AN ABSTRACT OF THE THESIS OF

Ioana Cosma for the degree of Master of Science in Civil Engineering presented on May 11, 2012

Title: Road User Understanding of Shared Lane Pavement Markings (Sharrows) Case Study - Corvallis, OR

Abstract approved:

Karen K. Dixon

This thesis focuses on shared use lane facilities and road user understanding. Shared use lanes (sharrows) are a common solution for road facilities that are too narrow to accommodate a full bicycle lane and where the local jurisdiction wants to reduce dooring crashes. In recent years, engineers have focused on incorporating sustainable transportation into new or reconstructed infrastructure improvements. Bicycle transportation connectivity, as an example, is essential to efficient bicycle commuting. Sharrows pavement marking is a well-engineered design but without education road users do not use it properly resulting in an increased risk of being in a crash.

Road User Understanding of Shared Lane Pavement Markings (Sharrows)
Case Study - Corvallis, OR

by

Ioana Cosma

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I understand that my thesis will become part of the permanent collection of Oregon State University libraries. My signature below authorizes release of my thesis to any reader upon request.

Ioana Cosma, Author

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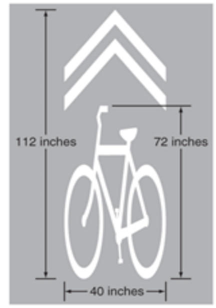
1.0 Introduction

In recent years, engineers have focused on incorporating sustainable transportation into new or reconstructed infrastructure improvements. These improvements can include facilities that promote methods such as carpooling, transit, and bicycling. Many companies are offering financial incentives to employees that commute to work via carpooling, transit, bicycling or walking. Bicycle transportation connectivity is essential to efficient bicycle commuting. Bike lanes are perceived positively because they offer bicyclists their own lane to the right of the motor vehicle travel lane. In some situations, the travel way is too narrow to provide bicyclists a bike lane at a sufficient distance from either parked vehicles or the face of curb.

One possible solution to facilitate bicycle network connectivity is for bicyclists and motorists to share the same lane. To indicate that a length of road is to be shared by both users the Manual on Uniform Traffic Control Devices (MUTCD) offers three options (FHWA, 2009). One solution would be to place sign R4-11 as depicted in the Figure 1 "Bicycle May Use Full Lane" where the travel way cannot accommodate a bicycle lane. This sign would inform road users that bicycles can occupy the travel way the same way as for motor vehicles. The second solution would be to place pavement markings known as shared lane markings also shown in the Figure 1. The shared lane markings not only inform road users that bicycles can occupy the travel way, but these markings also convey to bicyclists the lateral positioning that they should follow. A third solution would be to use both the shared lane pavement markings as well the "Bicycle May Use Full Lane" sign.

Sign R4-11



Shared Lane Pavement

Source: Federal Highway Administration

Figure 1: Bicycle May Use Full Lane Sign & Shared Lane Marking

According to the MUTCD, shared lane pavement markings may be used on roads with on-street parallel parking. In fact all of the studies that have been conducted throughout the United States examined portions of roadways with or without parallel parking. The literature review for this study (see Chapter 2) did not identify any additional research on other on-street parking options such as head in angle parking or back-in angle parking.

This report will focus on the road user understanding of shared lane pavement marking and the safety implications of shared lane pavement markings adjacent to street parking.

Outline of Report

Chapter 2 provides a literature review about shared lane pavement markings. The chapter will summarize the evolution of shared lane pavement marking, review of existing criteria, discuss previous before and after case studies, and inspect the proper bicyclist usage of this travel lane. Chapter 3 describes the research methodology used for this project. Chapter 4 provides the research data, and Chapter 5 summarizes the research analysis. Chapter 6 presents the conclusions of this research project. The bibliography contains the references cited in this paper. The Appendix includes tables that are cited in this paper but not deemed crucial to the context.

2.0 Literature Review

The literature review includes the evolution of shared lane pavement markings, a review of existing criteria, before and after case studies, and proper bicycle usage of these unique pavement markings.

2.1 History of Shared Lane Pavement Markings

The San Francisco department of parking and traffic conducted a shared lane pavement markings study for the City of San Francisco to determine the most effective pavement marking that improves the safety of bicyclists (Alta Planning + Design, 2004). The study initially included three shared lane pavement markings currently in place in Paris, France, Portland, Oregon and Gainesville, Florida. Figure 2 demonstrates the three pavement markings scenarios tested in San Francisco.

Bike-and-chevron marking Bike-and-separate-arrow marking Bike-in-house marking

Source: Alta Planning + Design, 2004

Figure 2: San Francisco's Three Test Sites

The San Francisco study results indicated that all the markings increased the motorist awareness of bicycles on the roadway. Out of the three designs, the researchers narrowed pavement markings selection down to two designs based on the message that the sign conveyed to bicycles. The bike symbol, which is now standard for bike lanes, conveyed the message of going straight at the intersection. The bike in house symbol and the bike with chevron marking provoked a higher response from motorists to slow down in the associated lanes. From the initial survey, the San Francisco

Department of Traffic and Parking chose to examine the bike in house pavement marking and the bike with chevron pavement marking.

2.1.1 Selected Test Designs: Modified Pavement Marking

The research team, working with the Technical Advisory Committee for the San Francisco study, selected the bike-in-house pavement marking as well as the bike-and-chevron pavement marking to further evaluate. Their ultimate goal was to narrow down their choices to one design that would bring awareness to the motorists that bicyclists will ride in the travel way while also helping to increase bicyclist safety by preventing open car door crashes (dooring crashes).

2.1.2 Bike-in-house

The San Francisco committee decided that the bike-in-house pavement marking should be 42 inches wide at the arrow points, 28 inches wide at the bottom of the marking, and 75 inches long (See Figure 3). In the center of this house would be the symbol of a bicycle rider wearing a helmet and riding a bike. This design is two times larger than the original bike-in-house. To encourage bicyclists to ride on the arrow of this pavement marking, the design has a bike wheel channel at the bottom of the pavement marking. Originally this pavement marking was used in Gainesville, Florida.

Source: Alta Planning + Design, 2004

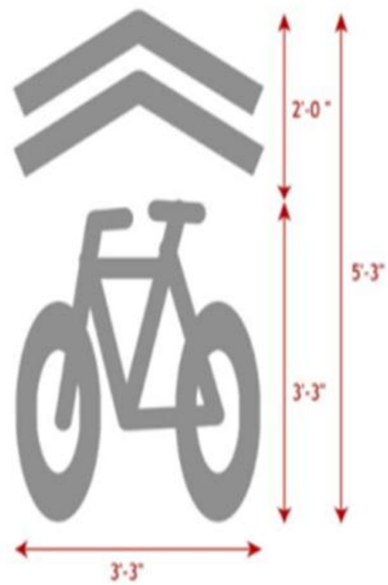
Figure 3: San Francisco Modified Bike-in-House 2004

2.1.3 Bike-and-Chevron

Based on the initial research, the Technical Advisory Committee recommended studying the bike-and-chevron pavement marking. This pavement marking had a width of 39 inches, the height of 39 inches, and two chevrons with a collective height of 24 inches. The total length of this pavement marking was 63 inches from the tip of the chevrons to the bottom of the wheels (See Figure 4). These dimensions were similar to the original bike-and-chevron pavement marking dimensions from the Paris, France design.

2.1.4 San Francisco Study Results

The results of the San Francisco study demonstrated that bicyclists and motorists moved further away from the parked vehicles where either a bike-in-house or bike-and-chevron was painted. The bike-and-chevron pavement marking made the most difference in the distance between the traveling vehicles and the traveling bicycle ranging from 2′7″ with no marking to 4′10″ for a bike-and-chevron marking versus or 4′7″ for a bike-in-house marking. Based on their results from the before/after study, the advising committee recommended the bike-and-chevron markings. The simplified name for bike-and-chevron pavement marking is **shared arrow** or the blending of the two words which makes "**sharrow**."



Source: Alta Planning + Design, 2004

Figure 4: San Francisco Bike-and-Chevron Marking, 2004

2.2 Review of Existing Criteria

The MUTCD details criteria placement of shared lane pavement markings, while the Oregon Driver Manual (2012) relays to the motor vehicle driver the message of the shared lane pavement marking, The Oregon Bike Manual (Oregon Bike and Pedestrian Program, 2012) relays to the bicyclists how they should travel on lanes with shared lane pavement markings.

2.2.1 Manual on Uniform Traffic Control Devices

The 2009 edition of the MUTCD adopted the sharrow (FHWA, 2009). The standard design for the pavement marking in the MUTCD is shown in Figure 5. This marking has different dimensions than the marking tested in San Francisco. The total height of the marking is 112 inches, twice the height of the San Francisco design of 63 inches. Figure 5 also depicts the original San Francisco design to aid to the aid with comparison of the two configurations.

MUTCD SHARED LANE PAVEMENT MARKING	SAN FRANCISCO 2004 SHARED LANE PAVEMENT MARKING

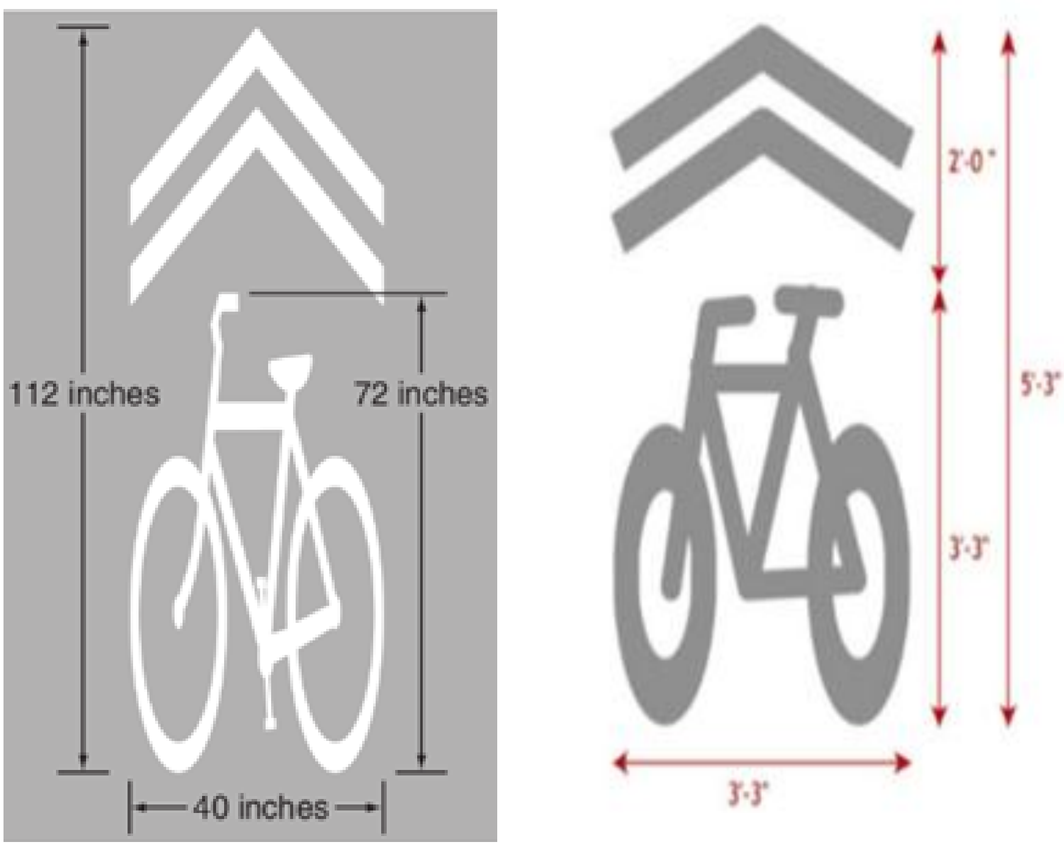


Figure 5 : MUTCD 2009 vs. San Francisco 2004

The MUTCD permits options and guidance on where sharrows may be used, where they should not be placed, and where the sharrows cannot be used.

According to the MUTCD, sharrows may be used to (FHWA, 2009):

- Help bicyclists with lateral positioning in a shared lane with on-street parallel parking in order to reduce the chance of a bicyclist impacting the open door of a parked vehicle;
- Improve a bicyclist's lateral positioning in lanes that are too narrow for a motor vehicle and a bicycle to safely travel side by side within the same traffic lane;
- Alert motorists of the lateral location bicyclists are likely to occupy within the traveled way;
- Encourage safe passing of bicyclists by motorist; and
- Reduce the incidence of wrong-way bicycling.

The MUTCD further provides guidance on the placement of sharrows (FHWA, 2009):

- If the shared lane markings are placed with on-street parallel parking, the shared lane markings should be placed in order to have the center of the marking at least 11 feet from the face of the curb or the edge of the pavement in the case that there is no curb;
- If the shared lane markings are placed on a street without on-street parking that has an outside travel lane less than 14 feet wide, the shared lane marking should be placed in order to have the center of the marking at least 4 feet from the face of the curb or the edge of the pavement in the case that there is no curb;

- Shared lane markings should be placed immediately downstream of an intersection and should be repeated at intervals less than 250 feet afterwards; and
- Shared lane markings should be placed on roadways with posted speed limits less than 35 miles per hour.

2.2.2 Oregon Bike Manual 2010-2011

The Oregon Bike Manual states that the symbol of a sharrow is "provided to show bicyclists where to ride on streets without bike lanes and to indicate to motorists where to expect bicyclists." The Oregon Bike manual also states that the sharrow pavement marking" is placed along a line of travel that avoids opening car doors."

2.2.3 Oregon Driver Manual 2011-2012

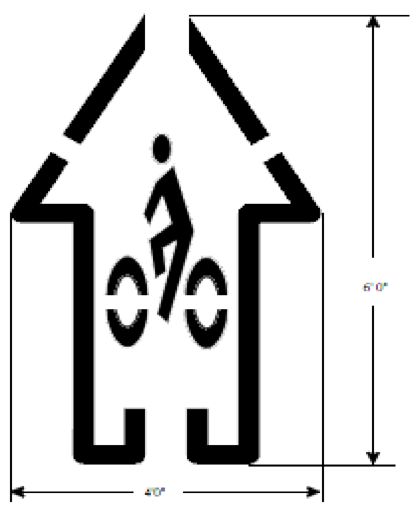
While the Oregon bike manual states that motors would know where to expect bicyclists in the lane, the Oregon driver manual does not clearly stipulate this information. The Oregon Driver manual states that "a bicycle sharrow indicates the lane is shared." It also says "vehicles or bicycle traffic may be in the lane, although you should always keep on the lookout for bicyclists this serves as an additional warning to watch for bicycles in the lane."

