

Where Wise People Will Park Their Bicycles (In Toronto)

Neighbourhoods, Type of Area(Premise Type) and Location Type

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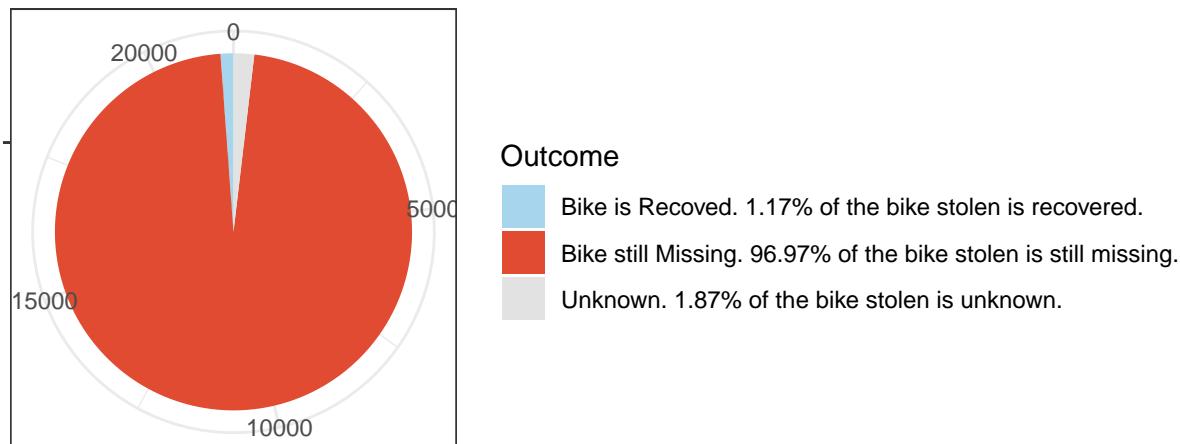
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In contemporary society, the main ways people transport themselves are bicycles, cars, on foot, and other public transportation. And many people choose to use bikes to transport themselves because bikes are cheap, convenient, and environmentally friendly. However, compared to other transportation like cars, bikes are the easiest to steal due to their low weight and small size. Under this circumstance, we need to know how to prevent bikes from being stolen. In other words, how to protect our bikes.

In Toronto, one of the most prosperous cities in the world, residents need bicycles for work, school, parties, and travel. In this condition, people who live in Toronto and mainly use bicycles to transport need to know where to park their bicycles so that their bikes will not get stolen. But will the bikes be easily recovered after being stolen? This leads to the first problem: how severe the outcome of bikes stolen can be?

1) Serious outcomes of Bikes Being Stolen

Percentage of Recovered, Missing, Unknown Bikes in Toronto



Map of Stolen Bikes in Toronto

The Highest Number of Different Outcomes in Different Neighbourhoods



Outcome Bike is Recovered Bike still Missing Unknown alpha 0.5

Here are two graphs answering how serious the outcome of bikes stolen can be. In these two visualizations, there are three outcomes:

