Pedestrian Safety Implications on the Lack of Sidewalks Along Aurora Ave N in Seattle, Washington

Pedro Popoca

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Rachel Berney, Chair

Andy Dannenberg

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Abstract

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Pedro Popoca

Chair of the Supervisory Committee:
Associate Professor Rachel Berney
Urban Design & Planning

The urban pedestrian experience is heavily based on how people feel, especially when walking along a busy street. The lack of sidewalks in north Seattle along Aurora Ave North has been a hot topic the city has been trying to solve for a while now. According to the Seattle Times, “Aurora Avenue North has consistently been one of Seattle’s most dangerous roads for drivers and pedestrians.” (Baruchman 2021, n.p.) Research observations examined how the lack of sidewalks creates safety hazards for pedestrians and how that can influence poor decision-making by pedestrians. The research questions are what the safety implications pedestrians face are when there are no sidewalks along Aurora Ave North, and how does that determine where

pedestrians will choose to walk. This research looked at the literature on what other cities have done to help solve the issue of no sidewalks in growing cities and what policies in Seattle at the time of construction led to development taking place but did not require sidewalks. Site observations were conducted in two different approaches, the first one being a walkthrough of observing site conditions and scoring each site using Gehl's Twelve Quality Criteria. The criteria provide observers with a method to examine public spaces using three different categories--protection, comfort, and enjoyment--to give scores based on conditions that influence the pedestrian experience. Each of the three categories has subcategories that influence the overall score and based on the average of each a score was given from one (low) to three (high).

Observations were done in four locations, 115th, 130th, 145th, and 155th all locations along Aurora Ave, with one location being a transitional zone between Seattle and the city of Shoreline, Washington. Scores were divided into two different observations for the same site. One of the locations was based entirely in Shoreline as a case study with a full network of sidewalks and other available pedestrian infrastructure. The second method of observation was done by observing the behavior of pedestrians when they came across areas of Aurora Ave that did not have sidewalks. All sites in the Seattle locations lacked sidewalks and pedestrians are faced with high levels of safety hazards. Overall research showed that Aurora Ave is a high-risk location for all types of pedestrians and improvements need to be made.

With sidewalks costing an average of $400,000 per city block (SDOT), constructing new sidewalks will continue to be a challenge and should be a high priority for the city of Seattle to start improving its pedestrian infrastructure around the Aurora corridor in north Seattle.

Recommendations are provided for improvements in street designs, including adding sidewalks on both sides of Aurora Ave and bike lanes to encourage safer cycling behaviors. Adding dedicated bus lanes and street trees would help create a more pedestrian-friendly environment.

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Section 1. INTRODUCTION

All over the United States, the safety of pedestrians is getting more attention as pedestrians are using walking as their primary transportation choice, especially in urban areas. In Seattle, where certain neighborhoods lack sidewalks, pedestrian safety has been a critical issue. Seattle currently has over 2,000 miles of sidewalks, yet over 24 percent of the city's streets (11,000 blocks) are missing sidewalks, according to Seattle's Department of Transportation. (SDOT) The city has a 20-year plan to help address the issue and has created a framework that prioritizes areas that most need sidewalks. This research analyzes the current conditions of the pedestrian infrastructure in four different locations, all located along Aurora Ave in northern Seattle and one adjacent location in the city of Shoreline. This stretch of road has been in the news several times regarding pedestrian accidents. According to the Seattle Times, "Aurora Avenue North has consistently been one of Seattle's most dangerous roads for drivers and pedestrians." (Baruchman 2021, n.p.) Seattle GIS data points to over 27 different occasions where a pedestrian was hit by a vehicle in the last ten years along the study area. (Seattle GIS 2022)

You may be asking how did this stretch of Aurora Ave become so bad? Aurora Ave has come a long way, going through tremendous changes. It first started as a city street in the late 1890s in the area we know today as South Lake Union, just north of downtown Seattle. As the city grew and extended north, more sections of the Aurora would get added. The completion of the Aurora bridge in 1929 brought a more direct route for those living in Seattle to the outer unincorporated towns. Businesses soon appeared in the form of motels, restaurants, and full-service car repair shops. Before the 1950s, much of the land north of 85th belonged to King County, which didn't require developers to build sidewalks. (Bhatt, 2007) Later Aurora Ave

expanded to a highway as the automobile was given priority and pedestrian infrastructure was put to the side. This eventually led to what we know as Aurora Ave today, a busy arterial with pedestrian infrastructure as an afterthought.

The study sites were chosen due to the lack of sidewalks in a high pedestrian traffic area. The location in Shoreline is included to better understand how the city of Shoreline was able to overcome the issue of no sidewalks along a main arterial and to use that location to compare how pedestrian infrastructure there has improved the pedestrian experience for all types of users. All the locations in this research are based on proximity to Seattle's RapidRide bus stops along Aurora Ave. Looking at the lack of sidewalks is a crucial point of my interest. As an urban planner specializing in urban design, one of the key aspects of improving pedestrian infrastructure is being able to research and analyze the current conditions of sites and observe the behaviors of pedestrians in situations that make it difficult for pedestrians to reach their destination safely.

My research observations examine how the lack of sidewalks creates safety hazards for pedestrians and how that can influence poor decisions made by pedestrians. The research question is: what are the safety implications pedestrians face when there are no sidewalks along Aurora Ave North, and how does that determine where a pedestrian will choose to walk. This research looked at the literature on what other cities have done to help solve the issue of no sidewalks in growing cities and what policies in Seattle at the time of construction led to development but did not require sidewalks. Site observations were conducted in two different approaches: a walkthrough of observing site conditions and scoring each location using Gehl's Twelve Quality Criteria, which looks at sites using three different scoring categories of protection, comfort, and enjoyment. These scores are based on conditions that influence the pedestrian experience. Each of the three

categories has subcategories that influence the overall score and based on the average of each a score was given from one (low) to three (high). The second approach was observing pedestrian behavior to determine how pedestrians interact when sidewalks are absent and how they are vulnerable to traffic.

