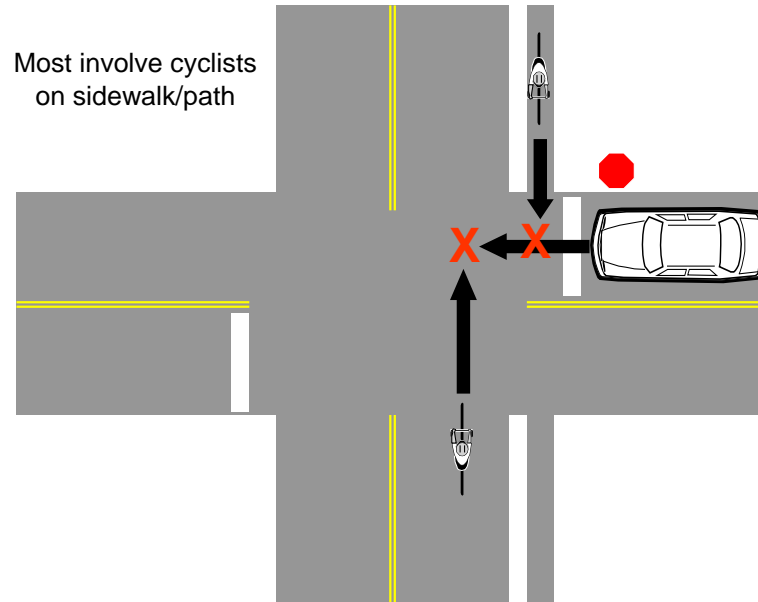


Figure 5: Drive-out collisions are the most common type of car-bike crash occurring to adult bicyclists. Most involve bicyclists riding on sidewalks or other paths parallel to the roadway.

4. Yield before Moving Laterally

Drivers must yield to traffic in the adjacent line of travel before moving laterally on the roadway. Yielding means looking back to see if overtaking traffic is close enough to pose a collision danger.

§ 20-146. (d) (1) A vehicle shall be driven as nearly as practicable entirely within a single lane and shall not be moved from such lane until the driver has first ascertained that such movement can be made with safety.

Bicyclists must change their position on the roadway when approaching turns, when passing, and when avoiding hazards. This includes lane changes as well as lateral movement within a single lane.

The first-come-first-served, yield-before-entering, and yield-before-moving laterally rules all imply a corollary rule that drivers must yield to oncoming traffic before turning left. Eight percent of urban car-bike crashes involve a motorist failing to yield before making a left turn across the bicyclist's path. This is similar to a common crash type for motorcyclists. Narrow vehicles may be less likely to be noticed, or drivers may misjudge arrival time.

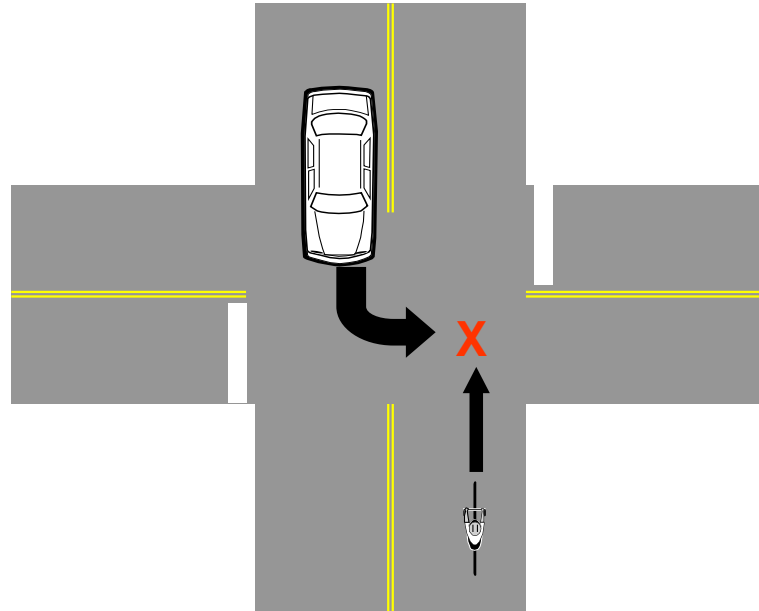


Figure 6: Left cross collision

5. Destination Positioning at Intersections

Drivers use the right side of the roadway for a right turn, use the center of the roadway for a left turn, and use a position between these extremes for straight travel. Drivers use the proper lane if lanes are marked for destinations.

