Quantifying the yellow signal driver behavior based on naturalistic data from digital enforcement cameras

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The yellow signal driver behavior, reflecting the dilemma zone behavior, is analyzed using naturalistic data from digital enforcement cameras. The key variable in the analysis is the entrance time after the yellow onset, and its distribution. This distribution can assist in determining two critical outcomes: the safety outcome related to red-light-running angle accidents, and the efficiency outcome. The connection to other approaches for evaluating the yellow signal driver behavior is also discussed.

The dataset was obtained from 37 digital enforcement cameras at non-urban signalized intersections in Israel, over a period of nearly two years. The data contain more than 200 million vehicle entrances, of which 2.3% (~5 million vehicles) entered the intersection during the yellow phase. In all non-urban signalized intersections in Israel the green phase ends with three seconds of flashing green, followed by three seconds of yellow. In most non-urban signalized roads in Israel the posted speed limit is 90 km/h.

Our analysis focuses on crossings during the yellow phase and the first 1.5 seconds of the red phase. The analysis method consists of two stages. In the first stage we tested whether the frequency of crossings is constant at the beginning of the yellow phase. We found that the pattern was stable (i.e., the frequencies were constant) at 18 intersections, nearly stable at 13 intersections and unstable at 6 intersections. In addition to the 6 intersections with unstable patterns, two other outlying intersections were excluded from subsequent analysis. Logistic regression models were fitted for each of the remaining 29 intersection. We examined both standard (exponential) logistic regression and four parameters logistic regression. The results show a clear advantage for the former. The estimated parameters show that the time when the frequency of crossing reduces to half ranges from 1.7 to 2.3 sec after yellow onset. The duration of the reduction of the relative frequency from 0.9 to 0.1 ranged from 1.9 to 2.9 sec.