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The effects of traffic wardens on the red-light infringement behavior of vulnerable road users

Xiaobao Yang [a,b,*], Mohamed Abdel-Aty [b], Mei Huan [a], Bin Jia [a], Yichuan Peng [b]

[a] MOE Key Laboratory for Urban Transportation Complex Systems Theory and Technology, Beijing Jiaotong University, Beijing 100044, China
[b] Department of Civil, Environmental & Construction Engineering, University of Central Florida, Orlando, FL 32816, United States

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ABSTRACT

In some Chinese cities, traffic wardens are employed to maintain traffic order at the intersections with a high mixed traffic flow in peak hours. The main work of a traffic warden is to advise pedestrians and riders to wait at the appropriate area during red light periods. In many other countries, there are also traffic wardens at the areas with dense crowds or vehicles, such as at some large parking lots near parks and shopping malls. This paper investigated the effects of traffic wardens on the crossing behavior of pedestrians, cyclists and electric bike riders at signalized intersections. A total of 795 samples with traffic wardens and 773 samples without traffic wardens at intersections in Beijing, China were observed. Logistic regression and multivariate analysis of variance were used to test the effect of traffic wardens on the red-light crossing behavior. The results indicated that the presence of traffic wardens would significantly reduce by 21% red-light infringement behavior of vulnerable road users. However, the effects of traffic wardens were different among different groups. The effect of traffic wardens on reducing the violation rate for pedestrians was smaller compared to cyclists and electric bike riders (8% vs. 23% and 27%, respectively). The effect of traffic wardens was significant for the individuals approaching straight ahead the intersection, while it was not significant for the individuals approaching from the left and right sides of the observed direction. The possible reasons for the different effects and some practical countermeasures to reduce red light infringement were discussed. This study provides insights into the effects of traffic wardens on enhancing the safety of vulnerable road users under mixed traffic conditions. It is useful for the administrators to evaluate the supervision performance of traffic wardens and make informed decisions to employ traffic wardens at locations with dense crowds or vehicles.

1. Introduction

The current road networks are planned and designed largely from a car-user perspective, which leads to the lack of adequate facilities for slow moving traffic (Li, 2013; Tiwari, Bangdiwala, Saraswat, & Gaurav, 2007). However, pedestrians and cyclists are regarded as vulnerable road users as they are hardly protected in traffic collisions (ETSC, 1999). Vulnerable road users involved injuries and fatalities are overrepresented in traffic accidents. Worldwide, pedestrians and two-wheeled

* Corresponding author at: MOE Key Laboratory for Urban Transportation Complex Systems Theory and Technology, Beijing Jiaotong University, Beijing 100044, China.
E-mail address: yangxb@bjtu.edu.cn (X. Yang).

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riders contribute to 46% of the total road traffic deaths (WHO, 2009). In 2010, 16,281 pedestrians and 10,653 riders of non-motor vehicles were recorded as killed in road accidents in China, representing 25.0% and 16.3% of road traffic fatalities, respectively (CRTASR, 2011). In Delhi, India, pedestrians and two-wheeled riders accounted for 70–85% of the total traffic deaths in the period 1990–2004 (Tiwari et al., 2007). In the developed countries, the proportion of road accidents involving pedestrians and cyclists are also high, though they have a relatively low rate of traffic fatalities. For example, in the Netherlands, there were a total of 19,100 persons seriously injured in traffic accidents in 2010, among which around 50% were caused by bicycle accidents (IRTAD, 2013). These data suggest that not enough effort is being done to meet the needs of vulnerable road users.

Fortunately, the safety of vulnerable road groups has been more of a concern to many researchers. In 2012, a special issue about vulnerable road users was published in Accident Analysis & Prevention (Shinar, 2012). However, many existing literature were conducted on the unsafe behavior, safety perception, safety evaluation, accidents and injuries. Relatively, only a few studies have been focused on how to improve the safety of vulnerable road users.

