

The Effectiveness of Red Light Cameras

In Washington and Oregon

By

Kate Elise Bradbury

A PROJECT

submitted to

Oregon State University

University Honors College

in partial fulfillment of
the requirements for the
degree of

Honors Baccalaureate of Science in Civil Engineering (Honors Scholar)

Presented March 12, 2010
Commencement June 2010

AN ABSTRACT OF THE THESIS OF

Kate Elise Bradbury for the degree of Honors Baccalaureate of Science in Civil Engineering presented on March 12, 2010. Title: The Effectiveness of Red Light Cameras in Washington and Oregon.

Abstract approved:

Katharine Hunter-Zaworski

This study considered collision data for Seattle, Washington and Portland, Oregon in order to determine whether or not red light cameras are effective in reducing red light running collisions. Red light running is extremely dangerous and is a leading cause of urban automobile collisions in the United States. Red light cameras have emerged as a potential means to reduce the incidence of red light running, but their use is clouded in controversy regarding effectiveness. There are two sides to the issue and any data can be viewed from either standpoint, depending on the beliefs of the individual. This has greatly complicated the interpretation of current studies on the issue and added to the controversy.

The results from the analysis of the data from Seattle and Portland were ultimately inconclusive. Both cities have very small amounts of collision data, making it difficult to draw conclusions with any certainty. The data does, however, show a general decrease in severe (angle) collisions, but the accuracy of this statement is unknown. In addition, the definition of effectiveness and location also play a role in the difficulty of interpreting the results.

Key Words: Red light camera, Washington, Portland, effectiveness, collisions
Corresponding E-mail Address: kate.e.bradbury@gmail.com

The Effectiveness of Red Light Cameras

In Washington and Oregon

By

Kate Elise Bradbury

A PROJECT

submitted to

Oregon State University

University Honors College

in partial fulfillment of
the requirements for the
degree of

Honors Baccalaureate of Science in Civil Engineering (Honors Scholar)

Presented March 12, 2010
Commencement June 2010

Honors Baccalaureate of Science in Civil Engineering project of Kate E. Bradbury
presented on March 12, 2010

.
APPROVED:

Mentor, representing Civil Engineering

Committee Member, representing Civil Engineering

Committee Member, representing The Seattle Police Department

Dean, University Honors College

I understand that my project will become part of the permanent collection of Oregon State University, University Honors College. My signature below authorizes release of my project to any reader upon request.

Kate E. Bradbury, Author

Table of Contents

	<u>Page</u>
Introduction.....	1
How Red Light Cameras Work.....	3
Red Light Camera Deployment: Two Case Studies	6
Red Light Camera Usage in Seattle, Washington	6
Red Light Camera Usage in Portland, Oregon	8
Red Light Camera “Costs and Benefits”.....	11
Benefits of Red Light Cameras	11
Issues with Red Light Cameras	13
The Measure of Effectiveness.....	15
What does “effectiveness” mean?	15
The Federal Highway Administration Study.....	16
Other Studies	17
Red Light Camera Collisions: A Tale of Two Cities.....	19
Seattle, Washington.....	19
Portland, Oregon	21
Analysis of Seattle and Portland Data.....	23
Seattle, Washington.....	23
Portland, Oregon	24
Comparisons and Conclusions	26
Conclusion	28
Works Cited	29
Appendices.....	32
APPENDIX A: List of Terms and Acronyms	33
APPENDIX B: RLC Intersections	34
APPENDIX C: Additional Data	35

List of Tables

<u>Table</u>	<u>Page</u>
1. Combined results for seven jurisdictions	16
2. Seattle RLC Intersection Data Summary	19
3. Collisions by Type for Seattle RLC Intersections	20
4. Portland RLC Intersection Data Summary	21
5. Collisions by Type for Portland RLC Intersections	22

List of Appendix Tables

<u>Table</u>	<u>Page</u>
Table 1. All Seattle Data – January 2003 through August 2009.....	35
Table 2. All Portland Data – January 1998 through December 2008	35

The Effectiveness of Red Light Cameras in Washington and Oregon

Introduction

This report considers data from two Northwest cities to determine whether or not the use of red light cameras (RLCs) or photo enforcement reduces the number of red light running collisions. The two cities examined were Seattle, Washington and Portland, Oregon.

Red light running occurs when a driver proceeds through an intersection when a red light is displayed on the traffic signal device. Variations may exist across different jurisdictions, but this definition is largely accurate. Red light running is an extremely dangerous problem and is a major cause of traffic collisions throughout the world. In the United States in 2007, approximately 900 people were killed and 153,000 people were injured in red light running related collisions (“The Red Light Running Problem”). People are aware of the issue of red light running, but the problem is not getting any better. Approximately “96% of drivers fear they will get hit by a red light runner when they enter an intersection”, however, over 55% of Americans admit to running red lights (“Red Light Cameras”). The use of red light cameras, or photo enforcement systems, has emerged as a potential approach to reducing the frequency of red light running occurrences and collisions. However, there is a great amount of controversy surrounding the use of red light cameras and whether or not they are effective.

Many locations around the world have incorporated red light cameras into their traffic systems, but the results have been mixed. Effectiveness is still an ambiguous

quality of the cameras. Numerous studies have been performed from cities around the U.S. as well as Canada, Australia, and other countries, but none of them seem to show conclusive results for effectiveness. It is extremely important to verify that the cameras are successful in reducing collisions and collision severity especially due to the high cost of camera installation and operation.