2.3 Before and After Studies

Between 1999 and 2011, researchers conducted several before and after sharrow studies in the United States of America. These studies were conducted in Gainesville, Florida, Cambridge, Massachusetts, Chapel Hill, North Carolina, Seattle, Washington and Austin, Texas.

2.3.1 Gainesville Florida

Five years before the San Francisco's sharrow marking study, Pein, Hunter, and Stewart (1999) conducted a study in Gainesville, Florida to evaluate shared use arrow pavement markings. The before and after study occurred along 13th Street in Gainesville, Florida. 13th Street is a 4 lane arterial with a speed limit of 30 mph and about 35,000 vehicles per day. Figure 6 depicts how the shared use arrow was displayed on the pavement. This pavement marking was placed 3.5 ft. away from the curb at locations where the travel lane was 15 ft. wide. As shown in Figure 6, the shared used arrow included an opening at the bottom of the arrow; the intent of the opening was to guide the bicycles to the correct lateral position. In other words, the bicyclist was expected to travel straight through this pavement marking using the guided openings.



Source: Pein, Hunter, and Stewart (1999)

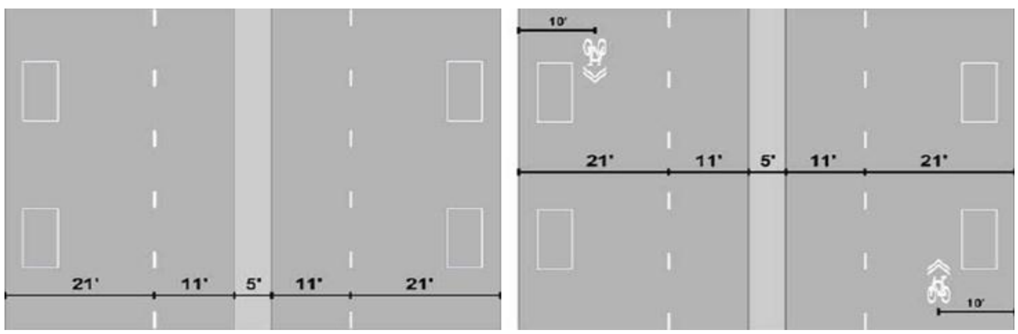
Figure 6: Gainesville Florida, Shared-Use Arrow

The Florida study results demonstrated that before the arrow pavement markings were placed about 39.3 % of bicyclists rode in the street with traffic. After the shared-use arrow pavement markings were placed, the researchers found an increase of 6% of bicyclists riding in the street with traffic. The researchers found a statistical significant with a p-value of 0.05 in favor of riding in the street with traffic after deployment of the shared use arrow pavement markings. This study is one of the pioneer studies that examined pavement markings for wide curb lanes.

2.3.2 Cambridge, Massachusetts

Cross Section of Massachusetts Avenue

BEFORE AFTER



Source: Hunter W. W., Thomas L., Srinivasan R., and Martell C. A, 2010

Figure 7: Cambridge, Massachusetts Before & After Road View

Massachusetts Avenue is a 4 lane divided street with parallel parking on both sides of the street. The posted speed limit for this section was 30 mph with an average of 29,000 vehicles per day. The objective of evaluating this location was to analyze whether placing sharrow markings would reduce the occurrence of dooring crashes. A door crash is a type of crash that happens when the driver or passenger of a parked vehicle opens his or her door in the path of a bicycle and the bicyclist hits the door. The distance between the curb and the middle of the chevron markings was 10 ft. for this study. The researchers (Hunter et al., 2010) knew that optimal chevron spacing from the curb is 11-ft, but in many areas of Cambridge, Massachusetts it is not feasible to achieve this placement. Figure 7 shows the before and after cross section of Massachusetts Avenue.

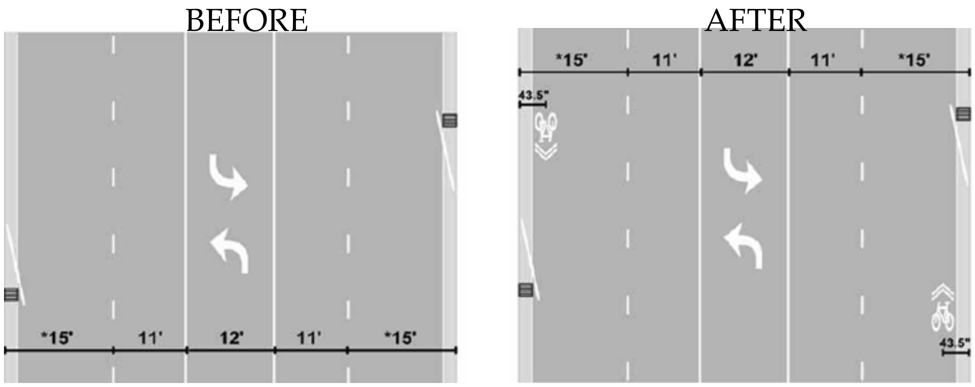
The researchers' (Hunter et al., 2010) analysis included the bicycle interaction with motor vehicles, by comparing the before period to the after period. As previously indicated, the purpose of the location of these shared lane markings was to reduce dooring crashes. Their analysis demonstrated that 94% of the total observed bicyclists chose to ride over the shared lane pavement markings. Their analysis also suggested that the placement of the shared lane markings increased the visibility of the bicyclist to the existing parked vehicles. The researchers found that "when a bicyclist was approaching, existing open doors decreased from 5 to 2 percent; opening of doors decreased from 4 to 0.3 percent (Hunter et al., 2010). Overall the placement of these shared lane markings demonstrated a bicycle safety benefit. The researchers found no significant impact to motor vehicle speed with the addition of the sharrows.

The Cambridge, Massachusetts before and after study included a sample of 351 bicyclists followed by motorists in the before period and 359 bicyclists followed by motorists in the after period. The statistical analysis of the data included chi-squared tests to compare the distributions and determine their equivalence. In other words, the analysis determined if the conditions in the before period matched the conditions in the after period.

<u>2.3.3 Chapel Hill, North Carolina</u>

Shared lane pavement markings (Sharrows) were placed on Martin Luther King Jr. Boulevard also known as MLK Boulevard. MLK Boulevard is a major route leading to the University of North Carolina and has a speed limit of 35 mph, about 27,000 vehicles per day, and about 40-70 bicycles per day. In the before condition, on average a third of the bicyclists were riding on the sidewalks. MLK Boulevard has a vertical grade between 3-4 percent. Compared to Cambridge, Massachusetts or Gainesville, Florida, this is a site that has segments with uphill and downhill grades. Figure 8 depicts the before and after cross section of MLK Boulevard and indicates the placement of the sharrows relative to the 24-inch-wide sunken drainage grates.

<u>Cross Section of MLK Boulevard</u>



Source: Hunter W. W., Thomas L., Srinivasan R., and Martell C. A, 2010

Figure 8: Chapel Hill, NC Before & After Road View

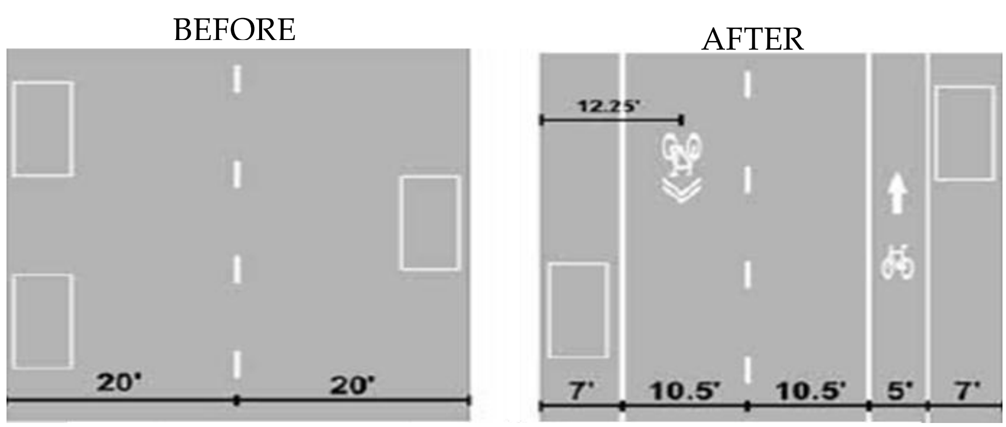
The city of Chapel Hill placed the sharrows 43.5 inches from the curb, with approximate spacing of 200 feet on both sides of MLK Boulevard. While previous Sharrow studies have evaluated reducing dooring crashes, this study considered reducing sidewalk riding as well as increasing the safety of bicyclists by keeping them away from the sunken drainage grates.

The researchers (Hunter et al., 2010) found that the lateral distance of motor vehicles driving in the outside lanes increased from the curb even in the absence of bicycles by about 7 inches, and overall the percentage of motor vehicles that were within 50 to 60 inches of the curb reduced. The placement of sharrows increased the bike lateral distance to the curb by a mean of 2.5 inches. On the downhill portion of the road, the researchers found a mean distance of 2.5 inches **further** from the curb yet in the uphill portion of the road the researchers found a mean distance of 2.5 inches **closer** to the curb resulting in a 5 inch total difference between uphill and downhill locations. The placement of the sharrows resulted in 97 percent of riders positioning themselves on top of the sharrows in the uphill portion and 88 percent of riders positioning themselves on top of the sharrows in the downhill portion of this arterial. This dramatic enhancement reduced the sidewalk riding, resulting in reduced bicycle/motor vehicle crashes on this corridor. Historically bicycle and motor vehicles crashes on this corridor occurred as bicycles rode on the sidewalks and crossed driveways and intersections.

2.3.4 Seattle, Washington

The city of Seattle placed sharrows on a downhill portion of Fremont Street. Fremont Street has a speed limit of 30 mph with about 10,000 vehicles per day. The purpose of the location of the shared lane pavement markings was to encourage bicyclists to take the lane and avoid the door zone. The redesign of Fremont Street took place in two phases. First, the city installed a bike lane on the uphill portion of the road as shown in Figure 9. Second, the city of Seattle installed sharrows on the downhill portion of this road.

Cross Section of Fremont



Source: Hunter W. W., Thomas L., Srinivasan R., and Martell C. A, 2010

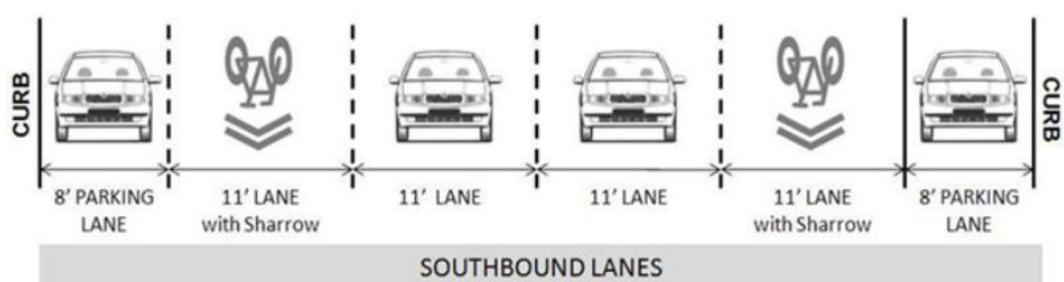
Figure 9: Seattle, Washington Before & After Cross Section View

In the before period the researchers (Hunter et al., 2010) observed 27 percent of riders positioned in the center of the lane. Following the placement of the sharrow markings, the researchers observed 25 percent of riders located in the center of the lane and about 15 percent of all bicycle riders positioned on top of the sharrow pavement markings.

The study suggested that there was no difference in the behavior of motorists when following and passing bicyclists, 97 percent of these maneuvers were determined to be executed safely. This study, unlike the previous studies, determined that sharrow pavement markings did not increase the percentage of bicyclists taking the lane. The researchers also concluded that narrowing the travel lane and adding the uphill bike lane might have had more effect on operations and spacing than the addition of sharrow pavement markings.

2.3.5 Austin, Texas

Austin, Texas placed shared lane markings on Guadalupe Street. This road is a four lane, one-way southbound street that extends from the University of Texas to the southern edge of downtown Austin. Figure 10 shows the lane geometry of this portion of the arterial. The study results showed a 9 percentage increase in bicyclists riding in the center of the lane (from 31 percent to 42 percent). The researchers (Brady et al., 2011) found that bicyclists were more likely to bypass a queue of stopped vehicles following the placement of the sharrow pavement markings than they did prior to the placement. This suggested to the researchers that sharrow pavement markings encourage bicyclists to assert themselves more when they are sharing the road with motorists.

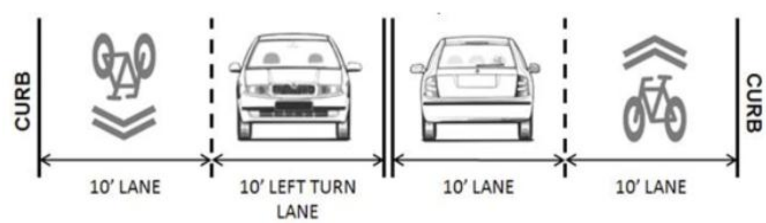


Source: Brady J.F , Loskorn, J. , Mills A. F., Duthie J., Machemehl R.B., 2011

Figure 10: Lane Geometry of Guadalupe Street Southbound

The second Austin location for the placement of shared lane markings was on East 51st Street, a two-way arterial in suburban north Austin (Figure 11). The 4 lane arterial had no on-street parking on either side of the road and the lanes where the shared lane pavement markings were constructed are only 10 feet wide.

Similar to the results on Guadalupe Street, researchers found a 10 percent increase in the percentage of bicyclists that rode on top of the sharrow pavement markings (from 44 percent to 54 percent). In the event of a queue, bicyclists were observed to ride around the long queue of vehicles. This observation suggested to the researchers that bicyclists on East 51st Street choose to ride around the queue of "vehicles for convenience, not for perceived lack of safety (Brady et al., 2011).



