Cyclist-Pedestrian Cohabitation in Seasonal Pedestrian Streets

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1 INTRODUCTION

There is a renewed focus on active modes of transportation given their multiple advantages, whether for human health or the environment in general. Interest has grown especially in 2020 after the COVID-19 pandemic, when several cities quickly implemented temporary facilities for walking and cycling in the context of physical distancing. Several measures piggybacked on existing programs such as the Montreal initiative for complete streets ("rues conviviales" or "social/festive streets") that selects streets each year for pilot projects and a final design implementation over a three-year period. This resulted in seasonal pedestrianization of about ten streets each year since 2020. Though active transportation brings together pedestrians and cyclists under a large umbrella, these users have very different characteristics and there may be conflicts of use if mixed in the same space. Cycling is thus generally forbidden on pedestrian streets. Despite these rules, there is cycling traffic on pedestrian streets as cyclists also enjoy car-free facilities, especially when pedestrian traffic is low, which generates complaints by pedestrians. To reconcile and help both categories of users coexist, two Montreal boroughs tried a new rule in the Summer of 2021, to let cyclists bike at walking speed on pedestrian streets while avoiding conflicts with pedestrians. There are few studies on cyclist-pedestrian interactions [1] [2], and, to the best of the authors' knowledge, none on interactions in pedestrian streets.

This work aims to study the coexistence or cohabitation of pedestrians and cyclists in several pedestrian streets through video-based analysis. Data were collected at several sites and on several days during the Summer of 2021 along three different pedestrian streets, two of them allowing cycling, to assess how cyclists and pedestrians interact, whether cycling is allowed or not.

2 METHODOLOGY

This study relies on the direct observation of pedestrians and cyclists. This is done by collecting video data for several days from a camera attached to poles like lamp posts. The video data is then semi-automatically analyzed using computer vision methods (from the open-source Traffic Intelligence project). This starts with camera calibration, to project the positions of the video image users to real positions. Road users' trajectories are then extracted, classified (between pedestrians and cyclists) and manually verified to obtain the road user trajectories. The pedestrian-cyclist cohabitation is analyzed through two categories of indicators:

1. traffic indicators for each cyclist: speed and acceleration; and
2. safety-related indicators about the interactions of cyclists with pedestrians.

The second category relies on surrogate measures of safety [3], which have been applied to cyclists using video data [4] and GNSS data [5]. Interactions occur when a pedestrian and a cyclist are close enough in space and time. The distance, time-to-collision (TTC), and cyclist speed near a pedestrian are computed for each interaction.

3 PRELIMINARY RESULTS

This paper reports on a preliminary analysis made for 20 to 30 min in the morning for each site. Four indicators are shown in Figure 1 for eight sites in three streets: cycling is allowed on the first two, Mont-Royal and Wellington, while it is forbidden on the third, Bernard.

