

INTRODUCTION TO INFORMATION ABOUT COMMON HIGH COLLISION PATTERNS

That May Be Used to Further Bike and Pedestrian Safety
Work

FOR PRESENTATION TO SEATTLE BIKE ADVISORY BOARD
September 17, 2024

MIKE MORRIS-LENT, PE

OBJECTIVES OF THIS PRESENTATION

1. Present SDOT's annual process for its High Collision Location program work
2. Introduce the set of Collision Patterns presented on the site **acrashcourse.net**
3. Why this information is significant to the Bike Board
4. A walk-through of one of the patterns presented on the site
5. Practical Applications of this work/Potential ways the Bike Board might use this information

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ABOUT MYSELF

I'm a PE.

I'm retired from SDOT, where I worked for 30 years.

The major focuses of my work while with SDOT included:

- Community outreach-related work and
- Work with traffic safety

My Work With High Collision Locations

For the purpose of our discussion, I am a former manager of SDOT's High Collision Location program.

I worked with the city's High Collision Location program for about 10 years, I was the program's lead for about 6 years.

SDOT'S ANNUAL HIGH COLLISION LOCATION PROGRAM

SDOT has a process that, in an annual way—

- Identifies locations that have way more than their share of collisions,
- Performs a preliminary review of them
- Based on their preliminary reviews, discusses and prioritizes them for full review
- Full reviews are performed
- And based on these, the program designs and makes street-related changes (the nuances of which can take many years to do right) to address the safety issues at these locations and
- In following years, the program monitors how these improvements are working

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The types/categories of locations worked on by Seattle's High Collision Location Program include—

High Collision Signalized Intersections

(These are defined as signalized intersections having 10 or more reported collisions within a one year period—typically the previous calendar year)

High Collision Non-Signalized Intersections

(5 or more reported collisions the previous year)
Often these are stop sign-controlled intersections.

High Collision Mid-Block Locations

(5 or more reported collisions the previous year)

Bike High Collision Locations

(location having 5 or more reported bike collisions over the previous 3 year period)

Pedestrian High Collision Locations

(location having 5 or more reported pedestrian collisions over the previous 3 year period)

P.5.2 “TAKE-AWAYS”

SUMMARY OF SDOT’S HIGH COLLISION LOCATION WORK

1. SDOT has a High Collision Location program.
2. It recognizes and works with 5 kinds of high collision locations. These are described on the page attached.
3. The locations the program tends to work with are “spot” locations. Though, SDOT can also perform corridor-long safety work. There are some ways it can perform city-wide “systemic” kinds of safety reviews, as well.
4. The High Collision Location program has an annual way of identifying and prioritizing these locations for review.
5. This program performs in-depth reviews of high collision locations.
6. Key elements of these reviews include review of data and field checks.
- 7. Typically, in review of high collision locations, it’s found that the locations have a “predominant collision pattern”.**

This pattern is what the program generally aims to address (with engineering improvements) to enhance safety at the location.

8. With each of these patterns, there tends to be a set of conditions—that when this set of specific conditions are in place at the same time and location, like a recipe, a specific type of collision tends to occur.

9. These conditions include:

- **A specific street design**
- **Specific traffic conditions and**
- **Specific movements that drivers/street users are trying to make**

10. From experience, there are 12 collision types that the program tends to encounter in work with high collision locations on Seattle streets.

These patterns can be viewed at this site— <https://acrashcourse.net/>

COMMON HIGH COLLISION LOCATION PATTERNS ON CITY STREETS

What They Look Like

While doing this work, I found that no one had ever pulled together information that lists the types of collisions that typically occur at urban street high collision locations.

Nor had anyone really done work that presents what these patterns “look like”, including:

- The street designs they typically occur on
- The traffic conditions they typically occur in
- The movements those involved the pattern are attempting and
- describing the safety challenges they present

This is significant because these are locations that drivers on city streets will inevitably encounter.

These locations are challenging.

Drivers often fail at them, collisions occur, and too often people get hurt.

AND these types of collisions occur at many more locations than high collision locations.

So based on my experience in Seattle, I started to pull this information together.

My initial aim in doing this was to find ways to better address the locations I was working on through engineering and street design.

But it quickly seemed clear to me that this information can be just as valuable as an educational tool.

