Accident Analysis and Prevention 45 (2012) 187–194

Contents lists available at ScienceDirect

Accident Analysis and Prevention

journal homepage: www.elsevier.com/locate/aap

Effectiveness of traffic light *vs.* boom barrier controls at road–rail level crossings: A simulator study

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ARTICLE INFO

Article history:
Received 17 June 2010
Received in revised form 8 June 2011
Accepted 18 June 2011

Keywords:
Rail safety
Road safety
Driving simulator
Active level crossings
Passive level crossings

ABSTRACT

Although collisions at level crossings are relatively uncommon occurrences, the potential severity of their consequences make them a top priority among safety authorities. Twenty-five fully-licensed drivers aged between 20 and 50 years participated in a driving simulator study that compared the efficacy, and drivers' subjective perception, of two active level crossing traffic control devices: flashing lights with boom barriers and standard traffic lights. Because of its common usage in most states in Australia, a stop sign-controlled level crossing served as the passive referent. Although crossing violations were less likely at the level crossings controlled by active devices than at those controlled by stop signs, both kinds of active control were associated with a similar number of violations. Further, the majority (72%) of drivers reported preferring flashing lights to traffic lights. Collectively, results indicate that the installation of traffic lights at real-world level crossings would not be likely to offer safety benefits over and above those provided already by flashing lights with boom barriers. Furthermore, the high rate of violations at passively controlled crossings strongly supports the continued practice of upgrading level crossings with active traffic control devices.

1. Introduction

Between January 2006 and June 2009 there were 219 collisions between road vehicles and trains at road–rail level crossings in Australia, a rate of approximately 0.34 crashes per million train kilometers travelled (Australian Transport Safety Bureau, 2009). In the United States, collisions at level crossings are more prevalent; during the same period, there were 9083 crashes, a rate of approximately 1.94 crashes per million train kilometers travelled (Federal Railroad Administration, 2010). Although train–vehicle collisions account for less than 1% of overall road vehicle fatalities, the economic and societal impact of this type of collision is significant and has the potential to be devastating, making it one of the top concerns among road and rail authorities.

Road–rail level crossings exist within all road categories, and can be either of two types: those protected by active devices (i.e., that provide a signal to vehicle drivers of an approaching train), or those that are unprotected (referred to as 'passive' level crossings). The latter are characterized by signage only (usually cross bucks, 'give-way', or 'stop' signs) and, as their name suggests, do not provide any active indication to drivers of the presence or absence of oncoming trains. The use of stop signs at level crossings is controversial. While certain analyses of historical crash data have revealed a lower accident frequency at level crossings with stop signs compared to cross bucks alone (Millegan et al., 2009), other studies have found the opposite trend, with stop signs being associated with the highest fatality rate compared to cross bucks or flashing lights (Raub, 2006). Since the early 1970s, in an effort to improve road safety, Australian and international railway authorities have made concerted efforts to reduce the number of road–rail level crossings, particularly those protected by passive devices (Edquist et al., 2009; Horton et al., 2009). For example, the number of level crossings in the state of Victoria, Australia has decreased by about 30% from the early 1970s to the year 2000, resulting in a large reduction in the number of collisions (73%) and an even larger reduction (85%) in the number of deaths at railway level crossings (Edquist et al., 2009). Despite this effort, though, many stop sign-controlled level crossings remain in operation. In 2010, approximately 24% of the 1057 passively controlled level crossings in Victoria were equipped with stop signs (Department of Transportation, 2010). As such, research is needed to investigate drivers' performance at, and understanding of, stop signs when they are used as passive level crossing controls.

In instances where it is determined that passive level crossings pose an unacceptable risk to drivers, they are often "upgraded" with active traffic controls devices; however, drivers may nonetheless fail to comply with active level crossing controls for a variety of reasons. For example, of 419 witness statements from drivers who failed to stop at active level crossings in the UK, 55% reported that they had been unwilling to stop because they believed they had enough time to cross before the train arrived (Pickett and Grayson,

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doi:10.1016/j.aap.2011.06.019