International Co-operation on Theories and Concepts in Traffic Safety

Assessing The Safety of Cyclist-Pedestrian Interactions in Seasonal Pedestrian Streets Using Computer Vision Techniques

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Introduction

Pedestrian streets, also known as streets closed to motorized traffic, serve to promote active modes of transportation. This concept offers the potential to enhance safety for the most vulnerable road users while concurrently reducing air pollution. The present study aims to evaluate the safety of interactions between pedestrians and cyclists, focusing on three pedestrian streets within the city of Montreal. Data collection is performed using cameras during summer days in 2021. Following camera calibration, a total of 80 hours of data is analyzed. Each road user detected and tracked is categorized as pedestrian or cyclist.

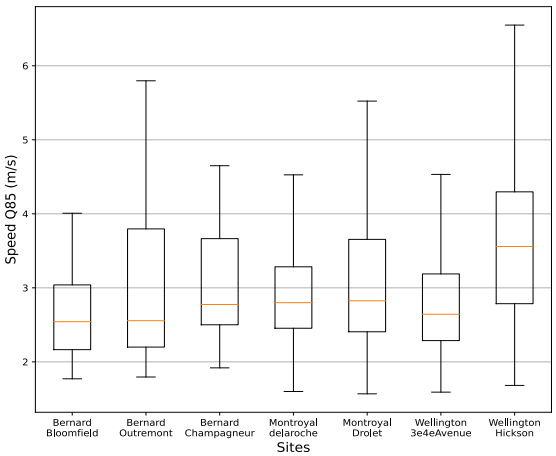
Methodology

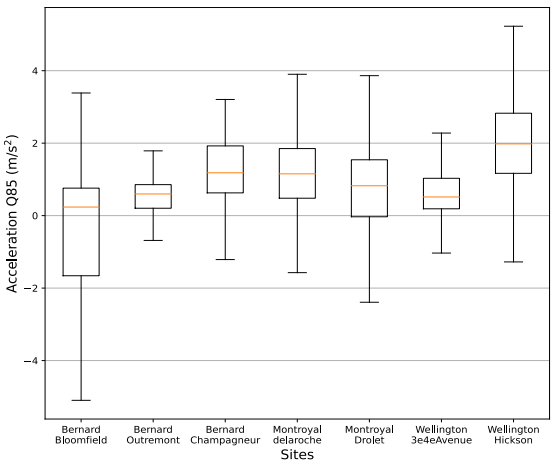
The safety analysis is executed, focusing on cyclist-pedestrian interactions. The open-source Traffic Intelligence project[1] was utilized in this study to examine the safety of interactions between cyclists and pedestrians.

The analysis involves the computation of indicators:

* At the user level: median, 15th and 85th percentiles of speed and acceleration for each cyclist involved in an interaction with a pedestrian.
* At the pedestrian-cyclist interaction level: minimum distances between users (d_{min}), and the 15th percentile of time to collision (TTC_{15}).

Results





[1] https://trafficintelligence.confins.net/

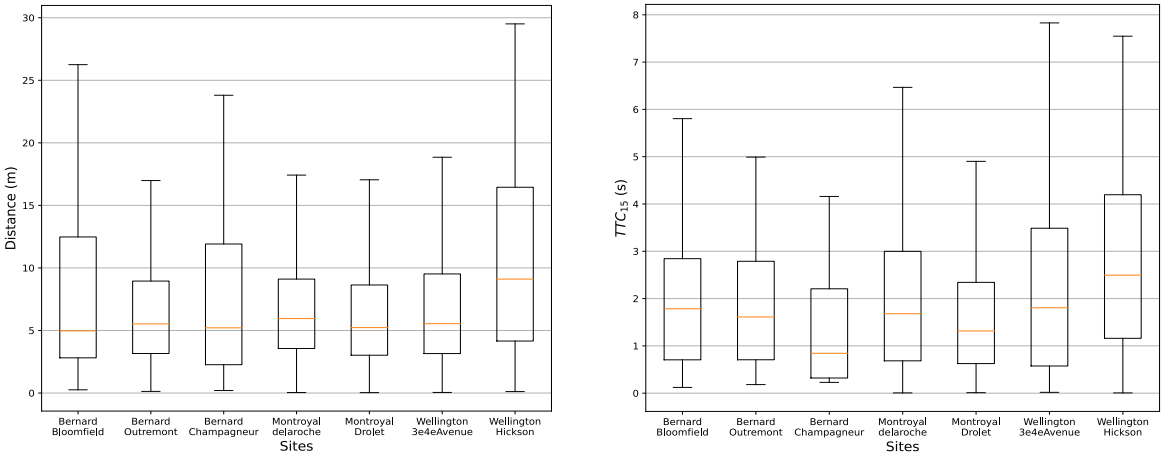


Figure 1 Boxplot of the 85th centiles of the speed (top left) and acceleration (top right) of each cyclist, distance (bottom left) and TTC_{15} (bottom right) of each cyclist-pedestrian interaction per site.

The safety indicators are presented in Figure 1, extracted across a total of eight sites situated within three distinct streets. While cycling is permitted on two streets, Mont-Royal and Wellington, it is prohibited on Bernard Street. The highest values of cyclist speed and acceleration are consistently observed at the Wellington Hickson site, the second site on Wellington Street, while the lowest values are consistently found at sites along Bernard Street where cycling is prohibited. Regarding interaction indicators, the most hazardous site is identified on Bernard Street, with average distance values around 5 m across sites, except for Wellington Hickson, which reaches approximately 9 m. Wellington Hickson also exhibits the greatest variability in values among all sites, indicating a diverse range of data points at this location.

To better understand the relationship between multiple variables, we develop linear regression models for two key interaction variables, TTC_{15} and v_{85}, with each serving as a dependent variable in separate models, and as independent variables in each other's models, to capture the dynamics of interactions between pedestrians and cyclists. The covariates include the minimum distance between pedestrians and cyclists, the 85th and 15th percentiles of acceleration of the cyclist, and the number of pedestrians detected within the camera view, as well as interactions with the site.

The statistical analysis indicates that elevated TTC values correspond to high acceleration and increased distances between pedestrians and cyclists. Additionally, high TTC values are negatively associated with the numbers of pedestrians detected on the roadway in the camera's field of view. Conversely, concerning speed, high values are linked to low TTC and distances, along with elevated acceleration values.

Conclusion

The safety analysis conducted in this study highlights the significant variations in safety indicator values across different sites, even those situated along the same road, despite the presence of regulatory measures. The results also suggest the need for more detailed analyses in future research to further examine the dynamics of cyclist-pedestrian interactions. Additionally, it is crucial to consider site-specific variables, such as street design and slope,

which may have a substantial influence on safety outcomes and should be incorporated into future analyses to gain a more comprehensive understanding of the factors contributing to the observed variations in safety indicator values.