I placed this information together on this site– <https://acrashcourse.net/>

My main aim in pulling this together is that it can be used as an educational tool to help drivers and cyclists and pedestrians -particularly learning drivers (through Drivers' Ed)-

- Be aware of these patterns and the challenges they present
- Recognize them when they encounter them on the street
- And, in drivers' ed, learn and practice strategies to drive/encounter them safely.

Other purposes include that this information can be used to support:

- Better street design
- Safety research

COMMON HIGH COLLISION LOCATION PATTERNS ON CITY STREETS—What They Look Like

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The Purpose of This Site

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3. On-Ramp Collision Pattern
4. Left Turn from Right-Hand Lane on One-Way Streets Collision Pattern
5. Left Turns In and Out of Driveways on Major Streets Collision Pattern
6. Looking X, Turning Y Pedestrian Collision Pattern
7. Left Turn from One-Way Streets Pedestrian Collision Patterns
8. Good Samaritan Pedestrian Collision Pattern
9. Downhill Bike, Right-Hook Collision Pattern
10. Downhill Bike, Left-Hook Collision Pattern
11. Bikes in Tracks Collision Pattern
12. Dooring
13. Right-Angle, Red Light Running Collisions
14. Crossing an Arterial Lane from a Stop-Controlled Approach

CHAPTER 2: Additional Lessons from High Collision Locations and Patterns

- Locations Where High Collision Locations Tend to Occur
- Characteristics Shared by Some High Collision Patterns

CHAPTER 3: Where Fatal Collisions Tend to Occur

CHAPTER 4: High Risk Behaviors

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The site presents, in detail, 14 collision patterns.

It also shares information (also derived from high collision location work) about–

- Where/what parts of the city high collision locations tend to occur and why and
- Factors that tend to come up and contribute to numbers of patterns.

It compares where fatal collisions tend to occur in the city versus where high collision locations occur.

It presents information on high risk behaviors, with an emphasis on distraction, as they contribute significantly to collisions, injuries and fatalities.

A significant number of the patterns identified by this work involve vulnerable road users—cyclists and pedestrians

These (in **bold**) are **bike collision patterns** that experienced cyclists know, But that many drivers—particularly young drivers—don't know.

Common Urban Collision Patterns

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These (in **bold**) are **Pedestrian-Related collision patterns**.

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These (in bold) are patterns that are generally motor vehicle-to-motor vehicle collision patterns, but these patterns are not exclusive to motor vehicles and **can involve, and are pertinent to, cyclists.**

- 1. Opposing Left-Turn on a 4-Lane Roadway Collision Pattern**
- 2. Bus Lane Collision Pattern**
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Using the Left Hook Pattern as an example, this is the kind of information the site presents—

DOWNHILL-BIKE, LEFT-HOOK COLLISION PATTERN

This Pattern Looks Like This

A cyclist is riding downhill in a marked bike lane.

A driver is headed uphill in the opposing direction, seeking to turn left.

There is a general traffic lane in the downhill direction, between the bike lane and the lane the left-turning driver is turning from.

Traffic backs up in the downhill, general traffic lane. This traffic is generally backed up from a nearby signal.

The bike lane is free-flowing; the cyclist is traveling at or near arterial speed.

The uphill driver attempts a left turn through a gap in the lane of backed-up traffic.

This is the basic description of the pattern. It describes:

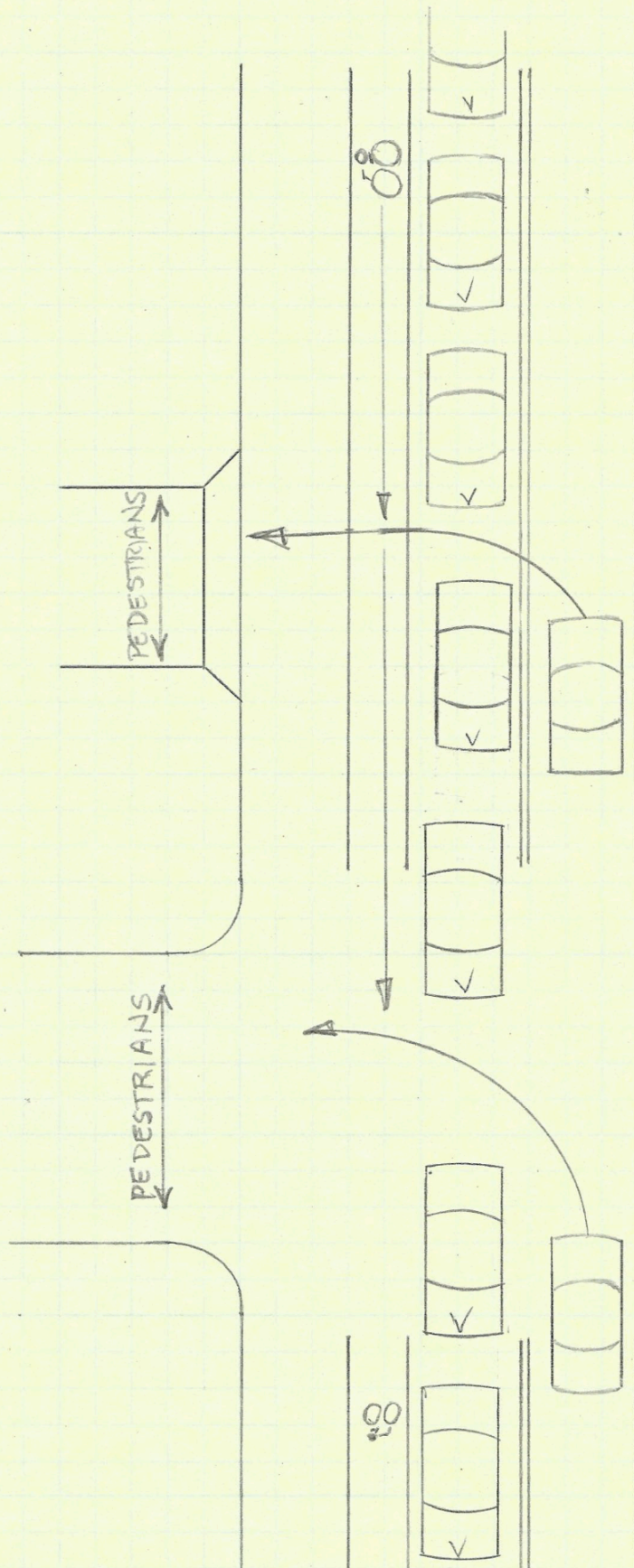
- **The street design** generally associated with the pattern
- **Traffic characteristics** generally associated with the pattern
- **The movements those involved in the pattern are trying to make**

On the next page is a sketch of the pattern, showing the basic street design, traffic characteristics and movements associated with the pattern.

This presents:

- The multiple ways one can encounter the pattern on the street and
- The challenges the pattern presents (in this case, the main challenge is with the line of sight). From the sketch, this challenge is really apparent.

DOWNHILL BIKES - LEFT HOOK COLLISION



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The Problem These are challenges that users face in these conditions.

The heavy lane of traffic in the downhill, general traffic lane limits the driver's ability to see and be aware of the bike lane. It limits the turning driver's ability to see cyclists in the bike lane and cyclists' ability to see the turning vehicle.

Drivers, in focusing on heavy traffic in the opposing direction and/or different kinds of traffic (including pedestrians and buses) that are common on city streets, may not be looking for and anticipating cyclists in the oncoming direction.

After the vehicle enters the bike lane, it either strikes or is struck by the cyclist.

Because these collisions are often t-bone collisions, the cyclists in them tend to be riding with speed, and (in some cases) the left turns made in them can be made with speed, they tend to be very severe.

Variations These are descriptions of different ways the pattern can present.

This kind of collision can occur at driveways and at intersections.

It can occur where the driver makes their turn from a center turn lane or a general traffic lane.

Though more common on streets with downhill grades, on which cyclists can easily pick up speed, this kind of collision can happen on flat grades as well.

There's often a parking lane between the bike lane and the curb, but sometimes not.

It can happen in locations where there's not a bike lane—for example, where there's a lane of parking that's open or cleared away and a cyclist is using it like a bike lane.

Sometimes the driver in the stopped vehicle nearest the turning driver, unaware of the approaching cyclist, will wave the turning driver through.

