Street Coaching for Pedestrians and Cyclists:

PUTTING LAWS INTO PRACTICE ON UNIVERSITY CAMPUSES

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Texas A&M Transportation Institute

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Authors: Amber B. Trueblood, Troy D. Walden,

Marcie Perez, James Woodward, Neal Johnson, Christine Adams

Center for Transportation Safety
Texas A&M Transportation Institute

Texas A&M Transportation Institute

CADES
Center for Alcohol and Drug Education Studies

Introduction

College campuses and the communities built around them, present challenges for pedestrians and bicyclists. They are typically dynamic environments, highly multimodal, and experience elevated motor vehicle, pedestrian, and bicyclist traffic which may result in increased conflict or crashes among the diverse road users.[1] These unique factors and challenges provide context that prompted the commission of a Texas Department of Transportation (TxDOT) sponsored project entitled "Street Coaching for Pedestrians and Cyclists: Putting Laws into Practice on University Campuses". The purpose of the project is to promote awareness of pedestrian and bicycle state laws on and around a college campus, specifically Texas A&M University.

As a deliverable to the project sponsor, researchers from the Texas A&M Transportation Institute (TTI) were required to conduct and then report the results of a pedestrian and bicycle crash analysis. This technical memorandum represents the investigative findings of that analysis. The findings, uncovered through the analysis, will ultimately be used to provide guidance in developing a mobilization plan and educational outreach materials that address areas of concern for pedestrian and bicycle roadway users on or near college campuses. Ultimately, the resulting products will be used as aids to help inform and provide direction for users regarding reinforcement and compliance with pedestrian and bicycle state laws. This in due course, will advance awareness of state laws and overall safety for vulnerable roadway users in and around the Texas A&M University campus.

Methods

Data Collection

College Station, Texas and Bryan, Texas pedestrian and bicycle crash data (2015-2019) was obtained from the Texas Department of Transportation Crash Reporting Information System (TxDOT-CRIS). The crash data was expanded beyond College Station, Texas in order to obtain university proximal crashes that occurred in Bryan, Texas due to the fact that the two city boundaries intersect within a block of the Texas A&M University campus. Data used in the crash analysis were obtained on November 30, 2020.

In addition to TxDOT-CRIS data, the research team used Google Earth/Google Maps to classify roadway characteristics for identified crashes with reported latitudes and longitudes. Crash characteristic classifications included: number of travel lanes, medians, sidewalks, marked crosswalks, pedestrian crossing signals, pedestrian crossing devices, street lighting/illumination, bike lanes, pedestrian or bicycle warning signs present near crosswalks, speed bumps, and mid-block crossings.

Data Analysis

Project researchers used descriptive statistics as well as geospatial analyses (mapping) to examine crash locations and assess pedestrian/bicycle crash factors. The findings derived from descriptive statistics, were constructed using Microsoft Power BI and Microsoft Excel. Results included crash frequency counts and percentages. Produced maps included hot spots using Microsoft Power BI. Finally, the results of all analyses were divided and grouped by bicyclist or pedestrian involvement.

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[1] Loukaitou-Sideris, A., Medury, A., Fink, C., Grembek, O., Shafizadeh, K., Wong, N., & Orrick, P. (2014). Crashes on and near college campuses: a comparative analysis of pedestrian and bicyclist safety. *Journal of the American Planning Association*, *80*(3), 198-217.

Definitions

The following terms and definitions were used for this analysis. [2,3]

- Pedestrian-involved crash: A reportable crash in which at least one of the persons involved was classified as a pedestrian (prsn_type_id=4).
- Bicyclist-involved crash: A reportable crash in which at least one of the persons involved was classified as a bicyclist (prsn_type_id=3).
- Fatal Crash (K): A crash in which at least one person was killed and died within 30 days of the crash (crash_sev_id=4).
    - Fatal Injury (K): Person was reported to be killed and died within 30 days of the crash (prsn_injry_sev_id=4).
- Suspected Serious Crash (A): A crash in which the highest injury severity reported for at least one person suspected serious injury (crash_sev_id=1).
    - Suspected Serious Injury (A): Person was reported to have a severe injury that prevents them from doing normal activities (e.g., broken bone, burns, traumatic brain injury) (prsn_injry_sev_id=1).
- Non-Incapacitating Crash (B): A crash in which the highest injury severity reported for at least one-person was a non-incapacitating injury (crash_sev_id=2).
    - Non-Incapacitating Injury (B): Person was reported to have an evident injury that did not stop them from doing normal activities (e.g., bruise, laceration) (prsn_injry_sev_id=2).
- Injury Crash was defined as a crash involving a fatality, suspected serious injury, or a non-incapacitating injury (KAB) (crash_sev_id=4 or crash_sev_id=1 or crash_sev_id=2).
- Possible Injury Crash (C): A crash in which the highest injury severity reported for at least one-person was possible injury (crash_sev_id=3).
    - Possible Injury (C): Person was reported to have an injury, but there were no visible signs (e.g., limping, verbal complaint of pain) (prsn_injry_sev_id=3).
- Not Injured Crash (O): A crash in which there was no injury reported (crash_sev_id=5).
    - No Injury (O): Person did not report having any injury (prsn_injry_sev_id=5).
- Unknown Crash Severity (U): A crash in which it was not able to determine if an injury occurred (e.g., hit and run) (crash_sev_id=0).
    - Unknown Injury (U): It was not possible to determine if the person had an injury (prsn_injry_sev_id=0).

The definitions and instructions used for classifying crash locations using Google Earth and/or Google Map can be found in the Appendix.

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[2] Texas Department of Transportation. (2010). Automated Crash Data Interface Files. Standard Extract. Retrieved from: https://www.txdot.gov/government/enforcement/data-access.html

[3] Texas Department of Transportation. (2020). State of Texas Instructions to Police for Reporting Crashes, 2019 Edition. Retrieved from: https://ftp.dot.state.tx.us/pub/txdot-info/trf/crash_notifications/2018/crash-report-100.pdf

Results

Bicyclist and Pedestrian Crashes

From 2015 to 2019, there were 369 reported crashes that involved a bicyclist and/or pedestrian in Bryan and College Station, Texas. The statistics in this section are for reported crashes, the following sections present results by bicyclist or pedestrian involvement. Of these, 197 (53.4%) were bicyclist-involved and 172 (46.6%) were pedestrian-involved. Overall, 3.7% (n=14) of crashes resulted in at least one fatality and 14.1% (n=52) resulted in at least one suspected serious injury. Most crashes were non-incapacitating (56.6%; n=209) (see Figure 1).

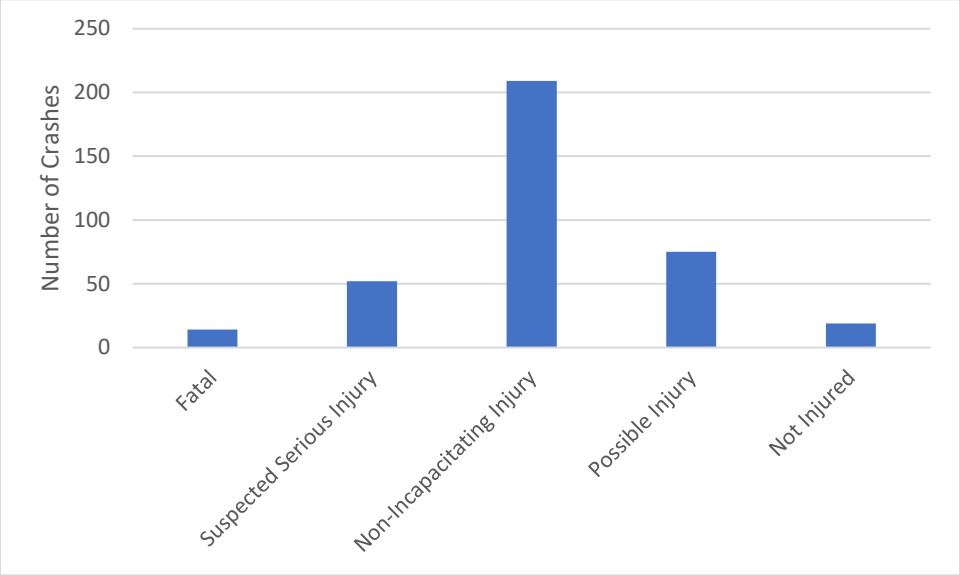

Figure 1. Reported Crash Severity for Bicyclist and Pedestrian-Involved Crashes in Bryan and College Station, TX 2015-2019.

Crash severity was then split by bicyclist or pedestrian involvement. Pedestrians had higher percentages of crashes that involved fatal or suspected serious injury crashes compared to bicyclist, 24.4% versus 12.2%, respectively (see Figure 2).

