MEASURING THE EFFECTIVENESS OF RED LIGHT CAMERAS IN REDUCING TRAFFIC CRASHES AND RED LIGHT VIOLATIONS

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Abstract

Many drivers often run red lights, placing themselves and other members of the motoring public at risk for crashes, injury and unfortunately death. A primary countermeasure for red light running is police traffic enforcement. In recent years, red light cameras have increasingly been used to supplement police efforts to enforce against noncompliance with traffic signals. The intent of camera enforcement is to modify driver behavior through deterrence and punishment of the violators. The fundamental objective of this research was to review and evaluate the available evidence to include documented research studies in the international literature regarding the effectiveness of cameras to reduce red light violations and crashes. Information was obtained through a survey instrument that was administered to a diverse citizen group within the Lakeland community.

Introduction

Various members of the City of Lakeland government, to include members of the police department and city commission, were contacted by community leaders and citizens complaining of the blatant violations of red light traffic signals by motorists in Lakeland. During this same time period, the Lakeland Police Department Traffic Section initiated a review of the last two years traffic fatality investigations to identify what violations were committed-and directly related to-the causation of the traffic crashes. The results of the review revealed during the calendar years of 2005 and 2006, a total of forty four traffic fatalities occurred of which five were directly related to the violation of a red light traffic signal or approximately 11.36 % of the overall total of forty four traffic fatality investigations.

As a result of coupling the community outcry and research results of the fatality review, the Lakeland Police Department's Traffic Section was tasked with researching alternatives to the traditional methods of enforcing red light violations by installing red light camera enforcement systems to reduce the number of traffic crashes and red light signal violations in the City of Lakeland.

Literature Review

For many years, traffic signals have been intended to promote a safe and efficient flow of traffic at busy intersections. The level of safety achieved is based largely upon the drivers' compliance with the signals. Numerous research projects have been completed on this issue and it has revealed drivers routinely violate red light signals, placing themselves and the other motoring public at risk

for a serious collision. Red light running is a frequent cause of crashes at signalized intersections and it continues to be a staggering problem throughout the United States. A nationwide study of fatal crashes at traffic signals in 1999 and 2000 estimated that 20 percent of the vehicles involved failed to obey the signals. (Campbell, Smith & Najm, 2004)

In recent years, many U.S. police agencies have begun using automated cameras as a supplement to the conventional methods of enforcing red light violations. The utilization of red light cameras is not a new technology. Some of the early noted uses of red light cameras for traffic enforcement date back to as early as 1969 in Israel, in Europe in the early 1970's, and in Australia on a wide scale in the 1980s. (Retting, Ferguson & Hakkert, 2003) In the United States, there are more than 200 communities that currently have red light cameras in use. (Insurance Institute for Highway Safety (IIHS), 2007)

There are some distinct advantages to using red light cameras as a supplement to conventional methods of traffic enforcement. For example, red light cameras provide 24 hours a day 365 days a year unbiased traffic enforcement and produce a record of evidence that cannot easily be disputed. The basic technology behind red light cameras was developed in the 1960's. The camera system monitors the status of the traffic signal by an electronic connection to the signal controller, with most systems determining vehicle presence using electromagnetic sensors that are buried in the pavement near the intersection entry point. Once the vehicle triggers the sensors indicating a red light violation occurred the camera records the images of the offending vehicle and the surrounding scene. Additional evidence is recorded such as the date and time of offense, vehicle speed, duration of the yellow signal, and how long after the red signal the offending vehicle began to enter the intersection. With most systems a second photograph is recorded to verify the offending vehicle proceeded through the intersection on the red signal.

As advances in technology were made, video processing and digital technology allowed the use of video and digital cameras as an enhancement to conventional wet-film devices. Most red light systems are fully portable and can be deployed at several intersections that are equipped with the necessary sensors and connections to a traffic signal. Some jurisdictions opt to install camera housings at multiple intersections without cameras actually being installed. The benefit is twofold to this strategy. By placing the housings at numerous intersections, more areas per camera can be covered and driver deterrence can potentially be increased.

Numerous published evaluations of red light camera effectiveness have been completed over the years on a state, national and international level, with most, if not all, notating red light cameras had a positive impact on reducing crashes and red light violations. This study intends to identify the specific studies, location where the studies were completed and the results rendered from the studies.

Florida

In November of 1993, the Polk County Community Traffic Safety Team (PCCTST) began a project designed to test and evaluate automated photo enforcement systems. The project was funded by the Federal Highway Administration (FHWA) and it was believed at the inception of the project the use of automated photo enforcement would decrease the frequency of vehicles running red lights and thereby reduce the frequency, and severity of traffic crashes at the signalized intersections.