Source: Brady J.F , Loskorn, J. , Mills A. F., Duthie J., Machemehl R.B., 2011

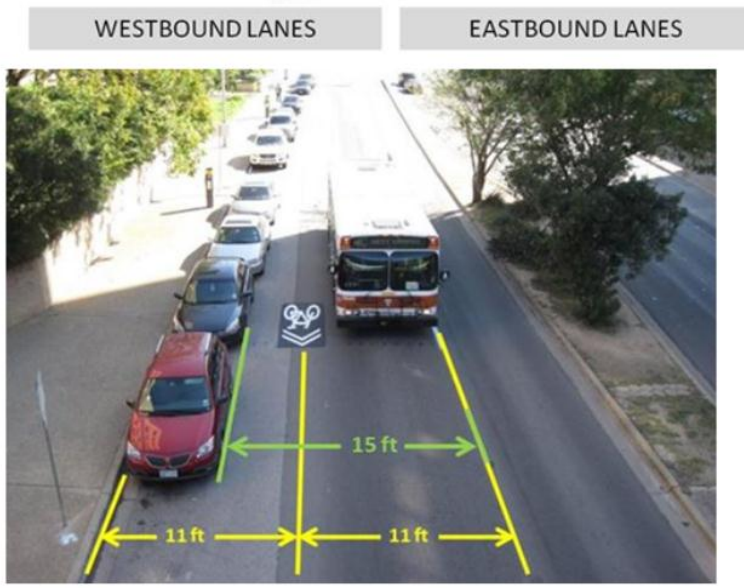
Figure 11: Lane Geometry of East 51st Street

The third Austin test location was a four lane divided arterial near the University of Texas campus known as Dean Keeton Street. On this street, the sharrow pavement markings were placed 4 feet away from the parking lane in the hopes of reducing dooring crashes. Figure 12 shows the westbound and eastbound lanes as well as the measurements between the parked motor vehicles and travel lane.

The research team collected bicycle position on the westbound portion of Dean Keeton Street for both the before and after period. The researchers found that during the before period the distribution of bicyclists' lateral position during passing events were distributed uniformly between 1.5

feet and 4.5 feet. After the placement of sharrows, the researchers found that 70 percent of bicyclists rode 3 feet from the parked vehicles.

The researchers observed a marginal shift in the average lateral position which they attributed to a large significant decrease in the proportion of bicyclists who rode within the opening car door areas (Brady et al., 2011).



Source: Brady J.F , Loskorn, J. , Mills A. F., Duthie J., Machemehl R.B., 2011

Figure 12: Dean Keeton Street, Austin, Texas

2.4 Proper Usage

Bicyclists should use the sharrows to guide their location within the travel lane. Bicyclists should be riding through the shared lane pavement marking because that is the safest lateral possition within the lane. By riding though the shared lane pavement markings, the bicyclists will have better visibility and will avoid dooring crashes. In the situation where the travel lane is too narrow to allow safe side-by-side traveling of both motorists and bicyclists, the motorists should yield to the bicyclists and share the road until it is safe to pass the bicyclist or until the bicyclists has turned off of the roadway.

Figure 13: Bicyclist Riding on Sharrow Pavement Marking

2.5 Literature Review Summary

The past studies followed a before and after methodology that assisted them in analyzing the effects of sharrows. In Gainesville, Florida the purpose of studying pavement marking was to reduce sidewalk riding and increase proper cycling. In San Francisco, California, 5 years later Alta+ Design evaluated three different shared lane pavement markings from Paris, France, Portland, Oregon and Gainesville, Florida. Alta+ Design determined that the bike-and-chevron marking (also known as a sharrow) had the best results out of the three. After the San Francisco study, many cities around the country wanted to study the sharrow pavement marking. In Cambridge, Massachusetts the purpose of studying sharrows was to reduce car door opening crashes, while in Chapel Hill, North Carolina the purpose of studying sharrows was to reduce potential accidents due to the depressed drainage grates. In Seattle, Washington the purpose of the studying sharrows was to reduce sidewalk riding. The study results from Cambridge, Massachusetts and Chapel Hill, North Carolina showed that 94 and 96% of bicyclists rode on top of the sharrow pavement marking while the study in Seattle, Washington showed that 15% of bicyclists rode on top of the sharrow pavement marking. The most recent study was conducted in Austin, Texas. The researchers in Austin, Texas examined two different applications of sharrow markings. One application was to reduce door zone crashes; they looked at two sites for this application. The other application was on a narrow lane and the purpose was to increase safety for bicyclists by moving them away from the curb and to reduce sidewalk riding. Overall the results from Austin, Texas showed an increase in proper usage of sharrows.

3.0 Experimental Methodology

The three general research questions for this thesis are: do drivers and bicyclists understand the correct lateral position on a Sharrow, does everyone understand how to properly use a Sharrow, and are there differences based on gender of the bicyclists?

The author collected two types of data for this project: observational data and road user survey data. The following sections review the study selection and location, the equipment used to collect data, and the field procedures deployed for collecting survey data.

3.1 Study Locations and Selection:

For the purpose of this study, the author evaluated several Corvallis, Oregon streets for bicyclists and motorists behavior.

3.1.1 NW 21st Street (NW Monroe to NW Van Buren)

Northwest 21st Street in Corvallis, Oregon, between Northwest Monroe Avenue and Northwest Van Buren Avenue as seen in Figure 14, is one of the study locations. Northwest 21st Street has parking on the right side and no parking on the left side. Cars and bikes can travel both directions. Northwest 21st street is a low volume road with a speed limit of 25 mph. Between Northwest Van Buren Avenue and Northwest Monroe Avenue, 21st street has a vertical uphill grade. This street does not have sharrows; however, motor vehicles and bicycles share the same travel lane.

Source: maps. Google © 2012 Google

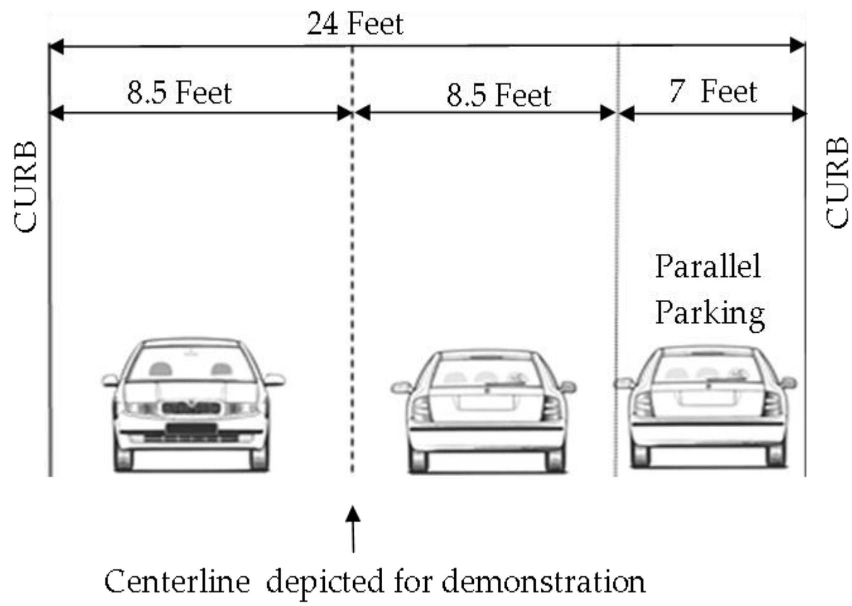


Figure 14: NW 21st Street, Corvallis Oregon

3.1.2 NW 16th Street (NW Monroe to NW Van Buren)

Northwest 16th Street between Northwest Monroe Avenue and Northwest Van Buren Avenue is depicted in Figure 15. Northwest 16st Street has parking on both sides of the street. Cars and bikes can travel in both directions. Northwest 16th Street is a low volume road with a speed limit of 25 mph. Between Northwest Van Buren Avenue and Northwest Monroe Avenue, Northwest 16st street has a constant grade. This street does not have sharrows; however, motor vehicles and bicycles share the same travel lane.

Source: maps. Google © 2012 Google

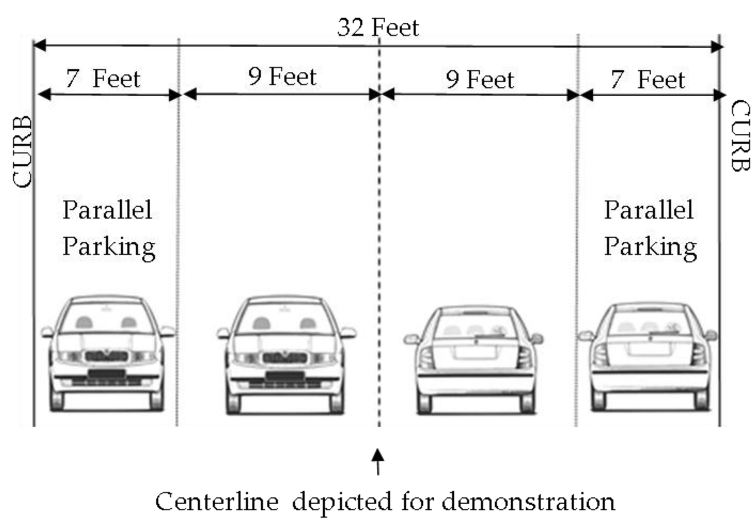


Figure 15: NW 16th Street, Corvallis Oregon

3.1.3 NW 14th Street (NW Monroe to NW Van Buren)

The Northwest 14th Street site is located between Northwest Monroe Avenue and Northwest Van Buren Avenue as shown in Figure 16. Northwest 14th Street has parking on the right side and no parking on the left side. Cars and bikes can travel in both directions. Northwest 14th Street has a higher volume of cars compared to the other locations with a speed limit of 25 mph. Between Northwest Van Buren Avenue and Northwest Monroe Avenue, 14th Street has a constant grade. Shared lane pavement markings are placed on 14th Street between NW Monroe Ave and NW Harrison Ave. The shared lane pavement markings in the northbound lane are the same size as the shared lane pavement markings in the southbound lane. The sharrow pavement markings on the southbound lane are placed 3 feet from the centerline and on the northbound the sharrows are placed 6 feet from the center line.

Source: maps. Google © 2012 Google

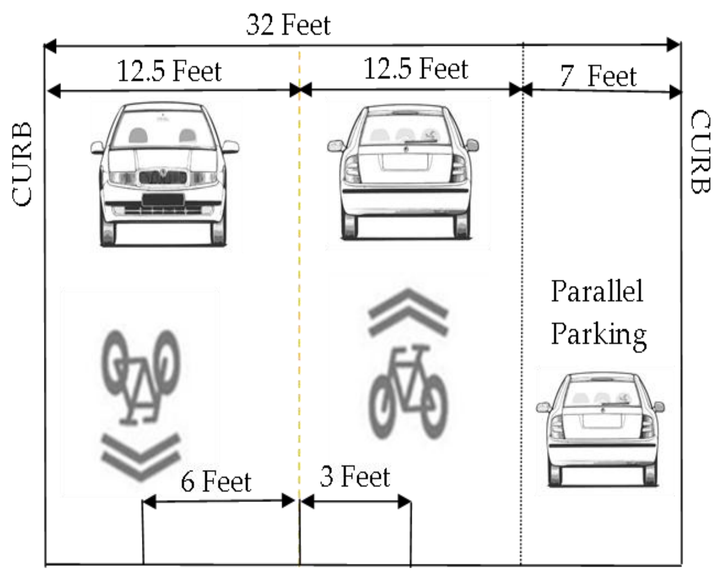


Figure 16: NW 14th Street, Corvallis Oregon

3.1.4 SW 11th Street (NW Monroe to SW Jefferson)

Southwest 11th Street between Northwest Monroe Avenue and Southwest Jefferson Avenue is illustrated in Figure 17. Southwest 11st Street has parking on the both side. Cars and bikes can travel in both directions. Southwest 11th Street is a low volume road with a speed limit of 25 mph. Between Northwest Monroe Avenue and Southwest Jefferson Avenue, 11th Street has a constant grade. This street does not have sharrows; however motor vehicles and bicycles share the same travel lane.

Source: maps. Google © 2012 Google

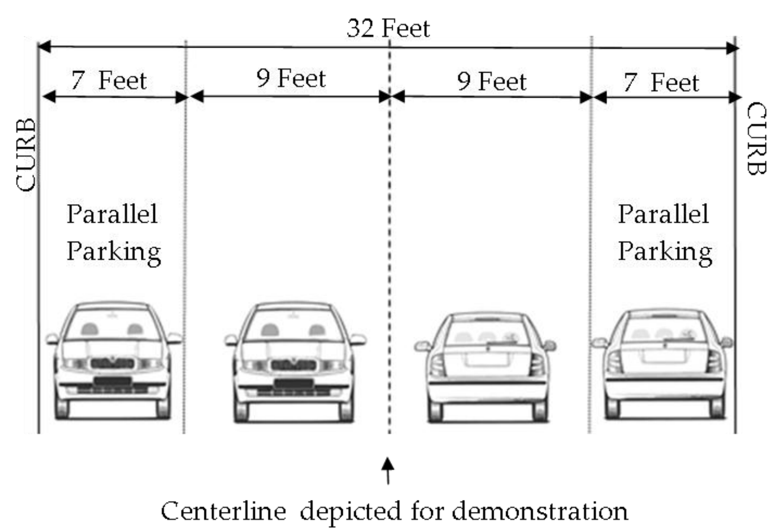


Figure 17: SW 11th Street, Corvallis Oregon

3.2 Equipment for Data Collection

The author acquired video log data using a digital video camera. The video camera was located out of the way of traffic and positioned either inside a car, on the sidewalk, or in the green landscape buffer. The on-site investigation of road characteristics helped the author determine the current placement of the shared lane pavement markings on 14th Street, their distance from the curb to the point of the chevron, and the distance from the point of the chevron to the center line.

3.3 Determine lateral position of bicyclists

The author created diagrams as depicted in Figure 18 prior to analyzing the video footage. The picture in the diagram is aligned with the center stripe so as to provide a guide to identify the lateral position of bicycles. If the position of the bicycle was in the vicinity of the black lines the bicycle was considered to have a center lateral position. The appendix includes the four lateral position diagrams derived for this study.

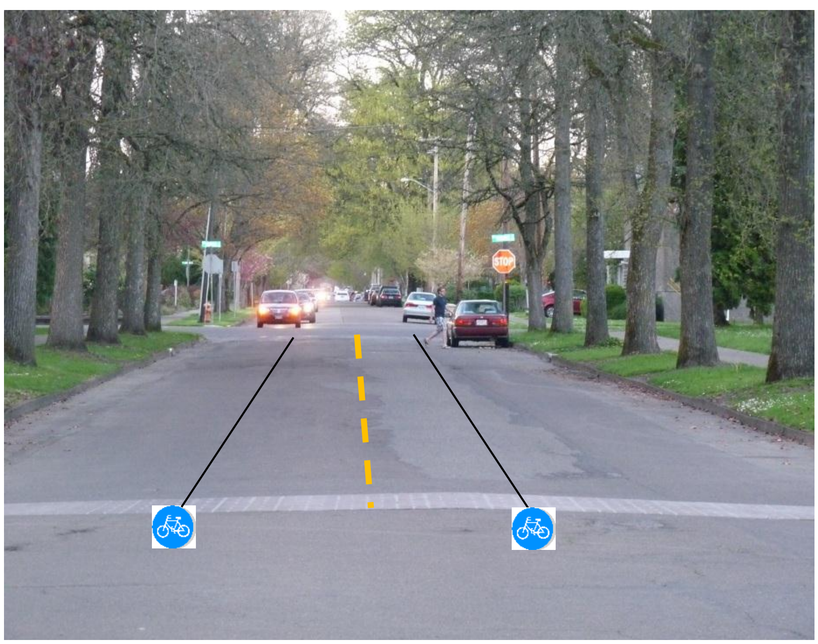


Figure 18: Example of Lateral Position Diagram

3.4 Field Procedure for Survey Data Collection

The second type of data that the author collected was survey data. The author started to conduct surveys of drivers and bicyclists after receiving approval from the Institutional Review Board (IRB) at Oregon State University. The actual survey that was given to the participants can be found in section 4 of the Appendix. All documents submitted to IRB and received from IRB can be found in section 4 of the Appendix.