As to the countermeasures of improving pedestrian safety, Retting, Ferguson, and McCartt (2003) summarized the engineering countermeasures and classified them into three groups: separation of pedestrians from vehicles, speed control of motor vehicle, and increase of pedestrians' visibility and conspicuity. A useful review on pedestrian safety education can be found in Duperrex, Bunn, and Roberts (2002). In addition, Federal Highway Administration (FHWA) published several reports about special measures to improve pedestrian safety, such as traffic calming and countdown pedestrian signals (Ewing, 1999; Singer & Lerner, 2005). Recently, Zegeer and Bushell (2012) proposed some potential strategies which included providing pedestrian-friendly geometric guidelines, promoting the use of enforcement, development and implementation of effective traffic control, safety education programs, safer bus stop and school routes, etc. Lipovac, Vujanic, Maric, and Nesic (2013a, 2013b) indicated that a countdown display would significantly reduce the total number of offenders. However, this reduction is not the same at various categories of pedestrians. Fredriksson and Rosén (2012) indicated that integrated systems of passive and active pedestrian countermeasures such as bonnets/airbags and autonomous braking can significantly reduce the likelihood of head injury compared to either of the two systems alone. Wei, Becic, Edwards, Graving, and Manser (2014) proposed several technology-based and infrastructure-based solutions to reduce the collisions between pedestrians and transit buses. In addition, waiting time was identified as a significant variable in pedestrians' red-light crossing behavior (Brosseau, Zangenehpour, Saunier, & Miranda-Moreno, 2013; Guo, Gao, Yang, & Jiang, 2011; Tiwari et al., 2007). Decreasing pedestrians' waiting times is likely to diminish dangerous crossing behaviors and the risk of car-pedestrian collision at signalized intersections.

As to the countermeasures of improving cycling safety, firstly, most measures for pedestrians can be correspondingly applied to enhance cyclists' safety, for example, educational programs, enforcement of speed limits, and some infrastructure measures such as traffic calming and the technique of space-sharing (ETSC, 2012; Wegman, Zhang, & Dijkstra, 2012). Secondly, some special measures for cyclists were put forward. For instance, some researchers focused on the effects of helmet use on reducing cycling injury (Dellinger & Kresnow, 2010; Fyhri, Bjørnskau, & Backer-Grøndahl, 2012). Wood et al. (2012) found that the use of reflective clothing can improve the conspicuity of bicyclists, while the presence of a bicycle light did not improve the conspicuity at night. Zhang and Wu (2013) indicated that sunshields installed at intersections can decrease by 5.5% and 4.8% the violation rates of two-wheeled riders on sunny and cloudy days, respectively. Wegman et al. (2012) suggested that we needed a paradigm shift to a sustainable safe traffic system which had five central principles: functionality, homogeneity, predictability, forgivingness and state awareness.

In this study, we explore another countermeasure-which is traffic wardens, and test their effects on the crossing behavior of pedestrians and bike riders at urban intersections in China. A similar study was conducted by Rosenbloom, Haviv, Peleg, and Nemrodov (2008). They used a questionnaire survey to evaluate the effectiveness of the crossing guard (i.e. traffic warden) program in Israeli elementary schools. The results indicated that the crossing guard program had a significant influence in some domains and within certain age groups.

Owing to the weakness of safety awareness and enforcement, red-light infringement behavior of pedestrians and bike riders is rather prevalent and represents a substantial safety problem at Chinese urban intersections (Wu, Yao, & Zhang, 2012; Yang, Deng, Wang, Li, & Wang, 2006). In addition, the intersections on the arterial streets are key nodes in urban traffic system and influence the safety and efficiency of the whole urban network. Therefore, traffic wardens are often employed to maintain traffic order at these crucial intersections in peak hours on weekdays in China. They usually stand near the intersection stop line for motor and non-motor vehicles, dressed in reflective clothing with a red flag in one hand (see Fig. 1). Although this measure requires manpower, it should effectively reduce the likelihood of red-light infringement behavior and relieve traffic congestion at urban intersections, which further improves the safety and efficiency of the whole urban network.

The main work of a traffic warden is to advise pedestrians and bike riders approaching the intersection during red light periods to wait at the appropriate area until the traffic light turns green. Apart from supervising the bike riders, traffic wardens sometimes blow the whistle to prevent pedestrians from infringement on the traffic signal. In addition, the presence of traffic wardens may make psychological pressures on the infringement behavior no matter where he/she waits. However, unlike traffic police, traffic wardens are not qualified to issue traffic tickets. Consequently, some people would not comply with the supervision of traffic wardens and cross against the traffic light. Therefore, it is necessary to evaluate the supervision performance of traffic wardens. It can be done by comparing the difference in red-light infringement behavior under different situations with and without wardens.