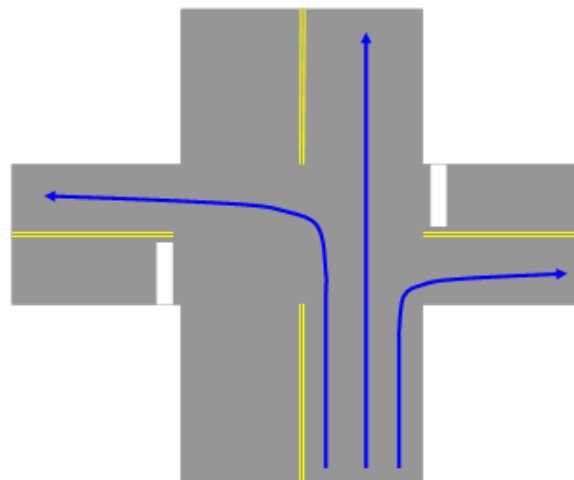


Figure 7: Destination positioning when approaching intersections eliminates crossing conflicts for the different movements

§ 20-153. Turning at intersections. (a) Right Turns. – Both the approach for a right turn and a right turn shall be made as close as practicable to the right-hand curb or edge of the roadway. (b) Left Turns. – The driver of a vehicle intending to turn left at any intersection shall approach the intersection in the extreme left-hand lane lawfully available to traffic moving in the direction of travel of that vehicle, and, after entering the intersection, the left turn shall be

made so as to leave the intersection in a lane lawfully available to traffic moving in the direction upon the roadway being entered.

Motorist-right-turn collisions with bicyclists usually involve thru bicyclists positioned to the right of right-turning motorists. Right-turning motorists should merge toward the curb on approach and not overtake cyclists just before turning. Bicyclists can also deter such collisions by positioning themselves farther from the roadway edge, and in-line with through traffic, when approaching an intersection.

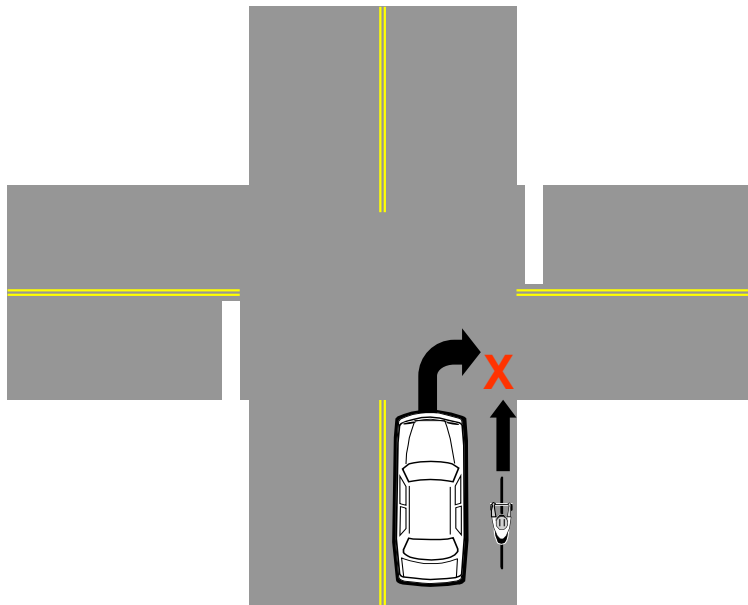


Figure 8: A right hook collision results from the failure of road users to use effective destination positioning on approach to an intersection or driveway.

A particularly dangerous right hook conflict occurs with large trucks and buses, which swing wide at intersections. A bicyclist in the driver's blind spot on the right can easily be knocked down and run over by the long vehicle's rear wheels. Large vehicle operators can reduce these risks by signaling right turns early and by not overtaking bicyclists before turning.