Section 2. LITERATURE REVIEW

Finding what has been done in similar situations in other cities plays a critical role in helping Seattle find solutions to a costly issue. The literature review looks at articles that look into what other cities are experiencing and what they have done to help address the issue that comes to safety when sidewalks are lacking. One of the first articles that helped shape how I would approach this research was "A comparison of three methods for assessing the walkability of the pedestrian environment" by the Journal of Transport Geography. In this article, the researchers are focused on the City of Leeds in the UK. They conducted a survey to determine how residents perceived the current status of the pedestrian infrastructure. The survey is similar to how Gehl's Twelve Quality Criteria asks participants to rate the conditions of the sidewalks from a score of 1(lowest) to 3 (highest), which is used in this research. The UK scores were given as a possible outcome to each scenario presented. For example, if a user chooses to walk in a cleaner street than the other. That would result in a positive outcome for that street, achieving a score of 2 or 3. The same thing follows for the rest of the attributes in the survey. (Kelly, C. 1500-1508)

To help guide my research in determining why pedestrians choose a specific walking route, I used the article Pedestrian Mobility Environments: A Review of Approaches, Factors, and Conditions from a Regional Urban Journal. This article details the fundamental roles that pedestrians will play when deciding which routes they will take or avoid on their everyday walks. This helps my understanding of my research because it will help me understand why pedestrians will choose to take routes that may not be obvious in terms of safety but rather how fast it gets them to where they need to go. (Valenzuela-Montes. 41)

Pedestrian jaywalking is a significant pedestrian safety concern that involves more cases where pedestrians are hit by vehicles. This research looks at a small portion of safety concerns in regards to jaywalking. The article in this research was "Systemwide intersectional signal timing optimization simultaneously minimizes vehicle and pedestrian delays." This article looks at the best ways to prevent traffic delays and decreases the time pedestrians wait for their turn to walk through a crosswalk. (Roshandeh, Arash Moradkhani)

Seattle isn't the only city that is dealing with the issue of the lack of sidewalks in their pedestrian infrastructure. The city of Indianapolis is also in the same scenario where they need $750 million to fully make Indianapolis a pedestrian-friendly destination, but with an annual transportation budget of $50 million and only $3 million marked for sidewalks, it will take the city years to get it where it needs to be. The article "Building sidewalks $3 million at a time: city is far short of the $750 million needed to take care of all its needs" goes into detail about the issues they face and how the city has come up with solutions to help prioritize areas that need the most attention. This article can be applied to this research because in the same instance how Indianapolis is dealing with the same sidewalk safety issues, the city of Seattle can use Indianapolis as a case study to determine what worked and what should be done differently. (Olson, Scott)

A possible solution to the rising safety concerns of no sidewalks is looking at what the city of Seoul, South Korea, has done to help alleviate the number of pedestrians getting hit while having to share the space with automobiles. "Shared Space and Pedestrian Safety: Empirical Evidence from Pedestrian Priority Street Projects in Seoul, Korea" is an article that talks about the low-cost

visual solutions the city of Seoul used to help address pedestrians' concerns facing narrow streets are shared with automobiles. (Lee, Haeryung) Since the city of Seoul has side streets that are often too narrow to support sidewalks, the city had to look into solutions that could be incorporated without adding sidewalks. The city decided to provide visual aids so that drivers in automobiles could more easily see pedestrians as they share the street. This can be a temporary solution that can be implemented along Aurora Ave in areas where there is currently a walkway, and the addition of visual aids could help improve the safety of pedestrians at a lower cost than building a complete sidewalk network.

Pedestrian injuries are a hot topic and an issue that many jurisdictions want to help address and prevent from occurring. The article “Identifying clusters and risk factors of injuries in pedestrians -vehicle crashes in a GIS environment” goes into detail about how different elements such as time of day, day of the week, age, pedestrian maneuvers, and inadequate lighting are significant risk factors for pedestrian injuries. Walking or driving under the influence and male pedestrians and/or motorists all contribute to an increase in the risk of injuries. The study goes into detail about how prevention programs are needed to help address the risk factors of pedestrians, especially during days that streets get the most used, such as on weekends and evenings. Children, seniors, and intoxicated pedestrians are at the highest risk as they are less likely to make sound decisions. This article highlights the importance of pedestrian safety in having the proper lighting so pedestrians are seen at nighttime when the risk of getting hit by a vehicle is the highest. (Dai, 2012)

The number of pedestrians being hit by a vehicle is alarming it is estimated that in 2014, a pedestrian was killed every 2 hours and one was injured every 7 minutes. The article "Epidemiology of Pedestrian - Motor Vehicle Fatalities and Injuries 2006-2005" analyzes data from motor vehicle collision injuries and fatalities from 2006 to 2015 and helps identify risk factors associated with death in pedestrians and motor vehicles collisions. The study found that the number of crash fatalities has declined in the past decade, but rises have occurred on a few occasions. The rise seems consistent with the higher phone use in both pedestrians and drivers who are getting distracted while driving or walking. Road design was also a major factor in pedestrians getting hit. In study areas where high pedestrian fatalities or injuries occurred, the built environment was to blame. Adding corner curb extensions, count-down crossing signals, and speed humps to slow down drivers are some environmental measures that help with pedestrian injuries. (Chong et al., 2018)

Section 3. METHODOLOGY

This research intends to help understand the behaviors of pedestrians when they are faced with a higher degree of danger due to the lack of safe walking spaces in high-vehicle traffic areas. Aurora Ave North is a highly used arterial roadway that runs through Seattle north to south. Average speed limits range from 30 to 35 mph and vehicles often exceed those speeds. These conditions alone set dangerous conditions for pedestrians, and in combination with no sidewalks and current street infrastructure geared for vehicles, very little attention is put on pedestrians. Pedestrians are faced with making unsafe decisions to get to their destinations. In this study, site observations were done to determine how pedestrians in this area use the space and what recommendations can be made to help address this. Two observational methods were used to help better understand the area. The Gehl Twelve Quality Criteria tool was used to analyze each site with 12 different criteria that look at how public space is performing in pedestrian environments. The second type of observation was site observations that examined pedestrian behaviors. For the purpose of this research, a pedestrian is defined as a person walking or using a nonfuel motorized vehicle to get around, for example, a person in a wheelchair that is powered by a battery is considered a pedestrian as a wheelchair is a primary mode of getting around for that person.

3.1 GEHL TWELVE QUALITY CRITERIA

Gehl's Twelve Quality Criteria is a tool used for researching how public spaces are experienced by their users. It is used to evaluate whether different features of public space are protective, comfortable, and enjoyable for people spending time there. The thinking behind these

three categories is as follows: 1) without basic protection from cars, noise, rain, and wind, people will generally avoid spending time in space; 2) without elements that make walking, using a wheelchair, standing, sitting, being able to see distances that are unhindered, and conversing comfortable, a place will not invite people to stay; 3) great public spaces tend to offer positive aesthetic and sensory experiences, take advantage of local climate, and provide human-scale elements, so visitors do not feel lost in their surroundings.