The goals of the project were to:

- Verify the feasibility and effectiveness of the automated photo enforcement technology in helping the enforcement of traffic laws.
- Demonstrate the usefulness of technology to Florida law makers; and
- Showcase the automated enforcement technology.

At the beginning of the project three intersections in three different cities within Polk County were selected to include:

- US 17/US 98 in Fort Meade
- US 27/County Road 17 in Haines City
- SR 37/Lemon Street in Lakeland

The intersections were selected based upon several criteria to include; traffic patterns, safety, vandalism, type of intersection, geometric considerations, and traffic composition. In September 1994 the installation of the cameras was completed and full operations commenced for the project until which time the project concluded in April 1996.

Results from the Polk County Project

The number of violations recorded significantly increases with the implementation of the camera systems. For example, cameras at the Fort Meade location recorded 5 violations/day on an average, whereas traditional police enforcement identified only 15-30 violations/year. The results were similar in Lakeland and Haines City with cameras recording 15-20 violations/day. Additionally, it was found that red light cameras at the Fort Meade location recorded a total of 669 violations during the four months of camera operation. (Burris & Apparaju, 1998)

Crash data was gathered for pre- (1994-1995) and post- (1996) campaign for Polk County which revealed:

	’94	’95	‘96
January-June	113	133	122
July-December	114	127	119
Totals	227	260	241

The Polk County crash statistics for the last six month period of 1996 (campaign period) shows 119 crashes, which is a decrease from the1995 statistics which shows 127 crashes. When evaluating the crashes for each year-the total for 1996 year is 241 versus the total for 1995 of 260 (showing a decrease). (Burris & Apparaju, 1998)

National level

A statewide red light camera law took effect in California in January 1996, which permitted municipal governments to establish local red light camera enforcement programs. Under this specific California law, a vehicle driver that ran a red light would be charged with a moving violation. Photography was utilized to capture the image of the driver and the vehicle's front license plate. In the cases reviewed, if the sex and estimated age of the photographed driver matched that of the registered owner, then the owner was presumed to be the driver and is issued a citation by mail. Under California law, citations issued through the red light camera enforcement efforts carried the same sanctions of a conventional traffic stop-currently $271.00 and one point assessed to the driver license.

Prior to going online with any red light camera initiatives, city officials embarked on an awareness campaign to inform the public of the future intentions and goals of installing red light cameras as a public safety measure. As a start, a 30-day warning period, during which red light cameras photographed violators, but citations were not issued. In addition to the warning period, California law required the city to install signage at the intersections advising motorists of the red light photo enforcement at the signalized intersections. The city also publicized the red light camera program by way of press releases and obtaining the assistance of the local media to get the word out regarding the upcoming red light photo enforcement program. On July 1, 1997, the actual enforcement initiative started at 11 select intersections in Oxnard, California.

As a means to implement some controls in the study, three California cities did not implement any red light camera enforcement during the study period. Two cities, Bakersfield and San Bernardino were selected because they each had approximately the same number of annual crashes as Oxnard and each city was more than 100 miles from Oxnard as well. The third city selected was Santa Barbara, which is approximately 40 miles north of Oxnard and Santa Barbara was utilized as a control in an earlier study where Oxnard was the focal point.

Crash data was secured for the four cities from the California Statewide Integrated Traffic Records System and the data was analyzed for a 29 month period preceding the camera enforcement (January 1995 – May 1997) and for 29 months of enforcement (August 1997 – December 1999).

Results of the Oxnard, California Study

Table 1 summarizes the changes in the number of crashes from the baseline period through the enforcement period, for signalized and nonsignalized intersections. For the three control cities, the frequency of crashes changed in a roughly similar manner at both signalized and nonsignalized intersections. In Bakersfield and Santa Barbara, the number of crashes declined at both types of intersections; in San Bernardino, it increased. (Retting & Kyrychenko, 2002)

Table two summarizes the changes in the number of injury crashes for signalized and nonsignalized intersections for all four cities. As was found for total crashes, the number of injury crashes in the control cities changed in a roughly similar manner at signalized and nonsignalized intersections from the baseline period through the enforcement period. (Retting & Kyrychenko, 2002)

Table three summarizes the effects red light camera enforcement at intersections on 2 primary types of multiple-vehicle crashes-right angle and rear end. Overall, right angle crashes accounted for 26% of all crashes at signalized intersections and 42% at nonsignalized intersections. (Retting & Kyrychenko, 2002)