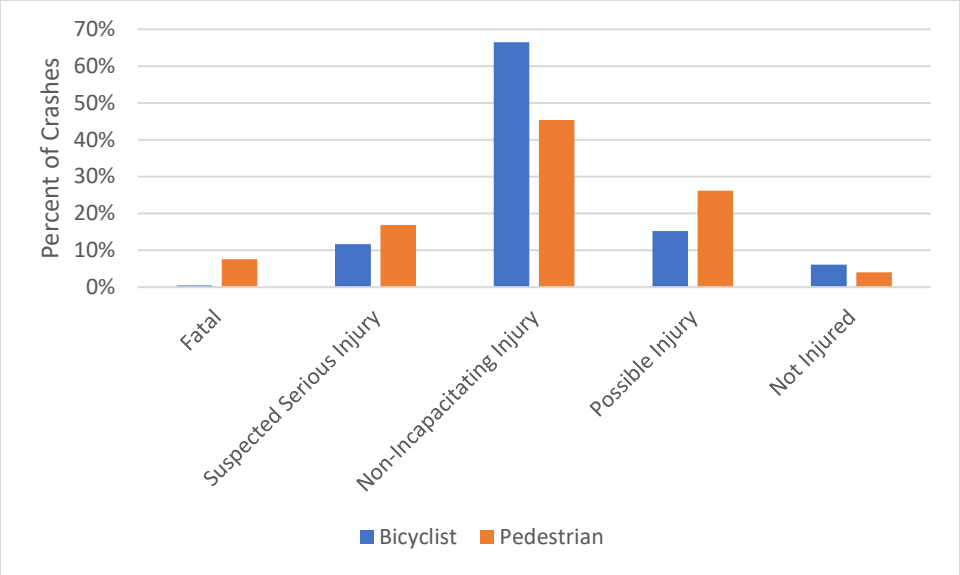

Figure 2. Reported Crash Severity Split by Bicyclist or Pedestrian Involvement.

To better understand contributing crash factors, the remainder of the analysis findings have been categorized as either bicyclist or pedestrian involved.

Bicyclist Crashes

Demographic Factors

Bicyclist

The research team explored bicyclist crash injury severity that occurred between 2015-2019 by gender (see Figure 3). There were 199 bicyclists involved in 197 bicycle crashes in Bryan and College Station (B/CS). Of the 197 reported bicycle crashes, a majority involved male riders (69.3%; n=138). No male bicycle riders and one female rider died as a result of a crash. Overall, male bicyclists sustained a higher percentage of suspected serious injuries and possible injury classifications as compared to females. Whereas female bicyclists experienced a higher percentage of non-incapacitating injuries in comparison to males.

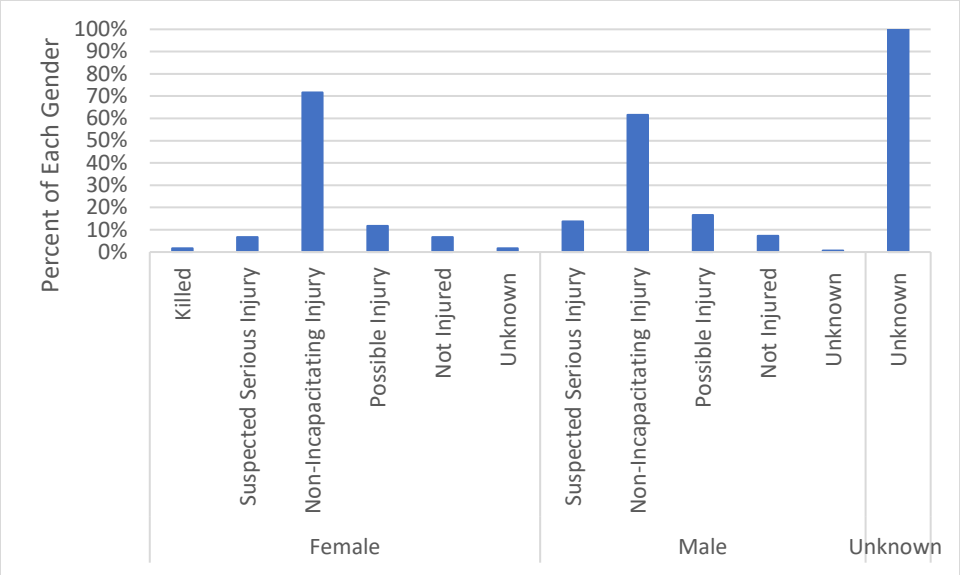

Figure 3. Gender and Crash Severity of Bicyclist Involved in a Crash in Bryan and College Station, TX 2015-2019.

Next, the research team explored age as a factor for bicyclists involved in crashes (see Figure 4). Approximately, half of all bicyclists involved in a crash (44.7%; n=89) were between the ages of 18 and 24 years. The next largest age group involved riders between the ages of 25 and 34 years (15.1%; n=30).

Interestingly, these two age range groups are typically more likely to be associated with college aged students who attend undergraduate or graduate schools.

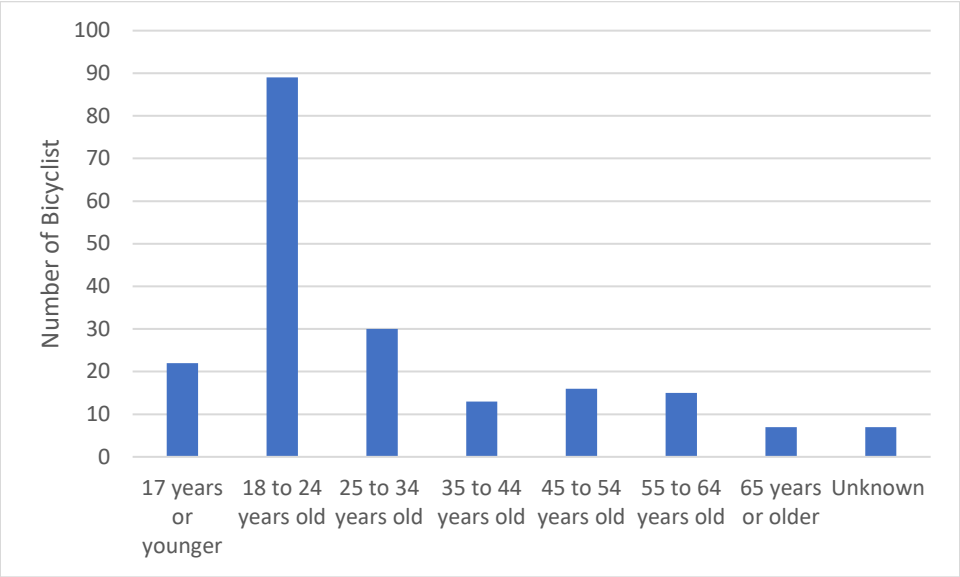

Figure 4. Age Category for Bicyclists Involved in a Bicyclist-Involved Crash in Bryan and College Station, TX 2015-2019.

Injury severity was then explored by age which found the only bicyclist fatality was in an individual aged 18 to 24 years old (see Figure 5). However, overall, those 65 years or older had the highest percentages of bicyclists injured in a crash.

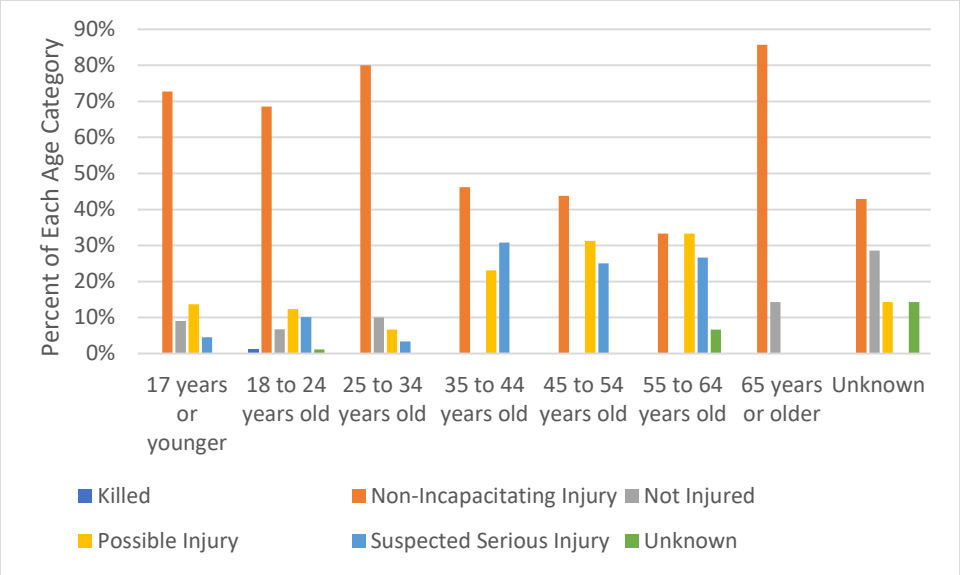

Figure 5. Bicyclist Age by Injury Severity for Bicyclist-Involved Crashes in Bryan and College Station, TX 2015-2019.

