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Effects of turning on and off red light cameras on fatal crashes in large U.S. cities

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ABSTRACT

Introduction: This study updates estimates of effects of activating red light cameras and offers a first look at effects of turning them off. *Method:* Among 117 large U.S. cities with more than 200,000 residents in 2014, trends in city-wide per capita rates of fatal red light running crashes and of all fatal crashes at signalized intersections were compared between 57 cities that initiated camera programs during 1992–2014 and 33 cities without cameras to examine effects of activating camera programs. Trends also were compared between 19 cities that removed cameras and 31 regionally matched cities with continuous camera programs to evaluate effects of terminating camera programs. Because several cities removed cameras during 2005–2008 and estimated effects might have been confounded by the subsequent economic downturn, primary analyses were limited to the 14 cities that removed cameras during 2010–2014 and 29 regionally matched cities with continuous camera programs. Poisson regression examined the relationship of activating and deactivating cameras with fatal crash rates. *Results:* After controlling for temporal trends in annual fatal crash rates, population density, and unemployment rates, rates of fatal red light running crashes and of all fatal crashes at signalized intersections were 21% and 14% lower, respectively, in cities with cameras after cameras were turned on than would have been expected without cameras; 30% and 16% higher, respectively, in 14 cities that terminated cameras during 2010–2014 after cameras were terminated than expected had cameras remained; and 18% and 8% higher, respectively, in all 19 cities that removed cameras, but not significantly. *Conclusions:* This study adds to the body of evidence that red light cameras can reduce the most serious crashes at signalized intersections, and is the first to demonstrate that removing cameras increases fatal crashes. *Practical applications:* Communities thinking about removing cameras should consider impacts to safety.

1. Introduction

In 2014, more than 2.5 million police-reported motor-vehicle crashes in the United States occurred at intersections or were intersection-related, accounting for 43% of all police-reported crashes (Insurance Institute for Highway Safety, 2016a). These crashes resulted in about 55,000 serious nonfatal injuries and 7697 deaths. More than a third of these deaths occurred at signalized intersections.

Running a red light is a common traffic violation, although drivers view red light running as dangerous. A 2015 national survey of drivers found that while 59% thought that running red lights was a very serious threat to personal safety, 39% reported driving through a traffic light that had just turned red in the past month (AAA Foundation for Traffic Safety, 2016). A study observing 19 intersections in four states found that there was an average of 3.2 red light running violations per intersection per hour (Hill & Lindly, 2003).

Red light running violations can have tragic consequences. In 2014, 709 people were killed and an estimated 126,000 were injured in police-reported red light running crashes, and more than half of those killed were pedestrians, bicyclists, or occupants of vehicles struck by red light runners (Insurance Institute for Highway Safety, 2016a).

Traditional police enforcement of red light running can help mitigate the problem, but other demands on police resources can limit its effectiveness. Red light cameras are a countermeasure that increases the public's perception that there is a high likelihood of being apprehended for running a red light. The installation of red light cameras has led to significant reductions in red light running violation rates at intersections with cameras, and at nearby signalized intersections without cameras (McCartt & Hu, 2014; Retting, Williams, Farmer, & Feldman, 1999a, 1999b). Red light cameras also have been shown to reduce injury crashes (Aeron-Thomas & Hess, 2005; Retting & Kyrychenko, 2002). For example, Retting and Kyrychenko (2002) found that after the installation of red light cameras in Oxnard, California, injury crashes declined by 29% and right angle crashes involving injuries dropped by 68% at signalized intersections.

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Hu, McCartt, and Teoh (2011) performed the first study that investigated the effects of red light cameras on fatal crashes in large U.S. cities. Among the 99 cities with more than 200,000 residents in 2008, 14 cities were identified with red light camera enforcement programs for all of 2004–2008 but not at any time during 1992–1996, and 48 cities were identified without camera programs during either period. Analyses compared the citywide per capita rate of fatal red light running crashes and the citywide per capita rate of all fatal crashes at signalized intersections during the two study periods, and rate changes were compared for cities with and without camera programs. After controlling for population density and land area, the rates of fatal red light running crashes and all fatal crashes at signalized intersections were 24% and 17% lower, respectively, in cities with cameras during 2004–2008 than what would have been expected without cameras.

Surveys of residents of cities with red light camera programs have found that a large majority of residents in most cities favor the programs (Cicchino, Wells, & McCartt, 2014; McCartt & Eichelberger, 2012). Yet, despite public support and the clear benefits of red light cameras, the programs have been controversial. Although the number of U.S. municipalities using red light camera enforcement increased rapidly before peaking in 2012 at 533 communities, by 2015 this number declined to 467 communities. Although new camera programs continued to be added, 158 communities ended their red light camera programs between 2010 and 2015. Communities have ended programs for a variety of reasons including changes in state law disallowing red light cameras, public referendums where voters rejected cameras, decisions by local government, court rulings, and lapsed contracts with vendors. Numerous studies have examined the safety effects of red light camera enforcement, but few if any strong studies have examined the effects of terminating camera programs on crashes.

