PERMISSIVE LEFT-TURN BEHAVIOR AT THE FLASHING YELLOW ARROW IN THE PRESENCE OF PEDESTRIANS

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1.0 INTRODUCTION

Protected left-turns can improve intersection safety, but they prohibit vehicles from utilizing potentially acceptable gaps in oncoming traffic and thus reduce efficiency. Protected/permissive left-turn (PPLT) phasing has become popular at intersections as a way to balance safety and efficiency. A driver facing a PPLT traffic signal indication must yield the right-of-way to opposing traffic (vehicles and bicycles) and conflicting pedestrians in the crosswalk. In this situation the driver workload is relatively high and drivers can fail to scan for pedestrians while performing permissive left-turns. This is particularly an issue in settings where driver expectation of pedestrians is low.

Past research has demonstrated the flashing yellow arrow (FYA) as the preferred signal indication for protected/permissive left-turn operation. Washington County, Oregon replaced many intersections that had protected left turn operations with FYA PPLT operation. Due to public comments of increased pedestrian discomfort in the crosswalk, operation of the FYA was halted at several intersections. This provided the research motivation and context to study the interaction between pedestrians and drivers making permissive left-turn maneuvers.

2.0 METHODOLOGY

This research project utilized the Oregon State University (OSU) driving simulator to model characteristics from candidate FYA locations identified from historical crash data. 27 subject drivers performed to 24 independent left-turns with varying physical intersection characteristics such as signal head configurations, opposing vehicular volume, and pedestrian traffic during a single 45 minute experimental trial. Data was collected using head mounted eye tracking equipment.

Driving Simulator

The OSU driving simulator is a high-fidelity moving base simulator with a full 2009 Ford Fusion mounted on top of a high performance electric pitch motion system.

2.0 METHODOLOGY CONTINUED

Eye Tracker

Eye tracking data was collected using the Mobile Eye-XG platform from Applied Science Laboratories, with a sampling rate of 30 Hz with an accuracy of 0.5° to 1°.

Areas of Interest

Areas of interest (AOI) were defined using the eye tracking software. Fixations of longer than 0.10 second were recorded, tabulated, and averaged. AOIs included Pedestrians, the FYA Signal, Opposing Vehicles, and the Turn Bay.

3.0 ANALYSIS & RESULTS

ATFD durations were next compared between pedestrian movement cases using an ANOVA analysis and family-wise comparisons were made using the Tukey-Kramer Honest Significant Difference.

4.0 CONCLUSIONS

1) Drivers have longer average total fixation durations on pedestrians when multiple pedestrians are present.
2) When pedestrians are present, 4% to 7% of drivers do not fixate on pedestrians in the crosswalk while completing their left-turn.
3) When pedestrians are not present, 39% of drivers do not fixate on likely pedestrian locations while completing their left-turn.

5.0 ACKNOWLEDGEMENTS

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