Involved-Drivers

Next, the research team examined driver involvement in bicycle related crashes. There were 201 drivers involved in reported bicycle crashes. Of those involved, a majority of drivers were found to be male (51.2%; n=103). The team explored driver injury severity by gender for the reported bicycle crashes (see Figure 6). No drivers were killed in any bicycle related crashes. Overall, 2.5 percent of female drivers and 1.9 percent of male drivers sustained a suspected serious injury or non-incapacitating injury in these crashes.

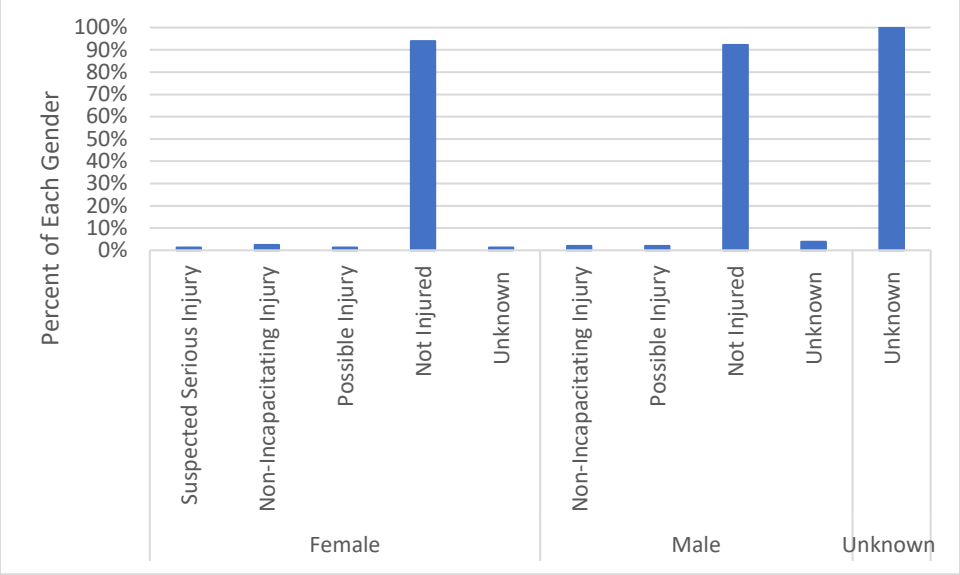

Figure 6. Gender and Crash Severity of Drivers Involved in a Crash with a Bicyclist in Bryan and College Station, TX 2015-2019.

Next, age was explored for drivers involved in a crash with a bicyclist (see Figure 7). One third of all bicycle involved crashes included a driver between the ages of 18 and 24 years (36.3%; n=73). The next

largest age group involved drivers between the ages of 25 and 34 years (14.9%; n=30). These two age range groups are typically more likely to be associated with college aged students who attend undergraduate or graduate schools.

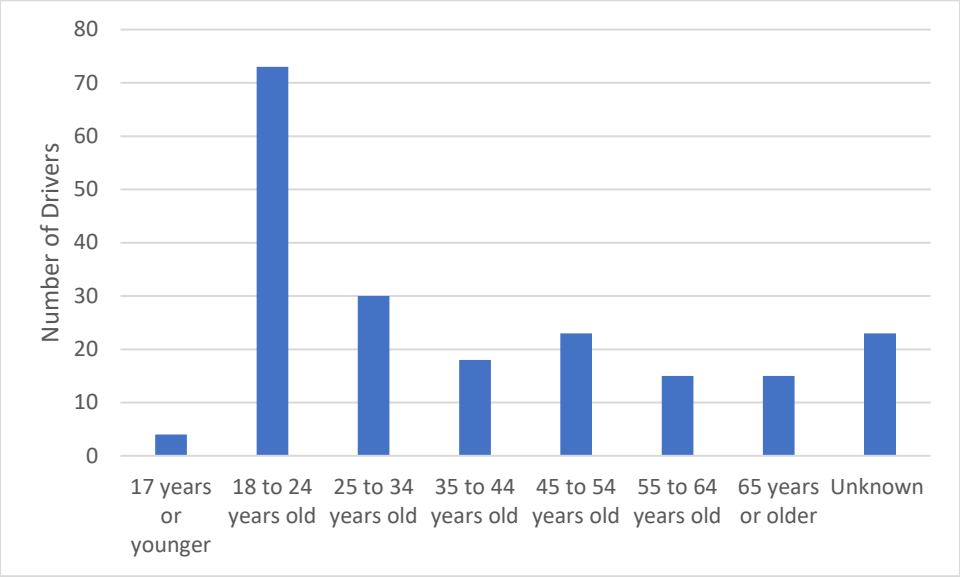

Figure 7.Age Category of Drivers Involved in a Crash with a Bicyclist in Bryan and College Station, TX 2015-2019.

Next, the research team explored injury severity by age. It was discovered that overall, drivers were rarely injured in bicycle crashes but those that were injured, were under 45 years of age (see Figure 8).

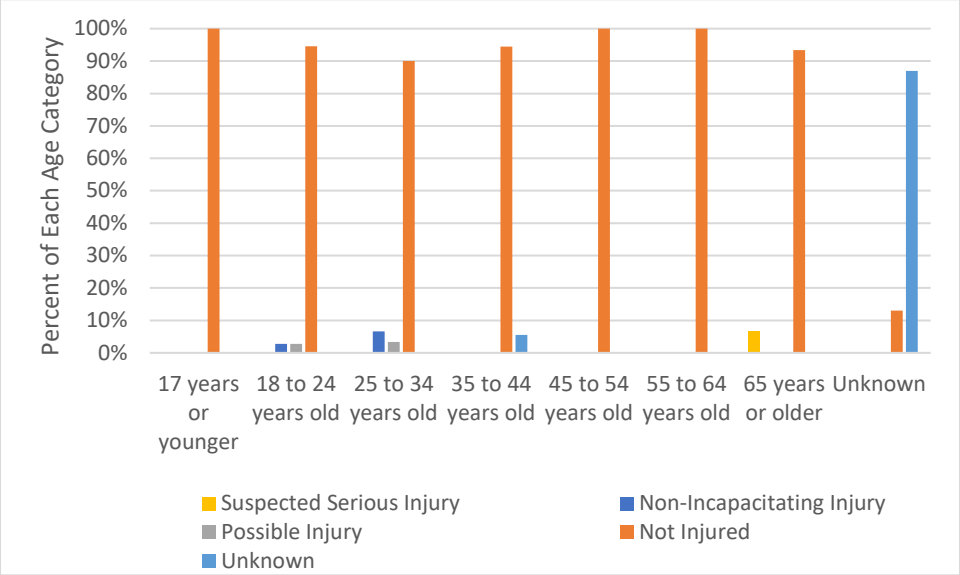

Figure 8. Age Category by Injury Severity for Drivers Involved in a Crash with a Bicyclist in Bryan and College Station, TX 2015-2019.

Environmental Factors

Next, environmental factors were examined. Researchers found that most bicycle involved crashes occurred in clear weather environments (80.2%; n=158); in the afternoon (41.1%; n=81); and in daylight conditions (77.2%; n=152) (see Table 1).

Table 1.. Environmental Factors of Bicyclist-Involved Crashes from 2015 to 2019 in Bryan and College Station, TX.

Environmental Factor	**n (%)**
Weather	
Clear	158 (80.2%)
Cloudy	30 (15.2%)
Rain	8 (4.1%)
Other	1 (0.5%)
Time of Day	
Morning (6am-11:59am)	58 (29.4%)
Afternoon (12-5:59pm)	81 (41.1%)
Evening (6-8:59pm)	43 (21.8%)
Night (9pm-5:59am)	15 (7.6%)
Lighting Condition	
Dark, Lighted	28 (14.2%)
Dark, Not Lighted	8 (4.1%)
Dawn	3 (1.5%)
Daylight	152 (77.2%)
Dusk	6 (3.0%)

Roadway Factors

Regarding roadway factors, the research team found that most bicycle crashes occurred on roadways possessing traffic control devices such as stop signs (30.5%; n=60) and signal controlled stop and go lights (20.8%; n=41). In addition, most bicycle crashes occurred on local roads or streets (61.4%; n=121); with speed limits between 25 and 44 mph (75.6%; n=149); with straight roadway alignment (95.9%; n=189); and having dry roadway surface conditions (93.9%; n=185). Lastly, more than one-half of all bicycle crashes occurred at an intersection (56.8%; n=112). Reported roadway factors for bicyclist-involved crashes are listed in Table 2.

Table 2. Roadway Factors of Bicyclist-Involved Crashes from 2015 to 2019 in Bryan and College Station, TX.

