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Advance yield markings and drivers' performance in response to multiple-threat scenarios at mid-block crosswalks

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ABSTRACT

This study compares, on a simulator, drivers' performance (eye fixations and yielding behavior) at marked mid-block crosswalks in multi-threat scenarios when the crosswalks have advance yield markings and pedestrian crosswalk prompt signs versus their performance in such scenarios when the crosswalks have standard markings. Advance yield markings and prompt signs in multi-threat scenarios lead to changes in drivers' behaviors which are likely to reduce pedestrian–vehicle conflicts, including increases in the likelihood that the driver glances towards the pedestrian, increases in the distance at which the first glance towards the pedestrian is taken, and increases the likelihood of yielding to the pedestrian.

1. Introduction

In the United States, 69,000 pedestrians were injured in motor vehicle crashes in 2008. Approximately 4400 pedestrians were killed in motor vehicle crashes in the United States that year (NHTSA, 2008). Seventy-six percent of pedestrian fatalities occurred at non-intersection locations crossings. Although many of these fatalities take place on freeways and interstates, a small but still significant number of fatalities still occur at uncontrolled, marked mid-block crosswalks. It is crashes at these latter locations upon which we will focus. A safety risk at uncontrolled marked mid-block crosswalks emerges when driver's view of the pedestrian in the crosswalk is obscured until just seconds or fractions of a second before the crash. We refer to scenarios in which the driver's view of the pedestrian in the crosswalk is obstructed as *sight-limited scenarios*. An example of a sight-limited scenario (see Fig. 1) is when there are parking spaces adjacent to the travel lane and the driver's view of the pedestrian in the crosswalk is obstructed by these vehicles (*parking lane obstruction* scenario). A similar situation occurs when the driver's view of the pedestrian in the crosswalk is obstructed by vehicles turning from the opposite lane (*opposing-lane obstruction* scenario); in this case, the obstruction is on the left side (see Fig. 2). Sight-limited scenarios at multilane roads are also associated with a type of pedestrian–vehicle conflict defined as a *multi-threat* crash scenario (Snyder, 1972). In a multi-threat scenario, a pedestrian in a crosswalk can potentially be struck by a vehicle (first threat) traveling in the same direction as a vehicle that is yielding or stopped (second threat) for a pedestrian in the crosswalk (see Fig. 3). Vehicles yielding or stopped too close to the crosswalks often obscure the visibility for drivers traveling in the adjacent lane.

In order to identify alternative treatments for sight-limited scenarios we need to identify why it is that drivers might be colliding with pedestrians in these situations. There are two very different possibilities. In one case, we might find that drivers are indeed looking for pedestrians, but just do not have enough time to stop. Increasing the number and intensity of warnings to motorist that a pedestrian crosswalk is ahead will do little to solve this problem. In the other case, we might find that drivers are not looking for the hidden pedestrian and thus are not actually aware of the potential danger—at least do not give any indication of being aware. In this case, making drivers more aware of the hidden threat could help. A driving simulator can be used to study this problem without creating dangers for the pedestrians.

Consider the first case, are drivers approaching a marked crosswalk indeed looking for pedestrians? Pradhan et al. (2005) explored this question in a driving simulator experiment with 24 novice

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