TABLE 1—Total Crashes Before and After Enforcement and Its Estimated Effects

City and type of Intersection	Before	After	Change (%)
Bakersfield			
Nonsignalized	760	753	–0.9
Signalized	771	739	–4.2
San Bernardino			
Nonsignalized	1220	1283	5.2
Signalized	1324	1400	5.7
Santa Barbara			
Nonsignalized	712	622	–12.6
Signalized	488	438	–10.2
Oxnard			
Nonsignalized	994	1011	1.7
Signalized	1322	1250	–5.4

Estimated Effects

Effect	Degrees of Freedom	Mean Square	F value	*P* value	Estimate	Change (%)
Camera	1	0.0013308	11.33	0.0281	–0.07296	–7.0
Error	4	0.00011741	...	...	...	...

TABLE 2—Injury Crashes Before and After Enforcement and Its Estimated Effects

City and type of Intersection	Before	After	Change (%)
Bakersfield			
Nonsignalized	245	241	–1.6
Signalized	243	233	–4.1
San Bernardino			
Nonsignalized	204	225	10.3
Signalized	239	246	2.9
Santa Barbara			
Nonsignalized	113	115	1.8
Signalized	89	84	–5.6
Oxnard			
Nonsignalized	173	194	12.1
Signalized	299	239	–20.1

Estimated Effects

Effect	Degrees of Freedom	Mean Square	F value	*P* value	Estimate	Change (%)
Camera	1	0.02865345	35.62	0.004	–0.33855	28.7
Error	4	0.00080437	...	...	...	...

license plate of a vehicle detected entering an intersection on a red light signal. The driver is not photographed in Fairfax as was the situation in the Oxnard, California study. The registered owner of the vehicle is subject to a $50.00 fine, but unlike the conventional enforcement method, there are no sanctions against the driver's license for the camera violation, as was the case in California.

Similar to the actions taken by the city officials in Oxnard, California, Fairfax instituted a 30-day warning program where red light violators were photographed, but no citations were issued. Signs were posted on major roadways and at numerous intersections advising motorists of the photo enforcement of traffic signals. Press releases were done with the media and postcards were mailed to all Fairfax residents informing them of the upcoming enforcement effort. Upon completion of embarking on the educational and awareness campaign, the actual enforcement effort began July 25, 1997.

Red light violation data was collected just prior to the warning period and then three months and one year after the enforcement began. A total of nine intersections were selected to be included in the study and two noncamera sites were selected in Fairfax ad two controls outside of Fairfax in nearby Arlington and Fairfax counties were selected as controls for the study.

Results of the Fairfax, Virginia Study

It was noted violation rates were lower at all camera and noncamera sites one year after the enforcement began. Overall reductions in violations/10,000 vehicles at the five camera sites were 7 percent three months after enforcement began and 44 percent after one year. Overall reductions at the noncamera sites were 14 percent three months after enforcement began and 34 percent after one year. (Retting et al., 1999)

International

Red light cameras have been used for quite some time outside of the United States, to include in; Europe, Australia and Singapore. In countries outside of the United States, it is predicted that road crashes will increase for at least the next two decades and, by 2020, road traffic injury is predicted to become the third greatest cause of death and disability in the world. (Aeron-Thomas & Hess, 2005)

In light of the numerous studies completed worldwide on the use of red light cameras, there is only 4 valid studies completed for countries outside the United States and all were completed prior to 1997. Of the studies reviewed during this research project three were from Australia and one from Singapore. After 1997, the only studies completed on red light cameras were from the United States.

In 1998, a study was completed in South Melbourne, Australia quantifying the impact of red light cameras on the incidence and severity of road crashes and casualties, as well as the incidence of red light violations. The study involved a three year before and after period of data collection on crashes, to include

casualty and rear end collisions. To determine which intersections would receive the red light cameras officials used selection criteria in terms of total right-angle and right-angle casualty crashes during 1997 to 1981 to ultimately select the 100 worst signalized intersections for the deployment of the camera systems.

The results of the study revealed a reduction in total casualty crashes, right-angle crashes, and rear end collisions.