Roadway Factor	**n (%)**
Traffic Control Device	
Stop Sign	60 (30.5%)
Signal Light	41 (20.8%)
Marked Lanes	30 (15.2%)
None	30 (15.2%)
Missing	36 (18.3%)

Roadway System	
Farm to Market	38 (19.3%)
Business State	19 (9.6%)
US Highway	1 (0.5%)
State Highway	14 (7.1%)
Private Road	3 (1.5%)
Local Road/Street	121 (61.4%)
Missing	1 (0.5%)
Surface Condition	
Dry	185 (93.9%)
Wet	12 (6.1%)
Speed Limit	
0-24 mph	11 (5.6%)
25-44 mph	149 (75.6%)
45-64 mph	36 (18.3%)
Over 65 mph	1 (0.5%)
At-Intersection	
Yes	112 (56.9%)
No	85 (43.1%)
Road Alignment	
Straight	189 (95.9%)
Curve	8 (4.1%)

Behavioral Factors

Next, the research team examined behavioral factors that contributed to the bicycle involved crash event (see Table 3). Overall, 2 percent (n=4) of reported bicycle crashes were found to involve speed as a behavioral factor. In addition, 1 percent (n=2) involved impairment by alcohol or other drugs as a behavioral factor contributing to the crash. The impaired-alcohol crashes represent an impaired bicyclist while the impaired-drug crash represents an impaired driver (data not shown).

Table 3. Crash Factors of Bicyclist-Involved Crashes from 2015 to 2019 in Bryan and College Station, TX.

Behavioral Factor	**n (%)**
Speeding-Involvement	
Yes	4 (2.0%)
No	193 (98.0%)
Impaired-Alcohol	
Yes	1 (0.5%)
No	196 (99.5%)
Impaired-Drug	
Yes	1 (0.5%)
No	196 (99.5%)

Locations

Locations of bicyclist crashes were then examined to identify common roadway characteristics, top locations, and hot spots. There were 197 reported crashes that involved a bicyclist from 2015 to 2019. Of these, ninety-five percent (n=188) of the crashes had reported latitudes and longitudes. Based on the reported Google review, a majority of the crash locations were on roads with two lanes (36.7%; n=69); no median (48.9%; n=92); sidewalks present on both sides of the road (67.0%; n=126); no marked crosswalks (54.3%; n=102); no bike lane (73.9%; n=139); lighting or illumination present (75.0%; n=141); and no bicycle warning sign near crosswalk (93.1%; n=175) (see Table 4).

Table 4. Location Characteristics of Bicyclist-Involved Crashes from 2015 to 2019 in Bryan and College Station, TX.

Location - Roadway Characteristics	**n (%)**
Number of Travel Lanes	
1	3 (1.6%)
2	69 (36.7%)
3	15 (8.0%)
4	34 (18.1%)
5	25 (13.3%)
6	26 (13.8%)
7	13 (6.9%)
8	2 (1.1%)
9	1 (0.5%)
Median	
None	92 (48.9%)
Flush	7 (3.7%)
Raised	63 (33.5%)
Two Way Left Turn Lane	25 (13.8%)
Sidewalks Present	
None	40 (20.3%)
One Side of Road	22 (11.7%)
Both Sides of Road	126 (67.0%)
Marked Crosswalks	
No	102 (54.3%)
Yes	86 (45.7%)
Bike Lane	
No	139 (73.9%)
Marked Bicycle Lane	45 (23.9%)
Separate Bicycle Path/Trail	1 (0.5%)
Unmarked Paved Shoulder	3 (1.6%)
Mid-Block Crossing	
No	187 (99.5%)
Yes	1 (0.5%)
Street Lighting/Illumination	
No	47 (25.0%)
Yes	141 (75.0%)
Bicycle Warning Sign Present Near Crosswalk	
No	175 (93.1%)
Yes	13 (6.9%)

The research team then identified roads with more than one bicyclist-involved crash to determine roadways of concern (see Table 5). The top three roads identified were Texas Avenue, University Drive, and George Bush Drive. Interestingly, each of these roadways directly border the Texas A&M University campus.

Table 5. Roads with More than One Bicyclist-Involved Crash from 2015 to 2019 in Bryan and College Station, TX.

Derived Roadway	Driveway Access	Non-Intersection	Intersection or Intersection-Related	Total
Texas Ave (BS0006R)	6	1	15	22
University Dr (FM0060)	7	1	14	22
George Bush Dr (FM2347)	0	2	9	11
Olsen Blvd	2	0	5	7
Briarcrest Dr (FM1179)	0	1	5	6
SH0006	0	4	2	6
Harvey (SH0030)	2	0	4	6
College Main St	2	1	1	4
E Wm J Bryan Pkwy (FM0158)	1	0	3	4
Harvey Mitchel Pkwy (FM2818)	0	1	3	4
Southwest Pkwy	0	3	1	4
Wellborn (FM2154)	0	0	3	3
Penberthy Blvd	1	2	0	3
Anderson St	1	0	1	2
Bizzell St	0	0	2	2
Brentwood Dr	0	0	2	2
E 29th St	0	0	2	2
Finfeather Rd	0	2	0	2
George Bush Dr E	0	0	2	2
Holleman Dr	0	0	2	2
Jane St	1	0	1	2
John Kimbrough Blvd	0	0	2	2
Longmire Dr	1	0	1	2
Marion Pugh Dr	1	0	1	2

Derived Roadway	Driveway Access	Non-Intersection	Intersection or Intersection-Related	Total
Old Main Rd	0	1	1	2
Rock Prairie Rd	1	0	1	2
Ross St	0	0	2	2
College Ave (SH0308)	0	0	2	2
US 0190	1	0	1	2
Wellborn Rd N	0	2	0	2
Welsh Ave	0	0	2	2

Next, the top roadways for intersection and intersection-related bicyclist-involved crashes were identified. Top roadways included: 1) University Drive and Wellborn Road (n=4); 2) Texas Avenue and Harvey Road (n=4); 3) University Drive and Texas Avenue (n=3); and 4) George Bush Road and Houston Road (n=3) (data not shown). University Drive and Wellborn Road, University Drive and Texas Avenue, and George Bush Drive and Houston Road intersections are all university proximal, directly bordering the university campus. The intersection of Texas Avenue and Harvey Road, while not university proximal, is largely filled with shopping centers and restaurants.

Ultimately, researchers generated a hot spot map which showsareas of concern in and around the Texas A&M University campus area (note the campus is the green area between FM 2818 and HWY 6) (see Figure 8).

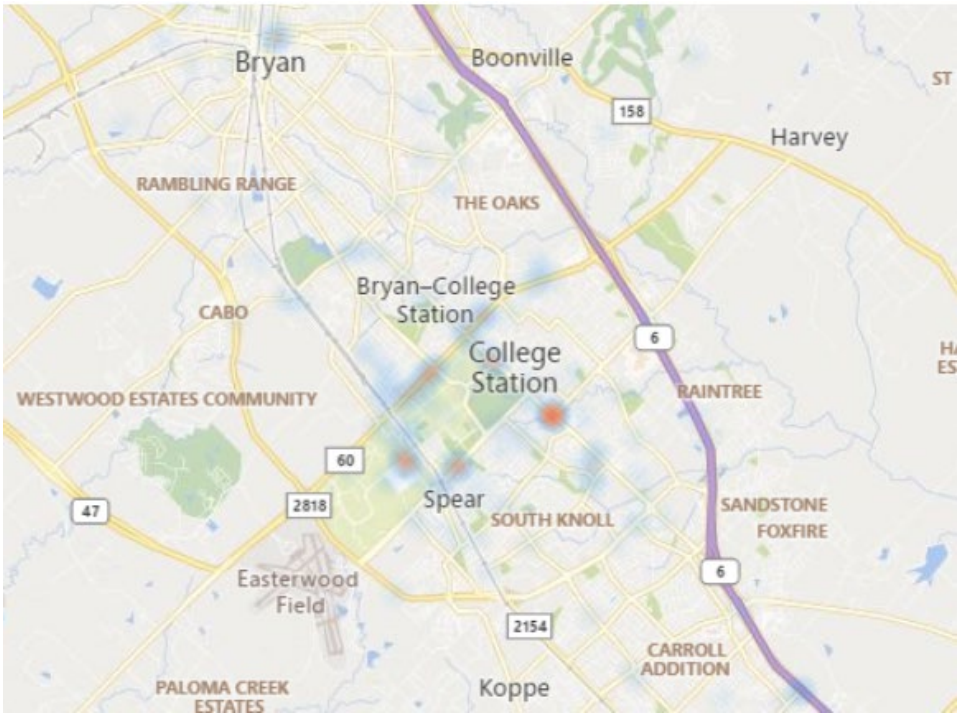

Figure 8. Hot Spot Map of Bicyclist-Involved Crashes from 2015 to 2019 in Bryan and College Station, TX.