Left-turn collisions into cyclists can occur in conditions when there isn't a lane of backed-up traffic. In this case, the lane(s) of traffic between the turning driver and the cyclist may be moving and active. In focusing on and trying to judge a gap in the general-traffic lanes, the turning driver doesn't see or is unaware of the cyclist. In this case, when accelerating through the gap in oncoming motor traffic, the left turn is made at a higher speed, adding to the severity of the collision.

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Different ways this pattern can be encountered include as the left-turning driver, the cyclist, and drivers in the lane of backed-up traffic through which the driver is turning.

This presents the different ways one can encounter the pattern— that one needs to be aware of. In this case, there are 3 different ways one can encounter this pattern—1) as the cyclist, 2) as the person making the left turn, and 3) as a driver in the backed-up traffic that affects the line of sight between the cyclist and the turning driver.

Each of these “roles” in the pattern present their own challenges, in this case these challenges center on the driver and cyclist being able to anticipate and see each other.

For each player involved there are specific, safe, reliable strategies that can be used to encounter these conditions.

WHY THIS INFORMATION IS IMPORTANT

1. A large and disproportionate number of severe-injury and fatal collisions that occur on city streets are those that involve pedestrians or cyclists. On Seattle streets, pedestrian and bike-related collisions account for about **40 percent of the city's traffic-related severe-injuries** and **two-thirds of the city's traffic-related fatalities**.

(See tables in SDOT's annual traffic reports. From 2020-2022)

2. There's the need for a range of tools to enhance bike and pedestrian street safety—particularly safety tools that are broad-reaching or systematic. And that these tools—

Have a reasonable method of/mechanism for being implemented.

3. Many of the patterns presented on the site are bike-related or pedestrian-related. They present conditions on city streets that drivers commonly encounter, at which drivers often fail and many cyclists and pedestrians are hurt.

4. These are patterns that many drivers—young drivers in particular—aren't familiar with and, therefore, don't have the strategies and skills to drive safely.

5. This information the site provides is unique/new.

It offers insights to help drivers (and cyclists and pedestrians) to—

- recognize common bike and pedestrian-related collision patterns
- understand their causes and how they work and
- how they can be safely encountered.

6. This information offers the potential to—

- instill awareness and understanding of these patterns and
- Instill sound strategies drive these specific patterns safely

7. Presented well through Drivers Education, this information can be a tool to meaningfully reduce numbers of collisions by which street users are hurt—particularly cyclists and pedestrians.

PRACTICAL APPLICATIONS OF THIS WORK/ POTENTIAL WAYS THE BIKE BOARD MIGHT USE THIS INFORMATION

I think there are a number of ways the Board can use this information.
These are some applications I'm following up on that the Board can weigh-in on, too-

1. *WEIGHING IN ON THE IMPLEMENTATION OF SENATE BILL (and House Bill) 5583—to raise greater attention to driver safety in the presence of cyclists and pedestrians* —through enhancing bike and pedestrian information included in the State-established drivers education curriculum

There's more background related to Bill 5583 below.
In short, the bill presents an opportunity to advance bike and pedestrian safety. It goes like this—

Vulnerable road users are a high priority and known safety concern in Washington.

There's a need to identify meaningful tools to enhance their safety in the state.

One potentially very powerful tool is drivers' education.

The curriculum for drivers' education is set by State agencies (the Department of Licensing and the Office of Superintendent of Public Instruction).

The State Legislature, through Senate Bill 5583 and House Bill 5583 will require new drivers to take and pass a drivers education course to obtain their drivers license.

This bill has been signed into law. Now the Legislature is actively working on refining the details of this legislation—particularly as this relates to changes to Drivers' Education—on how it should be implemented.

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The State's (DOL and OSPI's) current drivers' education curriculum presents a number of objectives that relate to bike and pedestrian safety. It calls for instruction that helps driving students learn and understand:

- suggested *driving procedures for sharing the road with bicyclists and pedestrians in common traffic situations* (section 5.1.D)
- *how to predict and anticipate the risks associated with the behavior of other road users, including bicyclists and pedestrians* (5.1.F)
- *how to adjust communication based on observation of the driving environment and actions of other road users* (5.2.C)
- *how to demonstrate appropriate communication of driving intentions to other road-users in a variety of driving situations* (5.2.D)
- the *special space management considerations* that should be given *when sharing the road with vulnerable road users, including bicyclists and pedestrians* (BTW5.1.C)
- *how to demonstrate the ability to predict and anticipate the behaviors and risks associated with the behaviors of other road-users including bicyclists and pedestrians* (BTW5.1.D)

Information like that given on the acrashcourse.net site is not presently incorporated into or referenced by the State's current drivers' education curriculum.

