Safety evaluation of right-turn smart channels using automated traffic conflict analysis

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A B S T R A C T

This paper presents the results of a before–after (BA) safety evaluation of a newly proposed design for channelized right-turn lanes. The new design, termed “Smart Channels”, decreases the angle of the channelized right turn to approximately 70°. The implementation of these modified right-turn channels is usually advocated to allow for safer pedestrian crossing. However, the benefits also extend to vehicle–vehicle interactions since the new approach angle affords drivers a better view of the traffic stream they are to merge with. The evaluation is conducted using a video-based automated traffic conflict analysis. There are several advantages that support the adoption of traffic conflict techniques in BA safety studies. Traffic conflicts are more frequent than road collisions and are of marginal social cost, they provide insight into the failure mechanism that leads to road collisions, and BA studies based on traffic conflicts can be conducted over shorter periods. As well, the use of automated conflict analysis overcomes the reliability and repeatability problems usually associated with manual conflict observations. Data for three treatment intersections and one control intersection in Penticton, British Columbia, are used in this study. The results of the evaluation show that the implementation of the right-turn treatment has resulted in a considerable reduction in the severity and frequency of merging, rear-end, and total conflicts. The total average hourly conflict was reduced by about 51% while the average conflict severity was reduced by 41%.

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1. Introduction

Channelized right-turn lanes are usually implemented at signalized intersections to reduce vehicle delay and increase efficiency, especially at locations with high right-turn traffic volumes. An alternative right-turn design has recently been proposed (Zegeer et al., 2002) that is more pedestrian-friendly and that supports improved traffic operations. The new design, termed “Smart Channels”, decreases the angle of the channelized right turn to approximately 70°. The goal is to reduce the pedestrian crossing distance which can lead to shorter distance exposure, shorter signal cycles, and reduced potential for pedestrians to be in conflict with vehicles (Zegeer et al., 2002; The City of Ottawa, 2009). While the implementation of these modified right-turn channels is usually advocated to allow for safer pedestrian crossing, the benefits can also extend to vehicle–vehicle interactions as the new approach angle affords drivers a better view of the traffic stream they are to merge with (Figs. 1 and 2).

The design has been adopted by the City of Ottawa (The City of Ottawa, 2009) in an effort to improve road safety. While often referred to as “Urban Smart Channels”, we have elected to term them simply “Smart Channels” as their benefits extend to suburban and rural environments as well. The new design conforms to the Transportation Association of Canada’s (TAC) guidelines that drivers should not have to look more than 120° back to check approaching traffic (Transportation Association of Canada, 1999). Traditional channelized right-turn lanes can require head turns of as much as 150°. The US Federal Highway Administration (FHWA) recognizes that older drivers have difficulty “turning [their] head at skewed (non-90°) angles to view intersecting traffic” and “at the end of an auxiliary (right)-turn lane in seeing potential conflicts well and quickly enough to smoothly merge with adjacent-lane traffic” (Staplin et al., 2001). In 2009, the British Columbia Ministry of Transportation and Highways started a pilot project to evaluate the safety performance of Smart Channels. The goal of this study is to undertake a before–after (BA) evaluation of the safety impact of Smart Channels. Data for three treatment intersections and one control intersection in Penticton, British Columbia, are used in this study. BA traffic safety analysis has traditionally relied on collision data collected pre- and post-treatment over several years using techniques such as the Empirical Bayes (EB) approach (Hauer, 1997; Sayed et al., 2004, 2010). The EB approach was shown to account for the main confounding factors such as the regression-to-the-mean and changes in other factors, such as traffic volumes. However,