Pedestrian Crashes

Demographic Factors

Pedestrian

Upon completing the bicycle crash analysis, researchers turned their attention to pedestrian crashes. First, the research team explored pedestrian injury severity by gender (Figure 9). There were 193 pedestrians involved in 172 reported pedestrian-involved crashes. Of the 172 reported pedestrian crashes, a majority involved males (58.0%; n=112). When fatalities were considered, males were more likely than females to be killed, 9.8% (n=11) versus 3.7% (n=3), respectively. Males also had a higher likelihood of increased injury severity (suspected serious injury) as compared to females, 18.8% (n=21) versus 13.6% (n=11), respectively. By way of comparison, females had a higher percentage of non-incapacitating and possible injury severities than did their male counterparts. No injury percentages were comparable across genders.

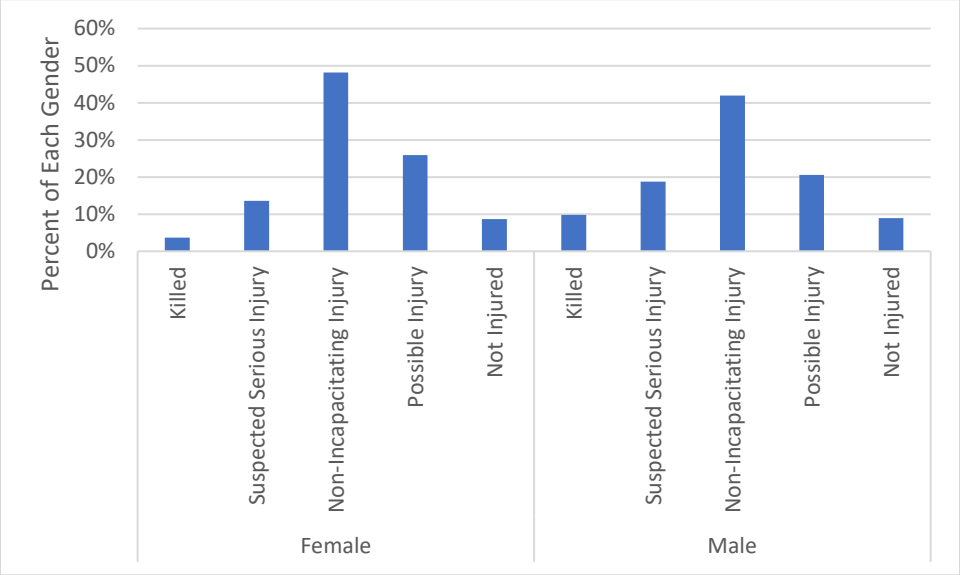

Figure 9. Gender and Crash Severity of Pedestrians Involved in a Crash in Bryan and College Station, TX 2015-2019.

Next, the research team explored age as a factor for pedestrians involved in crashes (see Figure 10). Forty percent of pedestrians involved in a crash were between 18 and 24 years (39.9%; n=77). The next largest age groups were those that were 17 years and younger (18.1%; n=35) and those between 25 and 34 years (16.1%; n=31).

Interestingly, these age ranges are typically more likely to be associated with college aged students who attend undergraduate or graduate schools.

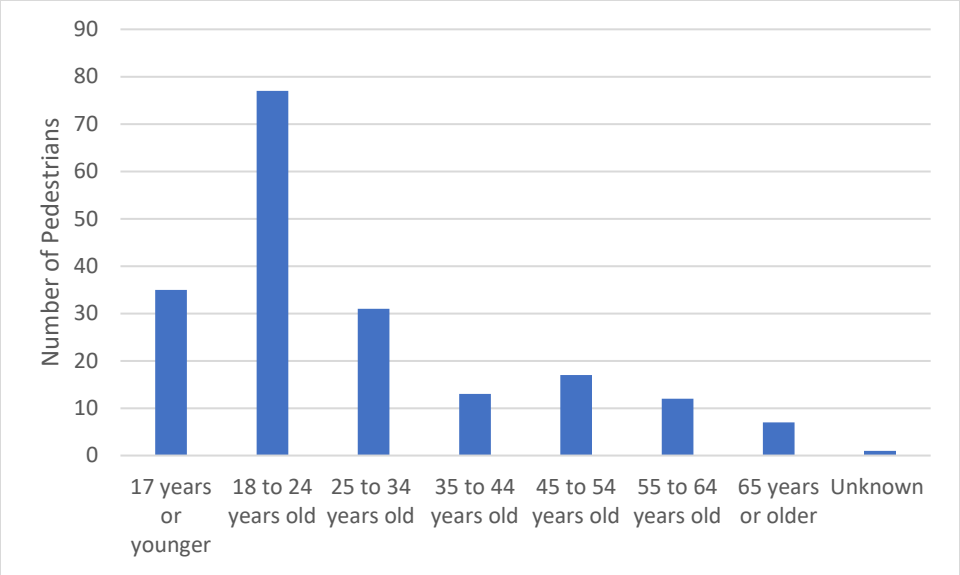

Figure 10. Age Category for Pedestrians Involved in a Pedestrian-Involved Crash in Bryan and College Station, TX 2015-2019.

The research team then examined injury severity by age and found fourteen pedestrian related fatalities (see Figure 11). The majority of pedestrians that were killed were between 18 and 24 years (n=5). Overall, individuals aged 18 to 24 years had the highest percentage of being involved in a pedestrian related crash that resulted in an injury (KAB) (76.6%; n=59).

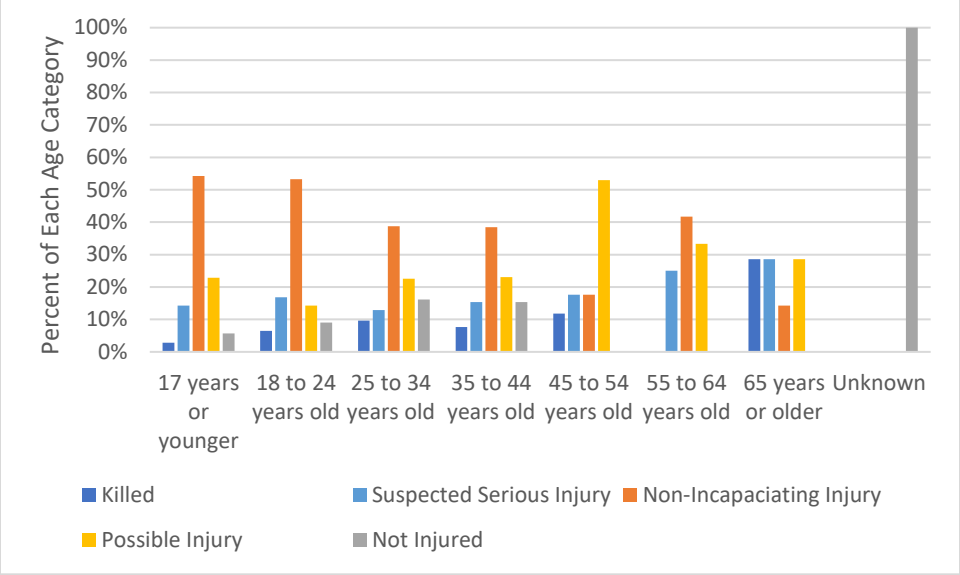

Figure 11. Pedestrian Age by Injury Severity for Pedestrian-Involved Crashes in Bryan and College Station, TX 2015-2019.

Involved-Drivers

Next, the research team examined driver involvement in pedestrian related crashes. There were 175 drivers involved in reported pedestrian crashes. Of those involved drivers, a majority were found to be male (51.4%; n=90). Approximately 1.2 percent (n=21) of the drivers were reported as an unknown gender. The research team explored driver injury severity by gender for the reported pedestrian crashes (see Figure 12). No drivers were killed in pedestrian related crashes and very few were injured at all.

Overall, 1.6% (n=1) of female drivers involved in pedestrian crashes sustained only possible injuries while 3.3% (n=3) of male drivers received non-incapacitating injuries.

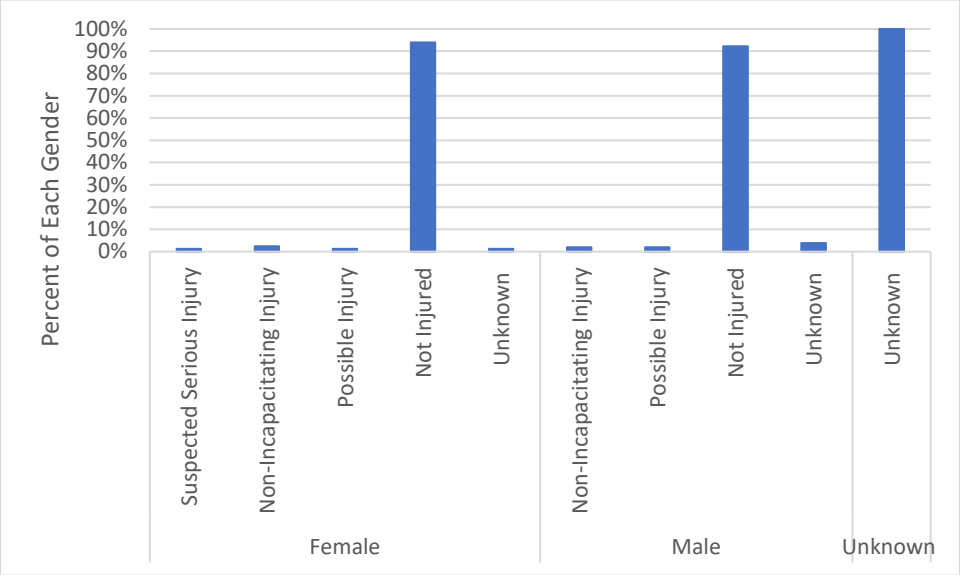

Figure 12. Gender and Crash Severity of Drivers Involved in a Crash with a Pedestrian in Bryan and College Station, TX 2015-2019.