The site locations were selected for their proximity to King County Metro Rapid Bus Stops. Each area has its share of services for residents, such as grocery stores, restaurants, banks, and social services. Four sites were analyzed three located in Seattle, Washington; 115th, 130th, 145th, and one at 155th in Shoreline, Washington, just north of Seattle. In the following sections, 115th, 130th, 145th, and 155th refer to N 115th St, N 130th St, N 145th St, and N 155th St, respectively. The site along 145th was split into two different site analyses as this is a transition zone from Seattle to Shoreline city limits. Each site observation consisted of a 10-minute walk north and south from the intersection and a five-minute walk east and west from the intersection of each observed site. The only exception to this was the site of 115th, as the western side as well as part of the eastern side of Aurora Ave is a cemetery.

115TH

Gehl Scores

PROTECTION	Protection Against Traffic and Accidents – Feeling Safe	Protection Against Crime and Violence	Protection Against Unpleasant Sensory Experiences
	1.8	1.5	1

COMFORT	Opportunities to Walk	Opportunities to Stand/Stay	Opportunities to Sit	Opportunities to See	Opportunities to Talk and Listen	Opportunities to Play and Exercise
	1.2	1	1	2.5	1	1

ENJOYMENT	Scale	Opportunities to Enjoy the Positive Aspects of Climate	Positive Sensory Experience
	3	2.25	1.25

Gehl's scores for the area around 115th were low in all three major categories. In the category of protection, it scored 1.40 out of 3.00. In subcategories where it placed low included the lack of eyes on the street, being as this area is surrounded by a cemetery on both sides, making it difficult for any nearby residents or businesses to have views of people walking along Aurora Ave. Protection against unpleasant sensory experiences was another subcategory that received low scores. In particular, the lack of any type of protection from weather elements brought its score down. In this part of Aurora, there is not much structural protection against rain or sun. Except for the trees located in the cemetery, there are not many trees on the actual walkway zone by the sidewalk. Incivilities here are seen with trash found all over the ground. In the comfort category, the area around 115TH placed the lowest with an overall score of

Figure 3.1A Aurora Ave looking north on 115Th showing desired paths

1.23 in areas where sidewalks are present. The sidewalk width is barely enough for two people to walk comfortably. Sidewalk conditions are poor. Often, obstacles such as telephone poles placed in the middle of the sidewalk can make it difficult for pedestrians to use the sidewalk. There are no areas for sitting and nothing invites users to stay. Pedestrians here are often walking fast to get to their destination. In the enjoyment category, it was placed on the lower end, with nearby trees from the cemetery giving the area a boost in a score of 1.85. This was primarily due to the plantings and the opportunity to provide shade to pedestrians. In determining the rubric score of the subcategory of scale in the enjoyment category, the notion of buildings being at a human scale was measured as less than three stories high. A high score was given if all buildings in the study area met the criteria.

130TH

PROTECTION	Protection Against Traffic and Accidents – Feeling Safe	Protection Against Crime and Violence	Protection Against Unpleasant Sensory Experiences
	2	2	1.25

COMFORT	Opportunities to Walk	Opportunities to Stand/Stay	Opportunities to Sit	Opportunities to See	Opportunities to Talk and Listen	Opportunities to Play and Exercise
	1.6	1.16	1.6	2.5	1.16	1

ENJOYMENT	Scale	Opportunities to Enjoy the Positive Aspects of Climate	Positive Sensory Experience
	3	2	1

Scores along 130TH are slightly higher than 115TH. In the category of protection, it scored 1.72, with the highest scores being based on how lively the public realm is. This area has a good overlap of functions of businesses that are open during the day and night. This part of Aurora has

spots with pedestrian-level lighting, which helped score higher in the subcategory of protection against crime and violence. This was primarily seen along the eastern side of Aurora and the northern side of 130TH east of Aurora. Here is the only section where sidewalks are complete. The subcategory that scored the lowest was protection against unpleasant sensory experiences. It lacked any type of protection against the elements, such as awnings. This part of Aurora Ave is largely connected with parking lots resulting in very little pedestrian infrastructure that provides protection from rain and heat. Incivilities are also an issue here, with trash found throughout. In the comfort category, it received a score of 1.52. Low scores are associated with obstructions found in the pedestrian zone, such as cars parking in the limited area pedestrians can walk. Noise levels are high, making it hard to hold a conversation while walking. There is not any type of

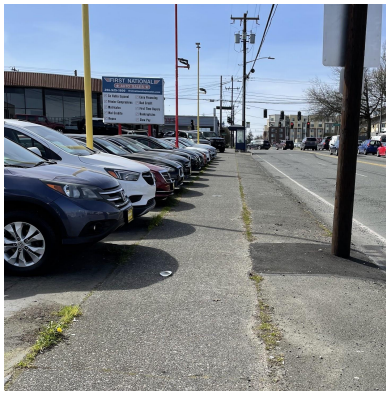

Figure 3.1B 130th showing no clear separation between private and public pedestrian spaces

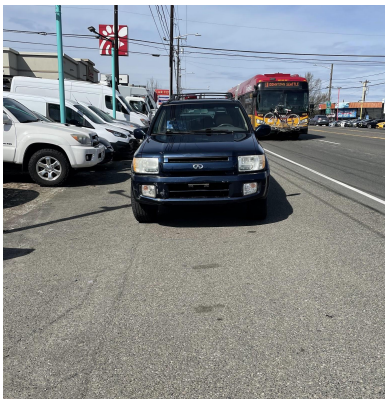

Figure 3.1C Aurora Ave facing 130th, vehicle parked along the available walk space

street furniture that provides staying other than bus stops. Areas to sit in are limited. In newer development areas by 125th, there are a couple of benches located next to Ivar's Seafood restaurant. Accessibility is also an issue as curb ramps are missing, and where curb ramps are present, they are not connected by sidewalks. The Enjoyment category scored a score of 1.57, low scores were found in the sub-category of Positive Sensory Experience. The lack of trees, plants, and water features make the area less enjoyable. This part of Aurora Ave is full of

shopping strip malls and car dealerships. Large parking lots make pedestrians feel uncomfortable walking.