Bicyclists who turn left from the right edge of the road are prone to collisions with traffic passing on their left. Left-turning cyclists reduce the risk of colliding with passing traffic by merging to near the center of the road or into the appropriate left-turn-lane when approaching their turn. This also allows them to focus exclusively on traffic in front of them once they reach the turn.

6 Speed Positioning

Passing generally occurs on the left, not on the right, and only when it can be done safely. Drivers traveling below the maximum posted speed limit use the right hand through lane except when passing or preparing for a turn. If no lane is marked, slower drivers operate as far right as is safe and practical, except when passing or preparing for a left turn.

(a) Overtaking on Left

§ 20-149. Overtaking a vehicle. (a) The driver of any such vehicle overtaking another vehicle proceeding in the same direction shall pass at least two feet to the left thereof, and

shall not again drive to the right side of the highway until safely clear of such overtaken vehicle. This subsection shall not apply when the overtaking and passing is done pursuant to the provisions of G.S. 20-150.1.

(b) Limitations on Overtaking on Right

Bicyclists, like other drivers, may not overtake other traffic on the right except when in a separate marked travel lane.

§ 20-150.1. When passing on the right is permitted. The driver of a vehicle may overtake and pass upon the right of another vehicle only under the following conditions: (1) When the vehicle overtaken is in a lane designated for left turns; (2) Upon a street or highway with unobstructed pavement of sufficient width which have been marked for two or more lanes of moving vehicles in each direction and are not occupied by parked vehicles; (3) Upon a one-way street, or upon a highway on which traffic is restricted to one direction of movement when such street or highway is free from obstructions and is of sufficient width and is marked for two or more lanes of moving vehicles which are not occupied by parked vehicles; (4) When driving in a lane designating a right turn on a red traffic signal light. (1953, c. 679.)

The prohibition of overtaking on the right when not in a separate marked travel lane helps prevent right-hook collisions that can occur when a driver is turning right.

(c) Slower Traffic Use Right Thru Lane

Drivers shall use the right hand marked lane appropriate for their destination when traveling below the legal maximum posted speed limit, except when passing or preparing for a left turn. If no lane is marked, drivers shall operate as far right as is safe and practical, except when passing or preparing for a left turn.

§ 20-146. Drive on right side of highway; exceptions. (b) Upon all highways any vehicle proceeding at less than the legal maximum speed limit shall be driven in the right-hand lane then available for thru traffic, or as close as practicable to the right-hand curb or edge of the highway, except when overtaking and passing another vehicle proceeding in the same direction or when preparing for a left turn.

(d) Limitations on Privilege of Overtaking and Passing

Drivers are prohibited from passing when unsafe due to conflicting traffic or inadequate sight distance.

§ 20-150. Limitations on privilege of overtaking and passing. (a) The driver of a vehicle shall not drive to the left side of the center of a highway, in overtaking and passing another vehicle proceeding in the same direction, unless such left side is clearly visible and is free of oncoming traffic for a sufficient distance ahead to permit such overtaking and passing to be made in safety. (b) The driver of a vehicle shall not overtake and pass another vehicle proceeding in the same direction upon the crest of a grade or upon a curve in the highway where the driver's view along the highway is obstructed within a distance of 500 feet. (c) The driver of a vehicle shall not overtake and pass any other vehicle proceeding in the same direction at any railway grade crossing nor at any intersection of highway unless permitted so to do by a traffic or police officer. For the purposes of this section the words

"intersection of highway" shall be defined and limited to intersections designated and marked by the Department of Transportation by appropriate signs, and street intersections in cities and towns. (d) The driver of a vehicle shall not drive to the left side of the centerline of a highway upon the crest of a grade or upon a curve in the highway where such centerline has been placed upon such highway by the Department of Transportation, and is visible.

Defensive Bicycle Driving

Defensive bicycle driving means going beyond the minimum requirements of the law that prohibit a bicyclist from **causing** a crash. Defensive bicycle driving means using proactive techniques that can reduce the risk that **other drivers** will make errors that cause crashes.