Next, age was explored for drivers involved in a crash with a pedestrian (see Figure 13). One third of all pedestrian crashes involved a driver between the ages of 18 and 24 years (33.1%; n=58). The next largest age group were drivers between the ages of 25 and 34 years (16.6%; n=29).

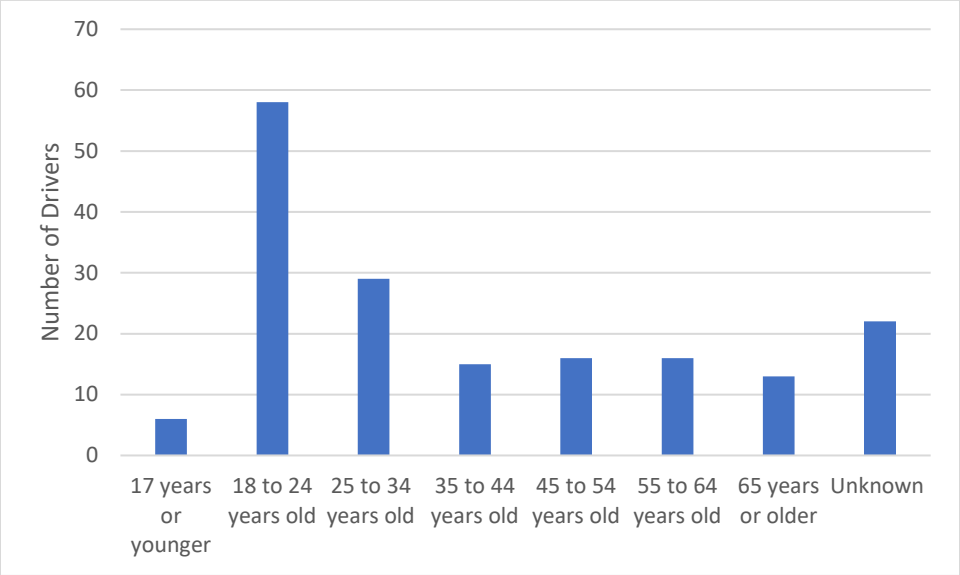

Figure 13. Age Category of Drivers Involved in a Crash with a Pedestrian in Bryan and College Station, TX 2015-2019.

Next, the research team examined injury severity by age. It was discovered that overall, drivers rarely sustained injuries in pedestrian crashes. However, those that were injured, reported non-incapacitating or possibly injured as the most frequent levels of severity. The greatest frequency of injured drivers

involved in a pedestrian related crash were found to be between 18 and 24 and between 35 to 44 years (see Figure 14).

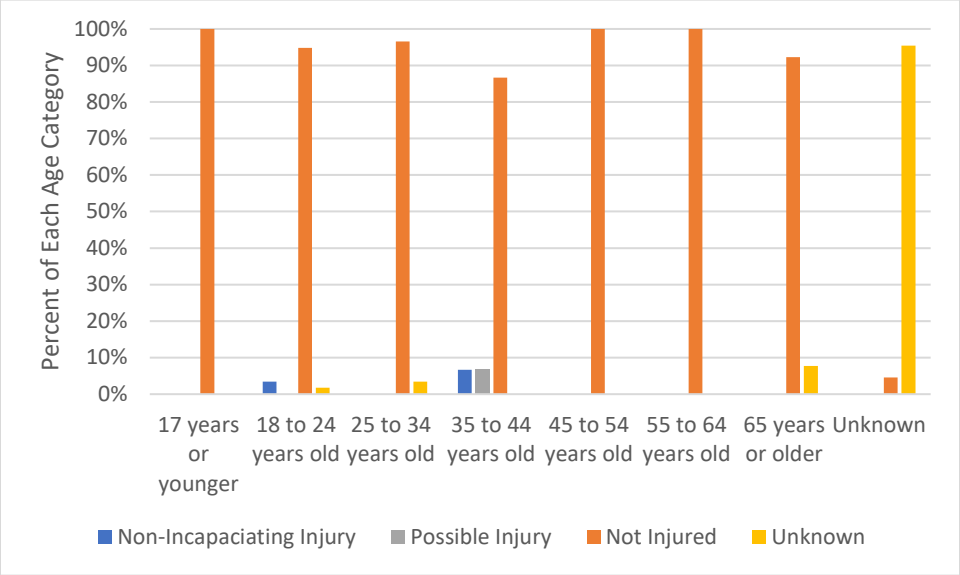

Figure 14. Age Category by Injury Severity for Drivers Involved in a Crash with a Pedestrian in Bryan and College Station, TX 2015-2019.

Environmental Factors

Next, environmental factors were examined. Researchers found that most pedestrian-involved crashes occurred in clear weather environments (72.7%; n=125); at night (31.4%; n=54); and in daylight conditions (31.4%; n=54). Environmental factors in pedestrian involved crashes are listed in Table 6.

Table 6. Environmental Factors of Pedestrian-Involved Crashes from 2015 to 2019 in Bryan and College Station, TX.

Environmental Factor	**n (%)**
Weather	
Clear	125 (72.7%)
Cloudy	34 (19.8%)
Fog	1 (0.6%)
Rain	11 (6.4%)
Snow	1 (0.6%)
Time of Day	
Morning (6am-11:59am)	38 (22.1%)
Afternoon (12-5:59pm)	46 (26.7%)
Evening (6-8:59pm)	34 (19.8%)
Night (9pm-5:59am)	54 (31.4%)
Lighting Condition	
Dark, Lighted	54 (31.4%)
Dark, Not Lighted	19 (11.0%)
Dawn	3 (1.7%)

Daylight	88 (51.2%)
Dusk	7 (4.1%)
Other (Explain in Narrative)	1 (0.6%)

Roadway Factors

Regarding roadway factors, the research team found that most pedestrian crashes occurred on roadways having marked lanes (30.2%; n=52) and having signal-controlled stop and go lights (23.3%; n=40). Furthermore, most pedestrian crashes occurred on local roads or streets (58.1%; n=100); on roads with dry surface conditions (87.2%; n=150); and on roads with straight alignments (98.3%; n=169). Most pedestrian crashes were found to be non-intersection related (61.6%; n=106) and on roads where speed limits were between 25 and 44 mph (33.1%; n=57) and 45 to 64 mph (30.8%; n=53). Roadway factors for pedestrian-involved crashes are displayed in Table 7.

Table 7. Roadway Factors of Pedestrian-Involved Crashes from 2015 to 2019 in Bryan and College Station, TX.

Roadway Factor	**n (%)**
Traffic Control Device	
Stop Sign	26 (15.1%)
Signal Light	40 (23.3%)
Marked Lanes	52 (30.2%)
None	33 (19.2%)
Missing	21 (12.2%)
Roadway System	
Farm to Market	31 (18.0%)
Business State	18 (10.5%)
US Highway	3 (1.7%)
State Highway	19 (11.0%)
Business US	1 (0.6%)
Local Road/Street	100 (58.1%)
Surface Condition	
Dry	150 (87.2%)
Wet	20 (11.6%)
Sand, Mud, Dirt	1 (0.6%)
Unknown	1 (0.6%)
Speed Limit	
0-24 mph	1 (0.6%)
25-44 mph	57 (33.1%)
45-64 mph	53 (30.8%)
Over 65 mph	5 (2.9%)
At-Intersection	
Yes	66 (38.4%)
No	106 (61.6%)

Road Alignment	
Straight	169 (98.3%)
Curve	3 (1.7%)

Behavioral Factors

Next, the research team examined behavioral factors that contributed to pedestrian related crashes. Behavioral factors included speeding and impairment by alcohol and drugs other than alcohol (see Table 8). Overall, 1.7 percent (n=3) of reported pedestrian crashes were found to involve speed as a condition. In addition, 12.8 percent (n=22) involved impairment which accounted for sixteen alcohol related crashes and two crashes involving drugs other than alcohol. An additional four pedestrian crashes involved a combination of both alcohol and other drugs.

