Canberra: Changing Gears on Bicycle Safety

An investigation on the uphill battle facing cyclists

The aim of this project was to explore several aspects related to cycling in the Australian Capital Territory (ACT), producing actionable suggestions on what can be done to reduce the rate of cycling accidents. This research will primarily make use of the ACT 'Cyclist Crashes' data provided by the ACT Government, along with other datasets, to identify any possible links between bicycle crashes: weather, time of day, and street lighting.

This report will specifically outline those relationships, while also outlining the methodology used to create the descriptive statistics of the following:

- The relationship between the number of cyclist and varying weather conditions
- The rate of cycling crashes and how they vary depending on weather conditions
- How the seasonal changes in natural light (time of sunrise/sunset) effect the rate of cycling crashes
- The geographical location of cycling crashes
- The effects of streetlight on cycling crashes that occur during hours of low lighting (after sunset/before sunrise)

The relationship between the number of cyclist crashes and varying weather conditions

To answer this question the 'Bike Barometer' dataset was used (collected from 23/11/2017-18/11/2021). This is a dataset provided by the ACT Government and is relating to an instrument located at 75 MacArthur Avenue (slightly north of central Canberra) which measures and reports the hourly number of bikes that travel over its sensor. Using this dataset, we then identified the daily total number of cyclists in Canberra.

The second dataset used was the Canberra airport weather station reporting rainfall data, which is provided by the Bureau of Meteorology (BOM) and is the closest weather station to the 'Bike Barometer'. This dataset contained the daily recorded amount of rain at the station.

These two datasets were merged on date and allowed us to explore the relationship between cyclist numbers and the weather conditions of the day. Correlation coefficient was calculated showing $r(1271) = -0.189$, $p < 0.001$. While this model was significant it explained a very small proportion of the variance seen in the data. We concluded that using daily summarisation of both cyclist estimation numbers and daily rainfall indicated that in the city of Canberra that numbers of cyclists only reduced by a very small amount on days that it rained. An alternative explanation is that due to lack of granularity in the rainfall data, that many cyclists may 'complete' their trip before the rain begins, to explore this theory more detailed rainfall data would need to be purchased from the BOM (approximately costing $130).

The rate of cycling crashes varies depending on weather conditions

Similarly, to the previous section, the rainfall data was merged on the sum of the daily crashes within the ACT (regardless of severity), while the dates were kept within the same range as the bike barometer readings to create a better picture of Canberra during this period. A t-test was run and revealed that there were significantly more cyclist crashes in Canberra when there had been no rain (rain crash mean = 0.351, no rain crash mean = 0.445, $p < 0.05$). This may be explained by many cyclists opting for alternative forms of travel or exercise when rain has been forecast.

How natural light (sunrise/sunset) effects the rate of cycling crashes

Using the cyclist crash data and matching the date and time supplied by the ACT Government we were able to use the "Sun" package to identify the exact sunset and sunrise times using the longitude and latitude of each crash. Identifying when the sun was down, we were able to isolate those crashes that happened in the 'dark' (classified if they occurred after the sunset or before the sunrise). With this information we were able to identify some interesting statistics. Of the crashes that happened after the sunset, 54% were within an hour of the sunsetting. The second interesting statistic that we were able to identify was that crashes were more likely to happen in the dark within the Winter months (compared to crashes that occur in Summer, Autumn, and Spring), with the Winter months containing 42.2% of all crashes.