145TH Seattle Side

PROTECTION	Protection Against Traffic and Accidents – Feeling Safe	Protection Against Crime and Violence	Protection Against Unpleasant Sensory Experiences
	1.67	1.75	1

COMFORT	Opportunities to Walk	Opportunities to Stand/Stay	Opportunities to Sit	Opportunities to See	Opportunities to Talk and Listen	Opportunities to Play and Exercise
	1.6	1.33	1	2.5	1	1

ENJOYMENT	Scale	Opportunities to Enjoy the Positive Aspects of Climate	Positive Sensory Experience
	3	2	1

Scores around 145TH on the Seattle side were second to lowest overall from all the sites. In the protection category, low scores were associated with higher concerns of being hit by vehicles due to the lack of sidewalks on this site. The only sidewalks are located around the Holiday Inn Express Hotel, which does not cover the entire block, and by the Margaritas Mexican Restaurant, located at the intersection of 145TH. Even that section of sidewalk is only adjacent to the restaurant. This part of Aurora lacks overlapping functions of day and night. Businesses here are mainly open during the day. Low scores were also found for all Protection against unpleasant sensory experiences subcategories. The lack of trees played a role in the low scores, which caused no protection from weather elements. Pollution was also found throughout, with trash on the ground on every stretch of Aurora and unpleasant odors of urine near the Holiday Inn. Air quality was

poor with all the cars idling waiting for the streetlight to turn green. In the comfort category, low scores were given due to the lack of sidewalks and missing curb ramps for accessibility. This area lacked any opportunities for standing or sitting, no benches were found. The only available benches are located next to bus stops or in the outdoor sitting area at the Kid Valley Restaurant. A high level of noise pollution was heard from high traffic, making it hard to have a conversation. There are no opportunities for physical activity to occur other than walking. The area has the space for bike lanes to be added. In the category of enjoyment scores here is a 1.57, which is associated with all buildings being designed at a human scale with most being one or two stories. The lack of street trees makes it hard for pedestrians to enjoy walking through the area with no protection from the sun in the summer months. With most of the ground being asphalt, there is a lack of aesthetically pleasing materials that could add to a positive pedestrian experience.

Figure 3.1D Showing Aurora Ave facing south towards 130th with cyclist in walkway

Figure 3.1E Vehicle using the walkway as a turning lane

Figure 3.1F Vehicle using the walking as a parking lane

145TH Shoreline Side

PROTECTION	Protection Against Traffic and Accidents – Feeling Safe	Protection Against Crime and Violence	Protection Against Unpleasant Sensory Experiences
	1.67	2	1.25

COMFORT	Opportunities to Walk	Opportunities to Stand/Stay	Opportunities to Sit	Opportunities to See	Opportunities to Talk and Listen	Opportunities to Play and Exercise
	2	2	1.67	2.5	1	1

ENJOYMENT	Scale	Opportunities to Enjoy the Positive Aspects of Climate	Positive Sensory Experience
	3	2.5	1.75

Moving onto the transitional side between Seattle and Shoreline Washington, just north of 145TH, the area on the Shoreline side was redone in 2017. Gehl's scores are second to highest of all the rest. This area is greatly improved with pedestrian amenities. Sidewalks are found on all sides of Aurora Ave. Marked crosswalks are done with sizeable red asphalt slabs to help distinguish walking and non-walking areas. In the protection category, scores for the presence of sidewalks received a 2, with sidewalks being present on Aurora Ave. However, they are lacking along both sides of 145TH. Eyes on the street from all buildings having windows and doors facing the street were high. Pedestrian level lights are present but only around bus stops. Areas where scores were not as high were in subcategories of having business functions day and night. Businesses around this part of Aurora are mainly small businesses open during the daytime. Protection against unpleasant sensory experiences was also where it received low scores. The lack of awnings for protection against rain is not present as most buildings are placed backed from the pedestrian walking zone. Pollution is present in both forms of trash and traffic noise. In the comfort category, higher scores were found with sidewalks and no obstructions within the pedestrian zone, and the

presence of windows and doors facing the pedestrian zone was high. Areas for both sitting and standing can be found in front of the Walgreens there is a zone for sitting that has a couple of benches that face the intersection and along Aurora Ave there are a few spots that have low-level retaining walls that pedestrians can use to sit. The subcategories where it received low scores are with opportunities to talk and listen as high street noise can be heard from high traffic areas. Aurora Ave is still considered an arterial roadway and as such gets a low score of 1. This part of Aurora lacks any type of opportunities to play and exercise.

155Th

PROTECTION	Protection Against Traffic and Accidents – Feeling Safe	Protection Against Crime and Violence	Protection Against Unpleasant Sensory Experiences
	2.33	2.75	1.75

COMFORT	Opportunities to Walk	Opportunities to Stand/Stay	Opportunities to Sit	Opportunities to See	Opportunities to Talk and Listen	Opportunities to Play and Exercise
	2.8	2	2	3	1.16	1

ENJOYMENT	Scale	Opportunities to Enjoy the Positive Aspects of Climate	Positive Sensory Experience
	3	3	2

The only site fully in Shoreline, Washington, with the highest Gehl Scores of all the sites and each category. This site sets a high standard for which the sites in Seattle could strive. The protection category scored a 2.2 with the highest scores associated with a complete sidewalk network being present. The public realm is very active and eyes on the street are visible with every building facing Aurora having both windows and doors that face the pedestrian zone. Pedestrian lighting can be found all throughout the area and continuous rows of street trees along both sides of Aurora Ave.

Subcategories where it scored the lowest was the lack of protection from the rain with most buildings lacking awnings for pedestrians to use as they sit further away from the pedestrian zone. Pollution from trash was present but not as much as at the other sites. In the comfort category, 155TH received a score of 2.1 with high scores being associated with sidewalks having plenty of room for walking, all sidewalks here have a least six feet of walking space with three feet of vegetation strip between the sidewalk and the roadway. At the time of observations, there were no obstructions on any of the sidewalks. All sidewalks were in good condition allowing accessibility for all types of pedestrians. There is even a pedestrian bridge that connects to the Interurban trail. Low scores were associated with high road noise and having this part of Aurora still considered an arterial brought the score for opportunities to talk and listen down to a 1. In the enjoyment category, all but two subcategories received high scores of 3. Low scores were associated with a lack of variety of different materials used on the ground all were similar types of concrete. All buildings are at a human scale being less than three stories high. There are street trees on both sides of Aurora Ave which helps make the pedestrian experience more enjoyable on hot summer days.