The author walked throughout the campus of Oregon State University, from 14th Street and Campus Way all the way to 35th and Campus Way and in various public areas of city of the Corvallis for the survey collection. The author did not have any financial incentives to offer to the participants, and the survey did not benefit them directly in any way.

When walking, if the author was passing someone, she would ask them "Hi, Do you drive or ride a bicycle, if so do you have a couple minutes to answer my survey?" The author would then explain what the study is about and why she was conducting this study. If they decided that they were available and willing to take the survey, they would then be handed the survey.

The survey participants were randomly selected. Survey data collection occurred on Tuesday (April 10, 2012), Wednesday (April 11, 2012), Thursday (April 12, 2012), Friday (April 13, 2012), Monday (April 16, 2012) and Tuesday (April 17, 2012).

One of the most common questions on the survey was "what does road user mean?" The second most common question that the author was asked was "if I am a biker and I ride for both recreational and errands/work which one do I choose", the author answered by asking them to choose the one that they do the most.

The author did not look at their answers but simply folded the survey and put it in a bag for later review and analysis. The author wanted the survey to be a representative sample of the City of Corvallis population. The survey was voluntary and people chose to complete the survey. Because the survey was voluntary and people have the right to choose, this procedure affects how the sample represents City of Corvallis population sample.

4.0 Data Reduction

For this project, the research effort incorporated two forms of data collection. The author collected video data for PM and AM conditions for NW 14th Street between NW Monroe Ave and Van Buren Ave, PM data for SW 11th Street between SW Jefferson Ave and NW Monroe Ave, PM data for NW 16th Street between NW Monroe Ave and Van Buren Ave and PM data for NW 21st Street between NW Monroe Ave and Van Buren Ave. The author also acquired survey data throughout Corvallis to determine the participants' understanding of shared lane pavement markings.

4.1 Field Data Reduction

Before reducing the field data, the author created a diagram that showed the lanes and the location of the lanes' centerline boundary. If a bicycle was riding on the right side of the boundary then the author considered the bicycles riding on the right side. Similarly, bicycle riding on the left side of the boundary were considered to be on the left side.

After the author determined the center line boundary for lanes at the study locations, she initiated video data reduction. The author made an excel document that included columns for a time stamp, the estimated bike location, whether there was a car present behind the bike or next to the bike, if there was a car present and the type of vehicle, and the gender of the bicyclists. The gender of the bicyclists was estimated by looking at the bicyclists, the type of bike and style of biking, as well as any other features that would give away their gender. An example of the video reduction worksheet content is illustrated in Table 1.

Table 1: Example of Video Reduction Worksheet Content

TIME	**BIKE**			**CAR**		**TYPE OF CAR**			**GENDER**	
Stamp	**L**	**C**	**R**	**Y**	**N**	**Compact**	**Pick-up/ SUV**	**Truck**	**Female**	**Male**
15.56.27		1			1				1	
16.05.27			1	1			1			1
16.06.30		1			1					1
16.09.37		1		1		1			1	

4.2 Survey Data Reduction and Analysis

For the reduction of the survey data, the author used to help organize the data. The author made a document in excel that had a column for every answer possible. The method started out by numbering the paper survey, then inserting a value of 1 under all the chosen answers. Using the value of 1 allowed the author to sum up the values at the end. A total of 70 surveys were gathered from around campus and different areas of the City of Corvallis. Ultimately, the number of analyzed surveys was 62. Surveys that were incomplete and had missing information were not included in the analysis.

After all the surveys were entered into the excel document, the columns were totaled to determine how many participants selected each option. Figure 19 shows the original survey including the summary response statistics. On the left of each option for a particular question is the number of participants that chose that specific answer. The choices that the participants selected most often are colored in blue. Table 2 depicts an example of how the author reduced the survey data using Excel.

ROAD USER (Questions 1- 4)

1. Gender: (Select 1)

36	**A.**	**Male**
26	B.	Female

2. Age: (Select 1)

43	**A.**	**24 years or less**
13	B.	25 to 44 years
5	C.	45 to 64 years
1	D.	65 years or more

3. This road marking means: (Select 1)

(present picture 1)

30	**A.**	**Only Bicyclist can travel on this road**
23	B.	Bicyclists and motorist can travel on the same road.
9	C.	Not Sure

4. Road User: (Select 1)

27	A.	Driver
8	B.	Bicyclists
27	C.	Both

If the answer is A then skip questions 5-13 and answer questions 13-20.

If the answer is B then answer questions 5-13 and skip questions 14-20.

BICYCLIST(Questions 5 – 13)

5. How do you classify yourself as a biker: (Select 1)

9	A.	Experienced
19	**B.**	**Moderate**
7	C.	Beginner

6. Why do you ride your bike: (Select 1)

5	A.	Exercise
5	B.	Errands
7	C.	Recreational
18	**D.**	**Work/School**

7. Do you typically ride on a road that has this marking? (Select 1) (present picture 1)

25	**A.**	**Yes**
10	B.	No

8. If Yes where do you ride in the lane?

2	A.	Left of the lane
6	B.	Middle of the lane
17	**C.**	**Right Edge of lane**

9. Do drivers seem to yield to you: (Select 1)

25	**A.**	**Yes**
10	B.	No

10. Can you explain?

11. If you have an option between a street with this marking vs. a street with designated bike lane which would you choose: (Select 1)(present picture 2)

23	**A.**	**Street with designated bike lane**
1	B.	Street with this marking
11	C.	Either
	D.	

12. Have you had any near-miss encounters with a vehicle? (Select 1)

14	A.	Yes
21	**B.**	**No**

13. Can you explain?

DRIVER (Questions 14 – 20)

14. How do you classify yourself as a driver: (Select 1)

35	**A.**	**Experienced**
18	B.	Moderate
1	C.	Beginner

15. Why do you drive: (Select 1)

5	A.	Recreational
26	**B.**	**Errands**
23	C.	Work/School

16. Have you encountered bicyclists on roads with this marking? (Select 1) (present picture 1)

40	**A.**	**Yes**
14	B.	No

17. If Yes where do bicyclist seem to ride in the lane?

5	A.	Left of the lane
12	B.	Middle of the lane
24	**C.**	**Right Edge of lane**

18. If you have an option between driving on a street with this marking vs a street with designated bike lane which would you choose to drive on: (Select 1) (present picture 2)

37	**A.**	**Street with designated bike lane**
0	B.	Street with this marking
17	C.	Either

19. Have you had any near-miss encounters with a bicycle ? (Select 1)

15	A.	Yes
39	**B.**	**No**

20. Can you explain?

LEGEND

#	Number of Participants Choosing This Option

Figure 19: Survey Questions and Response

Table 2: Sample Survey Data Reduction View

#	GENDER		AGE				ROAD USER		
	Male	**Female**	**< or = 24**	**25 to 44**	**45 to 65**	**65 or >**	**Driver**	**Bicyclists**	**Both**
1	1			1					1
2	1			1					1
3	1		1						1
4	1			1			1		
5	1		1					1	
6	1		1				1		

4.2.1 Contingency Tables

A contingency table is a statistical table that illustrates the observed frequencies of the data categories organized in a matrix style with rows that represent one variable and columns that represent another variable. Contingency tables contain count data, for example, gathered from surveys questions.

The word contingency was introduced by Karl Pearson in 1904 as a "measure of the total deviation of the classification from independent probability" (Agresti, 2002). There are two common ways of analyzing contingency tables, Fisher's Exact Test and the Pearson chi-square test of independence. The two statisticians took different approaches to analyzing contingency tables that look similar to Table 3.

Table 3: Gender vs. Riding on Sharrow

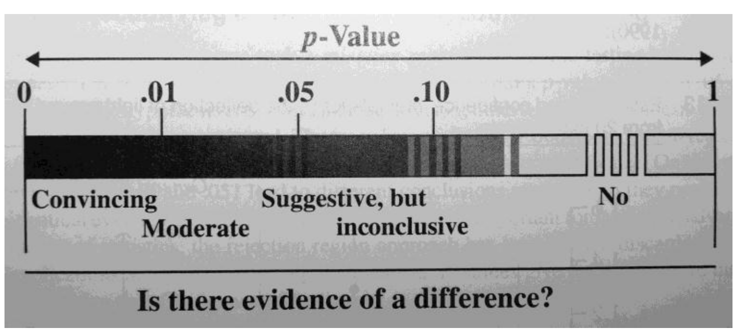
Gender	Ride on Sharrow		
	Yes	**No**	**Total**
Male	16	5	21
Female	9	5	14
Total	25	10	35

4.2.2 Fisher Exact Method

Fisher's exact method takes the totals of each row as fixed by the experiment and the columns are fixed by participants. According to Fisher's method the row totals are fixed by the experimenter and the column totals are fixed by the participants. The null hypothesis tests whether the bicycle rider chooses to ride on lanes with sharrow markings is independent of his or her gender. If you select 21 sample points at random, the probability that 16 of these 21 will actually ride on sharrows can be explained by the hypergeometric distribution.

A hypergeometric distribution is a discrete probability distribution that determines the probability of a set number of successes in a set number of draws from a finite population; once you draw you cannot put it back.

Using a statistical package and inserting the count data shown in Table 3, the p-value (the probability of getting a result "as extreme as or more extreme than the event observed value if the null hypothesis is true (Ramsay & Schafer, 2002)) for the null hypothesis which states that whether the bicycle rider chooses to ride on lanes with sharrow markings has no correlation to the bicyclist's gender is equal to 0.4736 using Fisher's Exact test. Using the scale from the Statistical Sleuth (Ramsey & Schafer, 2002) shown in Figure 20, it is noticeable that anything bigger than 0.1 is considered insignificant. This means that a p-value of 0.4736 shows no evidence to reject the null hypothesis that the two events are independent.



Source: Ramsey & Schafer, 2002

Figure 20: P-Value Scale

4.2.3 Pearson Chi-Squared Method

The Pearson Chi-Square test for independence takes the contingency table values as observed values. Using the totals of the columns and rows, the next step would be to calculate the expected number of observations. The expected number in each cell would be equal to its row total multiplied by its column total, than divided by the total number of responses. For example if our contingency table looks like Table 1 then the expected number for each column would be:

Table 4: Expected Values: Gender vs. Riding on Sharrow

Gender	**Ride on Sharrow Markings**		
	Yes	**No**	**Total**
Male	15	6	21
Female	7.14	4	14
Total	25	10	35

For men that ride on the sharrow pavement markings, the expected number would be:

$$x = \frac{25 * 21}{35} = 15$$

The Pearson Chi-Squared statistics looks like:

$$x^2 = \sum \frac{(observed\ count - expected\ count)^2}{expected\ Count}$$

The null hypothesis evaluates whether the bicycle rider chooses to ride on lanes with sharrow markings has nothing to do with his or hers gender. The Pearson Chi-squared degrees of freedom are calculated by taking the total number of rows minus 1 and multiplying it by the total number of columns minus 1. The p-value can be calculated by spreadsheet, by hand or by using a statistical program such as R. Using the R statistical program, for the null hypothesis which states that the bicycle rider chooses to ride on lanes with sharrow markings has nothing to do with his or her gender; the value is equal to 0.445 using Pearson's Chi-Squared Test.

The reason the two p-values are slightly different from each other has to do with the calculated expected counts in the chi-squared distribution. Previous studies (Agesti, 2002) suggest that the Pearson Chi-squared tests have improved accuracy when no more than 20% of the expected counts are less than 5 and all individual expected counts are of a value 1 or greater. However both values show that there is no dependency between gender as to whether or not they ride on sharrow pavement markings.

5.0 Data Analysis

The analysis for the project is summarized in this section. The observational analysis gives details about the current conditions, the observed conflicts for morning and afternoon conditions, and a description about past crashes that occurred place on this road. The survey and video data results analysis details the null hypothesis and results.

5.1 Observational Analysis on NW 14th Street

The author performed a field conflict study at northwest 14th Street between northwest Jackson Street and Northwest Monroe Ave. This portion of NW 14th street has sharrow pavement markings on both sides of the road. The sharrow pavement markings are not positioned in the lane based on the MUTCD guidance criteria. The MUTCD guidance suggests that shared lane pavement markings should be placed immediately after an intersection and should be repeated at an interval less than 250 feet afterwards. In the northbound lane of 14th Street, the sharrow pavement markings are placed almost 400 feet apart from one another. In the southbound direction, the sharrow pavement markings are placed about 360 feet apart. This portion of NW 14th Street does not have a "Bicycle may use full lane" sign as seen in Figure 1. The sharrow pavement markings on the southbound lane were placed on October 7th, 2009 prior to the publication of the December 2009 edition of the MUTCD; while the northbound sharrow pavement markings were placed on October 17, 2010.

For this traffic conflict study, the author collected data on two different days for a total of 5 hours of data. The main purpose for this traffic study was to determine the types of conflicts that occur on this portion of roadway and the abundance of potential incidents per conflict. The author collected the data on April 6, 2012 from 4pm to 6:30pm and on April 13th, 2012 between 7am to 10 am. On both days the weather was in the mid 50's

Fahrenheit with clear skies. The types of conflicts that the author observed could have resulted in different types of crashes ranging from rear-end crashes to sideswipe crashes.

The type of conflicts observed included: bike moving to the right to allow vehicles to pass, vehicle crossing the yellow line in order to pass bike, vehicles turning into driveways and cutting right in front of a bicyclist, vehicles backing out of driveways and the drivers not noticing on-coming bicyclists, drivers not noticing that they have a bike on the right side and at the intersection almost hitting the bike when attempting to turn into the right lane. During the conflict study the author also noticed 4 bicyclists traveling northbound on the southbound traffic lane.