Visibility and Conspicuity

Crash types such as drive out, left cross, right hook and motorist overtaking often occur to lawfully operating bicyclists when a motorist fails to see a bicyclist or register the bicyclist as relevant. Bicyclists can deter many such collisions by operating in a more conspicuous and relevant manner. This can be done by

1. Operating where the motorist is likely to be looking for traffic.
2. Operating where sight lines are less likely to be occluded.
3. Operating near the center of a travel lane when it is too narrow for a motor vehicle to pass within the same lane safely.
4. Operating side-by-side with another bicyclist.
5. Using good front and rear lights at night.

Conspicuous Lane Positioning

Riding away from the roadway edge, closer to the center of a travel lane, makes a bicyclist more likely to be seen by a motorist preparing to pull out from a side street or driveway, as shown below. Motorists typically look down the center of the lane for approaching vehicle traffic, and roadside clutter may occlude the view of a bicyclist near the edge of the road. Both the motorist and the bicyclist have more time to see and react to one another when the bicyclist is away from the edge.

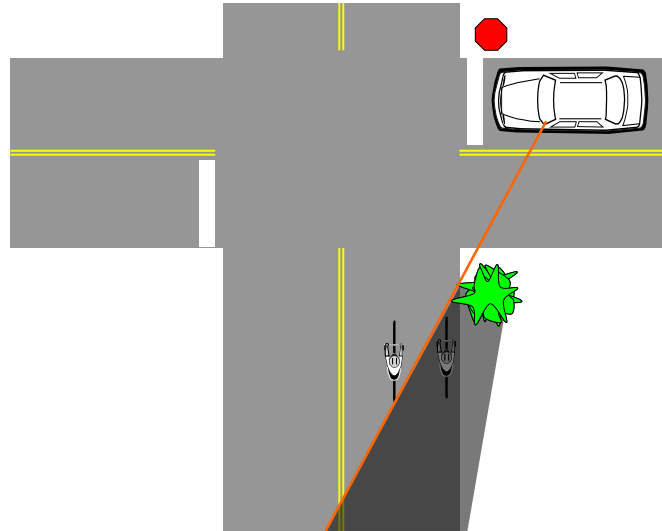


Figure 9: Drive-out screening effects at road edge versus conspicuity at lane center

A bicyclist operating away from the road edge is also less likely to be screened from the view of a left turning driver, as shown below:

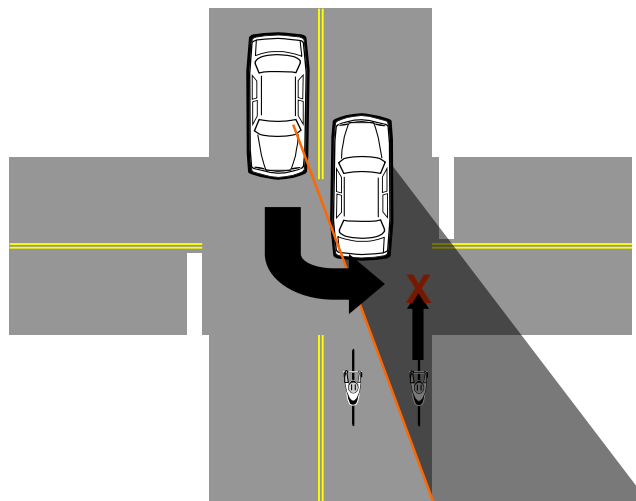


Figure 10: Left-cross screening effects at road edge versus better visibility farther left

Riding well away from the road edge deters motorists from passing immediately before turning right, or otherwise initiating right turns from a position to the left of the bicyclist. This is especially important around trucks, which must approach right turns with substantial distance between the cab and the curb. Right-turning trucks are an increasingly common cause of bicyclist fatalities in some urban areas of the US. Bicyclists can protect themselves from such conflicts by never passing on the right side of trucks and buses at intersections, and instead aligning themselves with other through traffic.

