



Safety effects of traffic signing for left turn flashing yellow arrow signals[☆]



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ABSTRACT

In 2010, the left turn flashing yellow arrow (FYA) signal displays were installed at signalized intersections on state routes in the Peoria, Illinois, area. Supplemental traffic signs with text “Left Turn Yield on Flashing Yellow Arrow” were mounted on the mast arm adjacent to the left turn signal at over half of the FYA installations. The purpose of this paper is to present the results of the effectiveness evaluation of the FYA supplemental sign on safety. Analyses are presented on the effects of the FYA supplemental sign for all drivers and a subset of drivers age 65 and older. A crash-based comparison of 164 FYA approaches including 90 approaches with the sign and 74 approaches without the sign showed greater crash reductions when the supplemental FYA sign was present. The results also showed that crashes involving drivers age 65 and older did not experience the same magnitudes of crash reductions as compared to all drivers. The findings of this research indicate that supplemental FYA signs may help in improving safety for left-turning vehicles during the permissive interval. Thus, it is recommended that supplemental signs be used when initially implementing the FYA, and that effort to educate the driving public on new traffic control be made to further improve safety at signalized intersections.

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1. Introduction

Left turns are considered by many to be one of the most challenging maneuvers to complete at an intersection. Approximately 27% of all intersection crashes in the U.S. are associated with left turns, with over two-thirds occurring at signalized intersections (California Center for Innovative Transportation, 2004). (MUTCD) (Federal Highway Administration, 2009) have included various traffic signal control strategies to help eliminate

driver confusion when turning left, while increasing safety and efficiency. There are four general ways to control the left-turn movement: permissive, protected, protected/permissive, and variable left-turn mode (Federal Highway Administration, 2009). Amongst these, the protected/permissive left-turn (PPLT) display has the most variability in the signal indication used for the permissive interval. Across the U.S. there are at least five signal indications used for the permissive interval of PPLT control, which include, circular green (CG), flashing circular yellow (FCY), flashing yellow arrow (FYA), flashing circular red (FCR), and flashing red arrow (FRA). In a 2003 study conducted as a part of the National Cooperative Highway Research Program (NCHRP) Report 493, the authors evaluated various signal indications for the permissive interval of PPLT control in order to identify the best display (Brehmer et al., 2003). The study concluded that FYA was well understood by drivers and recommended its use as a permissive left-turn signal indication. In 2009 the FYA was adopted into the MUTCD after the Federal Highway Administration (FHWA) approved their installation.

In the spring of 2010, the Illinois Department of Transportation (IDOT) began installing vertical four-section signal heads that included the FYA indication for the permissive interval of PPLT phasing at more than 100 intersections on state routes in the

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Peoria, Illinois area. At over half of the FYA approaches, a supplemental sign with text “Left Turn Yield on Flashing Yellow Arrow” was mounted on the mast arm adjacent to the FYA signal. At the remaining FYA approaches, just the four-section signal head was installed, without the sign. Research was conducted to investigate whether the use of a supplemental FYA sign improved safety for all drivers, and additionally for drivers age 65 and older. The authors of this paper have conducted research to evaluate the safety and effectiveness of the supplemental sign through an analysis of traffic crashes.

2. Characteristics of study approaches

The FYA signal indication was installed in the Peoria, Illinois area at 112 intersections on state routes with PPLT phasing in the Peoria, Illinois, area. However, at 26 of these intersections, other safety improvements were also installed, and thus these intersections were excluded from the evaluation study because the impacts of the FYAs could not be isolated. Thus, 86 intersections were eligible for inclusion in the evaluation where the FYA was installed at 164 study approaches. All 164 study approaches had dedicated left turn lanes and are located on state routes under the jurisdiction of the Illinois Department of Transportation. Before the FYAs were installed, the permissive phase of the PPLT control operated with a CG indication, and on the state routes, supplemental signs with text “Left Turn Yield on (Circular Green symbol)” were generally NOT present, with the exception of

5–6 approaches. The study approaches operated with PPLT phasing in both the “before” and the “after” periods. It should be noted however, that on city maintained roads in Peoria (which are not included in this crash-based analysis), approaches operating with CG indication for the permissive phase of PPLT control commonly have supplemental signs present to advise motorists to yield on the circular green indication.