Along with observing bicycle and vehicle interactions, the author also looked at crash records between January 1, 2008 and December 31, 2008 on NW 14th Street between NW Monroe Ave and NW Van Buren Ave. From the crash records the author developed a collision diagram. A collision diagram is a graphical display of crashes at a specific location, with details about the time the crash occurred, the pavement conditions, the lighting conditions, and the severity of the crash. An example of a collision diagram can be seen in Figure 21. The author displayed three collision diagrams for this section of road (see Appendix Section 1).

The crash history shows that in the last 3 years there have been 3 reported crashes between vehicles and bicyclists. For two of the three cases, the vehicles were at fault while the crash at NW Monroe Ave and NW 14th St took place because the bicyclist failed to stop at the stop light. One crash at NW 14th St and NW Van Buren Ave occurred when the driver of the vehicle failed to check his blind spot before turning right and crossing the bike lane. The second crash at NW 14th St. and NW Van Buren Ave happen when the driver of the vehicle failed to stop at the stop sign and subsequently hit the bike that was stopped as well as the pedestrian that was crossing the road. The records show that in the last 3 years, 3 vehicle-bicycle crashes were reported. Many vehicle-bicycle crashes are unreported either because the driver does not realize that they hit a bicyclist and drives on, or perhaps the driver does realize and stops and the first thing that comes to mind is to take the person to the hospital.

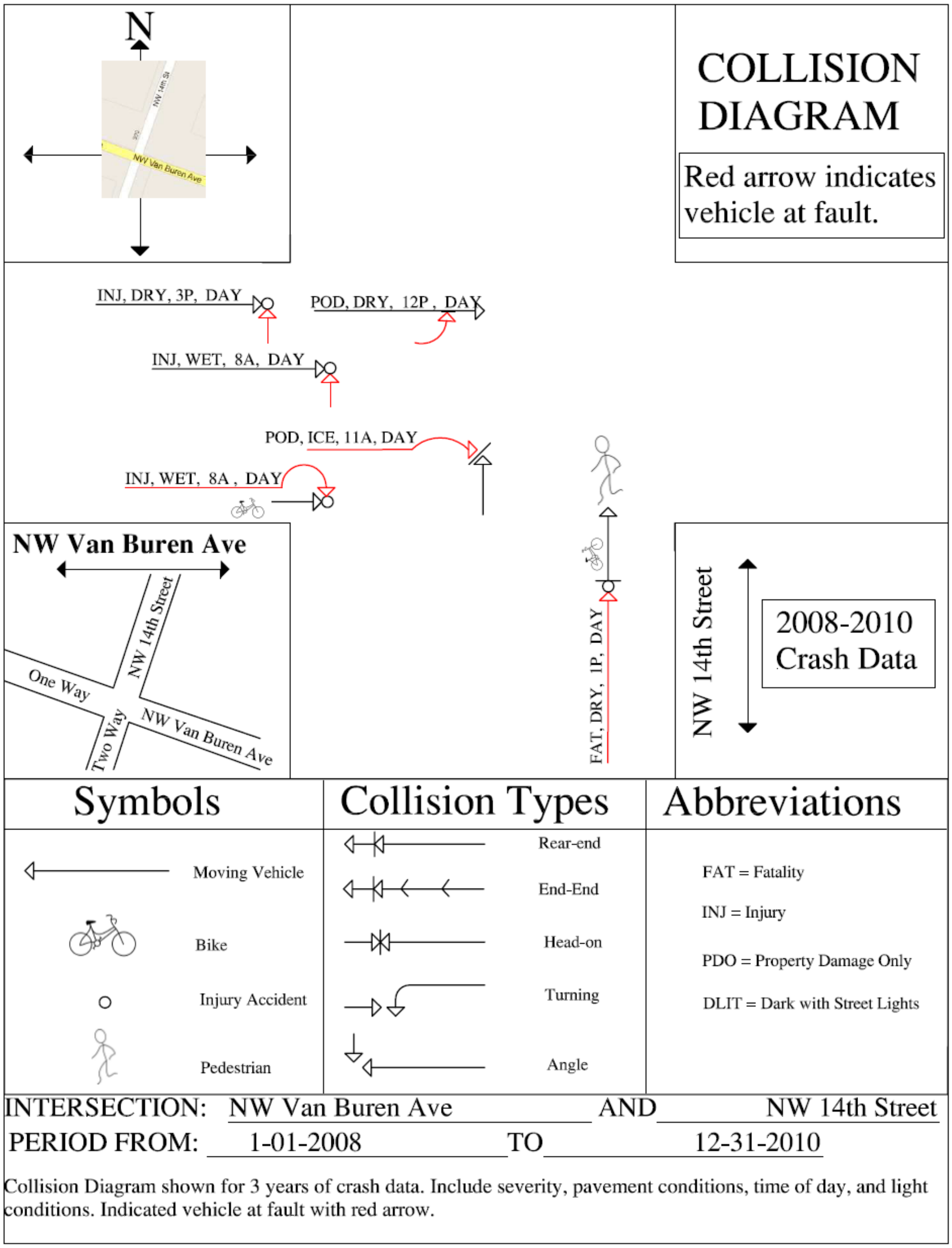


Figure 21: Example of Collision Diagram

5.2 Survey Results Analysis

In order to assess the potential user and site relationships, the author organized the survey data and created contingency tables for each question. For the survey results the author used an exploratory cross-sectional approach to answer the author's questions. The questions are as follows:

A. Does the understanding of sharrow pavement markings depend on gender?
B. Does the understanding of sharrow pavement markings depend on the road user?
C. Does the lateral position when riding on a shared use lane depend on gender?
D. Does choosing whether to ride or not on a shared use lane depend on gender?
E. Does the experience of the bicyclist determine whether or not he or she rides on shared lane facilities?
F. Does the understanding of sharrow pavement markings depend on the experience of the bicyclists?
G. Does the understanding of sharrow pavement markings depend on the experience of the driver?
H. Do drivers yield equally to both genders?

A. When looking at the understanding of sharrow pavement markings and whether it depends on gender, the null hypothesis assumes that the two groups are independent. The Chi-Squared Test returned a p-value of 0.459 and the Fisher Exact test returned a p-value of 0.53 as seen in Table 5. Both of these tests showed that there is no evidence to reject the null hypothesis that the two groups are independent.

Table 5: Understanding Sharrow Pavement Markings & Gender

Gender	**This road marking means**			**Total**		
	Bike Only	**Both**	**Not Sure**			
Male	15	15	6	36	Chi-Squared Test p-value= 0.459	Fisher Exact Test p-value=0.53
Female	15	8	3	26		
Total	30	23	9	62		

B. When looking at the understanding of sharrow pavement markings and whether it depends on the type of road user, the null hypothesis assumes that the two groups are independent. The Chi-Squared Test returned a p-value of 0.6228 and the Fisher Exact test returned a p-value of 0.6784 as seen in Table 6. Both of these tests showed that there is no evidence to reject the null hypothesis that the two groups are independent.

Table 6: Understanding of Sharrow Pavement Marking & Road Users

Road User	**This road marking means**			**Total**		
	Bike Only	**Both**	**Not Sure**			
Driver	12	8	7	27	Chi-Squared Test p-value= 0.6228	Fisher Exact Test p-value=0.6784
Bicyclists	5	2	1	8		
Both	13	13	1	27		
Total	30	23	9	62		

C. When looking at the lateral position of a bicycle rider on a shared use lane facility and whether it depends on the gender of the bicyclist, the null hypothesis assumes that the two groups are independent. The Chi-Squared Test returned a p-value of 0.07378 and the Fisher Exact test returned a p-value of 0.06157 as seen in Table 7. Both of these test show that there is suggestive but inconclusive evidence that the two groups are not independent. The sample size is small, with a bigger sample size the result might be less or more significant.

Table 7: Lateral Position of bicyclists & gender

Gender	**If Yes where do you ride in the lane?**					
	Left	**Center**	**Right**	**Total**		
Male	0	3	13	16	Chi-Squared	Fisher Exact
Female	2	3	4	9	Test	Test
Total	2	6	17	25	p-value= 0.07378	p-value=0.06157

D. When looking at a whether bicycle rider chooses to ride on a shared use lane facility depends on the gender of the bicyclists, the null hypothesis assumes that the two groups are independent. The Chi-Squared Test returned a p-value of 0.445 and the Fisher Exact test returned a p-value of 0.4736 as seen in Table 8. Both of these test show that there is no evidence against the null hypothesis. This means the relationship between the two groups is independent.

Table 8: Whether to ride or not on shared use lane & Gender

Ride On Sharrow	**Gender**				
	Male	**Female**	**Total**		
Yes	16	9	25	Chi-Squared	Fisher Exact
No	5	5	10	Test	Test
Total	21	14	35	p-value= 0.445	p-value=0.4736

E. When looking at the experience of the bicyclists and whether that determines if they ride on a shared use lane facility, the null hypothesis assumes that the two groups are independent. The Chi-Squared Test returned a p-value of 0.3539 and the Fisher Exact test returned a p-value of 0.3773 as seen in Table 9. Both of these tests show that there is no evidence against the null hypothesis. This means the relationship between the two groups is independent. This finding suggests that the level of experience a bicyclist has does not influence his or her decision on whether to ride on a sharrow.

Table 9: Experience Determine Whether or Not to Ride on Sharrows

Classify As Bicyclists?	**Ride**		**Total**		
	Yes	**No**			
Experienced	7	2	9	Chi-Squared Test p-value= 0.3539	Fisher Exact Test p-value=0.3773
Moderate	11	8	19		
Beginner	3	4	7		
Total	21	14	35		

F. When looking at whether the understanding of sharrow pavement markings depends on the experience of the bicyclists, the null hypothesis assumes that the two groups are independent. The Chi-Squared Test returned a p-value of 0.9085 and the Fisher Exact test returned a p-value of 1 as seen in Table 10. Both of these test show that there is no evidence against the null hypothesis. This means the relationship between the two groups is independent.

Table 10: Understanding of Sharrows & Experience of the Bicyclists

Classify As **Bicyclist**	**This road marking means**			**Total**		
	Bike Only	**Both**	**Not Sure**			
Experienced	4	4	1	9		
Moderate	10	8	1	19	Chi-Squared	Fisher Exact
Beginner	4	3	0	7	Test	Test
Total	18	15	2	35	p-value= 0.9085	p-value=1

G. When looking at whether understanding of sharrow pavement markings depends on the experience of the motorist, the null hypothesis assumes that the two groups are independent. The Chi-Squared Test returned a p-value of 0.5199 and the Fisher Exact test returned a p-value of 0.4952 as seen in Table 11. Both of these tests show that there is no evidence against the null hypothesis. This means the relationship between the two groups is independent.

Table 11: Understanding of Sharrows & Experience of the Motorist

Classify As **Driver**	**This road marking means**			**Total**		
	Bike Only	**Both**	**Not Sure**			
Experienced	15	16	4	35		
Moderate	9	5	4	18	Chi-Squared	Fisher Exact
Beginner	1	0	0	1	Test	Test
Total	25	21	8	54	p-value=0.5199	p-value=0.4952

H. When looking at whether drivers yield to bicyclists on sharrow pavement markings and whether that is related to gender, the null hypothesis assumes that the two groups are independent, meaning drivers yield equally to both genders. The Chi-Squared Test returned a p-value of 0.445 and the Fisher Exact test returned a p-value of 0.4736 as seen in Table 12. Both of these tests show that there is no evidence against the null hypothesis. This means the relationship between the two groups is independent.

Table 12: Drivers yielding vs. Genders

Gender	Drivers Yield				
	Yes	No	Total		
Male	16	5	21	Chi-Squared Test p-value= 0.445	Fisher Exact Test p-value=0.4736
Female	9	5	14		
Total	25	10	35		

5.2.1 Survey Statistical Finding Summary

The most notable result from the survey is correlation between education and experience. The bicycle education vs. experience had a p-value of 1 using the Fisher exact test and the motorists vs. experience had a p-value of 0.49 using the Fisher exact test. These p-values show that there is not a link between education and experience. Each person evaluates their experience differently, by how good they consider themselves as drivers or bicyclists, by how many years they have been driving or biking, and many more. In our situation, this shows that having experience biking or driving does not mean that driver or bicyclists know how to drive or ride correctly in shared use lane facilities.

5.3 Video Data Statistical Findings

As previously indicated, the author organized the video data in an excel document. The author wanted to look at the position of the bicycles and whether or not the position can be affected by the presence of a vehicle. One of the purposes of a sharrow is to make the bicycle rider feel more comfortable because the drivers would be more aware of the bicyclists and yield to them. Sharrow pavement markings are placed on NW 14th

street as previously mentioned. Along with 14th Street, the author examined the other 3 locations to see if there is a relationship between the position of the bicycle and the presence of a car.

On NW 16th Street, findings showed that there is no relationship between motor vehicle presence and bicycle positioning. Similar findings were found for NW 21st Street and SW 11th Street. Details on these findings can be found in Section 3 of the Appendix.

For the northbound lane of NW 14th Street, there were no statistically significant findings for dependency between bicycle location and whether a car was present.

Statistical significance was observed for the southbound lane of NW 14th Street for the dependency between bicycle location and whether a car was present. Pearson chi-squared returned a p-value of 0.0314 and Fisher Exact test returned a p-value of 0.027. The Fishers method resulted in a 95% confidence interval (0.0358, 0.8677) and an odds ratio of 0.213. These results suggest that the presence of a vehicle does affect the lateral position of the bicyclist.

Table 13: NW 14th Street, Bike Position vs. Presence of Vehicle

Vehicle	location			Total		
	L	c	R			
Yes	0	3	16	19	Chi-Squared Test p-value= 0.0314	Fisher Exact Test p-value=0.027
No	0	26	29	55		
Total	0	29	45	74		

5.3.1 Video Data Statistical Finding Summary

The most important result from the video data collected is the correlation between bicycle lateral position and presence of vehicle. This shows that drivers might not be aware that bicycles can be in the middle of the lane. This might also suggest that drivers choose to pass bicycles instead of staying behind them; as observed during the conflict analysis.

6.0 Conclusion

This chapter summarizes of the results of this thesis, a review of the results, and identifies potential future studies.

6.1 Results

The results in this thesis apply to the Corvallis area and the road users of Corvallis Oregon. Sharrow pavement markings have been implemented in Corvallis, Oregon since October 2009. Corvallis, Oregon is a college town where 50% of the population is students from around the world. Many of the students have not been exposed to this shared lane pavement marking and do not understand what they mean. When they buy a bicycle and become active cyclists in the region they may not be aware of the existence of an Oregon Bicycle Manual. It can be dangerous to bike around town without knowing the safe way to bike, safe practices that can save a person's life.

