

Research Summary

Safety Evaluation of Permissive Flashing Yellow Arrows for Left- Turn Movements in Missouri

Even before the Federal Highway Administration (FHWA) officially approved flashing yellow arrow (FYA) permissive left turn indications in 2009, the Missouri Department of Transportation (MoDOT) recognized an innovative opportunity. The agency began installing FYA under interim agreement in 2006 and deployed them with regularity from 2007 forward. With nearly two decades of use, and hundreds of FYA signals installed statewide, MoDOT decided to objectively investigate the safety performance of the system. Additionally, they wished to have an accurate inventory of all FYA installations statewide, and a determination of the economic impact of the signal system.

Prior to FYA, MoDOT relied on circular green indications and a sign bearing the legend LEFT TURN YIELD ON GREEN to denote a permissive left turn. They were concerned, however, that drivers might inadvertently mistake the signal as implying the left-turn vehicle has the right of way over oncoming traffic.

Other organizations shared that concern. The National Cooperative Highway Research Program (NCHRP) initiated a research project that eventually concluded FYA signals allowed more flexibility and operational benefits, provided significant improvements to left-turn

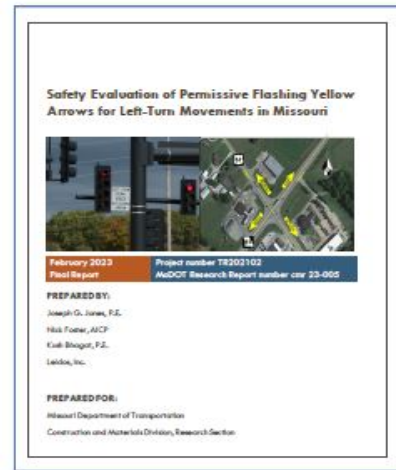
safety, and were better understood by the public than other left-turn signal variations.

Before any safety analysis could begin, the research team had to determine the location of every FYA left turn signal indication in the State. This involved a virtual examination of

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every signalized intersection statewide. The virtual examination was necessitated by the project's budget and timeline, and an existential pandemic—COVID-19—that was at its height during the data collection phase. The team used MoDOT's Automatic Road Analyzer (ARAN) video logs and the *Streets* function of Google Maps or Google Earth to perform the examinations.

Following the virtual survey and the documentation of installation dates for each FYA indication, the research team queried the corresponding crash data for a 3-year before and after installation. From this data, they were able to select sites for study and perform the safety



analysis. The simple before and after study they performed was sufficient to meet MoDOT's objective of determining the safety of FYA indications. Given this and the fact that the findings were generally consistent with previous nationwide research, the agency and the research team deemed a more robust analysis such as Empirical Bayes infeasible and unnecessary.

The virtual survey of every signalized intersection on the MoDOT system revealed 841 FYA signals, with installation dates ranging from 2007 to 2021. The safety analysis revealed that FYA operation appears to reduce fatal+injury (KABC) left turn crashes 14 to 16 percent, and left turn property damage only (O) crashes 13 to 18 percent. The economic analysis estimated the lifecycle benefits of installing FYA on an intersection approach are expected to be approximately 5 to 44 times greater than the installation cost.

Based on these results, FYA could be expected to produce a safety and economic benefit for left turn opposite direction crashes at locations where it is being used to replace circular green.



Figure 1. Flashing yellow arrow signal for permissive left-turn movement in an urban area.

Project Information

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