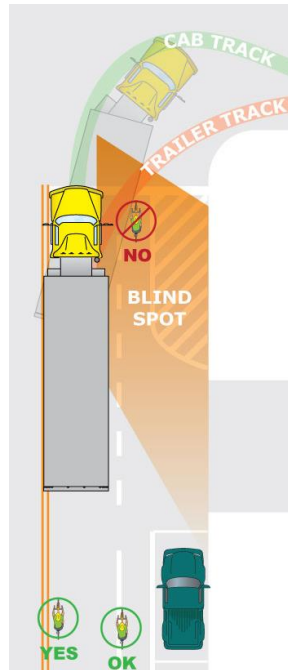


Figure 11: Staying away from the road edge when approaching an intersection, especially where traffic is queueing, deters right hook crashes. [Graphic by Keri Caffrey]

Lane Width Awareness

Most travel lanes are too narrow for a motorist and a bicyclist to operate side by side within the same lane safely; motorists must move into the adjacent lane to pass safely.



Figure 12: Scale drawing of a bicyclist and a pickup truck in a 10' wide lane. A bicyclist needs about four feet of operating space to maintain balance. There isn't enough room for a motorist to pass a bicyclist within the lane without risking a collision. [Graphic by Keri Caffrey]

For a typical car to pass a bicyclist at safe distance within the same lane, the clean, usable lane width must be at least fourteen feet wide. This accommodates a bare minimum of four feet of operating space for the bicyclist, a minimum 2-3 feet of clearance distance, and the width of the car. Few travel lanes are this wide. For a commercial truck, landscaping trailer, or transit bus to pass a bicyclist safely without changing lanes, the lane must be **at least sixteen feet wide**.



Figure 13: A minimum of 16 feet is required for safe same-lane passing of a bicyclist by a truck, transit bus, or landscaping trailer. [Graphic by Keri Caffrey]

Lane Control

When a bicyclist rides at the right edge of a narrow lane, many motorists will misjudge the available space and attempt to pass within the bicyclist's lane, risking a collision. Most daytime motor-vehicle-overtaking-bicyclist collisions involve a motorist who sees a bicyclist riding at the lane edge well in advance, but attempts to pass within the bicyclist's lane.

Knowledgeable bicyclists can deter unsafe same-lane passing by riding close to the center of the travel lane, known as **controlling the lane**. Operating near the lane center increases the bicyclist's visibility and provides a clear indication that other drivers must change lanes to pass. This causes drivers to slow down earlier and start planning their lane change from farther away, and consequently minimizes unsafe passing.



Figure 14: Controlling a travel lane by riding near its center deters unsafe same-lane passing and makes a bicyclist more visible to other drivers.

Bicyclists must consider a number of factors to determine whether conditions are acceptable to allow same-lane passing, including the range of widths of other vehicles that use the road, surface conditions at the edge of the lane, potential dooring conflicts with parked cars, and potential junction conflicts as previously described. Existing state law leaves it at the bicyclist's discretion to decide when to control a marked travel lane and when to ride at the right edge of the lane.

Avoiding the Door Zone

Dooring crashes occur when a parked vehicle occupant opens a door in front of a bicyclist traveling alongside the parked car. The bicyclist may be startled into suddenly swerving left into the path of an overtaking vehicle, or the bicyclist's handlebar may strike the door, throwing the bicyclist off the bike and leftward into the travel lane, landing on their head or back. Because a car door may be opened at any time, a bicyclist riding beside parked cars may not have time to look back and yield before moving to a safe position or to decelerate. Dooring is one of the most common causes of bicycling crashes in urban areas with lots of on-street parking, such as San Francisco⁵. The only reliable way to avoid dooring crashes is to avoid bicycling within five feet of parked cars.

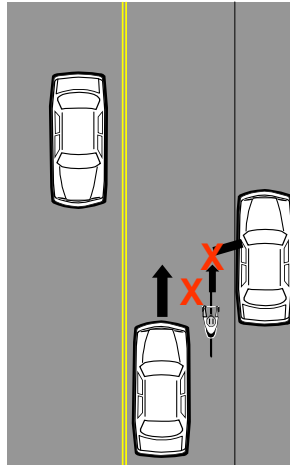


Figure 15: Dooring crashes include striking the door with the right handlebar, resulting in being thrown leftward into overtaking traffic, as well as being startled into swerving left suddenly.