The survey results showed that understanding of shared use lane pavement markings and the driver/bicycle experience are two independent features. Experience is evaluated by each individual based on many factors that can include the number of years they have been riding/driving. However, this study shows that having experience does not necessarily mean that the individual had the knowledge to perform correctly.

The video analysis demonstrated that there is no relationship between the gender of the bicyclists and their lateral position on the road. This relationship between lateral position and gender is true for both adjacent parallel parking as well as no adjacent parking. The p-values of these relationships can be viewed in Appendix 3.

The video analysis did show that there is a relationship between lateral position of the bicycle and the presence of a vehicle on the southbound lane of 14th Street (See Section 3 of Appendix). There are many reasons why a direct relation was found on the southbound lane of NW 14th

Street. Looking at bicycle and driver characteristics, one possible answer would be that the cyclist does not want to impede on the drivers right-of-way. This might come from the fact that the cyclist is also a driver, and when he or she drives they do not like it when the bicyclist travels in front of them at lower speeds than the vehicle causing them to slow down. Bicycles change their lateral position depending on whether a vehicle is present. This observation shows that bicycle riders prefer to ride their bike slightly away from parked vehicles. These results were also noticed on NW 16th Street, NW 21st Street and SW 11th Street. If parking was not present on that side, potentially the majority of bicycle riders would choose to ride on the right side close to the curb.

On the northbound lane of NW 14th Street there is no statistical significant because 85% of bicyclists ride on the right side of the lane, whether or not a vehicle is present. This location does not have on-street parking thereby demonstrating that the cyclists might feel more comfortable on the right side of the lane or might not understand how to ride on a sharrow properly.

6.2 Recommendations

Awareness and education of sharrow pavement markings should be strongly considered as an effort to increase bicycle safety and driver understanding. The Oregon Bicycle manual is a very informative booklet yet it is not accessible for bicyclists. Distributing this manual in bicycle shops, in student common areas such as the Oregon State University Library, and the City of Corvallis Library could increase awareness of proper bicycling and increase overall bicycle safety.

In order to increase the awareness of drivers of the lateral position of bicycles in a shared use lane, short announcements could be broadcasted on radio stations to raise attention to the driver of sharrows. The Oregon Driver manual with easy to understand updates (short sections) could be published separately and distributed throughout car dealerships, auto repair shops, Oregon DMV, USPS post office, Oregon travel agencies, and more.

Currently, Oregon State University campus police are working on a video that would teach the entire freshman class how to drive on a sharrow, how to ride your bicycle on a sharrow, and many other bicycle treatments. Their hope is to make this video mandatory to watch starting this fall 2012.

6.3 Future Research

The author recommends repeating this study after the Oregon State University campus police implement the educational bicycle video, to see if training has an effect on the users understanding of sharrow pavement markings.

Determining the effectiveness of the sharrow pavement markings after the educational video (after a period of a few years when more classes are exposed to the video) and following the distribution of supplemental sharrow information, it would be interesting to determine if drivers change their behavior on sharrow lanes and if bicyclists change their behavior and overtake the lane more often.

Examining a larger sample of road users and more geographically diverse sample would result in a better understanding of sharrow markings. Future research could examine the understanding of sharrow marking in more detail by having a larger sample of road users and more diverse population.

The current placement of the sharrow pavement marking does not meet the MUTCD guidelines on how frequent the pavement markings should be positioned. A future study could evaluate the impact the frequency of the pavement markings has on driver and bicycle awareness and if the 250 feet spacing should be more enforced.

Last but not least, a future project could look at different variations of the sharrow pavement marking such as dash lines around the pavement marking to display to cyclists where they should ride as well as color treatments that would make bicycle users and drivers more aware and potentially increase the safety of the bicycle on the sharrow.

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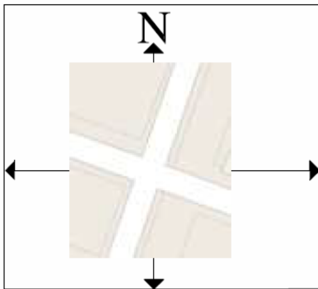
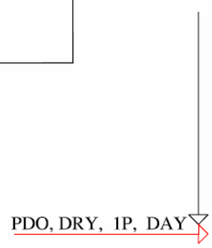
APPENDIX SECTION 1

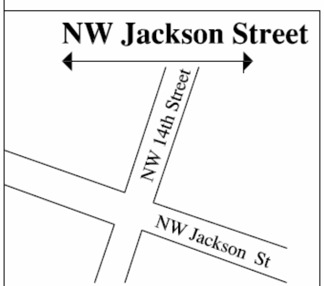
Collision Diagrams for NW 14th Street



COLLISION DIAGRAM

Red arrow indicates vehicle at fault.





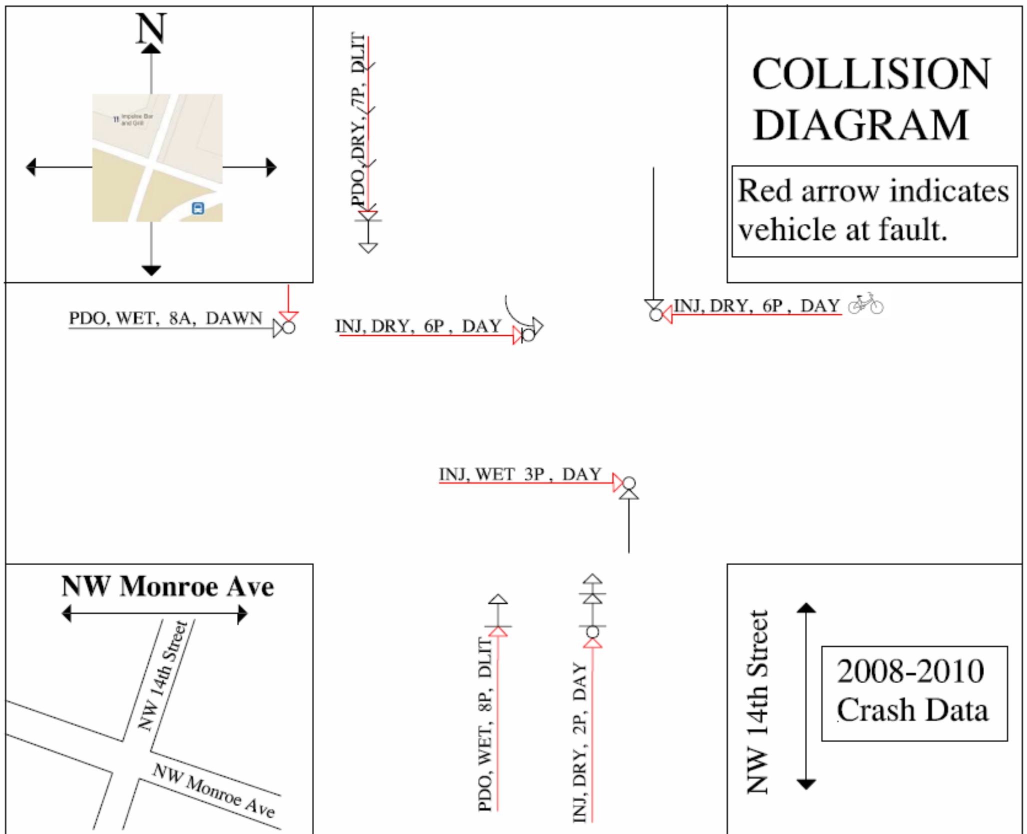
2008-2010 Crash Data

Symbols		Collision Types		Abbreviations
	Moving Vehicle		Rear-end	FAT = Fatality
	Bike		End-End	INJ = Injury
	Injury Accident		Head-on	PDO = Property Damage Only
			Turning	DLIT = Dark with Street Lights
			Angle	

INTERSECTION: NW Jackson Street AND NW 14th Street

PERIOD FROM: 1-01-2008 TO 12-31-2010

Collision Diagram shown for 3 years of crash data. Include severity, pavement conditions, time of day, and light conditions. Indicated vehicle at fault with red arrow.



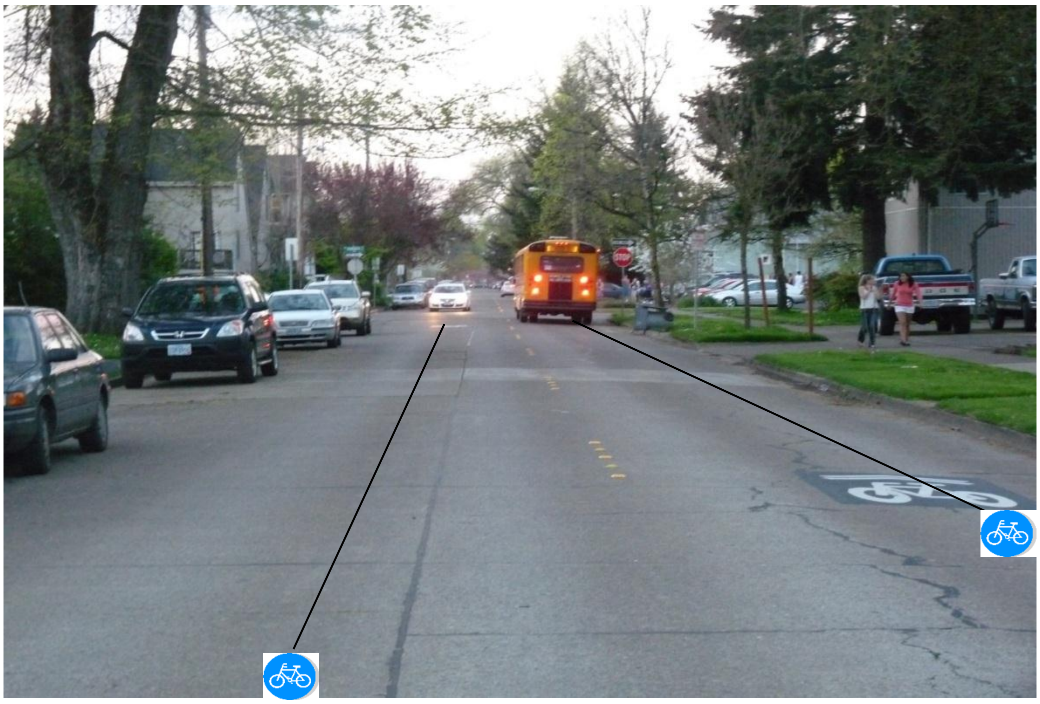
Symbols	Collision Types	Abbreviations
Moving Vehicle	Rear-end	FAT = Fatality
Bike	End-End	INJ = Injury
Injury Accident	Head-on	PDO = Property Damage Only
Backing Vehicle	Turning	DLIT = Dark with Street Lights
	Angle	

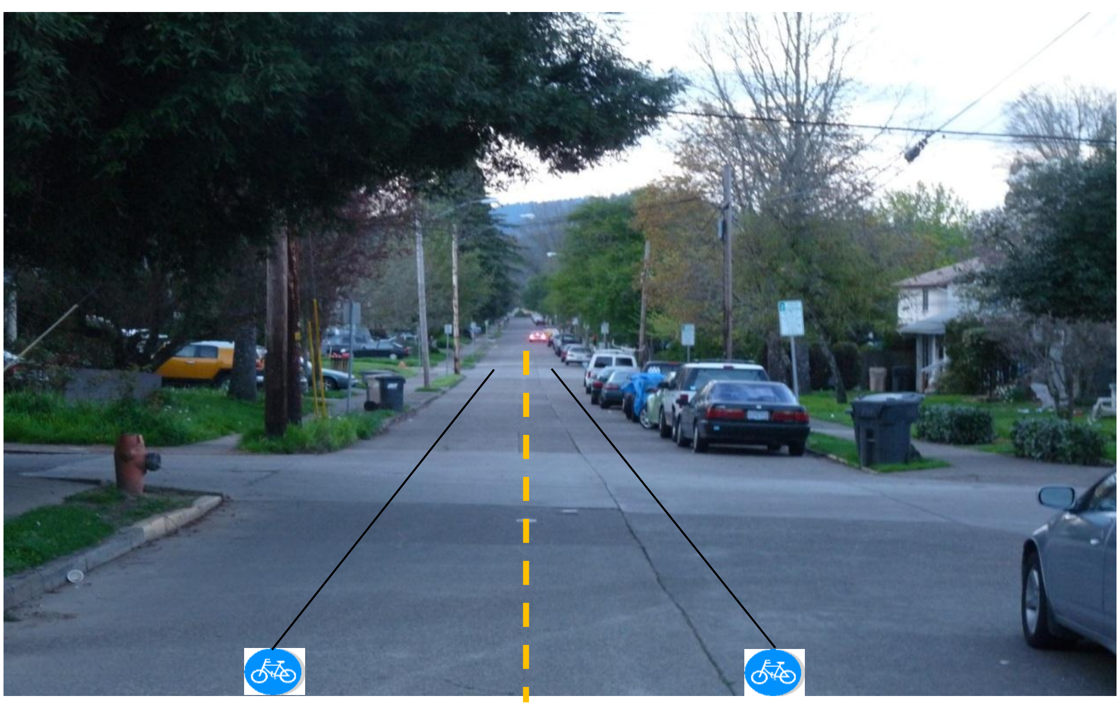
INTERSECTION: NW Monroe Ave AND NW 14th Street
PERIOD FROM: 1-01-2008 TO 12-31-2010

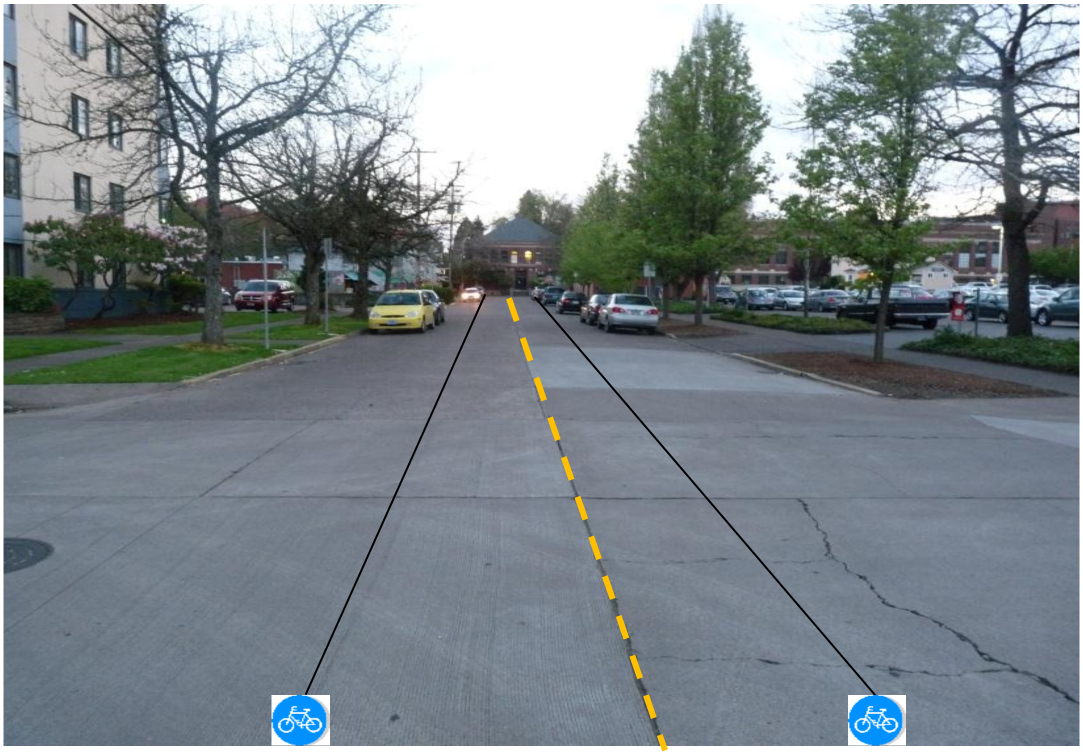
Collision Diagram shown for 3 years of crash data. Include severity, pavement conditions, time of day, and light conditions. Indicated vehicle at fault with red arrow.