Figure 3.1G Intersection of Aurora Ave & 155th / bike lanes

Figure 3.1H Aurora Ave north of 155th / clear separation between private and public walking spaces

Disclaimer on the data for scores being high or low. The average of all observations within the site where taken. Some areas received higher or lower scores due to the overall amount of number of observations for each subcategory. For example, if one area observed a higher amount of instances of trash along a section of the site it gave the overall score of the site a lower score even though only a part of the site had trash while the rest could have been trash free. This was a limitation of the data to create all sites equally the mode or the occurrence of each instance was used.

3.2 SITE OBSERVATIONS

Observations were performed to better understand how pedestrians interacted with no sidewalks along the busy arterial of Aurora Ave N and to document safe and unsafe behaviors.

115TH

115TH was chosen as a site to observe differences in how pedestrians interacted in a less busy part of Aurora Ave. A cemetery surrounds Aurora Ave on both sides and south of 115TH. North of 115TH only the western side has a cemetery. On the eastern portion of Aurora Ave are apartment complexes and a Home Depot. Safety considerations in this area include the lack of sidewalks on the western side of Aurora Ave. Pedestrians here were seen walking on desired paths parallel to the cemetery. However, north of 115TH pedestrians are forced to walk alongside the traffic. In some cases, having to walk close to traffic as parked vehicles or moving vehicles along the shoulder (only area for pedestrians to walk) created obstructions. Figure 3.2

Figure 3.2 Aurora Ave N looking North on 115Th vehicle on walkway

Figure 3.3 Aurora Ave N looking North on 115Th showing pedestrian on walkway

Pedestrians in this area seem to be traveling to and from the bus stop the most, only a few passing through. Those that had just gotten off the bus and had to wait at the intersection to cross seemed to become impatient for the light to turn green. I observed three pedestrians crossing before the light turned. Research has shown that pedestrians are willing to wait up to 45 seconds before becoming impatient and making hazardous decisions. The light for pedestrians here is over a minute long giving vehicles the right of way longer. The high speed of vehicles is also a safety concern in this area. The current speed limit is 35 MPH but while on the site I observed estimations of higher speeds. The type of pedestrians that was observed at this site consisted of walkers. 82% of pedestrians were walkers and 14% were cyclists. All of the cyclists would use the sidewalk on the eastern side of Aurora or the walking zone on the western side. Cyclists seemed to be concerned about their safety when they needed to turn left onto 115TH, instead of turning left on the roadway they would wait for the pedestrian light to turn so they could turn on 115TH.

130TH

130TH is located at the heart of the Bitter Lake Neighborhood. The area is known for its vast supply of used car dealerships and big-box stores with large parking lots. The area along Aurora Ave is highly used by pedestrians however only sections of sidewalks exist. Nearby senior housing adds to the complexity as the elderly are more likely to walk to their destinations. This stretch of Aurora Avenue is deemed unsafe for pedestrians. Pedestrians were observed using the parking lots to get to their destinations rather than using the existing sidewalks or walkways along Aurora Ave. Also, pedestrians seemed to prefer to walk through the business parking lots and unmarked alleyways, essentially any most convenient path. Most of the time, observations of pedestrians doing this were high coming from nearby residential complexes making their way to the bus stop. This phenomenon would be a great study to do separately to try and determine the psychological reasoning behind pedestrians walking through parking lots instead of available walkways. Could it be the most direct route, or do they feel safer walking through a parking lot? Those who did walk alongside Aurora were often faced with having to stop for a vehicle trying to turn onto the parking lot. Priority in this part of Aurora is given to vehicles. Drivers were constantly seen trying to merge into traffic with little disregard for pedestrians. Pedestrians were observed making eye contact with drivers to avoid being hit. Mid-block jaywalking is common near Burger King and the entrance of Asian Family Market, five occurrences were observed. The locations where pedestrians seem to be heading include walking to the bus stops, shopping centers, banks, nearby schools, and social services. Pedestrians who were walking consisted of 71% of total pedestrians observed. Less than 10% were elderly, with 4% using a wheelchair or walker. Those in wheelchairs would often choose the most direct route for where they were headed, often right next to traffic. Bikers consisted of

14% of users where they were seen using the small strip of space between the roadway and the available walkway and at times using the bus lane. Pedestrians with dogs were only seen to be using the side of Aurora that had sidewalks. At the pedestrian bridge, only 12% of pedestrians use the bridge. The pedestrian bridge lacks utilization as it's not very accessible. The elderly have a hard time going up and down the stairs. Those with wheelchairs and walkers are left unable to utilize the bridge as there are no ramps that would allow access for them. The bridge also only covers a small portion of Aurora Ave. It is more convenient not to use the bridge and cross the intersection by walking.

145TH

The intersection of 145TH is located at the Seattle/Shoreline transition zone. Here a great difference is observed when crossing from Seattle to Shoreline. Sidewalks are missing along the Seattle side, while sidewalks are present on the Shoreline side. South of 145TH is where high safety concerns are seen. With the lack of sidewalks, pedestrians will walk wherever they can at times walking close to high-speed traffic. Pedestrians will walk through parking lots that have vehicles going in and out. An unmarked walkway is present on the western side of Aurora Ave, but this is uncomfortable as vehicles are often traveling at speeds over the speed limit of 35 MPH. Car dealerships are common for a portion of this area and where car buyers are testing out a new car they often obstruct the available walkway as they use the space to park after they are done test driving their potential new vehicle. A combination of fast vehicle speeds and lack of pedestrian infrastructure make it hard for drivers to pay attention to any pedestrians walking by as drivers are more focused on merging into traffic. Pedestrians were seen trying to make eye contact with drivers

to ensure they could walk before the driver turned into a parking lot. Bikers were observed using the walking space to avoid traveling with cars often being right next to parked cars or even swerving between parked cars to create a barrier from moving vehicle traffic. The long blocks without any type of pedestrian crossing influence pedestrians to jaywalk. This

area observed the highest number of jaywalkers 50% of pedestrians jaywalked in the middle of the block by Kid Valley. On five occasions, I observed persons in wheelchairs and walkers jaywalking even as oncoming traffic was heading toward them. Pedestrians crossing at the intersection against the traffic signal is also a common occurrence. Pedestrians are either in a rush to get to their destination or have no regard for their safety as often vehicles will stop for pedestrians no matter who has the right of way. Pedestrian conditions are improved north of 145TH. Here sidewalks are present, and a clear separation of pedestrians and vehicle road space is seen. Next to the sidewalks is a planting strip that adds a sense of protection from vehicles passing by. As pedestrians walk, they do not need to pay attention to drivers trying to turn left as there is a planting strip median that prevents any left turns. A bus lane parallel to the sidewalk adds another barrier layer to pedestrians as drivers will use this lane to slow down before trying to enter a parking lot.