Table 1 South Melbourne, Australia (Aeron-Thomas & Hess, 2005)

Casualty crashes			
RLC before	RLC after	Control before	Control after
596	450	625	544
Right-angle crashes			
RLC before	RLC after	Control before	Control after
123	48	144	89
Rear end crashes			
RLC before	RLC after	Control before	Control after
68	63	59	85

In 1997, a study was completed in Ng Singapore, where 42 camera junctions were compared with 42 control locations. A three year before and after period of data collection for crashes, to include casualty and rear end collisions were used during the study. Camera sites were selected based upon the high incidence of collisions and/or violations, hazards from heavy traffic flow, and complaints from pedestrians.

Table 2 Ng Singapore (Aeron-Thomas & Hess, 2005)

Casualty crashes			
RLC before	RLC after	Control before	Control after
520	386	510	415
Right-angle crashes			
RLC before	RLC after	Control before	Control after
107.5	79.4	105.4	86.5
Rear end crashes			
RLC before	RLC after	Control before	Control after
73	57	66	48

Method

The purpose of this portion of the research is to obtain a community opinion regarding the use of red light camera photo enforcement in the City of

Lakeland. The data was collected through a survey instrument that was sent to various members of the Lakeland community with the goal of reflecting the demographic makeup of the community itself.

The survey outlined a wide spectrum of questions that strived to feel the pulse of the community on the use of red light camera photo enforcement in the City of Lakeland. The survey established first and foremost whether or not the person being surveyed was a resident of the City of Lakeland in addition to being a licensed driver in the State of Florida. If the respondent answered yes to both of these questions then the survey prompted the respondent to continue with completing the remainder of the survey. However, if a no answer was secured for either of these questions then the respondent was instructed to terminate the survey based upon the surveys intent to obtain information from City of Lakeland residents and licensed drivers only.

To gather information on the respondents support or lack thereof of red light photo enforcement the survey posed several questions relating to the potential outcome of using red light cameras if implemented. The survey submitted 5 questions asking the respondents if red light cameras were installed do they feel it would reduce the number of red light violations, improve traffic safety in Lakeland, reduce the number of collisions and injuries, save taxpayers money and would it lower insurance costs.

Additional data garnered from the survey included the age and sexes of the respondents to not only exhibit the demographics of those surveyed, but to also reflect those of the diverse Lakeland community.

Results

The survey was sent to 50 members of the community with 40 surveys being returned for consideration. Of the 40 surveys received 6 were disqualified from consideration based upon the respondent residing outside the City of Lakeland. Therefore, the data collected from the qualifying 34 surveys were used in the research portion. Appendix A.

Appendix B summarizes the opinion of the citizens surveyed regarding the potential outcomes that could be realized if red light camera photo enforcement was installed and used in the City of Lakeland. Of the 34 citizens surveyed, 23 felt the use of red light camera enforcement would have a significant impact in reducing the number of people who do run red lights in the City of Lakeland. Improving traffic safety was also overwhelmingly supported by those surveyed with 22 citizens reaffirming the use of red light camera enforcement would significantly improve traffic safety in the city if used. The reduction of the number of collisions and injuries were also seen as a positive outcome if red light camera enforcement was implemented in the City of Lakeland.

Appendix C summarizes the age group surveyed to achieve results that reflected the demographic makeup of those who reside in the City of Lakeland community. The respondents ranged from 18-74 years of age, with the highest percentage being from the group of 45-54 years of age. This is reflective of the

diverse Lakeland community based upon the City of Lakeland Demographic Guide produced for 2007.

Appendix D summarizes the gender of those surveyed with 24 females and 10 males meeting the standards set forth in the survey, which qualified their surveys to be included in the study.

Discussion

The goal of law enforcement traffic enforcement is to achieve high levels of compliance with traffic safety laws with the motoring public. Prior research indicates changes in behavior resulting from the traditional enforcement methods of law enforcement generally are limited in nature and do not produce lasting changes in driver behavior.

However, further literature review revealed not all states maintain laws that are supportive of this type of mechanism to enforce traffic laws within their jurisdictions. Most, if not all states, have current laws that allow the use of red light cameras to enforce red light running on various levels, such as; the camera must photograph the driver and license plate in California while in other states the capture of the license plate image is acceptable to issue a civil traffic citation. Currently, the State of Florida law does not support red light camera enforcement on a city ordinance level, due in part to the state statute that already regulates this particular function. Therefore, most city and county attorneys deem the use of red light camera enforcement as unconstitutional.

In reviewing the literature on the national and international levels, it is clear that red light camera enforcement is highly effective in reducing red light violations and right-angle injury crashes associated with red light running. Although results vary considerably due in part to the methodology used to secure the outcomes, the results all indicate red light camera enforcement reduces injury crashes approximately 25-30% (Retting, Ferguson & Hakkert, 2003). The studies and supporting data clearly indicate red light camera enforcement does work in reducing red light violations and some traffic crashes directly related to right-angle or red light running as causation.