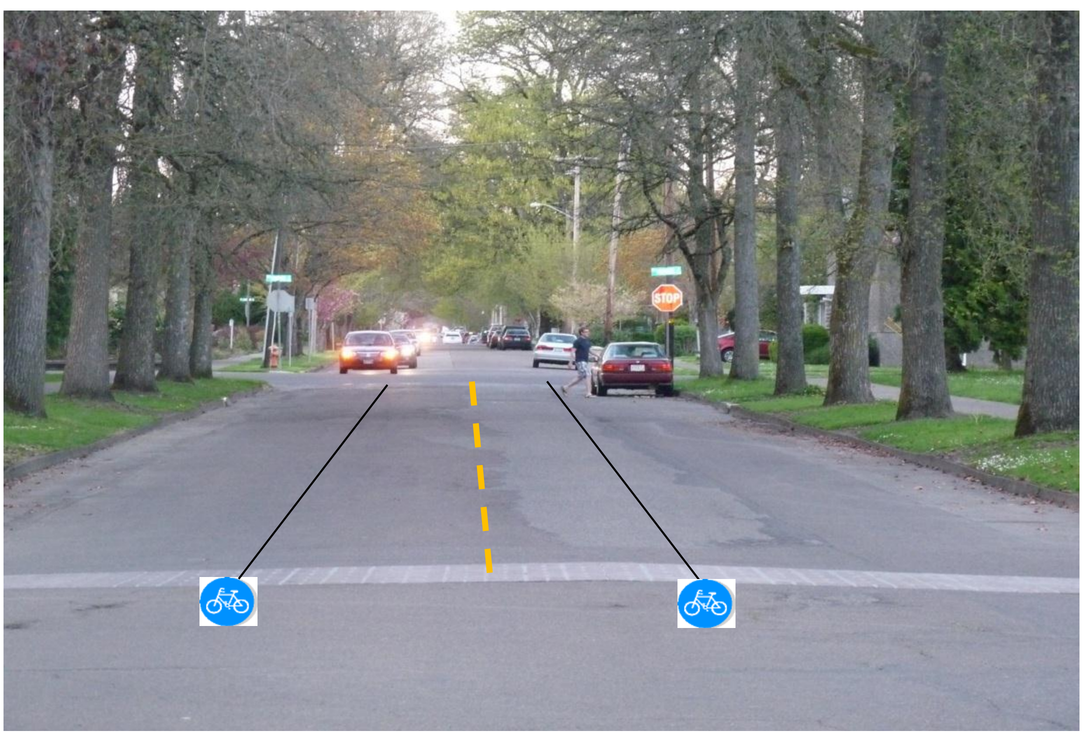
APPENDIX SECTION 2

Visual Diagrams for Video Data Reduction




STOP




STOP

APPENDIX SECTION 3

Video Data Tables of Analysis

16th Street – parking on both sides

Gender	Location			Total		
	L	c	R			
Female	4	11	3	18	Chi-Squared Test p-value= 0.4986	Fisher Exact Test p-value=0.5375
Male	7	15	10	32		
Total	11	26	13	50		

Vehicle	Location			Total		
	L	c	R			
Yes	0	3	3	6	Chi-Squared Test p-value= 0.2214	Fisher Exact Test p-value=0.2771
No	11	23	10	44		
Total	11	26	13	50		

11th Street –parking on both sides

Gender	Location			Total		
	L	c	R			
Female	0	13	5	18	Chi-Squared Test p-value= 0.2718	Fisher Exact Test p-value=0.3276
Male	0	11	9	20		
Total	0	24	14	38		

Vehicle	Location			Total		
	L	c	R			
Yes	0	4	4	8	Chi-Squared Test p-value= 0.3852	Fisher Exact Test p-value=0.4332
No	0	20	10	30		
Total	0	24	14	38		

21st Street Southbound

Gender	Location			Total		
	L	c	R			
Female	1	6	9	16	Chi-Squared Test p-value= 0.8613	Fisher Exact Test p-value=0.8921
Male	3	12	25	40		
Total	4	18	34	56		

Vehicle	Location			Total		
	L	c	R			
Yes	0	4	9	13	Chi-Squared Test p-value= 0.4913	Fisher Exact Test p-value=0.6943
No	4	14	25	43		
Total	3	17	34	56		

21st Street Northbound

Gender	Location			Total		
	L	c	R			
Female	2	5	10	17	Chi-Squared Test p-value= 0.8708	Fisher Exact Test p-value=0.8277
Male	3	13	23	39		
Total	5	18	33	56		

Vehicle	Location			Total		
	L	c	R			
Yes	1	2	5	8	Chi-Squared Test p-value= 0.86	Fisher Exact Test p-value=0.863
No	4	16	28	48		
Total	5	18	33	56		

14th Street Northbound

Gender	Location			Total		
	L	c	R			
Female	0	3	15	18	Chi-Squared Test p-value= 0.94	Fisher Exact Test p-value=0.1
Male	0	3	21	24		
Total	0	6	36	42		

Vehicle	Location			Total		
	L	c	R			
Yes	0	1	17	18	Chi-Squared Test p-value= 0.1614	Fisher Exact Test p-value=0.2142
No	0	5	19	24		
Total	0	6	36	42		

14th Street Southbound

Gender	Location			Total		
	L	c	R			
Female	0	12	25	37	Chi-Squared Test p-value= 0.3408	Fisher Exact Test p-value=0.3410
Male	0	17	20	37		
Total	0	29	45	74		

Vehicle	Location			Total		
	L	c	R			
Yes	0	3	16	19	Chi-Squared Test p-value= 0.0314	Fisher Exact Test p-value=0.027
No	0	26	29	55		
Total	0	29	45	74		

APPENDIX SECTION 4

IRB Documents

Thank You
For
Participating

Oregon State University
Civil & Construction Engineering

The School of Civil and Construction Engineering is carrying OSU's long tradition of engineering excellence into the 21st century. To learn more about our program, please contact us at:

School of Civil & Construction Engineering
101 Kearney Hall, Corvallis, OR 97331

541-737-4934
cce@engr.oregonstate.edu

ROAD USER UNDERSTANDING OF SHARROW MARKINGS

The purpose of this study is to evaluate driver and bicyclist comprehension of sharrows. This study is being conducted by Ioana Cosma for the completion of her thesis. You are being invited to take part in this study because you are a road user. The benefit of this study will be a better understanding of roads marked with sharrow markings. This study is not designed to benefit you directly. There are no known risks to participate. Also no identifiable information will be gathered. Participating in the research project is voluntary, if you decide to participate, you are free to withdraw at any time.

Survey duration: 2 to 4 minutes to complete.

If you have any questions about this research project, please contact: Karen K. Dixon

Phone: 541-737-6337

ROAD USER (Questions 1- 4)

1. Gender: (Select 1)

A. Male

B. Female

2. Age: (Select 1)

A. 24 years or less

B. 25 to 44 years

C. 45 to 65 years

D. 65 years or more

3.This road marking means: (Select 1)

(present picture 1)

A. Only Bicyclist can travel on this road

B. Bicyclists and motorist can travel on the same road.

C. Not Sure

4.Road User: (Select 1)

A. Driver

B. Bicyclists

C. Both

If the answer is A then skip questions 5-13 and answer questions 14-20.

If the answer is B then answer questions 5-13 and skip questions 14-20.

BICYCLIST(Questions 5 – 13)

5.How do you classify yourself as a biker: (Select 1)

A. Experienced

B. Moderate

C. Beginner

6.Why do you ride your bike: (Select 1)

A. Exercise

B. Errands

C. Recreational

D. Work/School

7.Do you typically ride on a road that has this marking? (Select 1) (present picture 1)

A. Yes

B. No

8. If Yes where do you ride in the lane?

A. Left of the lane

B. Middle of the lane

C. Right Edge of lane

9.Do drivers seem to yield to you: (Select 1)

A. Yes

B. No

10. Can you explain?

11.If you have an option between a street with this marking vs. a street with designated bike lane which would you choose: (Select 1)(present picture 2)

A. Street with designated bike lane

B. Street with this marking

12.Have you had any near-miss encounters with a vehicle? (Select 1)

A. Yes

B. No

DRIVER (Questions 14 – 20)

14. How do you classify yourself as a driver: (Select 1)

A. Experienced

B. Moderate

C. Beginner

15. Why do you drive: (Select 1)

A. Recreational

B. Errands

C. Work/School

16. Have you encountered bicyclists on roads with this marking? (Select 1) (present picture 1)

A. Yes

B. No

17. If Yes where do bicyclist seem to ride in the lane?

A. Left of the lane

B. Middle of the lane

C. Right Edge of lane

18. If you have an option between a street with this marking vs a street with designated bike lane which would you choose to drive on: (Select 1) (present picture 2)

A. Street with designated bike lane

B. Street with this marking

19.Have you had any near-miss encounters with a bicycle ? (Select 1)

A. Yes

B. No

20. Can you explain?

PICTURE 1

PICTURE 2

A

B

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http://oregonstate.edu/research/ori/humansubjects.htm

NOTIFICATION OF EXEMPTION

March 29, 2012

Principal Investigator:	Karen Dixon	Department:	Civil Construction Engineering
Study Team Members:			
Student Researcher:	Ioana Cosma		
Study Number:	5215		
Study Title:	Driver & Bicyclist Understanding of Sharrows		
Funding Source:	None		
Funding Proposal #:	N/A		
PI on Grant/Contract:	N/A		
Submission Type:	Initial Application received 02/21/2012		
Review Category:	Exempt	Category Number:	2

The above referenced study was reviewed by the OSU Institutional Review Board (IRB) and determined to be exempt from full board review.

Expiration Date: 03/25/2017
*The exemption is valid for **5 years** from the date of approval.*

Annual renewals will not be required. If the research extends beyond the expiration date, the Investigator must request a new exemption. Investigators should submit a final report to the IRB if the project is completed prior to the 5 year term.

Documents included in this review:

- ☒ Protocol
- ☒ Consent forms
- ☐ Assent forms
- ☐ Grant/contract
- ☐ Other:
- ☐ Recruiting tools
- ☒ Test instruments
- ☐ Attachment A: Radiation
- ☐ Letters of support
- ☐ External IRB approvals
- ☐ Translated documents
- ☐ Attachment B: Human materials
- ☐ Project revision(s)

Comments:

Principal Investigator responsibilities:

- Amendments to this study must be submitted to the IRB for review prior to initiating the change. Amendments may include, but are not limited to, changes in funding, personnel, target enrollment, study population, study instruments, consent documents, recruitment material, sites of research, etc.
- All study team members should be kept informed of the status of the research.
- Reports of unanticipated problems involving risks to participants or others must be submitted to the IRB within three calendar days.
- The Principal Investigator is required to securely store all study related documents on the OSU campus for a minimum of three years post study termination.

If you have any questions, please contact the IRB Office at IRB@oregonstate.edu or by phone at (541) 737-8008.

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NOTIFICATION OF PENDING ITEMS

March 12, 2012

Principal Investigator:	Karen Dixon	Department:	Civil and Construction Engineering
Study Team Members:			
Student Researcher:	Ioana Cosma		
Study Number:	5215		
Study Title:	Driver and Bicyclist Understanding of Sharrows		
Funding Source:	None		
Submission Type:	Initial Application received 2/21/2012		
Review Category:	Exempt	Category Number:	2

The IRB reviewed the above-referenced research and determined that the submission requires the following revisions, clarification, or additional information:

1. Please revise section 3 of the consent document to include a statement that subjects must be at least 18 years old in order to participate.

A statement has been added to Item 3 of the Consent Form indicating that the subject must be at least 18 years old to participate.

INSTRUCTIONS FOR RESPONSE

- Any revisions should be made in track changes and emailed IRB@oregonstate.edu
- Include the study number in the title of all electronic files related to this protocol.
- Use this notice as the cover letter for your response by inserting your response(s) in bold under each item.
- In the absence of adequate written justification for a delay, this study will be administratively closed if a response is not received within **60 days** of the date of this notice.

If you have any questions, please contact the IRB Office at IRB@oregonstate.edu or by phone at (541) 737-8008.

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INITIAL APPLICATION

Study ID

Study Title:	Driver & Bicyclist Understanding of Sharrows		
Principal Investigator:	Karen K. Dixon		
email address:	karen.dixon@oregonstate.edu	Telephone:	541-737-6337
College, Center, or Institute:	Engineering		
If "other", indicate college:			
Department:	Civil Construction Engineering		
If "other", indicate department:			

1. **In one paragraph, state your primary research question or purpose:** What is the driver and bicyclist understanding of sharrow road markings? The purpose of this research study is to evaluate driver and bicyclist understanding of sharrow markings on roads. The research findings will benefit future education campaigns and application of sharrow markings.

2. **Anticipated Level of Review**
See Review Level Determination form at http://oregonstate.edu/research/ori/forms/IRBreview.doc

☒ Exempt ☐ Expedited ☐ Full Board

3. **Research is:** ☐ Funded ☐ *internal* ☐ *external* ☐ *pending* ☐ *awarded*
☒ Unfunded

4. **Ethics and Compliance Training**

All study team members involved in this project must complete training in the ethical use of human participants in research prior to submitting an IRB application. Please refer to the Education Requirement Policy at: http://oregonstate.edu/research/ori/humansubjects.htm

If you have additional study team members, please submit the information on a separate sheet.