155TH

Of the four sites, 155TH has the best pedestrian infrastructure. Sidewalks are present on all sides with planting strips located between the sidewalk and roadway. The use of bikes is high in the area, as the Interurban Trail is nearby and has a connection to the Burke Gilman Trail 25% of all users were cyclists, most of whom take advantage of the pedestrian bridge that goes over 155TH.

A combination of pedestrians with their dogs was observed in 22% of all users. On the street level, a more diverse group of pedestrians compared to the other sites was observed ranging from kids to the elderly. Elderly in both walkers and scooters were seen using the sidewalks to get to and from the bus stop or the Safeway. Even a skateboarder was seen using the sidewalk. The combination of sidewalks with bike lanes allows for a more diverse group of pedestrians to use and feel comfortable in the space. Pedestrians were observed to be more casually walking versus having to pay attention to the traffic. In this part of Aurora Ave, the city of Shoreline has put the safety of pedestrians at the front while also making it safer for drivers. In recent studies, street trees in the median planting strips along with on the side of the sidewalk have shown that drivers tend to drive slower when there is tree coverage as opposed to areas without such as in the other sites in this research study. In the other observed sites of Aurora Ave, street trees are less common which could associate with the higher traffic speeds.

Section 4. DATA

			Seattle	Seattle	Seattle	Shoreline	Shoreline
PROTECTION			**115TH**	**130TH**	**145TH**	**145TH**	**155TH**
Protection Against Traffic and Accidents – Feeling Safe	Sidewalks		2	2	2	2	3
	Intersections		2.5	2	2	1	2
	Eliminating Fear of Traffic		1	2	1	2	2
Protection Against Crime and Violence	Lively Public Realm		2	3	2	2	3
	Eyes on the Street		1	1	2	3	3
	Overlapping Functions Day and Night		1	2	1	1	2
	Good Lighting		2	2	2	2	3
Protection Against Unpleasant Sensory Experiences	Rain/Snow	Marquees/Awnings	1	1	1	1	1
	Heat/Cold	Street Trees	1	1	1	2	3
		Windscreens and Heat Lamps	1	1	1	1	1
	Pollution	Air quality, trash, odors	1	2	1	1	2
AVERAGE			1.41	1.73	1.45	1.64	2.27

Table 1. Gehl Analysis - Protection

			Seattle	Seattle	Seattle	Shoreline	Shoreline
COMFORT			**115TH**	**130TH**	**145TH**	**145TH**	**155TH**
	Room for Walking	Width of Pedestrian Zone	1	2	2	2	3
	Interesting Facades		1	2	1	1	2
		Obstructions within the Pedestrian Zone	2	1	3	3	3
	No Obstacles	Sidewalk Conditions	1	2	1	2	3
Opportunities to Walk	Accessibility for Everyone	Curb Ramps	1	1	1	2	3
	Edge Effect/Attractive Zones for Standing/Staying	Presence of Windows and Doors	1	1	2	3	2
	Defined Spots for Standing	-	1	1.5	1	2	2
Opportunities to Stand/Stay	Facades with Good Details that Invite Staying	-	1	1	1	1	2
	Zones for Sitting		1	1	1	2	2
	Good Places to Sit	-	1	2	1	2	3
Opportunities to Sit	Benches for Resting		1	2	1	1	1
Opportunities to See	Reasonable Viewing Distances, Unhindered Sightlines	-	3	3	3	3	3

	Lighting (When Dark)		2	2	2	2	3
	Low Noise Levels	Road Designation	1	1	1	1	1
		Noise Level	1	1.5	1	1	1.5
Opportunities to Talk and Listen	Street Furniture that Provides "Talkscapes"	Number of "Talkscapes"	1	1	1	1	1
Opportunities to Play and Exercise	Invitations for Creativity, Physical Activity, Exercise and Play		1	1	1	1	1
AVERAGE			1.24	1.53	1.41	1.76	2.15

Table 2. Gehl Analysis - Comfort

			Seattle	**Seattle**	**Seattle**	**Shoreline**	**Shoreline**
ENJOYMENT			**115TH**	**130TH**	**145TH**	**145TH**	**155TH**
Scale	Buildings and Spaces Designed at Human Scale		3	3	3	3	3
Opportunities to Enjoy the Positive Aspects of Climate	Sun/Shade		3	3	3	3	3
	Heat/Coolness		2	1	1	2	3
Positive Sensory Experience	Good Design and Detailing, Good Materials	-	1	1	1	1	1
	Trees, Plants, Water	Trees	2	1	1	3	3
		Plants	1	1	1	2	3
		Water	1	1	1	1	1
AVERAGE			1.86	1.57	1.57	2.14	2.43

Table 3. Gehl Analysis - Enjoyment

Area Observed	Where are pedestrians walking at?	How are pedestrians interacting with no sidewalks?	Hazards	Where are people heard to?	Types of Pedestrians	Other Observations
155Th / Shoreline Safeway	Sidewalks	Pedestrians will walk through parking lots to get to the sidewalk	Jaywalking	Safeway	Pedestrians (Walking) 45	Pedestrians are more casually walking versus having to pay attention to traffic
	Interurban Trail	Desired paths in front of Safeway and Chevron		Bus Stop	Elderly 13	Bike use is high likely due to nearby trails and bike lanes
	Biker are using bike lanes			Gas Station	Scooter 3	Skateboarder feels safer here due to dedicated sidewalk/bike space
				Interurban Trail	Seated Scooter 3	Planting / grass areas for dogs to relief themselves, dogs are more curious to explore plants
					Kids 1	Observed a lot of the same people walking back and forth (Safeway / Bus Stops)
					Skateboarder 1	
					Dog Walker 6	
					Using Pedestrian Bridge	
					Pedestrians 24	
					Bikers 35	
					Dog Walkers 7	