Recommendation

After extensive review of the literature and survey instrument submitted to various citizens of the Lakeland population, there are some recommendations that can be made.

- Lobby the State of Florida to modify the current laws to support the use of red light camera enforcement.
- Continue to educate the community on the tragedies and hazards associated with red light running.
- Law enforcement organizations should closely track the causations of traffic crashes and related fatalities to determine those related to red light running.

- Install and use red light camera enforcement as an additional means to enforce red light running to save lives.

Even if all of the recommendations are implemented there is no guarantee the motoring public will stop running red lights and causing traffic crashes resulting in injury or unfortunately death. However, it is incumbent upon law enforcement, the citizens of the State of Florida to do as much as possible to save lives and prevent future tragedies of this nature.

Mike Link has been with the Lakeland Police Department since 1986. He has worked in several areas to include Patrol, Street Crimes, SWAT, Criminal and Special Investigations. Mike is currently assigned to the Special Operations Section as the Officer in Charge of the Traffic Section and several other areas. He has a Bachelor's degree in criminology from St. Leo University.

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APPENDIX A

LAKELAND Traffic Safety Survey

Below is a survey regarding a local traffic safety issue within the Lakeland community. Please take a moment to review the survey and circle your response. Once completed, please return the survey to Lieutenant Mike Link of the Lakeland Police Department Traffic Section.

A. __ Are you a resident of the City of LAKELAND?

YES.....
NO.....TERMINATE

1. __ Are you a licensed driver in FLORIDA?

YES.....1
NO.....TERMINATE

2. __ Do you believe red light running is a problem in LAKELAND?

YES.....1
NO.....2
UNSURE.....8
REFUSED.....9

3. __ In many cities and states throughout the nation, law enforcement officials use red light cameras at intersections to monitor red light running offenses and enforce the law against dangerous drivers that run those red lights. Are you familiar with the use of red light cameras as a traffic safety device?

YES.....1
NO.....2
UNSURE.....8
REFUSED.....9

Below is a list of potential outcomes of using red light cameras. For each one, please circle whether or not you believe that red light cameras can help achieve these outcomes. The first outcome is to…

	YES	NO	UNS	REF
4. __ Reduce the number of people who run red lights.	1	2	8	9
5. __ Improve traffic safety in LAKELAND.	1	2	8	9
6. __ Reduce the number of collisions and injuries.	1	2	8	9
7. __ Save taxpayer dollars by reducing crash cleanup costs.	1	2	8	9
8. __ Lower insurance rates.	1	2	8	9

9. __ Would you say you would be more careful to observe red light signals if LAKELAND had red light cameras?

YES, MORE CAREFUL.....1
NO, NOT MORE CAREFUL, NO DIFFERENCE.....2
UNSURE.....8
REFUSED.....9

10. _ Red light cameras have been proven to reduce traffic violations and collisions; do you support or oppose using red light cameras at LAKELAND's most dangerous intersections to monitor drivers who run red lights, and to enforce the law against those drivers?

SUPPORT/STRONGLY 1
SUPPORT 2
OPPOSE 3
OPPOSE/STRONGLY 4
UNSURE 8
REFUSED 9

11. _ Studies from around the nation show that in cities where red light cameras are used, violations are down by as much as 60% where red light cameras are in use. In light of this data, are you more or less favorable towards the use of red light cameras?

MORE FAVORABLE 1
LESS FAVORABLE 2
NO DIFFERENCE 3
UNSURE 8
REFUSED 9

12. _ Sometimes in a survey like this, people's opinions change after they learn more about the topic being discussed. In light of statistics like these, has your opinion of red light cameras become more or less supportive, or has there been no change in your opinion?

MORE SUPPORTIVE 1
LESS SUPPORTIVE 2
NO DIFFERENCE 3
UNSURE 8
REFUSED 9

Below are a few simple questions designed to learn more about you to be sure we have a sample that includes all segments of the community.

15._ What was your age on your last birthday?

18-24 1
25-34 2
35-44 3
45-54 4
55-64 5
65-74 6
75+ 7
NOT SURE 8
REFUSED, NO ANSWER 9

16. _ Which of the following best describes your current employment status?

EMPLOYED FULL TIME 1
EMPLOYED PART TIME 2
UNEMPLOYED OR TEMPORARILY LAID OFF 3
RETIRED 4
HOMEMAKER 5
STUDENT 6
SOMETHING ELSE (SPECIFY)_____ 7
UNSURE 8
REFUSED 9

17. _How many minutes does it typically take you to drive to or from work?