The goals of the current study were twofold. The first was to update Hu et al.'s (2011) estimates of the effects of installing red light cameras on per capita citywide rates of fatal red light running crashes and per capita citywide rates of all fatal crashes at signalized intersections in large cities. The current study accounted for the effects of the economy, used a more rigorous design that accounts for trends in crash rates over time within cities, and examined a larger number of cities with red light cameras than Hu et al. (2011). Trends in per capita fatal crash rates over time were compared for cities with and without camera programs for each crash measure. The second goal was to assess the effects of deactivating red light camera programs on per capita citywide rates of fatal red light running crashes and per capita citywide rates of all fatal crashes at signalized intersections. For each fatal crash measure, temporal trends in crash rates were compared for cities that turned off cameras and cities with continuous camera programs.

2. Method

The first U.S. community with a camera program for traffic enforcement was New York City, which tested one red light camera in 1992 and turned on more cameras the following year. The number of communities using red light cameras has increased dramatically since then (Insurance Institute for Highway Safety, 2016b). Fatal crash data at the time of the current study were available only through 2014, so analyses covered the period 1992–2014.

Large U.S. cities were defined as those with more than 200,000 residents; there were 117 such cities in 2014 (U.S. Census Bureau, 2014). Information on red light camera programs in these 117 cities was obtained from news reports and calls to city police departments or public works departments. For cities with camera enforcement, program start and end dates were obtained. Other historical information was sought but was not available for all cities, including the number of cameras and number of signalized intersections over time.

Among the 117 cities in this study, 57 cities turned on red light cameras at some point during 1992–2014, and the cameras remained on in 2014; 38 cities had no camera programs during the entire time period; 20 cities turned cameras on and later turned them off, including 3 cities (Los Angeles, CA; San Diego, CA; Houston, TX) that turned cameras off twice; and 2 cities (Virginia Beach, VA, and Arlington, VA) turned cameras off and later turned them on.

Data on fatal crashes at intersections with signal lights in each city were extracted for 1992–2014 from the Fatality Analysis Reporting System (FARS), which contains detailed information on all fatal motor-vehicle crashes occurring on U.S. public roads (National Highway Traffic Safety Administration, 1992-2014). Fatal red light running crashes were defined as the subset of these crashes that involved a driver traveling straight who was assigned the driver level contributing factor of "failure to obey traffic control devices." This definition was developed jointly by the Insurance Institute for Highway Safety and Federal Highway Administration so that consistent estimates of red light running crash losses would be produced (Retting, 2006). Annual counts of fatal red light running crashes and all fatal crashes at signalized intersections were obtained for each of the 117 cities in each year during 1992–2014.

Annual population estimates for 1992–2014 were obtained for each city from the U.S. Census Bureau (1999, 2010a, 2014). For each city in each year, the annual per capita rates of fatal red light running crashes and rates of all fatal crashes at signalized intersections were calculated as the annual fatal crash counts divided by annual population estimates (crashes per million population). Census information on cities' land areas is available only from the decennial reports (U.S. Census Bureau, 1990, 2000, 2010b). Therefore, the 1990 land area data were used for years 1992–99, the 2000 data for years 2000–09, and the 2010 data for years 2010–14. Six of the 117 cities in the study (Gilbert, AZ; Chula Vista, CA; Louisville, KY; Fayetteville, NC; Winston-Salem, NC; Laredo, TX) had substantial changes in land areas (more than 50% increase) during the study period. These six cities, of which five had no camera programs and the remaining one (Fayetteville, NC) had turned cameras off, were excluded from analyses, because large changes in land area could potentially confound the relationship between camera enforcement and fatal crash rates.

The annual population density was calculated as the population divided by the land area. Hu et al. (2011) found that an increase in population density was associated with decreases in fatal crash rates, although not always significantly. A possible explanation is that denser populations generally lead to lower travel speeds and thus fewer fatal crashes (Cerrelli, 1997).

Annual unemployment rates during 1992–2014 were obtained for each city from the U.S. Bureau of Labor Statistics (1992-2014). Annual unemployment rate was included to account for potential effects of the economy on fatal crash rates. It is well-established that fatal crash rates and economic factors are associated with one another (Partyka, 1991).

2.1. Analyses of effects of turning on red light cameras

Years 1992–2014 represented the study period. The 57 cities that turned cameras on and kept them on comprised the camera group. The 33 non-camera cities without substantial changes in land areas comprised the control group. The 22 cities where cameras had been turned off during the study period were excluded from these analyses. Table 1 lists cities in the camera and control groups and the program start year in each camera city.

Using the city-specific data, Poisson regression models were used to rigorously examine the relationship of camera enforcement and other variables with fatal crashes. The Poisson models accounted for the autoregressive (first order) covariance structure due to repeated measures, because each independent unit of analysis (city) had 23 consecutive annual observations (years 1992–2014). A Pearson scale parameter was included to test and adjust for overdispersion, if present. Separate models were developed for the fatal red light running crashes and all fatal crashes at signalized intersections, with the annual crash counts