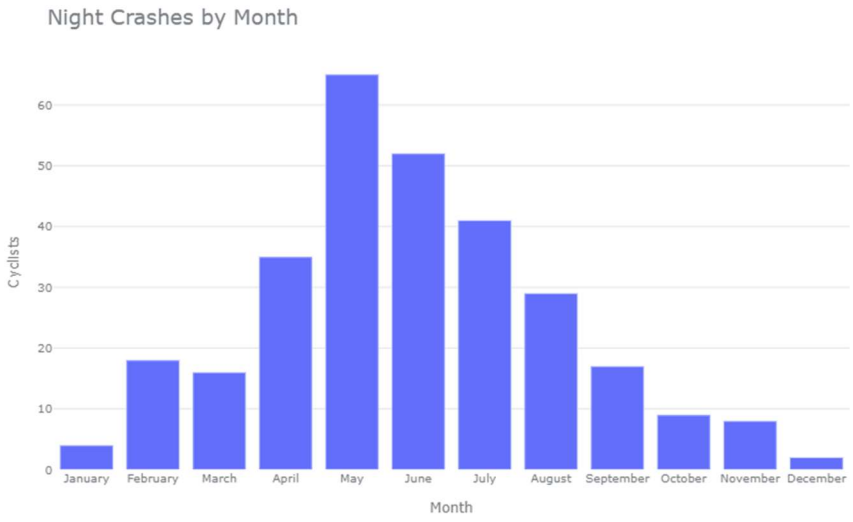

Figure 1: Monthly distribution of crashes that occur in the dark

One potential explanation of these data points is that the riding behaviours in Canberra focused on time rather than the seasonal conditions, and that there's a greater proportion of trips being completed after dark during these months as the riders need to maintain their schedule despite the early sunsets. This is further illustrated in the next graph where we have a distribution of the time of day that crashes happened, figure 2 shows that the distribution of crashes is heavily weighted towards the beginning and end of the business day.

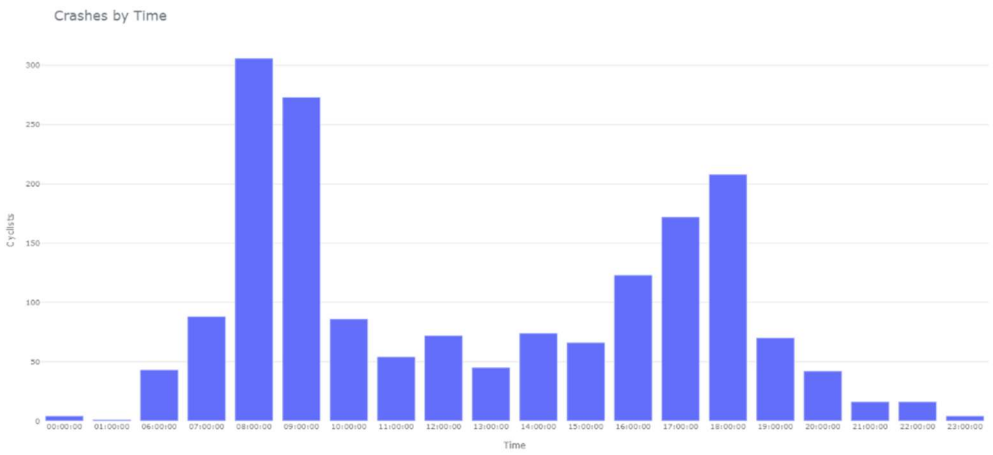

Figure 2: Time distribution of all crashes

The following graph was not created using any of the data used in the analysis, however, shows the sunset and sunrise data throughout the months in Canberra[1]. This image illustrates that if your mode of transport to work was cycling and you worked during the Winter months you would very likely be riding in reduced, or no natural light.

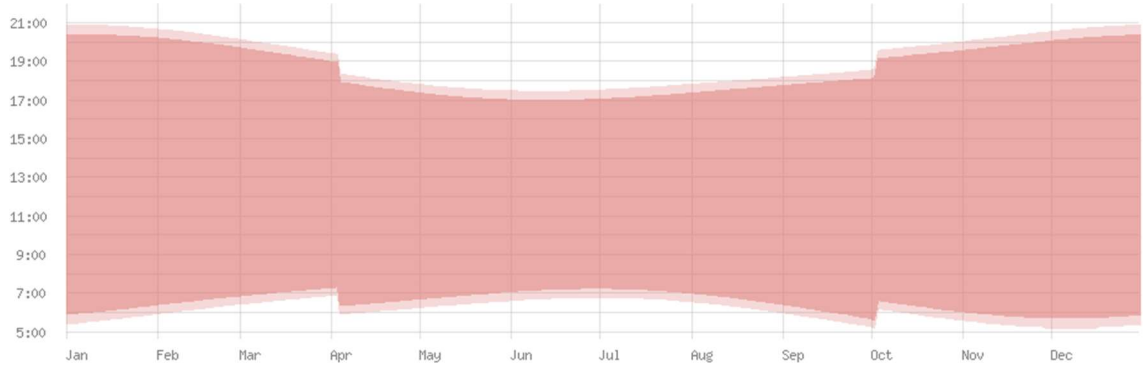

Figure 3: Average length of daylight hours in Canberra

The geographical location of cycling crashes

When looking at the geographical locations of crashes during the 04/01/2012- 01/10/2020 period, there were a few notable points. The first point is that when we initially embarked on this investigation, we were looking at the breakdowns of suburbs from 'todays' Canberra. We may have failed to factor in suburb and population changes that have occurred within Canberra over this time period due to the introduction of new suburbs and significant population growth. When viewing the data, we noticed that Canberra City consistently topped the highest number of crashes over the years. We concluded that this was probably due to the large number of commuters convening in this area, and an increase in population density.