Figure 16: To avoid the danger of being struck or startled by opening car doors on this street, a bicyclist must operate left of the solid white line.

Traffic Signs and Markings Related to Lane Control

As transportation planners and traffic engineers have become more aware of the safety benefits of bicyclists riding farther away from the lane edge, these professionals have begun using traffic control devices to encourage and endorse it in many locations. The Bicycles May Use Full Lane sign

⁵ "Pedalers in Peril: San Francisco's Most Dangerous Streets for Cyclists," Bay Citizen, February 7, 2011 <https://www.baycitizen.org/news/bikes/san-francisco-bike-accidents/#causes>

is a standard traffic sign (#R4-11) in the Manual of Uniform Traffic Control Devices that traffic engineers may use to remind motorists and bicyclists of bicyclists' legal rights on roads with narrow lanes or where edge bicycling may otherwise be hazardous.



Figure 17: R4-11 sign (MUTCD)

Another device is the “shared lane marking,” aka “sharrow” stencil, a standard marking which may be applied to roadways in areas where it is particularly useful for bicyclists to ride farther away from the road edge, such as where lanes are narrow. The City of Raleigh has installed shared lane markings in the center of many travel lanes that are narrower than 14 feet.



Figure 18: Shared Lane Marking in the center of a travel lane on Saint Mary's Street, Raleigh

Note that R4-11 signs and Shared Lane Markings do not assign bicyclists the right to use a full lane. In North Carolina, bicyclists have the legal discretion to decide when to use a full lane, because they have the exact same right to a marked lane as other drivers of vehicles under state law. Some states have discriminatory bicycle-specific laws that require bicyclists to ride at the right edge of a marked lane, where motorists will try to squeeze by them at unsafe distance, risking collisions. North Carolina has no such law.

“Bicyclists usually ride on the right side of the lane, but are entitled to use the full lane.... Drivers wishing to pass a bicyclist may do so only when there is abundant clearance and no oncoming traffic is in the opposing lane. When passing a bicyclist, always remember the bicyclist is entitled to use of the full lane.” – North Carolina Driver’s Handbook, p.p. 77-78.⁶

A motorist may pass within the same lane as a bicyclist when it is safe to do so and the bicyclist has moved to the right side of the lane. Bicyclists are usually happy to extend this courtesy when it is safe to do so and provides a significant net benefit to the motorist.⁷

⁶ NC Driver Handbook, http://www.ncdot.gov/download/dmv/handbooks_ncdl_english.pdf

⁷ “What Is a Courteous Cyclist?” <http://iamtraffic.org/education/courteous-cyclist/>

Operating Side-by-Side

Riding double file, aka two abreast, is a common defensive bicycle driving technique used by groups of bicyclists⁸. Compared to single file, a double file formation makes the group more visible from the front and behind, and shortens the length of the group by half. This greatly reduces the likelihood of drive out, left cross, right hook, and motorist-overtaking crashes.

Experienced cyclists report fewer too-close passes and other near-collisions when riding double file than when riding single file near the edge of a narrow lane. Although double-file cycling is popular, actual rear-end collisions involving cyclists riding double file are extremely rare. The vast majority of overtaking-type crashes involves solo or single file cyclists at the roadway edge. Bicycling groups riding two abreast in daylight are highly conspicuous, making it easy for same-direction motorists to see them and slow in time. The few media-reported crashes involving double-file cyclists in North America generally result from hazards in front of the group, such as head-on collisions involving impaired drivers careening onto the wrong side of the road.

Riding double file helps motorists make the right decision when overtaking on a narrow-laned road. The figure below depicts what a motorist sees when approaching cyclists from behind. Edge bicycling encourages motorists to imagine passing within the same lane when they aren't close enough to judge the space accurately. Riding double file makes it clear from a long distance away that there isn't room, so motorists can start planning safe maneuvers early.

