Safety effects of wider edge lines on rural, two-lane highways

Eun Sug Park a,+, Paul J. Carlson a,1, Richard J. Porter b,2, Carl K. Andersen c,3

a Texas Transportation Institute, Texas A&M University System, 3135 TAMU, College Station, TX 77843-3135, United States
b Assistant Professor, Civil and Environmental Engineering, University of Utah, 110 Central Campus Drive, Salt Lake City, UT 84112, United States
c Roadway Team Leader, Office of Safety Research and Development, Turner-Fairbank Highway Research Center, Federal Highway Administration, 6300 Georgetown Pike, McLean, VA 22101, United States

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ABSTRACT

Although it is generally expected that wider lines will have a positive effect on vehicle safety, there have not been any convincing evidence based on the crash data analysis, partly because of the lack of relevant data. In this paper, the safety effect of wider edge lines was examined by analyzing crash frequency data for road segments with and without wider edge lines. The data from three states, Kansas, Michigan, and Illinois, have been analyzed. Because of different nature of data from each state, a different statistical analysis approach was employed for each state: an empirical Bayes, before-after analysis of Kansas data, an interrupted time series design and generalized linear segmented regression analysis of Michigan data, and a cross sectional analysis of Illinois data. Although it is well-known that causation is hard to establish based on observational studies, the results from three extensive statistical analyses all point to the same findings. The consistent findings lend support to the positive safety effects of wider edge lines installed on rural, two-lane highways.

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1. Introduction

The Manual on Uniform Traffic Control Devices (MUTCD) establishes standards and guidelines for traffic control devices, including pavement markings (MUTCD, 2009). Longitudinal pavement markings (center lines, lane lines, and edge lines) provide a continuous stream of information to drivers helping them prevent the roadway alignment and maintain appropriate lane position. The MUTCD specifies a nominal width of 4 in. for longitudinal pavement markings. Some state agencies have chosen to use wider pavement markings, mostly on freeway type facilities and mostly with edge lines. Wider longitudinal pavement markings may provide a safer environment for drivers by increasing visibility. There is, however, evidence that some safety-related treatments have an adverse safety effect at some locations (Evans, 1985; Bahar et al., 2004). Driver adaptation has been proposed as one reason for the counterintuitive findings: for example, improved visibility leads to increased driver comfort and higher operating speeds. This adaptive effect has been identified as a focus of future safety research (Transportation Research Board, 2009) and it is becoming clear that safety effects cannot be deduced purely from human factors theory alone. The safety effects of wider lines must be empirically explored before conclusions can be drawn.

Across the United States, the use of 4-in. markings is the default application, with wider markings being used on a selective basis. The existing research does not provide conclusive results on the benefits of wider markings and the results of various studies often conflict. Despite these inconclusive findings, the use of wider markings is on the rise (Obeng-Boampong et al., 2009).

The objective of this paper is to evaluate the safety effects of wider pavement markings, specifically edge lines on rural, two lane roadways. This paper presents enhanced statistical analyses of the potential safety effects of wider edge lines on rural, two-lane highways in Kansas, Michigan, and Illinois. Three different evaluation approaches, an empirical Bayes before-after analysis for Kansas data, an interrupted time series design and generalized linear segmented regression analysis for Michigan data, and a cross-sectional safety comparison for Illinois data, were utilized to account for different characteristics of the data from each state.

2. Previous studies

One of the first safety evaluations of wider edge lines was conducted by Cottrell (1987, 1988) in Virginia. The researcher