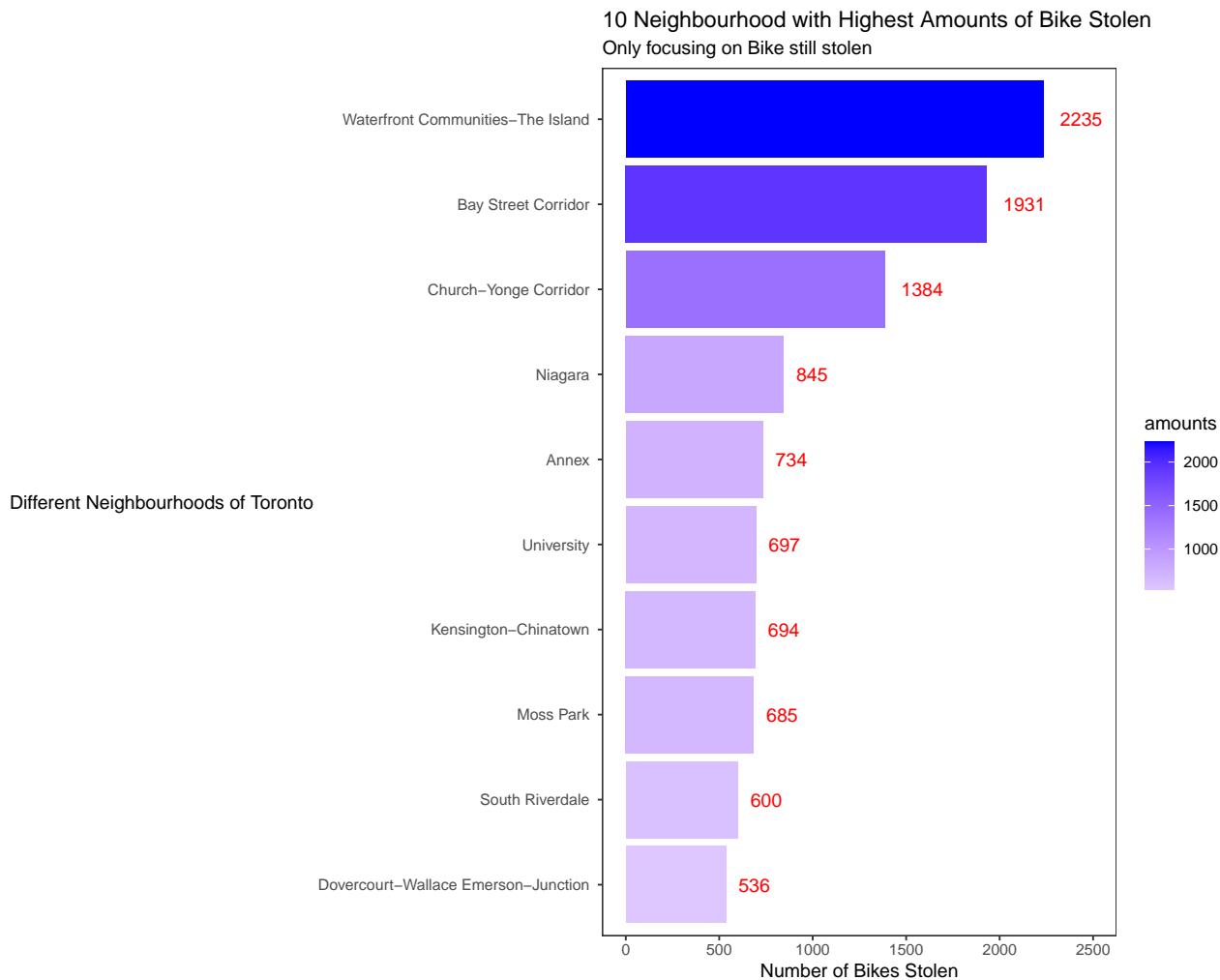
- 1.The bike is recovered, represented by blue color.
- 2.The bike is still missing, represented by red color.
- 3.The condition of the bike is unknown, represented by grey color.

The size of each color in the map and pie chart represents the number of cases of different outcomes. And there is no doubt that most of these two visualizations are under red color. And based on the data, if your bike is stolen, the probability of it still missing is higher than 95 percent. In other words, if someone steals your bike, the bike is almost impossible to be recovered. And the reason for this phenomenon is that compared to cars, bikes do not have the high technology to protect themselves. To be more specific, if your car is stolen, the police can find it based on the locator of the car. However, most of the bikes do not have a locator on them. Moreover, the bike's size is pretty small compared to cars, and most of the bikes look very similar. Under this condition, it is hard for police and other people to recover their bikes.

So, in conclusion, the awareness and actions of bike protection are vital due to the low probability of bike recovery.

So here comes the next question, how to prevent the bikes from being stolen? And here, we will focus on neighborhoods. More specifically, What neighborhoods should wise people avoid if they need to park a bike in one neighborhood?