LESS THAN 10 MINUTES 1
10 MINUTES TO 20 MINUTES 2
20 MINUTES TO 30 MINUTES 3
30 MINUTES TO 45 MINUTES 4
45 MINUTES TO 1 HOUR 5
GREATER THAN 1 HOUR 6
DO NOT DRIVE TO WORK/WORK FROM HOME 7
UNSURE 8
REFUSED 9

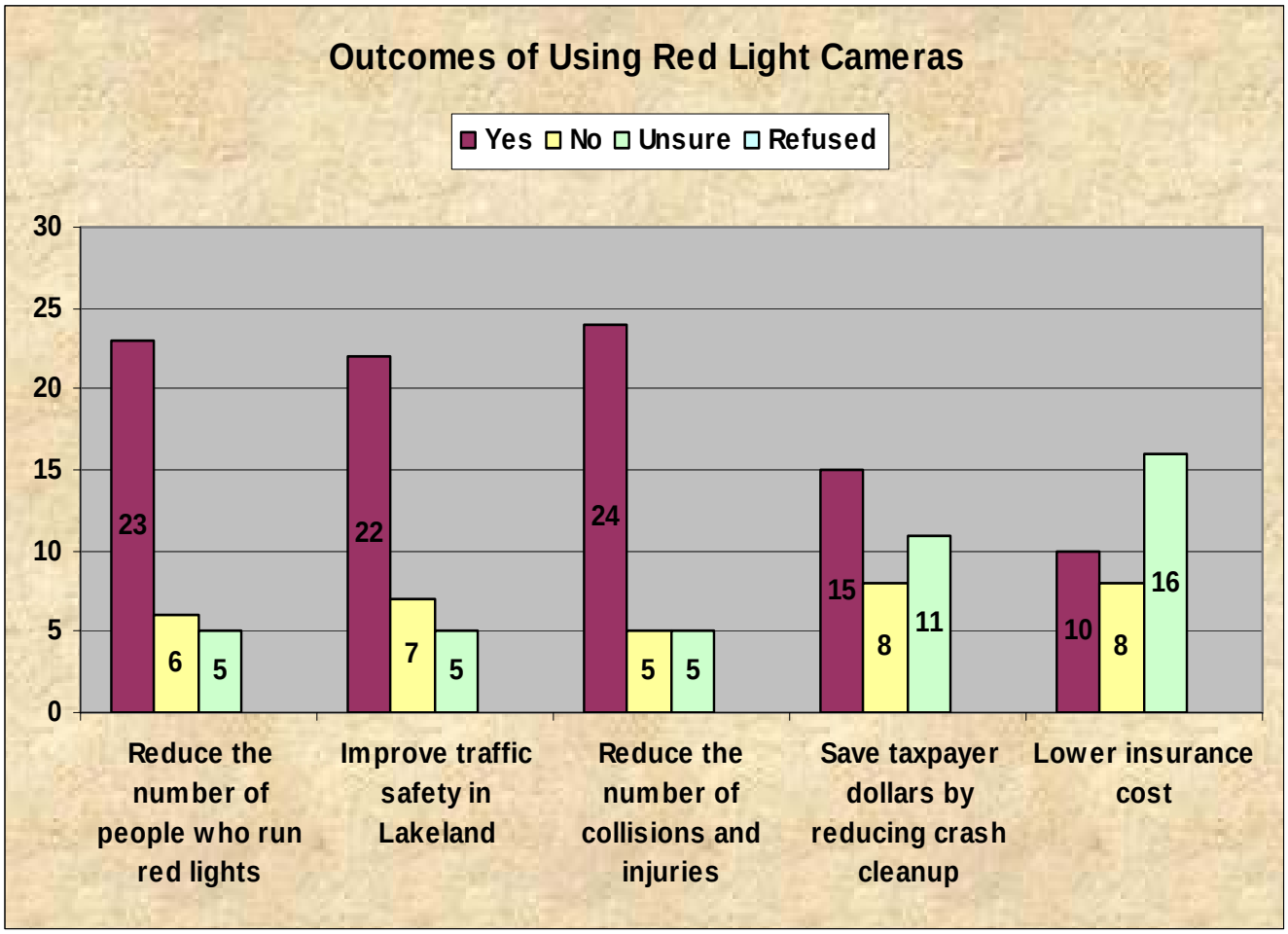
18._ What is the highest level of education that you had an opportunity to complete?

