EFFECT OF VARIOUS TYPES OF TRAFFIC SIGNAL ON RED LIGHT RUNNING

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To my beloved mother and father

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ABSTRACT

Traffic signal assigns the right-of-way to various conflicting traffic movements at an intersection. However, when a driver's approaches a signalized intersection at the onset of amber, he/she is forced to make decisions about whether to pass or stop during a very short time period. This can be a difficult decision when the vehicle is located within the dilemma zone. It may result in a rear-end crash due to a sudden stop or red-light violation due to insufficient time to stop safely. In the present study six intersections, two with countdown timer, two with no-countdown timer and two with vehicle actuated system were analyzed to study the effect of various traffic signal systems on red light violation. The data of off-peak hour traffic was collected to minimize the influence of congestion on driver's behavior by using video-recording technique. The data collected are those pertaining to the analysis of vehicles' approaching speed distance from the stop line, the decision made by driver (i.e. stop abruptly, accelerate through amber and run red light) at onset amber as well as the types of vehicles driven. The finding of the study indicates that relatively large proportion of drivers did not willing to stop at onset of amber signal. The study suggests that a vehicle-actuated traffic signal system has resulted a higher rate of red-light violation with 55.56 percent compared to the others types of signal system studied. However, more data are required to validate this finding.

ABSTRAK

Lampu isyarat menentukan hak jalan kepada pelbagai konflik pergerakan lalu lintas di persimpangan jalan. Akan tetapi, apabila pemandu menuju hampir ke persimpangan lampu isyarat pada masa kuning, mereka terpaksa membuat keputusan sama ada meneruskan perjalanan atau berhenti dalam jangka masa yang singkat. Ini merupakan keputusan yang sukar dibuat kerana pemandu berada dalam situasi dilemma. Ini akan mengakibatkan berlakunya perlanggaran/kemalangan disebabkan pemandu berhenti mendadak atau melanggar lampu merah kerana tempoh masa untuk berhenti dengan selamat tidak mencukupi. Kajian dijalankan pada enam persimpangan berlampu isyarat; dua sistem lampu isyarat dengan penunjuk tempoh, dua lampu isyarat tanpa penunjuk tempoh, dan dua lampu isyarat berdasarkan pengawalan penggerak kenderaan, dianalisa untuk mengkaji kesan pelbagai sistem lampu isyarat terhadap pelanggaran lampu merah. Cerapan data dilakukan pada masa aliran tidak tepu untuk mengurangkan kesan kesesakan lalulintas terhadap kelakuan pemandu dengan menggunakan teknik rakaman video. Data yang dicerap adalah berkaitan dengan had laju pemandu, jarak daripada garisan berhenti, keputusan yang dibuat oleh pemandu pada masa kuning (berhenti mendadak, melajukan kenderaan dan melanggar lampu merah) dan jenis kenderaan. Kajian telah mendapati bahawa sebahagian besar pemandu tidak berhenti pada masa kuning. Kajian juga menyatakan bahawa system lampu isyarat pengawalan penggerak kenderaan menunjukkan kadar yang tertinggi dalam kes melanggar lampu merah dengan mencatat 55.56 peratus berbanding dengan sistem lampu isyarat lain yang dikaji. Namun demikian, lebih banyak data diperlukan bagi mengesahkan hasil kajian ini.

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AASTHO	American Association of State Highway and Transportation Officials American
DZ	Dilemma Zone
CDS	Crashworthiness Data System
CD	Compact Disk
FHWA	Federal Highway Administration
GHM	Gazis, Herman and Maradudin
ITE	Institute of Transportation Engineer
JKR	Jabatan Kerja Raya
km/h	Kilometer per hour
m	Metre
m/s	Metre per second
NHTSA	National Highway Traffic Safety Administration
PRT	Perception Reaction Time
RRL	Run Red Light
s	Second
UFOV	Useful Field Of View
X_0	Stopping Distance
X_C	Critical Distance
χ^2	Chi Square

CHAPTER I

INTRODUCTION

1.4 Background

Traffic signals are intended to promote safe and efficient traffic flow at busy intersections. However, the level of safety achieved is largely dependent on drivers' compliance with the signals. Research shows that many drivers routinely violate red signals, placing themselves and other road users at risk for serious collisions. A study conducted during several months at five busy intersection approaches in Fairfax City, Virginia, found that violation rates averaged 3 per intersection per hour (Retting et al., 1999). During peak travel times, red light running was more frequent.

