Title: STRATEGIES TO REDUCE INTERSECTION CONFLICTS BETWEEN AUTOMOBILES AND BIKES IN CHINA

Presenting Author: Christopher Cherry

Authors: C.R. Cherry 1;T.Q. Hill 2;

Affiliation
1. Civil and Environmental Engineering, University of Tennessee, Knoxville TN, USA, 2. Center for Transportation Research, University of Tennessee, Suite 900 James K Polk Building, 505 Deaderick St. Nashville, TN, USA,

Abstract:
With an ever-expanding population and rapid modernization, China is faced with transportation related problems that are both familiar and foreign to the rest of the industrialized world. There is also a large increase in rural-urban migration, resulting in large income disparities and thus diverse transportation needs. While a small but growing percentage of the urban population is adopting automobiles, there are still many people who rely on two-wheel transportation. Engineers and planners in many of the urban cities in China are facing challenges resulting from an increase in the number of conflicts between various transportation modes including bicycles, electric bicycles, buses, cars, and pedestrians. This paper examines reasonable operational and geometric measures that could be taken to reduce the number of conflicts between cars and VRU's at intersections using microsimulation, with a primary focus of reducing right turning vehicle conflicts with heavy through two-wheeler (bicycles and electric bikes) flows in adjacent bicycle lanes and crossing pedestrians. To test different configurations, representative intersections in Kunming, China are analyzed. The unique traffic flows and geometric layout at three representative intersection resulted in various alternatives being applied at each intersection. Those alternatives include signal phase changes such as staggered green phases and separate bicycle phasing. Geometric changes are also modeled, such as the addition of turn lanes that allow cars to weave through bicycle traffic upstream of the intersection, which could reduce the intensity of and angle of the conflict at a single point at the intersection.

There are four main operational parameters for the evaluation of the existing conditions and the alternatives; speed, delay, queue lengths, and travel times. Each alternative is compared with the existing conditions to determine their effectiveness of reducing conflict while quantifying their impact on traffic flow parameters for all road users. The addition of right-turn lanes, which does little to decrease net conflicts relative to other alternatives, yielded the shortest queue lengths, delay, and average travel times, particularly at oversaturated intersections. Although the total conflicts are not reduced, this strategy reduces the intensity of conflicts, transferring the conflict point upstream from the intersection where bike density is significantly lower. This design does not significantly reduce conflicts with pedestrians. Separating bicycle and pedestrian and car signal phases, or giving different road users a staggered start is meant to reduce the conflicts of the densest platoons of vehicles at the beginning of the green phase. This design eliminates or greatly reduces conflict between cars, bikes, and pedestrians, but proved to increase delay for most road users, primarily because of the oversaturated nature of most intersections during peak periods.

These findings can be generalized to show that staggered phasing of green start times for different road users (and enforcing no right-on-red rules) greatly reduced conflicts, but significantly increased delay and queue length at oversaturated intersections. In areas where right-of-way exists, transitioning right turning vehicles through bicycle lanes upstream of the intersection reduced the intensity of conflicts at the intersection, while maintaining sufficient operational performance of the intersection. This strategy does not however reduce the number or nature of conflicts between right turning cars and pedestrians. As more personal cars fill China's urban

streets, the conflict between VRU's and cars intensifies. This research aims to reduce one of the most significant conflicts, those between VRU's and right turning vehicles at intersections and finds several strategies can be effective depending on design and operational constraints at the intersection.