Traffic Safety Facts
Vehicle Safety Research Notes

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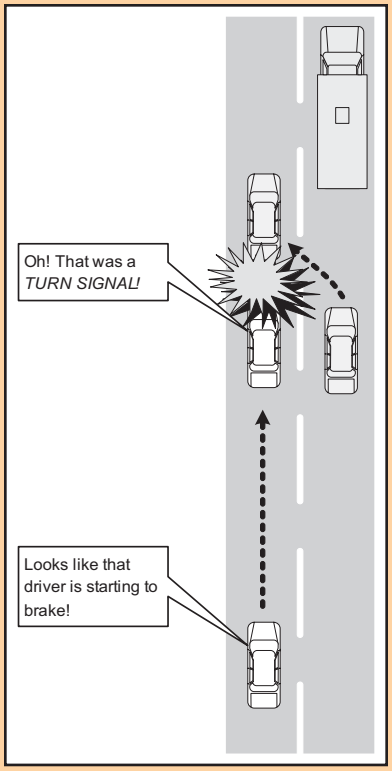
The Influence of Rear Turn Signal Characteristics on Crash Risk

Requirements for the color of rear turn signals differ between the standards set by the Economic Commission for Europe (ECE) and United States standards. In the ECE standards, all rear turn signals are required to be amber, while in the United States, they can be either red or amber. This difference has led to questions about whether there are safety differences associated with turn signal color. Consistent color coding of functions might facilitate recognition of the meaning of a signal, allowing a driver to respond more efficiently. It is also possible that, apart from color coding, an amber turn signal is more conspicuous to a following driver amid a field of red tail and stop lamps. This might allow an amber turn signal to be recognized more quickly or confused less often with another rear signal. Figure 1 illustrates one way in which such confusions might lead to rear-end collisions.

Figure 1. A hypothetical crash scenario in which a turn signal is mistaken for a brake signal



The possible effects of turn signal color have been explored in a limited number of previous laboratory studies and crash analyses, with mixed results. Some laboratory studies suggest no effect on driver responses, while others cite advantages with amber lamps. Crash data analyses are similarly mixed.

The following analysis revisits this issue with the benefit of a larger pool of crash data than before, and a logistic regression model that includes many factors—such as driver age, gender, vehicle model, and vehicle age—that were not considered in previous analyses.

Method

This analysis examines the crash records of seven States to determine if there is an association between turn signal color and the risk of a rear end collision into a turning vehicle, taking into account a variety of other characteristics associated with the crash. To perform the analysis, detailed rear signal characteristics were determined for the top 50 vehicle models involved in crashes in Kentucky, Maryland, New Jersey, North Carolina, and Pennsylvania during 2003. For each model, the history of the rear signal configuration was examined over a 15-year window beginning with 1990, identifying rear signal color, lamp function configuration (i.e., whether a turn signal is separated from the stop lamp or tail lamp), light source (LED, tungsten filament), and optical characteristics.

The detailed lamp characteristics were combined with several other factors identified in the crash datasets of Florida, Kentucky, Maryland, Michigan, New Jersey, North Carolina, and Pennsylvania between the years 2002 to

2004. A stepwise logistic regression modeled the odds of a rear-end collision while turning, merging, or changing lanes (i.e., a turn-signal-relevant maneuver), as a function of all of these factors. In a slight departure from previous crash analyses, the contrast group (used as the denominator of the odds ratio) in the first analysis was made of the striking vehicles from the same collisions. In a second analysis, the contrast group was made of rear-struck vehicles engaged in maneuvers that were not turn-signal-relevant.

Results

The first analysis found a reduction of between 3 and 28 percent in the odds of being the struck (versus striking) vehicle in a turn-signal-relevant maneuver when the vehicle was equipped with amber versus red turn signals. In addition, an effect of rear signal light source was also observed, such that LED turn signals appeared to reduce crash odds between 33 and 92 percent. Although interesting, the latter result is based on a single vehicle model equipped with LED turn signals and cannot be readily generalized to all vehicles equipped with LED turn signals.

"...Amber turn signals may be associated with a lower odds of rear-end collision during turning, merging, or lane change maneuvers."

The second analysis found no association between turn signal color and the odds of being struck in a turn-signal-relevant maneuver, although turn-signal reflector optics (versus lens optics) were found to reduce the odds by between 5 and 51 percent. However, similar to the previously described LED result, this result is largely based on a few vehicle models equipped with turn signals with reflector optics, and generalization to all such lamps would be premature.

The differences between the two analyses indicate that selection of a contrast group can influence the effects observed. Because the contrast group in the first analysis is better insulated from the influence of rear signals, these results may be more accurate than those from the second analysis, implying that amber turn signals may be associated with a lower odds of rear-end collision during turning, merging, or lane change maneuvers.

Conclusions

Although the analysis suggests that there may be a safety benefit associated with amber turn signals, it is unclear that turn signal color itself is completely responsible for the benefit. It is important to recognize that color is likely to be confounded with other factors that could also contribute to this effect. For example, although separation of functions was partly controlled for in this study, amber turn signals are usually separated from red stop and tail lamps. Also, requirements for the minimum and maximum candlepower of amber turn signals are 1.6 to 2.5 times greater than red turn signals. Further investigation of these other factors seems warranted before drawing the strong conclusion that turn signal color, by itself, is responsible for the observed differences.

U.S. Department of Transportation
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This Vehicle Safety Research Note is a summary of the technical research report: *The Influence of Rear Turn Signal Characteristics on Crash Risk* (DOT HS 811 037). This report can be downloaded free of cost on the Vehicle Safety Research section of NHTSA's Web site (www.nhtsa.gov).