SOME GRADE SCHOOL (GRADES 1-8) 1
SOME HIGH SCHOOL (GRADES 9-11) 2
GRADUATED HIGH SCHOOL (12TH GRADE) 3
SOME COLLEGE 4
GRADUATED COLLEGE 5
GRADUATE/PROFESSIONAL SCHOOL 6
REFUSED 9

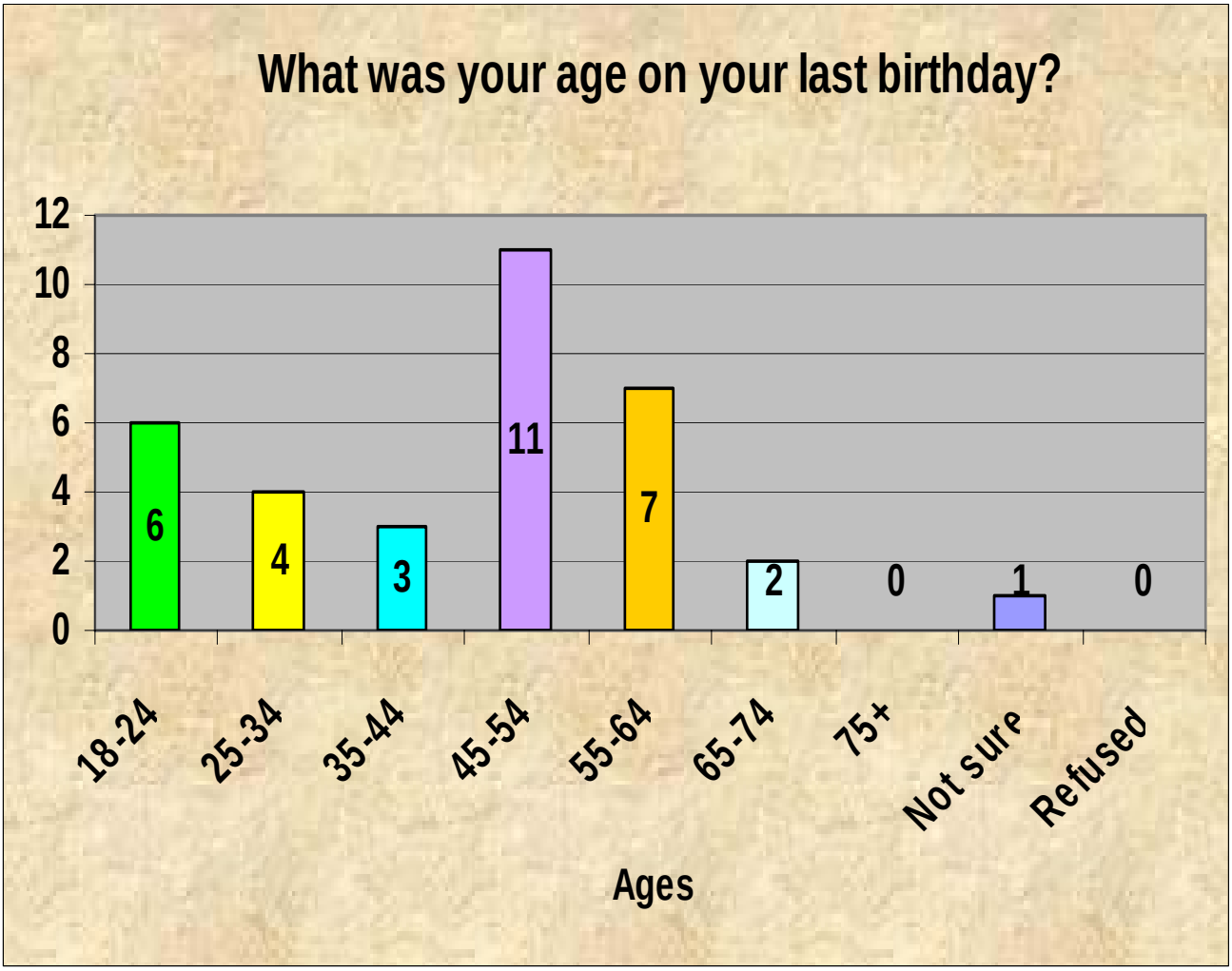
19. _ Record sex of respondent:

MALE 1
FEMALE 2

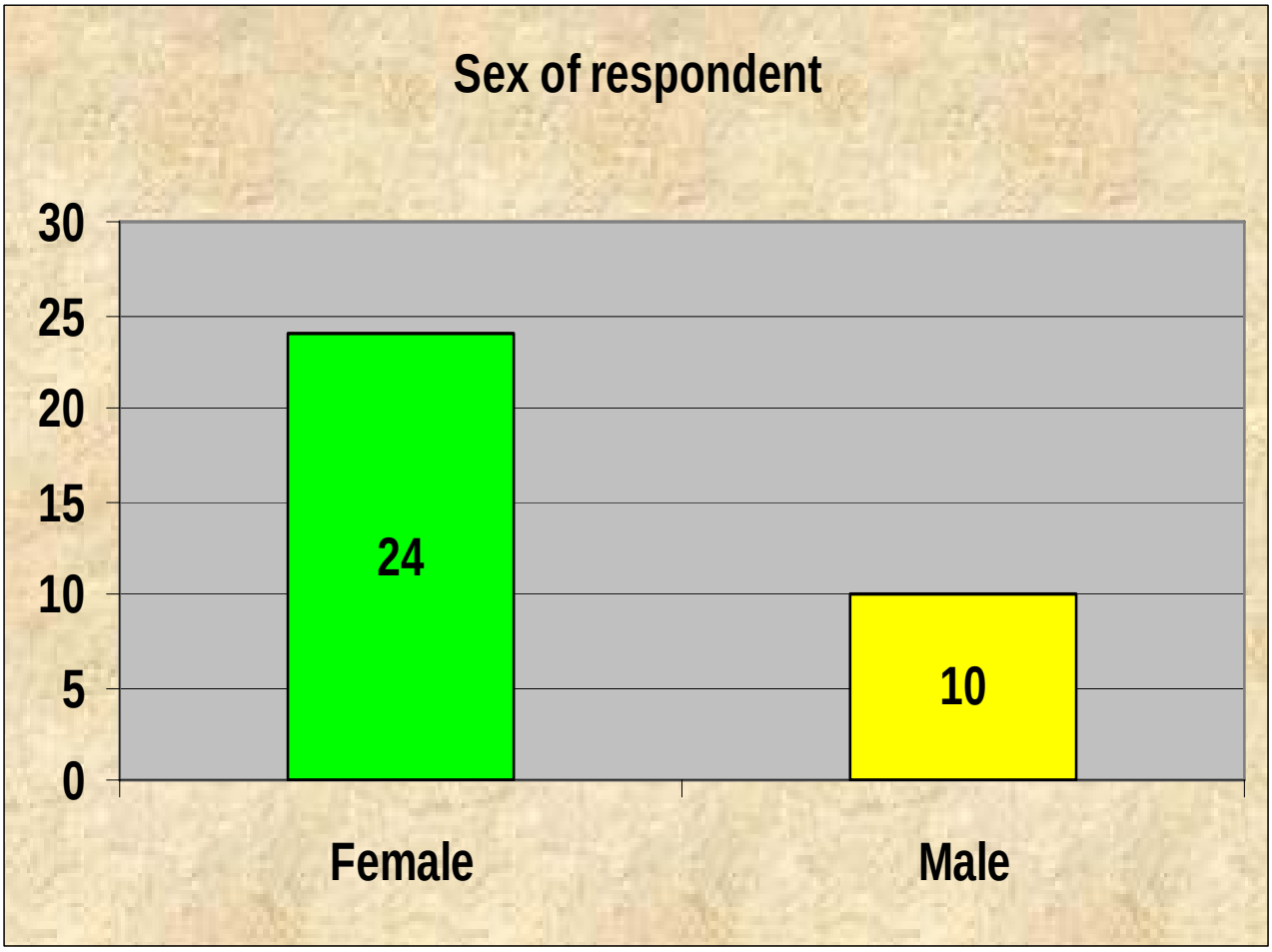
APPENDIX B


Outcomes of Using Red Light Cameras
Yes
No
Unsure
Refused
30
25
20
15
10
5
0
23
6
5
22
7
5
24
5
5
15
8
11
10
8
16
Reduce the number of people who run red lights
Improve traffic safety in Lakeland
Reduce the number of collisions and injuries
Save taxpayer dollars by reducing crash cleanup
Lower insurance cost

APPENDIX C


What was your age on your last birthday?
12
10
8
6
4
2
0
6
4
3
11
7
2
0
1
0
18-24
25-34
35-44
45-54
55-64
65-74
75+
Not sure
Refused
Ages

APPENDIX D


Sex of respondent
30
25
20
15
10
5
0
24
10
Female
Male