Study Team Member(s)	Role in Project	OSU email Address*	Ethics Training Completed
Karen K. Dixon	Principal Investigator	karen.dixon@oregonstate.edu	☒ Yes ☐ No
Ioana Cosma	Student Researcher	cosmai@onid.orst.edu	☒ Yes ☐ No
	Student Researcher		☐ Yes ☐ No
	Student Researcher		☐ Yes ☐ No
	Student Researcher		☐ Yes ☐ No
	Student Researcher		☐ Yes ☐ No
	Student Researcher		☐ Yes ☐ No

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	Student Researcher		☐ Yes ☐ No
	Student Researcher		☐ Yes ☐ No

**Do not use personal email addresses (gmail, hotmail, yahoo, etc.) unless no secure address exists.*

5. Risk/Benefit Assessment for adults and/or children

Minimal risk: The probability and magnitude of harm or discomfort anticipated in the research are not greater in and of themselves than those ordinarily encountered in daily life or during the performance of routine physical or psychological examinations or tests.

Adults

☐ Not enrolling adults
☒ Minimal risk
☐ Greater than minimal risk

Children

☒ Not enrolling children
☐ Minimal risk
☐ Greater than minimal risk, but holds prospect of direct benefit to subjects
☐ Greater than minimal risk; no prospect of direct benefit to subjects but likely to yield generalizable knowledge about the subject's disorder or condition
☐ Research not otherwise approvable but presents an opportunity to understand, prevent, or alleviate a serious problem affecting the health or welfare of the subjects

6. Total number of subjects (*not a range*) that will be enrolled over the course of the study: 60

7. Participant age range (check all that apply):

☐ 0-7: include parental consent form (unless seeking waiver) and description of oral assent process

☐ 8-17: include assent form and parental consent (unless seeking waiver)

☒ ≥18: include consent document or oral consent guide (unless seeking waiver)

8. Target population(s)

Targeted	Permitted	Excluded	Populations	For targeted population(s)
☐	☐	☒	Adults lacking capacity to consent	*Protocol must include additional safeguards*
☐	☐	☒	Children in foster care or wards of the state	*Research must be (1) related to their status as wards; or (2) conducted in schools, camps, hospitals, institutions, or similar settings in which the majority of children involved as subjects are not wards. IRB must appoint an advocate for each child who is a ward.*
☐	☐	☒	Prisoners	*Ineligible for exempt review*
☐	☒	☐	Pregnant women	*See IRB Website for guidance*
☐	☒	☐	OSU Students or employees	*See IRB Website for guidance*

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☐	☐	☒	**Non-English speakers**	*Protocol must include qualifications of the translator(s) and of the research staff or student(s) obtaining consent in a language other than English*

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9. If the research involves any of the following, check the appropriate box

☐	Study of existing data	*Data must be "on the shelf" prior to conception of current study in order to be considered existing*
☐	Audio or video recording	*Consent document must indicate whether recording is optional or a required study activity. If optional, include an opt-in/opt-out section for subjects to initial*
☐	Deception	*Requires full board review*
☐	Radiation	*Complete attachment A. IRB will forward submission to Radiation Safety*
☐	Human biological materials	*Complete attachment B. IRB will forward submission to Biosafety*
☐	Microorganisms or Recombinant DNA	*IRB will forward submission to Biosafety*
☐	Sending or receiving biological materials	*Contact the Office for Commercialization and Corporate Development regarding the potential need for a Material Transfer Agreement (541) 737-4437*
☐	Using Chemical Carcinogens	*List of applicable chemicals: http://oregonstate.edu/ehs/carclist IRB will forward to Chemical Safety*
☐	Waiver of documentation (signature) of informed consent	*If you do not think that the requirement for a signed consent document is appropriate for this study, include justification in protocol. See IRB website for guidance on a verbal or alternative consent process.*
☐	Waiver of informed consent	*If you do not think that the requirement for obtaining consent to research is appropriate for this study, include justification in protocol.*
☐	Translated documents	*Include material in English and translated into a language spoken by participants*
☐	Multiple institutions	*Complete relevant section of the protocol*
☐	External research sites	*Complete relevant section of the protocol*

10. Attachments *(check all that apply)*:

☒ Protocol (required)
☒ Consent Document(s)
☐ Assent Document(s)
☐ Attachment A: Radiation
☐ Attachment B: Human Materials
☐ Grant application or funding contract
☐ Recruiting tools (e.g., ad copy, flyers, letters)
☒ Test instruments (e.g., questionnaires, surveys)
☐ Material(s) in other languages
☐ External IRB Approvals
☐ Letters of support from external research sites
☐ Other:

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11. Does the study need to be registered with ClinicalTrials.gov?

☐ **Yes** Applicable* Clinical Trials:

Trials of Drugs and Biologics: Controlled clinical investigations of a product subject to FDA regulation, other than Phase I investigations

Trials of Devices: Controlled trials with health outcomes of devices subject to FDA regulation, other than small feasibility studies and pediatric postmarket surveillance
**NIH encourages registration of ALL trials whether required under the law or not.*
http://grants.nih.gov/grants/guide/notice-files/NOT-OD-08-014.html

☒ **No**

12. Conflict of Interest

Federal Guidelines require assurances that there are no conflicts of interest in research projects that could affect the welfare of human subjects. If this study presents a potential conflict of interest, additional information will need to be provided to the IRB.
Examples of potential conflicts of interest in research involving human subjects may include, but are not limited to:

- A researcher or family member participates in research on a technology, process or product owned by a business in which the faculty member holds a financial interest.
- A researcher participates in research on a technology, process or product developed by that researcher.
- A researcher or family member has a financial or other business interest in an entity which is supplying funding, materials, products, or equipment for the current research project.
- A researcher or family member serves on the Board of Directors of a business which is supplying funding, materials, products, or equipment for the current research project.
- A researcher receives consulting income from an entity that is funding the current research project.

Do any members of the study team, or any of their family members, have a financial or other business interest in the source(s) of funding, materials, or equipment related to this research study?

☒ No
☐ Yes – Please describe:

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INITIAL APPLICATION

Study ID

PRINCIPAL INVESTIGATOR'S ASSURANCE STATEMENT

I understand Oregon State University's policies concerning research involving human subjects and I attest:

☒ that the information contained in this application is accurate and complete;
☒ that research involving humans, including recruitment, will not begin until IRB approval has been granted;
☒ to the scientific merit and importance of this study;
☒ to the competency of the study team member(s) to conduct the project and their time available for the project;
☒ that facilities, equipment, and personnel are adequate to conduct the research.

Furthermore, I agree to:

☒ comply with all IRB policies, decisions, conditions, and requirements;
☒ accept responsibility for the scientific and ethical conduct of this research study;
☒ obtain prior approval from the IRB before amending or altering the study and/or study documents;
☒ report to the IRB in accord with current policy, any adverse event(s) and/or unanticipated problem(s);
☒ complete and submit continuing review documentation or a final report prior to the expiration date;
☒ notify the IRB immediately of the development of any potential conflict of interest not already disclosed.

Study Title:	Driver & Bicyclist Understanding of Sharrows
Principal Investigator:	Karen K. Dixon
Date:	February 21, 2012

Applications will only be accepted if submitted by the Principal Investigator

PI should email completed application and all relevant attachments to IRB@oregonstate.edu

- File names for all attachments should include the last name of the Principal Investigator, document title, and version date. For example: Smith_Protocol_10272009.doc

- All attachments should include the last name of the Principal Investigator, document title, version date, and page numbers.

Institutional Review Board • Office of Research Integrity
B308 Kerr Administration Building, Corvallis, Oregon 97331-2140
Tel 541-737-8008 | Fax 541-737-3093 | IRB@oregonstate.edu
http://oregonstate.edu/research/ori/humansubjects.htm

RESEARCH PROTOCOL

February 21, 2012

1. Protocol Title Driver & Bicyclist: Understanding of Sharrow Pavement Markings

PERSONNEL

2. Principal Investigator Karen K. Dixon
3. Student Researcher(s) Ioana Cosma
4. Co-investigator(s) Not Applicable
5. Study Staff Not Applicable
6. Investigator Qualifications:

   All investigators have completed the CITI Human Subjects Protection Training Program. Dr. Dixon has extensive experience conducting human subject surveys. Dr. Dixon has a PhD in Civil Engineering with particular emphasis on creating transportation facility design, operation and safety that serves all potential users.

7. Student Training and Oversight:

   The student researcher, Ioana Cosma, has been trained to obtain informed consent. She will work in close contact with the PI and will be required to immediately report any unexpected events. The research team does not expect the PI to be absent for any extended amount of time.

FUNDING

8. Sources of Support for this project:

   This study is unfunded.

DESCRIPTION OF RESEARCH

9. Description of Research:

   Sharrow markings are placed on roads to indicate that a bike and car can share the same lane. By analyzing the survey responses, we can determine the understanding of all users. The purpose of this study is to evaluate driver and bicyclist comprehension of sharrows. This study is being conducted by Ioana Cosma for the completion of her thesis.

10. Background Justification:

   Sharrow markings are placed on roads to indicate that a bike and car can share the same lane. The markings are not fully explained to the public and it is assumed that everyone understands what they mean and how to bike/drive on them. Sharrow makings are supposed to indicated to the bicycle where they should ride their bike (the tires should run on the tip of the chevron makings) making it safer for bikes. The City of Corvallis has placed sharrow markings on many roads hoping to increase the bike connectivity and

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reduce bicycle –vehicle crashes. This effort will examine the question: do users understand how to respond to sharrows?

11. Subject Population

The participant population is not restricted to any gender or ethnic group. The total target number of people that will agree to participate in the research is 60. In this study we are excluding anyone under the age of 18. Oral surveys will be conducted in public areas such as in the middle of town, middle of campus and other gathering areas.

12. Consent Process

Participants are not exposed to any risk by participating in this survey. Each participant would be given a consent form similar to the template offered by IRB. Oral consent will be obtained from the participants after each participant has read over the consent form, the benefits and risks.

13. Assent Process

Sharrow markings are placed on roads to indicate that a bike and car can share the same lane. By analyzing the survey responses, we can determine the understanding of all users. The purpose of this study is to evaluate driver and bicyclist comprehension of sharrows. This study is being conducted by Ioana Cosma for the completion of her thesis.We are asking you if you want to be in this study because your are a road user and may have encountered sharrow markings. If you take part in this study, we will ask you to fill out a simple survey. If you say yes now, you can change your mind later. Please ask questions if there is something that you do not understand.

14. Eligibility Screening:

All participants over the age of 18 are eligible for this project. Excluding prisoners, adults lacking capacity to consent as well as non-english speaking adults.

15. Methods and Procedures

Oral surveys will be conducted in public areas such as in the middle of town, middle of campus and other gathering areas. Participants can choose if they want to participate or not.

16. Compensation:

No compensation will be given to the participants.

17. Cost:

No cost will be acquired by the participant.

18. Anonymity or Confidentiality

No identifiable information about the participant will be kept (no exact age or name, no social security numbers, no addresses, no telephone numbers etc.). Data will be kept for 3 years post study termination.

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19. Risks

    There are no known risks to participate. Each participant will be issued a number and no names or other identifiable information will be gathered.

20. Benefits:

    The benefit of this study will be a better understanding of diver and bicyclist understanding of roads marked with sharrow markings. Having a better understanding of their perception of these markings could help transportation engineers determine if there is a need for more education on their proper usage and purpose. This study is not designed to benefit you directly.

21. Assessment of Risk: Benefit ratio:

    No known risk to the participant, the potential benefits to individuals and knowledge gained for society are great.

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CONSENT FORM

Project Title:	Driver and Bicyclist: Understanding of Sharrow Pavement Markings
Principal Investigator:	Karen K. Dixon
Student Researcher:	Ioana Cosma
Co-Investigator(s):	Not Applicable
Sponsor:	Not funded research
Version Date:	February 21, 2012

1. WHAT IS THE PURPOSE OF THIS FORM?

This form contains information you will need to help you decide whether to be in this study or not. Please read the form carefully and ask the study team member(s) questions about anything that is not clear.

2. WHY IS THIS STUDY BEING DONE?

The purpose of this study is to evaluate driver and bicyclist comprehension of pavement markings known as sharrows. This study is being conducted by Ioana Cosma for the completion of her thesis.

3. WHY AM I BEING INVITED TO TAKE PART IN THIS STUDY?

You are being invited to take part in this study because you drive or bike on a road with sharrow markings. You must be at least 18 years old to participate in this study.

4. WHAT WILL HAPPEN IF I TAKE PART IN THIS RESEARCH STUDY?

The study activities include completing a survey about roads with sharrow markings.

Study duration: The survey will take 2 to 4 minutes to complete.

5. WHAT ARE THE RISKS AND POSSIBLE DISCOMFORTS OF THIS STUDY?

There are no known risks to participate. Each participant will be issued a number and no names or other identifiable information will be gathered.

6. WHAT ARE THE BENEFITS OF THIS STUDY?

The benefit of this study will be a better understanding of user understanding of roads marked with sharrow markings. Having a better understanding of their perception of these markings could help transportation engineers determine if there is a need for more education on their proper usage and purpose. This study is not designed to benefit you directly.

7. WILL I BE PAID FOR BEING IN THIS STUDY?

You will not be paid for being in this research study.

9. WHO WILL SEE THE INFORMATION I GIVE?

The information you provide during this research study will be kept confidential to the extent permitted by law. Research records will be stored securely and only researchers will have access to the records. Federal regulatory agencies and the Oregon State University Institutional Review Board (a committee that reviews and approves research studies) may inspect and copy records pertaining to this research. If the results of this project are published your identity will not be made public.

To help ensure confidentiality, we will not collect identifiable information. We will not collect names, exact age, residence location, or other information that could be used to identify an individual.

9. WHAT OTHER CHOICES DO I HAVE IF I DO NOT TAKE PART IN THIS STUDY?

Participating in the research project is voluntary, if you decide to participate, you are free to withdraw at any time.

10. WHO DO I CONTACT IF I HAVE QUESTIONS?

If you have any questions about this research project, please contact: Karen K. Dixon, *Phone:* 541-737-6337 or at karen.dixon@oregonstate.edu

If you have questions about your rights or welfare as a participant, please contact the Oregon State University Institutional Review Board (IRB) Office, at (541) 737-8008 or by email at IRB@oregonstate.edu