2) Neighbourhoods are associated with the Numbers of Bike Stolen



There are, in total, 158 neighborhoods in Toronto, each with different inhabitants, cultures, and life. So the following two problems are: will different neighborhoods result in a distinct chance of bikes being stolen? What neighborhoods should we avoid if we need to park our bikes in one neighborhood? To answer these questions, look at the barplot above. The length of each bar represents the number of bikes stolen from 2014 to 2019 in that particular neighborhood. And the barplot shows the top ten neighborhoods with the highest number of bikes stolen from 2014 to 2019.

For the first question, since the length of each bar is different, we can conclude that different neighborhoods will result in a different chance of bikes being stolen. For the second question, since we arranged the graph in descending order, it is evident that Waterfront Communities — The Island is the neighborhood where most of the bikes being stolen took place. As a result, instead of parking in these ten neighborhoods, wise people will choose to park their bikes in other neighborhoods close by to protect their bikes.

And the main reason for the phenomenon that some neighborhood is safer for bike owners is that different neighborhoods have different levels of security. In other words, the level of protection might be higher in a wealthier neighborhood, resulting in low numbers of stolen bikes. What is more, the passenger flows of different neighborhoods are different, resulting in different numbers of stolen bikes.

However, more than knowing which neighborhoods to park bikes in is needed. The reason is that there are different premise types where people can park their bikes. For example, people can park their bikes outside, in their apartments, under commercial buildings, and so on. So the next problem is: which premise type a

wise person will choose to park their bikes?

3) Premise type are associated with the Numbers of Bike Stolen



People who had to go to these neighborhoods, either because of workplace or home, faced the problem of how to protect their bikes in those neighborhoods. Then comes the question of which type of areas (premise type in the data)a wise person will choose to park their bikes. To answer this question, we chose four neighborhoods from the top-risk neighborhoods (neighborhoods with the highest number of stolen bikes) since we thought each could represent a specific type of neighborhood. Waterfront Communities-The Island stands for wealthy ones; Bay Street Corridor stands for the busy ones; Kensington-Chinatown stands for distinctive multicultural neighborhoods; University stands for the neighborhood around a university.

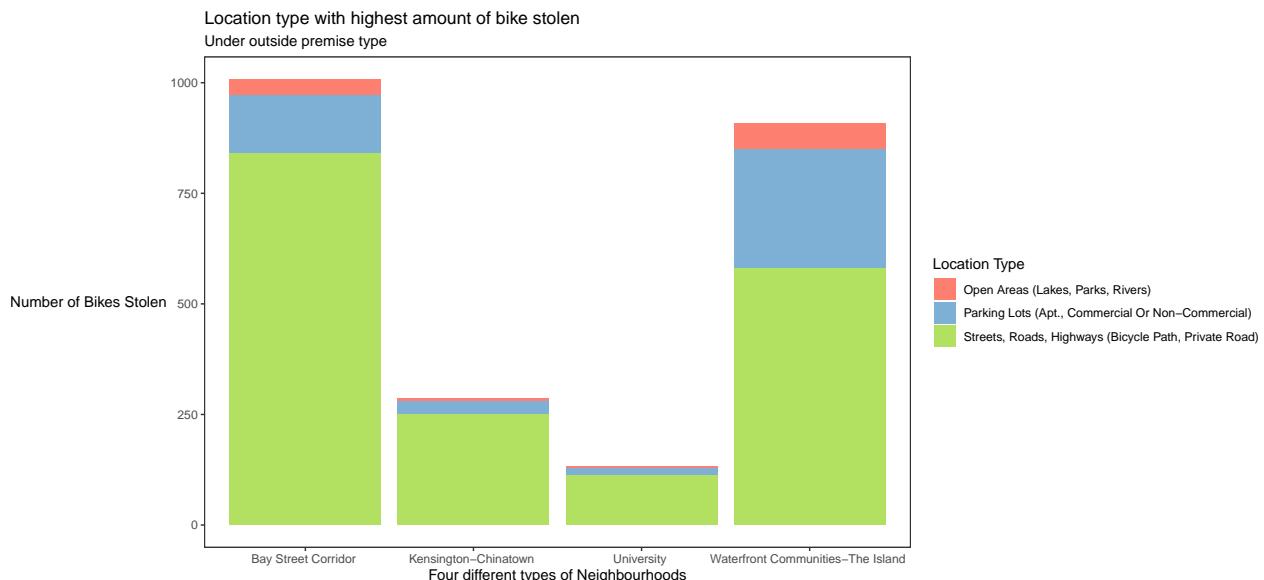
In the data visualization, we show the number of bikes that are stolen according to the different types of areas in all the neighborhoods of Toronto. What is more, for the four distinct types of neighborhoods above, we designed a similar visualization of every one of them. From the left graph, it is clear the number of bikes stolen outside is much higher than the other types in all the neighborhoods in Toronto, and commercial