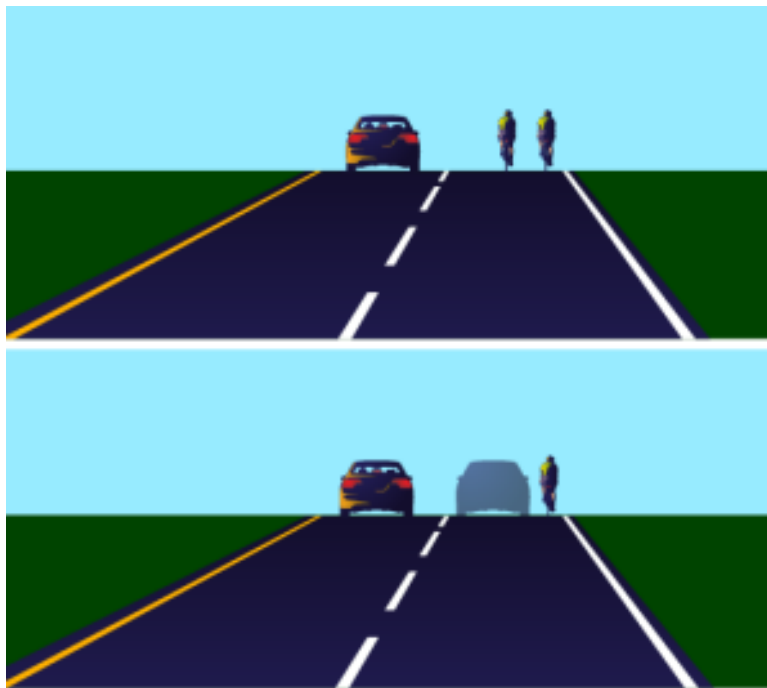


Figure 19: Motorist perception of bicyclist position and available passing space. [Graphic by Keri Caffrey]

When cyclists operate in a disciplined, cooperative manner, they pose less danger to other bicyclists and are less likely to surprise motorists. Unfortunately, some groups ride in a disorganized and chaotic fashion, with bicyclists drifting or swerving about unpredictably, even crossing lane lines

⁸ "Why Cyclists Ride Two Abreast" <http://www.bikewalknc.org/2015/04/why-cyclists-ride-two-abreast/>

without looking for or yielding to other traffic. This creates uncertainty and stress for everyone, including other bicyclists. Riding on the lane edge or suddenly moving into the next lane without first looking and yielding is a violation of § 20-146. (d) (1):

§ 20-146. (d) (1) A vehicle shall be driven as nearly as practicable entirely within a single lane and shall not be moved from such lane until the driver has first ascertained that such movement can be made with safety.

Bicyclists riding beside others must do so in compliance with the slower traffic law, § 20-146 (b), which means they must usually stay in the right hand marked thru lane except when passing or preparing to turn left. Cyclists riding in a paceline for efficiency must occasionally rotate positions when the lead bicyclists get tired. Rotation involves the rest of the group passing the former leaders after the leaders have looked back to ensure that the movement can be done in safety. When a double paceline rotates, the group will temporarily appear three or four across as the leaders drop back, but this maneuver can and should be executed within a single marked lane.

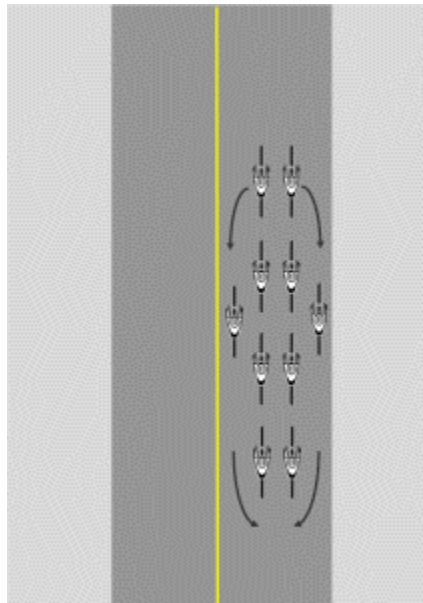


Figure 20: Double file paceline rotation within a single marked travel lane. The leaders may drop back on opposite sides of the group if there is space, or on the same side if the lane is particularly narrow and they start the rotation together.