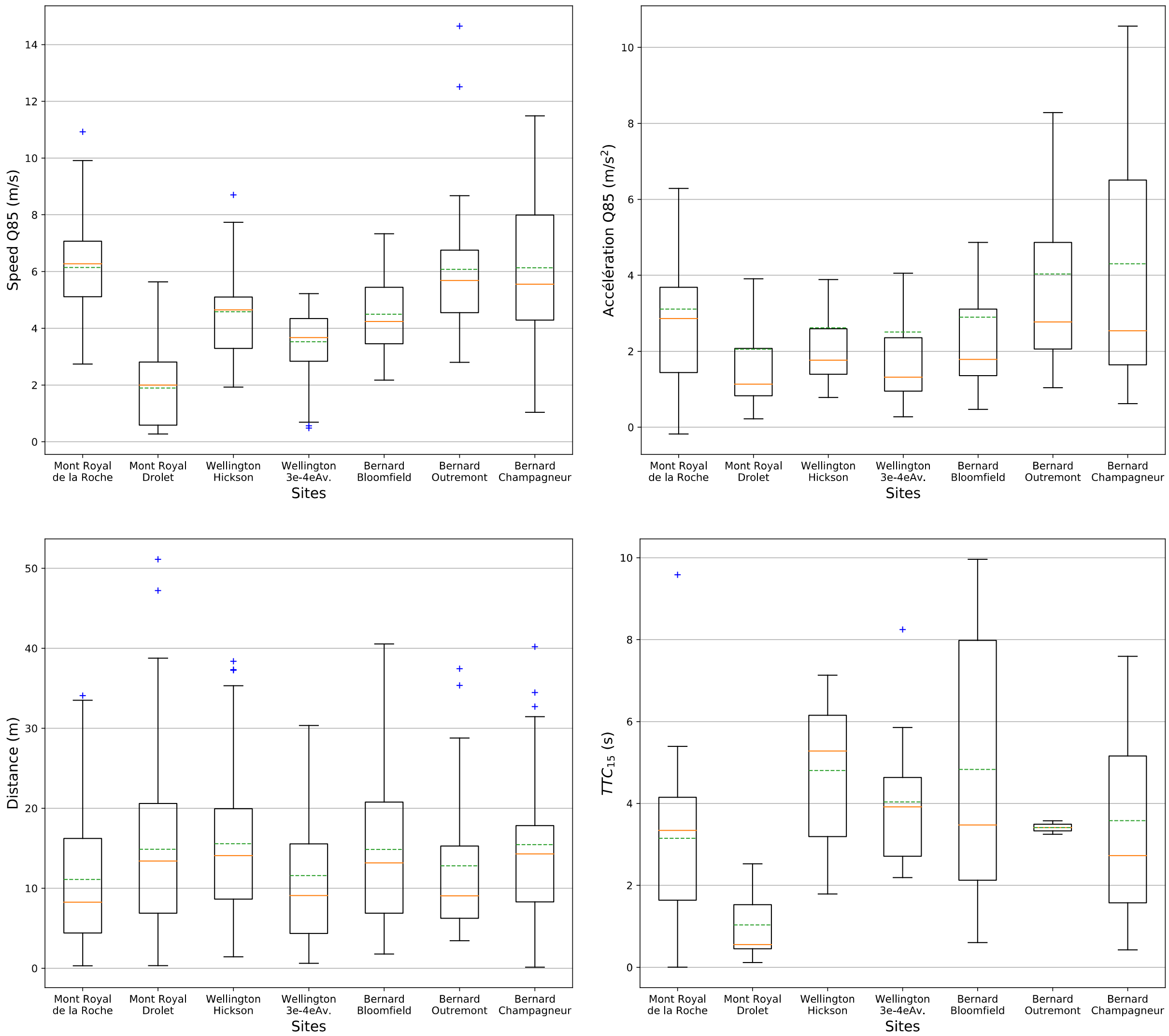

Figure 1 Boxplot of the 85th centiles of the speed (top left) and acceleration (top right) of each cyclist, distance (bottom left) and TTC_{15} (bottom right) of each cyclist-pedestrian interaction per site

The speeds vary between the different sites, but not according to the rule for cycling. Some values are unexpected: the lowest speeds were recorded on the site where the slope is the steepest, i.e., Mont-Royal and Drolet, and the highest values also on Mont-Royal, at the De La Roche site. Thus, other factors could explain the observed speeds: for example, the width of the street has become narrower (and "feels" narrower) at Drolet due to the addition of terraces and urban furniture, which encourages cyclists to reduce their speed, especially in the presence of other users. Regarding accelerations only the 85th percentile is presented here as it corresponds to the maximum accelerations: it shows the lowest values on Wellington, a disparity in value between the two sites on Mont-Royal, similar to speed, and the highest values on the Bernard sites. Despite the data cleaning, the accelerations remain very high and are probably overestimated.

When looking at cyclist-pedestrian interactions, their distances (minimum value) seem adequate for all sites. The speeds of cyclists near pedestrians are not shown in the plots for lack of space and because the results are similar to the other speed data. As for the TTC values, the 15th percentiles (minimum values) shown in Figure 1 (bottom right) are generally high (more than 2 s) for most sites. Only the Mont-Royal and Drolet site presents relatively low values compared to the other sites, which seems surprising considering the other indicators, which requires more detailed analyses.

4 CONCLUSION

The conclusion of these preliminary results is that cyclist-pedestrian interactions seem to be safe, regardless of the rules about cycling in pedestrian streets. These results will be confirmed on the analysis of the whole dataset (two or three days of data for each of the eight sites) and the behaviour of cyclists will be characterized according to other factors such as the width of the street, its organization and pedestrian density.

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