Crashes resulting from red light running are a frequent occurrence. A nationwide study of 9,951 vehicles involved in fatal crashes at traffic signals in 1999 and 2000 estimated that 20 percent of the vehicles failed to obey the signals (Brittany et al., 2004). In 2005, more than 800 people were killed and an estimated 165,000 were injured in crashes that involved red light running (Insurance Institute for Highway Safety, 2006). About half of the deaths in these crashes were pedestrians and occupants in other vehicles who were hit by the red light runners.

Red-light running is a complex problem. There is no simple or single reason to explain why drivers run red lights. There is a tendency to cite driver error-either intentional or unintentional disregard of the traffic signal. Some drivers indecently enter an intersection after onset of a red signal: other commit intentional acts of red-light running. Because drivers cannot predict the onset of a yellow signal, the likelihood that a drivers will stop is related to speed and distance from the intersection when the signal changes. This is called dilemma zone, where some drivers are going too fast when the signal changes to yellow to either enter prior to the onset of red or abruptly stop (Milazzo *et. al.*, 2001). There is also evidence that drivers may be induced into running red lights because of improper signal design or operation. These elements make red-light running difficult to predict and a difficult problem to solve. However, many drivers who run the red lights are provided adequate opportunity to stop safely but choose instead to proceed through a red signal: these drivers related to deliberate red light runners.

There is a wide range of potential countermeasures to the red-light-running problem. These solutions are generally divided into two broad categories: engineering countermeasures and enforcement countermeasures. Enforcement countermeasures are intended to encourage drivers to adhere to the traffic laws through the threat of citation and possible fine. In contrast, engineering countermeasures (which include any modification, extension, or adjustment to an existing traffic control device) are intended to reduce the chances of a driver being in a position where he or she must decide whether or not to run the red indication. Studies by Retting *e.t al.* (2002), have shown that countermeasures in both categories are effective in reducing the frequency of red-light-running. However, most of the research conducted to date has focused on the effectiveness of enforcement; little is known about the effectiveness of many engineering countermeasures.

1.5 Research Problem

This study is concerned with the factors that influencing of red light runners at various types of signalized intersection. Signalized intersections are generally the most heavily traveled intersection types and are therefore a major element of the highway fatality especially at an onset of amber.

Traffic engineers rely heavily on traffic signals to control and separate conflicting traffic movements at busy intersections. Safe signal operation requires a high degree of voluntary driver compliance, and many drivers do not comply with red lights (Porter *et. al.*, 2000). Although traffic lights are installed to regulate and minimize the conflicts among vehicles, the risk of collision is still exist among the intersecting vehicles, affecting as well other road users, including pedestrians and bicyclists. When a vehicles approaches an intersection, whether the driver stops before the stop-line or not depends on the vehicles approach speed and distance from the intersection. Other factors of engineering design parameters for signalized intersections such as vehicle volume, change interval, amber time, cycle length, total phases, number of approach legs, are also deemed to affect runners behaviors. This report describes the result of a study carried out to evaluate those factors in influencing red light runners at intersection.

1.6 Aim and Objective

The aim of this study is to evaluate the effect of various types of traffic signal systems on red light running at onset of amber period. Satisfying of the following objective helps achieve this aim:

i. To collect driver’s decision on onset of amber period.
ii. To determine the effect of traffic signal system studied on red light running.

1.4 Scope and Limitation

The study focuses on the effect of traffic signal system on red light running at signalized intersection. Potential factors that could affect the vehicles speed such as the lanes gradient will not be taken into consideration. Therefore, in order to obtain a more accurate data on the vehicles speed, the gradient value should be equivalent to zero. The factors of engineering design parameters for signalized intersections such as vehicle volume, change interval, amber time, cycle length, total phases, number of approach legs, are considered to affect runners behaviors. Other factors such as gender and age are not considered because the data are difficult to observe. Other than that, number of vehicles caught in dilemma zone is also taking into account for the analysis.