Table 4. 155TH Site Observations

Area Observed	Where are pedestrians walking at?	How are pedestrians interacting with no sidewalks?	Hazards	Where are people heard to?	Types of Pedestrians	Other Observations
145Th Shoreline/Seattle Transition Area	Through Parking Lots	Pedestrians use parking lots to get to their destinations	Jaywalking	Bus Stop	Pedestrians (Walking) 22	Bikers ride super close to parked cars/ far away from traffic as possible
		Pedestrians utilize available walkway even though it is right next to traffic	Jaywalking on wheelchair		Elderly 4	Pedestrians go behind drivers at intersections to avoid being hit
			Jaywalking on walker		Wheelchair 4	Bikers will ride between barriers (Parked cars)
			Crossing crosswalk before their time		Assisted Walker 1	Drivers tend to use the extra space on the road for passing/turning lanes
					Bikers 5	Vehicles entering traffic tend to obstruct pedestrian zone
						Pedestrians tend to walk between barriers such as parked cars/planter beds
						Midblock jaywalking is common
						Pedestrians constant fear of vehicles turning left
						In area next to car dealerships, vehicle test drivers will use the walking space to park and checkout their vehicle before driving into the dealership, blocking the walkway and making pedestrians walk around them
						Pedestrians will walk the closest to parked cars
						Merging cars from parking lots are more concern on trying to merge traffic than looking out for pedestrians as traffic speeds are fast
						No define walking space, pedestrians will walk where the quickest route is for them usually walking through parking lots
						Bikers use the walking space as speeds on the road are too fast for safe bike use
						Conditions for elderly are hazardous as they are typically slower walkers and make it harder for turning vehicles to see

Table 5. 145TH Site Observations

Area Observed	Where are pedestrians walking at?	How are pedestrians interacting with no sidewalks?	Hazards	Where are people heard to?	Types of Pedestrians	Other Observations
130Th Shopping Center / Parking Lots	Parking Lots	Pedestrians give priority to vehicles that are trying to merge onto traffic or waiting to enter parking lot	Jaywalking	Bus Stop	Pedestrians (Walking) 50	Pedestrians give cars priority to allow cars to pass through
		Pedestrians will walk through parking lots even though it is not the most direct route		Shopping Centers	Elderly 8	Pedestrians seems to walk wherever it's easy for them if no sidewalk is present
				Banks	Wheelchair 3	Wheelchair users use the most direct route even if that means being right next to traffic
				Social Services	Assisted Walker 1	Pedestrians tend to walk through businesses / unmarked alleyways
				School	Bikers 12	Jaywalking occurs at the middle of the block, happened most around the area next to Burger King and Jack in the Box
					Using Pedestrian Bridge 11	Pedestrians are constantly having to make eye contact with drivers
						Bikers tend to use small space between road and available walkway (bus lane area)
						Same person in wheelchair jaywalked multiple times
						Dog walkers were only seen on the side with sidewalks
						Pedestrians will walk the furthest away they can from the main roadway
						If there is space that allows for parking, pedestrians will walk between parked cars and roadway as to create a barrier
						Bikers swerve in and out of walking areas to avoid obstacles in the walkway
						Pedestrian bridge users were young individuals

Table 6. 130TH Site Observations

Area Observed	Where are pedestrians walking at?	How are pedestrians interacting with no sidewalks?	Hazards	Where are people heard to?	Types of Pedestrians	Other Observations
115Th Cemetery / Home Depot	Available walkway but as far away from the roadway as much as possible along desired paths	Pedestrians walk along desired paths	Jaywalking	Bus Stop	Pedestrians (Walking) 39	Bike users use the sidewalk/bus lane
			No barriers to separate pedestrians with traffic (such as parked cars)			
	Pedestrians utilize the one sidewalk available more common	Pedestrians walking on the side with no sidewalk will walk as far away from traffic		Apartment Complex	Dog Walkers 1	Pedestrians seem most impatient on the crosswalk signal as the wait time was over 1 minute
			Fast moving Traffic	Work	Bikers 7	Cars seems to park along the only walking area space for pedestrians on the side that has no sidewalks
				Passing through		Observed unsafe driving behaviors
						Pedestrians tend to jaywalk the most to catch the bus
						Bikers will use pedestrian turn light to cross the intersection instead of turning left with traffic

Table 7. 115TH Site Observations

Section 5. RECOMMENDATIONS

Recommendations on improving pedestrian infrastructure for each location are based on what was lacking and what each area can do to improve. Along 115TH with the cemetery surrounding the west and east side of Aurora Ave, improvements are limited but can still be accomplished. Sidewalks on both sides a combined bike lane located on one side of Aurora Ave and two dedicated bus lanes are possible if the center turn lane is removed. Figure 5.1 Pushback that can be brought on if the center lane is removed is the less flexibility for vehicles to be able to turn or merge into traffic. The addition of U-turn areas is important to consider as this allows vehicles to be able to turn back around. This is successfully done in Shoreline, WA where the center turn lane was removed and a tree median was added. Traffic still has the opportunity to make U-turns at points throughout the block. Limiting where vehicles can turn and merge plays a critical role in improving pedestrian safety as there are fewer opportunities for collisions between vehicles and pedestrians. For the removal of the center turn lane and dedicated U-turn areas a traffic flow analysis should be conducted to determine how traffic flow will be impacted.

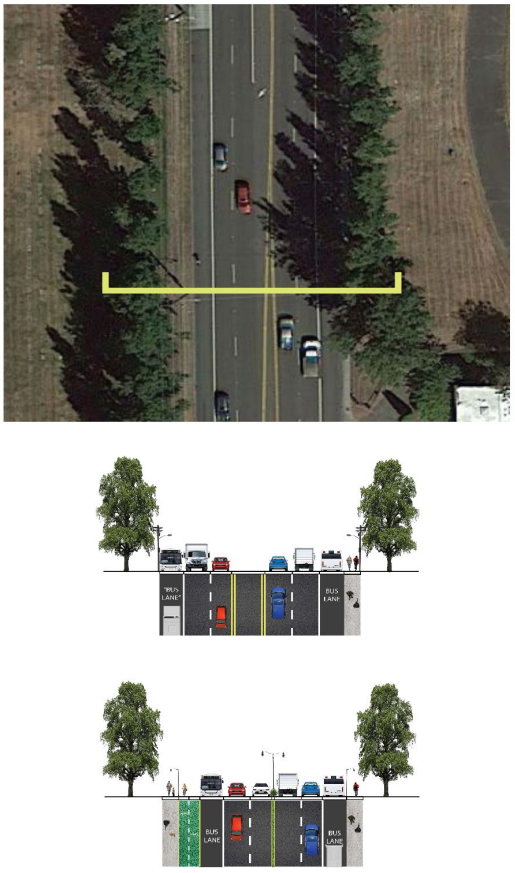

Figure 5.1 Plan view and section of current conditions on 115th with a street redesign

