Research Summary

Evaluating the Safety Impacts of Flashing Yellow Permissive Left-Turn Indications in Massachusetts: Approach Level Analysis

Research Need

The purpose of this research project was to understand the approach-level impacts of the FYA left-turn indication and develop benefit-cost ratios and CMFs that present their safety benefits at signalized intersections throughout Massachusetts.

Goals/Objectives

This project addressed four main objectives:

1. To develop and disseminate a survey in order to obtain design specifications for each FYA intersection in Massachusetts, while inventorying all-red clearance intervals, conflicting pedestrian phases, and use of supplementary signage
2. To stratify the approach-level before and after crash information using the FYA and CG PPLT location database that was established during Phase 1. Crash narratives and diagrams were manually reviewed to determine: intersection-level, PPLT approach-level, left-turn specific, and left-turn-opposing-through crashes.
3. To analyze the safety benefits from the LT FYAs, primarily focusing on LTOT impacts. Benefit-to-cost ratios and CMFs were developed to determine the improved safety conditions at FYA approaches.
4. To provide MassDOT an overarching recommendation regarding the safety benefits of LT FYA approaches, and deliver a list of recommendations for future FYA installations within Massachusetts. These guidance were steered by the CMFs developed, which should be used in future project.

Methodology

In this project, the research team conducted a secondary analysis of statewide FYA installations using a directed method of approach-level crash analyses. In an effort to utilize up-to-date FYA information, a statewide field data collection effort was initiated to inventory both operational and infrastructure information at 200 PPLT signalized intersections. All-red clearance, presence of conflicting pedestrian phasing, and use of supplementary signage were the key metrics collected in this inventory. Crash data was extracted from MassDOT IMPACT and cleaned to represent 2-years of before and 2-years of after data at these intersections.

The PPLT (FYA and CG) intersections were evaluated through naive before/after analysis (including EPDO), benefit-to-cost analysis, CMF using comparison groups, and infrastructure and operational safety impacts. The naïve before/after analysis emphasized target crashes of PPLT phasing, including injury severity and manner of collision outcomes. These measures were reported in EPDO values to assess injury significance. A cost-benefit analysis was conducted to estimate the economic impact of PPLT FYA signal installations, ultimately leading to benefit to cost (BC) ratios. Severe injury crashes were highlighted as fatal and injury (FI = $441,000/crash) and property damage only (PDO = $16,700/crash). A comparison group of CG PPLT approaches were included to develop FYA CMFs, and infrastructure and operational impacts were assessed.

Key Findings

The research team evaluated the safety effectiveness of FYA approaches throughout Massachusetts:

- Significant reduction in EPDO for both LT- and LTOT-related samples of FYA crashes (95%); however, there were significant increases in EPDO for LT- and LTOT-related sample of CG crashes (95%)
- LT- and LTOT-related crash data resulted in BCs ranging from 18:1 to 2:1 and 21:1 to 3:1, respectively
- LTOT sample of crashes yielded significant CMFs with 95% confidence regarding severe crash type reduction (head-on, angle, sideswipe), as well as injury crash reduction
- Total crash CMFs (including PDO) was significant at 90% confidence

Overall, the results provided directed evidence of safety benefits with the installation of FYAs compared to the CG PPLT signal indication in Massachusetts, including a conservatively sufficient benefit-to-cost ratio for FYA installations.

Use of Findings

This study enhanced the findings regarding the safety efficacy of PPLT FYA signals in Massachusetts, and provides directed evidence for practitioners to apply in future FYA installation designs. The updated FYA inventory, including operational and infrastructure related data can be provided to MassDOT in an effort to monitor and assess updates/upgrades. The CMFs developed herein can be utilized in future FYA applications. Further studies could evaluate and compare the effectiveness of the FYA in right-turn applications and evaluate the implementation of permissive-only FYA signals. Given the findings in this study, the benefits of the FYA should be disseminated to both state and municipal agencies to allow for refined design impacts in future signalized intersection projects.

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Project Information

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