In presenting common collision patterns involving bicyclists and pedestrians, information, like that presented on acrashcourse.net, would support all of these objectives (above) in a very tangible, real-world way.

To meet these objectives and to reinforce bike and pedestrian safety as a principle objective of the State's required driver training curriculum, ***I'd advocate that information from the acrashcourse.net site (or similar information) be:***

- ***included in the curriculum OR***
- ***cited/referenced in the curriculum as a tool to be used to support the curriculum.***

This would also support State efforts to enhance roadway safety through its *Target Zero* work and *WSDOT's Vulnerable Road User Safety Assessment*.

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I'd note:

The intent of what I'm suggesting is not to overhaul the Driver Training curriculum. It's a good document.

With this said, setting this up will likely require substantial work—

It would include identifying what parts of this information to offer in drivers education trainings. This will vary, for example, according to the part of the state where the trainings are performed—e.g., urban versus rural. The information presented on crashcourse.net is urban/city-based.

It would likely affect, to some degree, the content and how driver education schools present the curriculum.

Work would be needed to identify, among driving professionals, the recommended strategies that drivers can use to safely encounter the conditions presented.

A place/site would need to be identified to maintain this information—so that driving schools and instructors can readily access it as a resource to design their classes and present their lessons.

This work would require coordination and time and effort from the DOL, OSPI, and representatives from professional driving schools.

The logistics of doing these things will more than likely extend past the January 1, 2025 date that's the target for implementing the 5583 legislation.

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SB 5583 *Background, in more detail*

SB 5583 is a bill the State Legislature is actively working on.

It will require:

- new drivers in the state under the age of 22 to take and pass a full driver education course—taught through a professional driver school or by a public school to receive their license and
- new drivers between the ages of 22 and 25 must complete a condensed drivers ed/traffic safety course before they can obtain their drivers license.

Its aim is to significantly enhance roadway safety/to reduce numbers of collisions, injuries, and fatalities—particularly those involving new, young drivers.

Every year, roughly 80,000 new drivers obtain their first drivers license and start to drive on Washington roadways.

Research has found that taking Drivers' Ed improves the safety of new drivers.

The bill has round legislative support.

The Cascade Bike Club is a strong proponent of this legislation.

It was signed into law in 2023.

The details regarding this legislation's implementation are actively being worked out as we speak.

The law required the Department of Licensing to conduct a study and provide recommendations to the legislature on bill-related changes regarding drivers education.

The Legislature is waiting for this study and recommendations from the DOL.

These are expected within the next few months.

Further work will be done regarding the bill's implementation after this report is received.

The bill/law is targeted to go into effect on January 1, 2025.

The curriculum for Drivers' Ed taught by driving schools is set through the State's Department of Licensing (DOL).

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The curriculum for Drivers' Ed taught in public schools is set by the Office of Superintendent of Public Instruction (OSPI).

The present curriculum, developed by the DOL and OSPI, can be viewed here—
<https://dol.wa.gov/media/1525/download?inline>

The overall goal of the State's required driver training curriculum is “of reducing fatalities from traffic collisions” and to “create changes needed to decrease young driver fatalities and move us closer to Target Zero.” Washington State's *Driver Training: Required Curriculum*, August 2018, p.6

An Opportunity

A lot of work went into putting together the state's driver curriculum. It presents a comprehensive list of concepts that are essential to safe driving and new drivers need to learn. It's a good document.

In Seattle, and in other cities, a major proportion of severe injuries and fatalities are the products of bike-related collisions and pedestrian-related collisions—so much so that current State (WSDOT) Target Zero and vulnerable road user safety work is actively seeking—as a priority—to identify ways to significantly reduce bike and pedestrian injuries and fatalities as a principal means of greatly reducing the number of traffic-related injuries and fatalities throughout the state.