When conditions are safe to encourage passing without a lane change on two lane roads, such as where there is a wide shoulder in good condition away from intersections, most cycling groups will single up as a courtesy to other drivers. Group riders must make this decision cautiously. If the usable pavement narrows again before motorists have completed passing, cyclists may get sideswiped or a motorist may need to merge into the middle of the group. Communication, coordination and time are required for a group to transition between road positions and formations. As a result, cycling groups cannot exploit short-distance opportunities to facilitate motorist passing as easily as solo bicyclists can.

Lights at Night

A white headlamp plus red rear lamp or red rear reflector are legally required for bicycling at night on any public way.

§ 20-129. Required lighting equipment of vehicles. (e) Lamps on Bicycles. – Every bicycle shall be equipped with a lighted lamp on the front thereof, visible under normal atmospheric conditions from a distance of at least 300 feet in front of such bicycle, and shall also be equipped with a reflex mirror or lamp on the rear, exhibiting a red light visible under like conditions from a distance of at least 200 feet to the rear of such bicycle, when used at night.

In North Carolina, night collisions represent a quarter of all car/bike crashes, half of bicyclist fatalities, and half of all overtaking collisions⁹. Most night collisions involve bicyclists not using lights. Most of these collisions occur at intersections, where motorists drive out or turn left in front of the bicyclist.¹⁰ Bicyclists need headlamps to be seen at junctions. Drivers who are preparing to enter or cross a road will often not see the front or side reflectors of an approaching bicyclist, because their headlamps do not illuminate them in time.¹¹

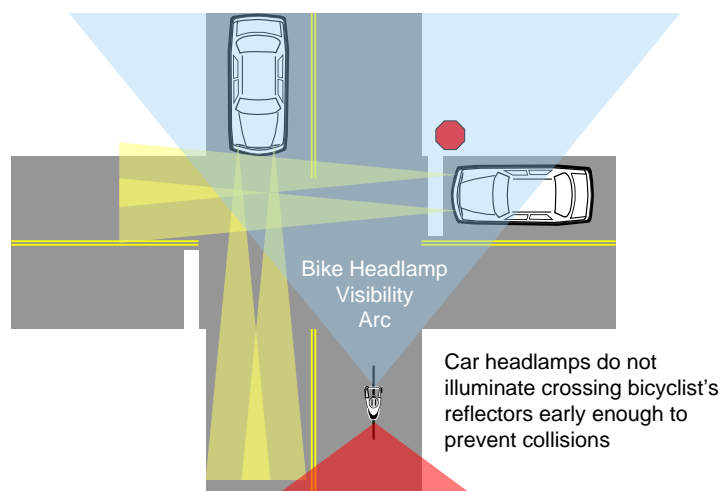


Figure 21: A headlamp is required for visibility at intersections

The stock rear reflectors sold on new bicycles are small and suffer from poor visibility in a number of situations, including off-angle conditions where drivers are turning at intersections, and on high speed roads such as urban thoroughfares and rural highways. At 45 mph, a typical driver's stopping distance is nearly 200 feet when including bare minimum reaction time and assuming emergency-mode *maximum braking*.¹² The state's legal requirement that a rear reflector be visible from just 200 feet behind the bicycle is inadequate when one considers driver distraction and visual clutter in the road environment. BikeWalk NC recommends that every bicyclist traveling at night use a modern LED rear lamp, mounted rigidly to the bicycle and aimed properly, in addition to a white headlamp¹³. Such rear LED lamps are much brighter than stock reflectors when viewed at range,

⁹ http://www.pedbikeinfo.org/pbcat_nc/_bikequery.cfm

¹⁰ John Schubert, "Why Reflectors Don't Work," <http://www.sheldonbrown.com/reflectors.html>

¹¹ John Allen, "About Bicycle Reflectors," <http://www.bikexpert.com/bicycle/reflectors/>

¹² <http://www.driveandstayalive.com/Info%20Section/stopping-distances.htm>

¹³ "Bicycling at Night," <http://www.bikewalknc.org/2014/05/bicycling-at-night/>

Attachment to BikeWalk NC Recommendations on North Carolina Traffic Laws

when headlamps are not pointed directly at them, or when a driver's headlamp is not operating. A typical LED bicycle tail lamp is visible from over 1000 feet behind the bicycle.