

Research Report Summary

David A. Noyce

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Driving Simulator Evaluation of Countermeasures to Improve Pedestrian and Bicycle Safety

Although the number of total crashes decreased annually in the U.S. until 2015, the percentage of pedestrian and bicyclist fatalities increased. The percentage of pedestrian fatalities with respect to total roadway fatalities increased from 11% in 2004 to 15% in 2015, while the percentage of cyclist fatalities increased from 1.7% in 2004 to 2.3% in 2015 (1, 2).

Numerous factors contribute to the occurrence of pedestrian and bicyclist crashes. Driver-related factors are considered among the most significant ones.

Driver-related factors include a failure to yield to either pedestrians or bicyclists that may increase the likelihood of a crash.

Need for Research

Failure-to-yield factors demonstrate the need for supplemental traffic signal devices that warn left-turning drivers about crossing pedestrians and bicyclists at intersections. A signal could be activated when the pedestrian pushes a call button or when a bicyclist is detected.

Project Goals

Supplemental signal designs were evaluated for communicating the presence of pedestrians/cyclists to left-turning drivers focused on finding a gap in the oncoming traffic (high workload) or not focusing on the environment (low workload).

Four different supplemental traffic signal designs were proposed and evaluated in two stages using a modified version of the American National Standards Institute (ANSI) standard Z535.3 procedures as an alternative to more complex driving simulator evaluations.

User-comprehension surveys of the two stages were conducted using tablet-computer and paper-based surveys. Results from the two stages are discussed in the following sections.

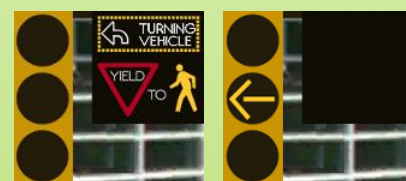
Tested supplemental traffic signal devices



Design 1



Design 2



Design 3




Design 4

Stage 1

The objective of this stage was to serve as a screening tool to eliminate confusing designs. Subjects were told the context and the intended meaning of the traffic signal devices and were asked to rank how well each design conveyed the message. A total of 259 survey responses were collected. Table 1 summarizes the results from Stage 1 using score for the design. A lower score value indicates better comprehension of a design by subjects. Therefore, Designs 1 and 3 were identified as the most promising designs and were selected for further evaluation in the second stage.

Table 1: Results of comparing different traffic signal designs in Stage 1

Design 1	Design 2	Design 3	Design 4
			
Overall: 2.18 ± 1.0 Women: 2.00 ± 0.12 Men: 2.23 ± 0.07 Age ≤ 18: 2.17 ± 0.06 Age ≥ 65: 2.4 ± 0.34	Overall: 2.74 ± 0.9 Women: 2.44 ± 0.11 Men: 2.84 ± 0.06 Age ≤ 18: 2.76 ± 0.06 Age ≥ 65: 2.4 ± 0.22	Overall: 2.50 ± 1.2 Women: 2.73 ± 0.16 Men: 2.42 ± 0.08 Age ≤ 18: 2.51 ± 0.08 Age ≥ 65: 2.3 ± 0.44	Overall: 2.56 ± 1.13 Women: 2.82 ± 0.13 Men: 2.49 ± 0.08 Age ≤ 18: 2.55 ± 0.07 Age ≥ 65: 2.9 ± 0.40

Stage 2

The objective of Stage 2 was to assess comprehension of traffic signal devices using open-ended questions. Respondents were asked, "If you want to turn left and you see the signal indication that is shown, what will you do?" General demographic questions were also asked about age, gender, level of education, and the number of hours spent driving per week. A total of 160 survey responses were collected. Table 2 shows survey response by percentage of correct/incorrect responses in addition to a breakdown by gender. Results show that Design 3 was comprehended by subjects better than Design 1. These findings can be used to support further evaluations using a driving simulator.

Table 2: Summary of responses to Stage 2 open-ended questions

Design	Response	Response Example	Response Percentage
Design 1	Correct	Yield for pedestrians and traffic while looking for an opening to turn left.	60.63%
	Incorrect	Proceed if there is no oncoming vehicle.	39.38%
Design 3	Correct	Turn left, yielding to pedestrians.	74.38%
	Incorrect	Stop before turning.	25.63%

References

- National Center for Statistics and Analysis. (2017, March). *Bicyclists and other cyclists: 2015 data*. (Traffic Safety Facts. Report No. DOT HS 812 382). Washington, DC: National Highway Traffic Safety Administration.
- National Center for Statistics and Analysis. (2017, February). *Pedestrians: 2015 data*. (Traffic Safety Facts. Report No. DOT HS 812 375). Washington, DC: National Highway Traffic Safety Administration.