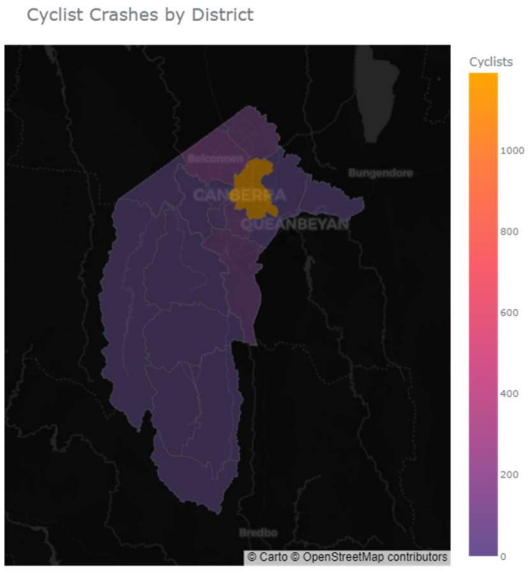

Figure 4: Distribution of Canberra cyclist crashes by suburb

The effects of streetlight on cycling crashes that occur during hours of low lighting (after sunset/before sunrise)

When aggregating the streetlight data, we used the reported longitude and latitude provided for the crash and matched it to the reported locations of streetlights within the ACT. From this distance we decided that 30 meters from the streetlight (on ground level), was the maximum distance a person could obtain any significant increase in immediate visibility. The distance of 30 metres was determined through testing by one of the participants with various types of streetlights around the Canberra region. It was noted that a limitation of the measurement model was that there were some streetlights in Canberra that were considerably larger and provided more lighting than others, however we decided to continue with the 30 meters measurement as these smaller lights were far less common. In Figure 5, we can see that the distribution of crashes was positively skewed, with 64% of crashes that occur during the night are in an area with fewer than 4 streetlights within a 30-meter radius of them.

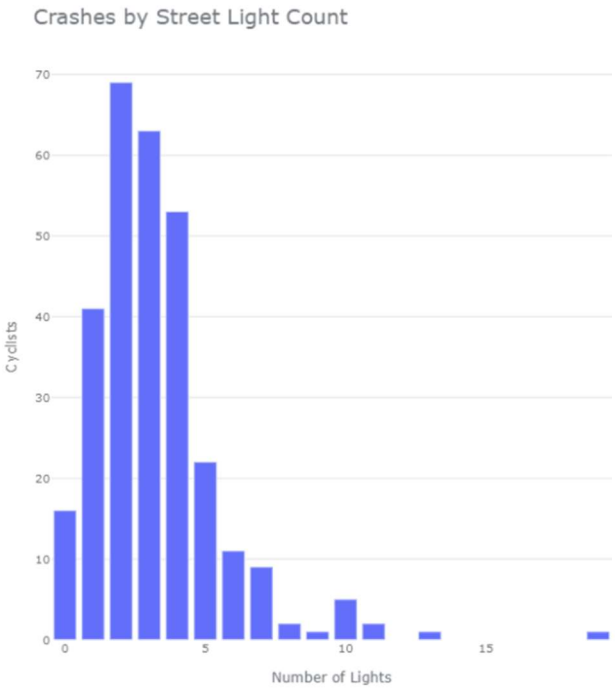

Figure 5 Number of streetlights within crash location

From the data put forward in this report we can conclude that in Canberra on days that there is rain that there are significantly less cyclists on the roads. Due to the reduced cycling traffic, there are significantly less crashes recorded on days when rain was recorded. The second conclusion that was drawn is that cyclists in Canberra appear to crash more heavily around common commuting times. The impact of reduced light during the typical commuter times in the Winter months may also have an overall effect on the number of crashes. Lastly, we concluded that crashes that occur during periods of reduced natural lighting were more likely to occur when there were less streetlights within a 30-metre radius of the crash.

Reference

1. https://www.worlddata.info/australia/australia/sunset.php