Along 130TH more improvements can be made due to more space available on the west side of Aurora. Currently, there is underutilized space on the west side of Aurora Ave next to the parking lots that sit empty most of the day. Here, there is enough space to add six-foot-wide sidewalks on each side with one side having bike lanes and two dedicated bus lanes. Planting strips of trees and shrubs can be placed in between the sidewalk and roadway to enhance the pedestrian experience of being safe from vehicular traffic. In the median instead of having a turn lane, the median can be used for planting trees or shrubs that can act as a refuge for pedestrians. Figure 5.2 These recommendations can also be applied to the area around 145TH. Figure 5.3 The final street redesign should have a close configuration to what is currently being done in Shoreline, WA. Figure 5.4 shows the current design that allows for a safe and positive pedestrian experience. The current status of the available sidewalks along the study area has shown that they are not adequate for the everyday use they are receiving. At some spots, only a three-foot wide sidewalk is available. The city needs to expand the sidewalk to at least five feet to allow two users to pass by without brushing next to each other.

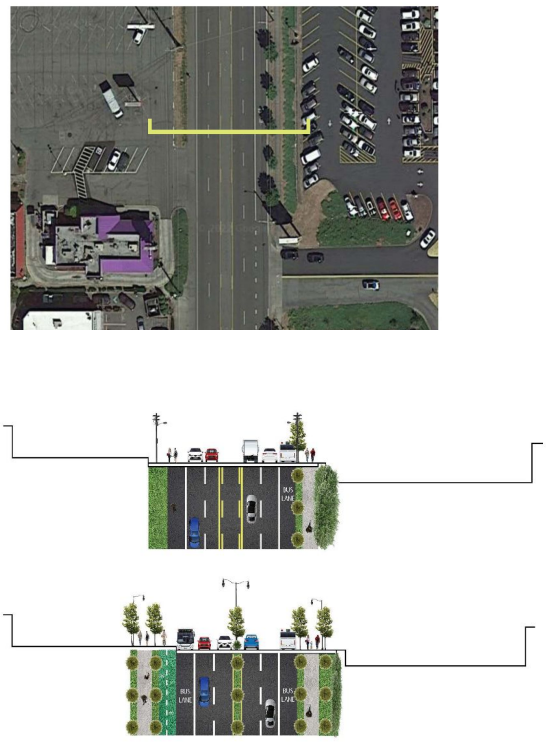

Figure 5.2 Plan view and section of current conditions with a street redesign along Aurora / 130th

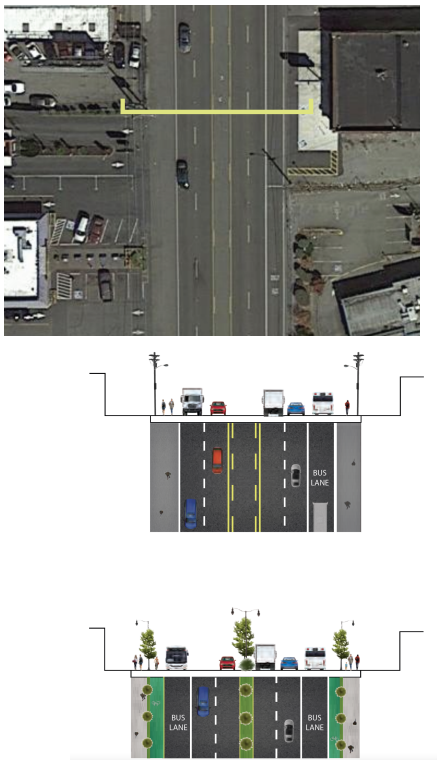

Figure 5.3 Plan view and section of current conditions with a street redesign along Aurora / 145th

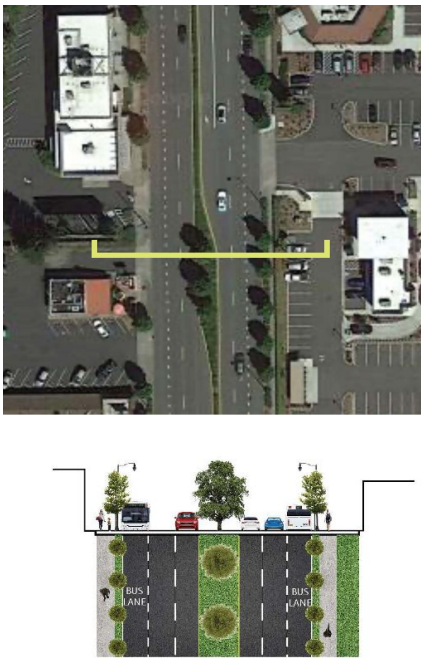

Figure 5.4 Plan view & Section of current conditions at Aurora Ave & 155th

Section 6. CONCLUSION

Overall results show that pedestrians will walk in hazardous walking conditions if that is the only way to get to their destination. If given the opportunity, pedestrians will look for any type of barrier such as a parked car or planting bed that can separate them from oncoming traffic. Pedestrians along this part of Aurora Ave tend to walk through parking lots and have to constantly make eye contact with drivers to avoid getting hit. What was surprising to observe was seeing pedestrians go out of their way to try and take a safer path that is not right next to traffic. This was seen multiple times in the area around 130th.

The most significant limitation of this research was the amount of time spent collecting observational data. If more time was allowed to conduct more research in more scenarios, such as comparing pedestrian behavior during other weather conditions, different times of day, and additional days to look at which days of the week particular pedestrians are out and about. I would have been able to get a better scope of pedestrian behavior. With that being said all pedestrian behavior is not always predictable, as was observed in some instances where the same pedestrian would walk around the same block accounting for data to be skewed. The mental health of some of the pedestrians along Aurora Ave might be questioned based on the unsafe judgments observed, such as jaywalking multiple times in front of moving traffic and not paying attention to vehicles that almost hit them as drivers tried to enter a parking lot. The available data on where pedestrians get hit by vehicles seems to be located near intersections and midblock accidents are second. Next steps would be to do more research in the form of a heat map showing where pedestrians are involved in traffic-related accidents that would help understand areas the city of Seattle can focus on improving the pedestrian street network.

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