The new four-section vertical signal heads replaced the vertically-mounted five-section signal heads operating with the CG indication for the permissive interval as shown in Fig. 1. At 90 of the FYA approaches, a supplemental sign with text “Left Turn Yield on Flashing Yellow Arrow” was mounted on the mast arm adjacent to the FYA signal. At the remaining 74 FYA approaches, just the four-section signal head was installed, without the sign. The decision by IDOT to install the FYA supplemental sign at certain locations was subjective; not based on data analysis or crash trends. In general, the FYA supplemental signs were installed at locations geographically: at isolated intersection approaches, and at every few approaches along corridors operating with the FYA. The rationale for not installing the supplemental sign at all approaches along corridors was that drivers were likely to have read the sign at the upstream intersections and may not be necessary.

The initial version of the sign installed at 10–15 FYA locations included text and a yellow arrow symbol, as shown in Fig. 2a. Since it was determined that the yellow arrow symbol used was not an approved MUTCD symbol at that time, a sticker with the text “Yellow Arrow” was made and placed over the arrow symbol at

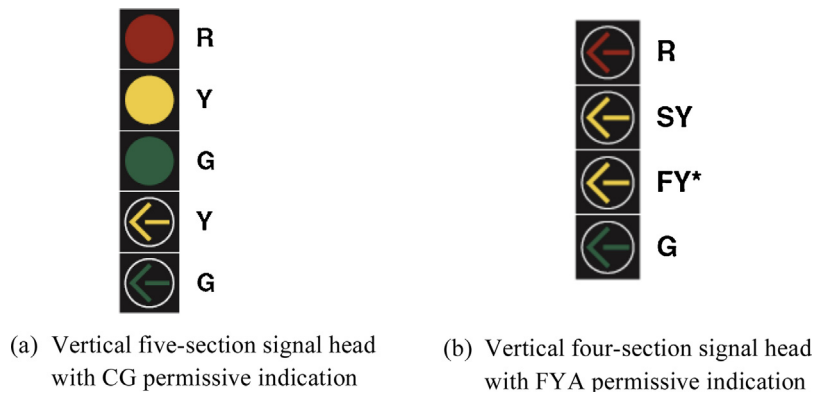


Fig. 1. Signal Heads for CG and FYA operations.

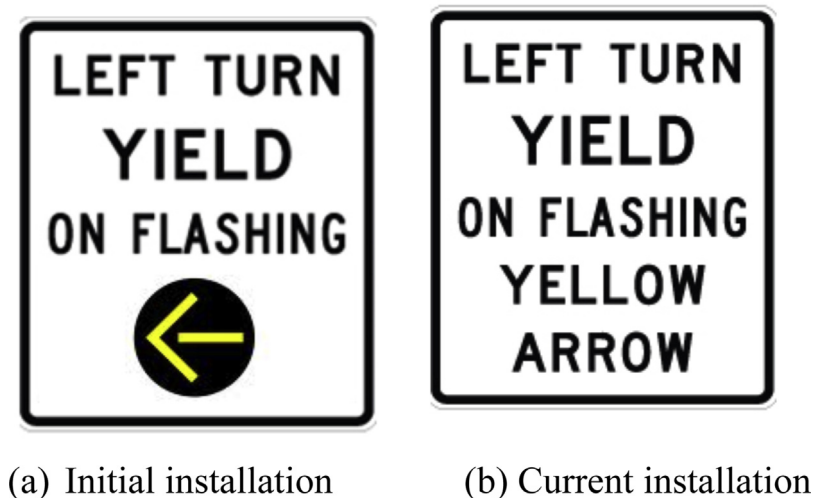


Fig. 2. FYA Left-turn supplemental signs used.

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