Title: Exploring cyclist behavior at signalized crossing: perspective of cyclist-pedestrian conflict analysis

Authors: Ming-Yi Tseng, National Taiwan University, Taiwan, r06521501@ntu.edu.tw
Yu-Ting Hsu, National Taiwan University, Taiwan, yutinghsu@ntu.edu.tw

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To develop safer and friendlier environments for cycling and walking has received increasing attention to foster sustainable transportation, particularly from the perspective of transforming street design. The growing popularity of cycling also induces the argument over the right of way for cyclists: sharing lanes with motorized vehicles exposes cyclists to the risk and pressure of interacting with those faster-moving vehicles, while riding on sidewalks leads to potential conflicts with pedestrians. Hence, many cities have deployed dedicated bike lanes to separate cyclists from other traffic flows in light of the described development trend and safety concerns, aiming to establish well-connected cycling routes or networks and thereby encouraging the use of greener mobility.

However, the effectiveness of dedicated bike lanes is questioned in terms of their utilization rates. Especially, for those built on sidewalks, it is frequently observed that some cyclists still ride on the areas of pedestrian walkways; on the contrary, there are also pedestrians walk on dedicated bike lanes. As cyclists and pedestrians have different movement characteristics, conflicts between them seem to remain. Nevertheless, such cyclist-pedestrian conflicts are comparatively minor in general, and therefore few records of them are made, which presents the challenge to better comprehend the behavior of cyclists and pedestrians. Likewise, current design guidelines are primarily based on conceptual principles but lack theoretical understanding and explanation from the perspectives of road users.

This research seeks to explore the behavioral patterns related to cyclist-pedestrian conflicts against the presence of dedicated bike lanes, to provide both empirical and quantitative insights for the current design guidelines. Upon the consideration of data collection, this research focuses on the cyclist-pedestrian conflicts occurring at signalized crossings, where higher frequencies of conflicts are expected. The design of flow separation at signalized crossings can affect the performance and safety level of the associated network, while how to effectively manage intense interactions between heterogeneous flows within limited space de facto depends on how road users respond to the presented environment.

In this research, we film video streams over the signalized crossings around a university campus in Taipei, Taiwan. Heavy cyclist and pedestrian traffic can be observed at the selected signalized crossings, as college students can be one of the major cyclist groups; among some of these crossings, the average crossing traffic can attain nearly 100 bikes and more than 150 pedestrians per minute for one direction during peak hours, which can result in a great degree of flow weaving and probably the consequence of collision.

Based on the recorded video, we abstract the trajectories of individual cyclist and pedestrian flows to identify the behavioral pattern of crossing streets with the presence of dedicated bike lanes. Both actual and potential conflicts related to cyclist flows are specified and classified into different types of conflicts and evasions. The spatiotemporal characterization of each conflict is analyzed against signal timing, road geometry, and the separation of the designated right of way. The mixed logit model is employed to investigate the behavior of cyclists and pedestrian, respectively, in terms of whether they ride or walk on the designated right of way or intrude the space of other modes. Such a behavioral pattern is further associated with the types of conflicts by factoring the trajectories before conflicts into right-of-way usage and flow characteristics. Risky crossing behavior is distinguished
thereupon, and conflict-prone areas over crossing walkways and bike lanes are delimited. Finally, we retrieve further insights regarding the interactions between heterogeneous flows by comparing the associated flow patterns with those of homogenous flows (all-pedestrian), so as to highlight the effect of deploying dedicated bike lanes for signalized crossings.

Collectively, this research re-examines the current design of dedicated bike lanes at signalized crossings based on the derived behavior patterns of cyclists and pedestrians in the context of conflict analysis. The derived research findings may feedback to the current design guidelines and following policy making. Ultimately, we are seeking to extend the relevant insights to the problem of flow separation on sidewalks and provide the capability to develop better urban design for cycling traffic management.