For the pedestrian crashes that involved only alcohol, 9 drivers were reported to be impaired while 11 pedestrians were designated as impaired. The two pedestrian crashes that involved drugs other than alcohol listed 1 driver and 1 pedestrian as being impaired. Crashes involving the combination of both alcohol and drugs other than alcohol listed 2 drivers and 2 pedestrians as being impaired. Note: There may be more impaired individuals than impaired crashes since more than one person can be impaired at the time of a crash.

Table 8. Crash Factors of Pedestrian-Involved Crashes from 2015 to 2019 in Bryan and College Station, TX.

Behavioral Factor	n (%)
Speed Involved	
Yes	3 (1.7%)
No	169 (98.3%)
Impaired-Alcohol	
Yes	16 (9.3%)
No	156 (90.7%)
Impaired-Drug Other Than Alcohol	
Yes	2 (1.2%)
No	168 (97.7%)
Impaired-Combination of Alcohol and Drug Other Than Alcohol	
Yes	4 (2.3%)
No	168 (97.7%)

Locations

Locations of pedestrian-involved crashes were examined to identify common roadway characteristics, top locations, and hot spots. There were 172 reported crashes that involved a pedestrian from 2015 to 2019. Of those, 98 percent (n=169) had reported latitudes and longitudes. Using Google Earth/Google Map, researchers classified crash location roadway characteristics (see Table 9).

The majority of the pedestrian crashes were located on roads comprised of two lanes (41.4%; n=70); having no median (43.8%; n=74); sidewalks present on both sides of the road (53.9%; n=91); no marked crosswalks (65.1%; n=110); no pedestrian crossing signal (76.9%; n=130); no pedestrian crossing device

(98.8%; n=2); lighting and/or illumination was present (76.3%; n=129); and no bicycle warning sign was found near the crosswalk (95.9%; n=162).

Table 9. Location Characteristics of Pedestrian-Involved Crashes from 2015 to 2019 in Bryan and College Station, TX.

Location - Roadway Characteristics	**n (%)**
Number of Travel Lanes	
0	1 (0.6%)
1	1 (0.6%)
2	70 (41.4%)
3	8 (4.7%)
4	37 (21.9%)
5	21 (12.4%)
6	11 (6.5%)
7	18 (10.7%)
8	2 (1.2%)
Median	
None	74 (43.8%)
Flush	7 (4.1%)
Raised	47 (27.8%)
Two Way Left Turn Lane	41 (24.3%)
Sidewalks Present	
None	55 (32.5%)
One Side of Road	23 (13.6%)
Both Sides of Road	91 (53.9%)
Marked Crosswalks	
No	110 (65.1%)
Yes	1 (34.9%)
Pedestrian Crossing Signal	
No	130 (76.9%)
Yes	39 (23.1%)
Pedestrian Crossing Device	
No	167 (98.8%)
Yes	2 (1.2%)
Mid-Block Crossing	
No	168 (99.4%)
Yes	1 (0.6%)
Street Lighting/Illumination	
No	40 (23.7%)
Yes	2 (76.3%)

Pedestrian Warning Sign Present Near Crosswalk	
No	162 (95.9%)
Yes	7 (4.1%)

The research team then identified roads with more than one pedestrian-involved crash to determine roadways of concern (see Table 10). The top three roads identified were: Texas Avenue, University Drive, and State Highway 21. Interestingly, Texas Avenue and University Drive directly border the Texas A&M University campus.

Table 10. Roads with More than One Pedestrian-Involved Crashes from 2015 to 2019 in Bryan and College Station, TX.

Derived Roadway	Driveway Access	Non-Intersection	Intersection or Intersection-Related	Total
Texas Ave (BS0006R)	0	12	6	18
University Dr (FM0060)	0	2	13	15
SH0021	2	9	1	12
SH0006	0	4	4	8
Harvey Mitchel Pkwy (FM2818)	0	2	4	6
Southwest Pkwy	0	1	4	5
Wellborn Rd (FM2154)	0	0	4	4
Harvey (SH0030)	0	2	2	4
BOYETT ST	0	0	3	3
E Wm J Bryan Pkwy (FM0158)	0	0	3	3
W Villa Marie Rd (FM1179)	0	0	3	3
Agronomy Rd	0	2	0	2
Beck St	0	1	1	2
Church Ave	0	0	2	2
Dominik Dr	0	1	1	2
George Bush Dr (FM2347)	0	1	1	2
Holleman Dr W	0	1	1	2
John Kimbrough Blvd	0	1	1	2
Louise Ave	0	0	2	2

Derived Roadway	Driveway Access	Non-Intersection	Intersection or Intersection-Related	Total
Luther St W	0	2	0	2
S Bryan Ave	0	2	0	2

Next, the top three roadways for intersections and intersection-related pedestrian-involved crashes were identified (data not shown). Top roadway intersections included: 1) University Drive and Wellborn Road (n=6); 2) FM 2818 and Welsh Avenue (n=3); and 3) Southwest Parkway and Anderson (n=3). The intersection of University Drive and Wellborn Road is university proximal while FM 2818 and Welsh Avenue border A&M Consolidated High School. Finally, Southwest Parkway and Anderson border alongside of residential housing and a variety of retail businesses and restaurants.

Ultimately, researchers generated a hot spot map which plotted roadway areas of concern in and around the Texas A&M University campus area and in areas having high concentrations of residental housing and places of commerce (note the campus is the green area between FM 2818 and HWY 6) (see Figure 15).

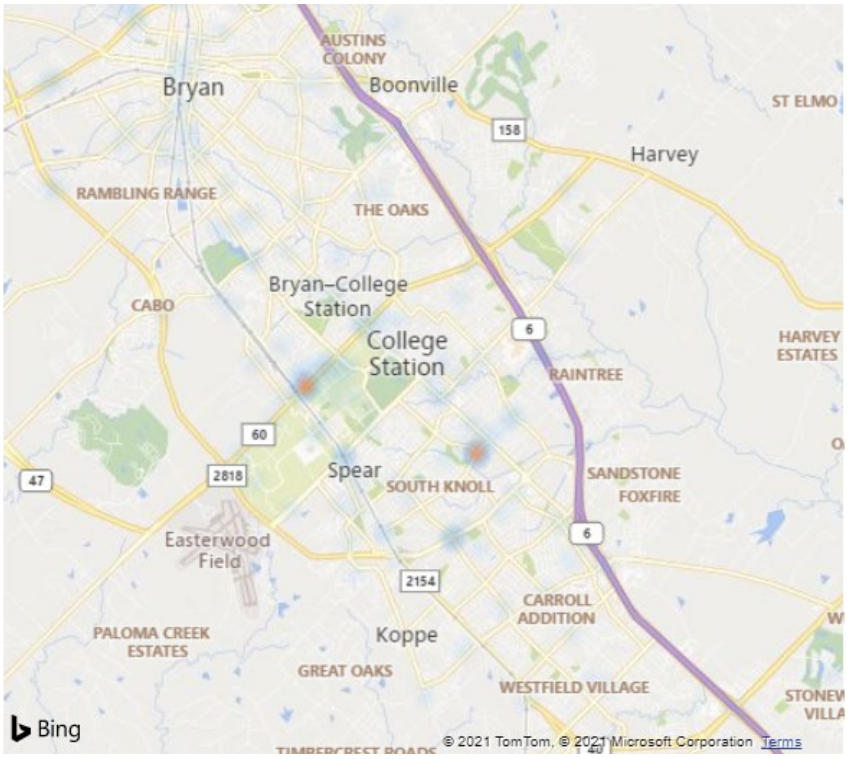

Figure 15. Hot Spot Map of Pedestrian-Involved Crashes from 2015 to 2019 in Bryan and College Station, TX.

Discussion

The completed crash analysis allowed the research team to better understand the circumstances of how bicyclist and pedestrian-involved crashes occur on roadways in Bryan and College Station, Texas. One important finding discovered was that most bicyclist and pedestrian crashes occur on:

- Local roads or streets,
- On roadways with speed limits between 25 to 44 mph,
- During clear weather conditions,
- During daylight hours, and
- Involve males between the ages of 18-24 years.

Understanding these factors has given the research team insight to prepare for and later develop tailored educational materials that will address walking/riding/driving laws.

The crash analysis findings highlighted the need to promote an increased awareness of state laws and emphasize how investing in enforcement strategies and mobilization can improve safety. Through the analysis, research staff discovered that 56.9% of bicyclist-involved crashes and 38.4% of pedestrian-involved crashes occurred at intersections. These findings support a strong need to educate bicyclists and pedestrians about the importance of following laws focused on safe intersection crossings and yielding right-of-way. Promoting these findings and educating vulnerable roadway users may very well help reduce the incidence of pedestrian and bicycle crashes at intersections.