A basic challenge to bike and pedestrian safety is that ***a lot of drivers—including many young drivers—are simply not aware of common driving conditions in which bike and pedestrian collisions occur.***

This includes what these conditions “look like”—

- the type of street involved
- the street's design
- traffic conditions
- the movements that street users are trying to make and
- the interactions and challenges these conditions create

This kind of information exists for city streets (acrashcourse.net), but it's not included in detail in the curriculum. This information is new.

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Students learn better from tangible examples to which they can relate.

The curriculum document notes that it's a dynamic document and it welcomes input from instructors and stakeholders to improve its content. (p.6)

With SB 5583, this information—with the Legislature's support—can be included in the curriculum.

Potential Benefits of including this kind of information in/with the State's drivers' education curriculum include helping drivers to:

- 1) recognize common patterns that involve cyclists and pedestrians when they encounter them on the street and
- 2) identify and practice, as part of their drivers' education, strategies to encounter these conditions safely.
- 3) From these specific patterns/examples, learn and internalize general lessons about safety when driving in the presence of cyclists and pedestrians, and
- 4) in providing information about these specific collision patterns, provide a real-world, tangible way to help young drivers understand and internalize basic safety concepts presented in the current curriculum.

From the perspective of the State's Driver Training Curriculum, this information would help drivers meet these objectives—learn and understand:

- suggested *driving procedures for sharing the road with bicyclists and pedestrians in common traffic situations* (section 5.1.D)
- *how to predict and anticipate the risks associated with the behavior of other road users, including bicyclists and pedestrians* (5.1.F)
- *how to adjust communication based on observation of the driving environment and actions of other road users* (5.2.C)
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WEIGHING IN ON WSDOT's statewide *Vulnerable Road User Safety Assessment* and state-wide adopted strategies to enhance bike and ped safety

As part of WSDOT's Target Zero work, this document aims to use the collision data WSDOT has on hand to assess and guide the effort statewide to greatly reduce the numbers of bike and pedestrian traffic-related injuries and fatalities.

This is challenging work. There are many constraints toward performing this work—one main one being real constraints in the data available to perform this work. WSDOT's *Vulnerable Road User Safety Assessment* is a good document, and it's up front in explaining this challenge.

I think there are several strategies WSDOT can explore to further bike and pedestrian safety. One product of this work could be WSDOT advocating for drivers' education that's aimed at helping drivers:

- being better able to recognize roadway conditions in which (patterns of) bike collisions occur and
- identifying and practicing strategies to encounter these conditions safely.

What would be notable about recommending an education strategy is that engineering agencies generally advocate engineering solutions to their issues—but there's nothing wrong with advocating for an education-based strategy (or another kind of strategy if it can be effective), particularly when it's safety, injuries, and fatalities that are on the line. There are certain advantages an educational strategy can offer, relative to engineering strategies—and by which it could complement engineering-related safety strategies.

WSDOT's Vulnerable Road User Safety Assessment work is more technical than that related to SB 5583. With that said, if you're interested in reading it/reading it, I'd be happy to connect and share some ideas on how this work might be shaped to enhance bike safety.

CONTACT INFORMATION

If, in thinking about this more, you have questions about it or would just like to chat, please feel welcome to contact me. You can do this by reaching me through Hallie. OR I can be contacted directly at morrislentengineeringllc@gmail.com

Mike

RELATED REFERENCES

Washington State's **Senate Bill 5583 (SB 5583)**

<https://legiscan.com/WA/text/SB5583/2023>

Washington State's **Driver Training: Required Curriculum**, August 2018

<https://dol.wa.gov/media/1525/download?inline>

WSDOT Vulnerable Road User Safety Assessment 2023

<http://targetzero.com/wp-content/uploads/2023/11/VRU-Safety-Assessment-2023.pdf>

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Bicycling crash circumstances vary by route type: a cross-sectional analysis

Kay Teschke^{1*}, Theresa Frendo¹, Hui Shen¹, M Anne Harris², Conor CO Reynolds³, Peter A Cipton⁴, Jeff Brubacher⁵, Michael D Cusimano⁶, Steven M Friedman⁷, Garth Hunte⁵, Melody Monro¹, Lee Vernich⁶, Shelina Babul⁸, Mary Chipman⁶ and Meghan Winters⁹

https://www.researchgate.net/publication/268787436_Bicycling_crash_circumstances_vary_by_route_type_a_cross-sectional_analysis