parking is a safer place with fewer stolen bikes. Security in the commercial area and apartment can be the most crucial factor behind the low stolen number, preventing theft from entering the parking area. In addition, the lack of regulation and the high amount of visitor flows for the outside area allows the theft to steal the bikes more easily. However, in the university, most pedestrians are students, who aren't motivated to steal bikes, so, unlike other neighborhoods, the outside type in the university don't have the highest number of bike stolen.

Does that mean parking at commercial is the best choice for all neighbors? The answer is no. When we take a closer look at the data, the graph for each representative neighborhood, the house is the safest for the three of them, but for university neighbors, the commercial is the best one. In most neighborhoods, parking at commercial is recommended, but parking at a house is a better choice for some specific ones. One possible explanation is that fewer bikes are near each housing area in these neighborhoods than in the others. Or in these neighborhoods, the area for the house is much smaller than the area for other areas. We recommend that cyclists park in the commercial area for most neighborhoods, but parking near the house is a better choice for certain neighborhoods.

However, what we illustrate above has a default condition that all the cyclists are allowed to park their bikes wherever they want: the charge from commercial and permission from house and apartment. Therefore, most of them had to choose to park their bicycles outside. In this case, what kind of outside a wise person will choose to park their bikes?

4) Location type are associated with the Numbers of Bike Stolen



Sadly, some cyclists cannot park their bicycles in safer areas, such as houses or commercial parks, due to the lack of permission and unaffordable fees. The problem is: how do they choose a safer place to park their bicycles among all the outside areas in the risk neighborhoods (the number of the stolen bike are the most)?

The data shows three location types in the outside part: open areas, parking lots, and streets. In the data visualization, we can see that in all four representative neighborhoods, the number of stolen bikes parking on streets, highways, and roads is the highest, much higher than all other types. This phenomenon might be because of high visitor flow, the high number of bikes parking there, and the poor regulation. Parking in open areas is the safest location among these three, mainly resulting from the low visitor flow and the low total number of bikes parking there.

Since open areas have fewer stolen bikes, cyclists can protect their bicycles from being stolen by parking there.

Final Thoughts and Recommendations

In conclusion, since the recovery rate of stolen bicycles is extremely low, cyclists must choose a safe place to park their bicycles. We archive this question from an enormous scope to a closer one. First, because Waterfront Communities The Island has the highest number of stolen bikes, we recommended people avoid parking there and in the other nine neighborhoods shown in the second plot. In these risky neighborhoods, since stolen bikes are found less in commercial and houses parking lots, we recommended parking there. For people who are only allowed to park outside, which has the highest risk among all premise types, open areas, such as lakes, parks, and rivers, are the best choice for them due to the low number of stolen bikes.

However, some limitations and potential problems still exist in our study. First, our recommendations can be more precise if more data is provided. To be more specific, the dataset can include data like the social status of the people who lost their bikes. In this case, we can provide different recommendations for people with different social statuses. Second, if we have more time and data to map all the bikes stolen in Canada instead of only Toronto, we can make better recommendations. Third, the time period of our current data is from 2014 to 2019. Due to the situations changing over time, especially with the effect of COVID-19, the contemporary condition of bike parking might change. Under this circumstance, this might lead to some things that could be improved in our recommendations. Updating the data with current information can help to remedy it.