The analysis results specifically call for integrating the following Texas Transportation codes into any outreach and educational materials: Texas Transportation Code §552.001 (Traffic Control Signals), §552.002 (Pedestrian Right-of-Way: Control Signal), §552.003 (Pedestrian Right-of-Way at Crosswalk), §552.005 (Cross at Point Other Than Crosswalk), §552.008 (Drivers to Exercise Due Care), and §547.107 (Method of Giving Hand and Arm Signals).[4] Additionally, since 29.4% of bicyclist-involved crashes occurred in dark environments, there is a real need to educate bicyclists on §551.104 (Safety Equipment). This includes the legal requirement of bicyclists to ensure proper use of safety equipment, such as headlamps and red reflectors affixed to their bicycle[4].

In closing, the results of the analysis will provide guidance for developing educational outreach materials that will increase awareness of state bicyclist and pedestrian laws. Furthermore, researchers will be able to provide pedestrians, bicyclists, and motorists with insight into crash characteristics, recommend countermeasures that address identified challenges, increase knowledge of traffic laws, and coordinate/mobilize ongoing activities with campus leaders to eliminate bicycle and pedestrian crashes, injuries, and deaths.

[4] State of Texas. (2021). Texas Constitution and Statutes. Retrieved from: https://statutes.capitol.texas.gov/?link=TN

Appendix

1. You will be using Google Earth and/or Google Maps for this project using satellite or streetviews.
    a. Web Versions
        i. Google Earth: https://www.google.com/earth/
        ii. Google Maps: https://www.google.com/maps
    b. Download
        i. Google Earth: https://www.google.com/earth/versions/#download-pro
2. For each lat/long in the spreadsheet you will add the following information. Pictures and definitions are included for some of the more complicated fields.

- Column A: Crash Severity (None This is Pulled with Crash Data)
- Column B: Lat (None This is Pulled with Crash Data)
- Column C: Long (None This is Pulled with Crash Data)
- Column D: Classification (None This is Pulled with Crash Data)
- Column E: Intersection Status (None This is Pulled with Crash Data)
- Column F: Date of Streetview Imagery in Google Earth
    - The date you looked at Google Earth or Google Map
        - Note: Only available if streetview imagery is available for location. If not available, input: “No streetview available.”
- Column G: Number of Travel Lanes
    - Total number of travel lanes, including turn lanes, but not including medians.
- Column H: Median
    - 0=None
    - 1=Flush
    - 2=Raised
    - 3=Two Way Left Turn Lane
    - Examples:

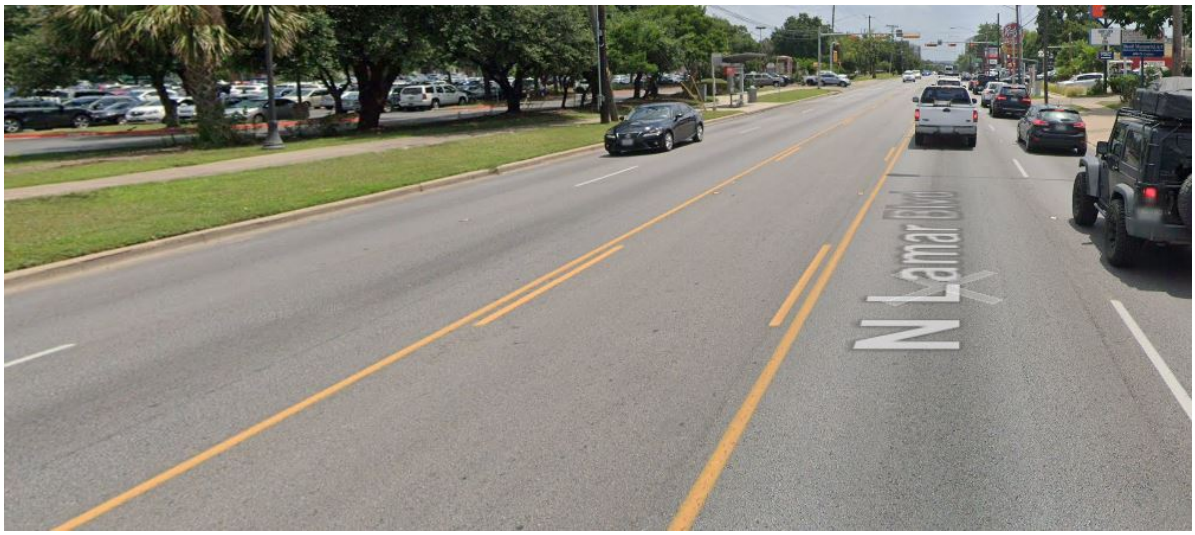

Figure 16. Two Way Left Turn Lane (TWLTL)

Figure 17. Raised Median

Figure 18. Flush Median

Figure 19. Flush Median (with Brick Inlay)

- Column I: Posted Speed Limit 1
  - If no speed limit sign is found in proximity of the crash, write "No sign found."
- Column J: Posted Speed Limit 2
  - Note speed of intersecting road if different than the primary road.
- Column K: Location of Speed Limit Sign
- Column L: Sidewalks Present
  - 0=None
  - 1=One side of road
  - 2=Both sides of road
- Column M: Marked Crosswalks
  - 0=None
  - 1=Yes
    - Defined using FARS/CRSS
      - **0 (None Noted)** used when the case materials indicate there is no marked crosswalk present **OR** when it cannot be determined if a marked crosswalk was present (e.g., not displayed on the diagram, not identified in the narrative, or not in a relevant report field). This attribute may also be selected if a marked crosswalk is not indicated in the case materials and the crash occurs in a location where crosswalk presence is unlikely (e.g., rural roadway, interstate).
      - **1 (Yes)** used when the case materials indicate the presence of a **marked** crosswalk at the crash site. To select this attribute, you only need to establish presence of a marked crosswalk at this location (i.e., the

person does not have to be in or near the crosswalk and the crosswalk does not have to be relevant to the crash).

- Column N: Pedestrian Crossing Signal
  - 0=None
  - 1=Yes

Figure 20. Example Pedestrian Crossing Signal.

- Column O: Pedestrian Crossing Device
  - 0=No
  - 1=Rectangular Rapid Flashing Beacon
  - 2=LED Embedded Sign
  - 3=Pedestrian Hybrid Beacon
  - 4=Other
  - Examples:

Figure 21. Pedestrian Hybrid Beacon (PHB)

Figure 22. Retangular Rapid Flashing Beacon (RRFB)

Figure 23. LED-Em Sign

- Column P: Street Lighting/Illumination
  - 0=No
  - 1=Yes

- Is there a light visible on either side of the location without you having to move to find one?

- ## Column Q: Bike Lane
  - Defined using modified MMUCC
  - 0=No
  - 1=Marked Bicycle Lane
  - 2=Separate Bicycle Path/Trail
  - 3=Unmarked Paved Shoulder
  - 4=Wide Curve Lane

- ## Column R: Pedestrian Warning Sign Present Near Crosswalk
  - 0=No
  - 1=Yes
  - Check all signs leading up to the crossing location in each direction. This would include any sign that you can see the back of from the crossing location. Specifically, look for any pedestrian or bicycle warning signs.
  - Examples:

Figure 24. Pedestrian Crossing Sign

Figure 25. Pedestrian Crossing Ahead Sign

- Column S: Bicycle Warning Sign Present Near Crosswalk
    - 0=No
    - 1=Yes
    - Check all signs leading up to the crossing location in each direction. This would include any sign that you can see the back of from the crossing location. Specifically, look for any pedestrian or bicycle warning signs.
    - Examples:

Figure 26.Bicycle Crossing Sign

- Column T: Speed Bump Present Near Crosswalk
    - 0=No
    - 1=Visible from Crosswalk
    - 2=Crosswalk on Road Hump

Figure 27. Example Speed Bump Visible from Crosswalk.

Figure 28. Example Crosswalk on Road Hump.

- Column U: Mid-Block Crossing
  - 0=No
  - 1=Yes

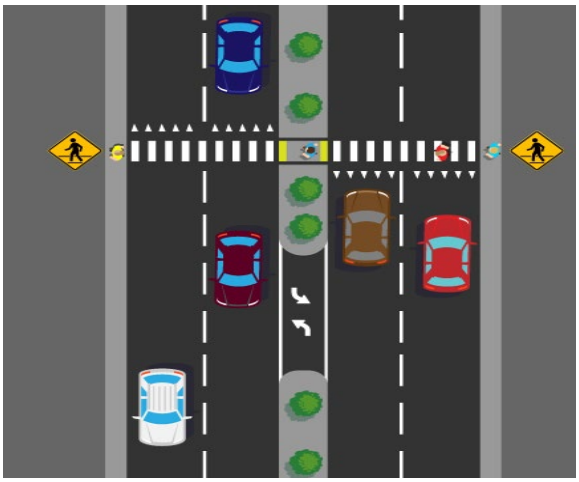

Figure 29. Example Mid-Block Crossing

- Column V: Notes from person reviewing.
    - Insert anything you think is relevant or noteworthy here.