Not all red light camera systems are the same, however, and it is important to understand how they work and what types of equipment are used. This will be discussed in the first section followed by an overview of RLC use in Seattle and Portland in the second section. The third section is a consideration of the costs and benefits of using RLCs and section four takes a look at what the measures of effectiveness are for interpreting RLR data. The next section, section five, will present the data collected from the RLC intersections in Seattle and Portland. Finally, there will be an analysis of the data from the two cities, conclusions regarding the analysis, and recommendations for further study or action in section six.

How Red Light Cameras Work

Red light cameras are used in many different places around the world to serve the same purpose, however, the setup and equipment can vary greatly from place to place. In general, red light camera systems include at least one camera, at least one trigger, and a computer (Harris). For each of these components, there are multiple options for the type of equipment used. The cameras can be film cameras, digital cameras, video cameras, or some combination of these. Different types of triggers include induction loops, laser, radar, and air-tube sensors (Harris).

The camera component is critical to the red light camera system, so the type of camera can have a big impact on how well the system functions (see Figure 1). Film cameras are the most common camera used for red light running detection; however, as technology has advanced, digital cameras have improved the effectiveness of the systems and are typically the choice for new systems (“Red Light Cameras”). Film cameras can produce photos in black and white or in color, but color is preferred more often since it does not allow for any question of the color of the traffic signal (“Red Light Cameras”). Digital cameras are beginning to replace film cameras, however, due to greater advantages as a result of better technology. Digital cameras allow higher resolution in the photos, are able to prevent reflections or light from distorting the images, both improving vehicle/driver identification, and they provide easy collection (“Red Light Cameras”). In addition to a still frame camera, a video camera can also be present in the red light camera system. A video camera can be a very beneficial addition to a system since video footage can help citation reviewers understand the overall situation and better

determine if a citation is warranted. This added information can greatly improve the efficiency of a red light camera system and help to avoid issuing unwarranted citations.



Figure 1. Typical Red Light Camera Setup (“Red-Light-Camera-Springfield-Ohio.jpg.”)

The cameras are an integral part of the red light running system, but the devices that trigger the cameras are also very important components. Induction loops are the most common form of trigger for the cameras and include two induction loops placed in the pavement near the stop line (Harris). The loop is made up of electrical wire embedded in the pavement, just like sensors for actuated traffic signals, and a current that is sent through the wire creates a magnetic field that is broken when a vehicle passes over it. Two loops are typically used so that they can detect the speed of a vehicle at a certain point on an approach (Harris). The computer relates this to the phase of the traffic signal and uses the information to decide if the vehicle will run the signal and if the cameras should be activated. And while other types of triggers, such as radar, lasers, and air-tube

sensors are used in some areas, they are very limited in use, typically less favored over induction loops.

All of these important components together in various combinations make up a red light camera system. While there is a lot of variation in the setups, the general function and operation of the systems are fairly similar. Typically, if a vehicle has passed into the intersection (i.e. crossed the stop line) after the traffic signal has changed to red, the induction loops in the pavement will activate the cameras (Harris). If a video camera is included in the system, this will start the recording of video footage in addition to triggering the still frame camera(s). Some systems have two still frame cameras so that one camera can capture the vehicle before and after it enters the intersection while the signal is red and the other camera can capture the vehicle's license plate. However, with the high resolution available with digital cameras, one camera can be used to capture all of this information.

Even if the triggers activate the cameras and a vehicle is captured on camera, this does not automatically signify a citation. A review process occurs before citations are issued to make sure that a traffic infraction has actually occurred. But once it is confirmed, the police or local jurisdiction will look up the license plate and issue a citation in the mail to the owner of the vehicle along with the photos, which include the date, time, and intersection of the infraction (Harris). This process is pretty typical for many red light camera systems, but more specifics regarding Seattle and Portland's systems will be provided in the next section.

Red Light Camera Deployment: Two Case Studies

Red Light Camera Usage in Seattle, Washington

The Seattle Police Department in association with the City of Seattle initiated a pilot red light camera program in July of 2006, installing cameras at four intersections across the city. Following a 12 month study, the City determined that RLR decreased by approximately 50% over the time period and that while total number of collision did not decrease, the severity of these crashes did (“City of Seattle Traffic Safety Camera Pilot Project”). Based on these results, and somewhat on the revenue generated from the citations, the City identified 18 new intersections where they would implement cameras as well as existing intersections that would add cameras. After the new cameras are installed, Seattle will have a total of 30 cameras at 22 intersections around the city (see Appendix B).

Washington State Law only allows red light cameras to take pictures of the offending vehicle and its license plate, not the driver or any passengers (“RCW 46.63.170”). Due to this, positive identification of the driver is not guaranteed. The registered owner of the vehicle is responsible for any RLR infraction, but since they may not have been the one operating the vehicle at the time of the violation, it is possible for them to sign an affidavit declaring that they were not driving and the citation can be dismissed (“RCW 46.63.170”). While it would be rather simple to get out of a ticket in this manner, a very small percentage of the people who wish to contest the citation in

Seattle end up signing the affidavit (Quinn). One other way that a citation may be thrown out is if it is not mailed to the registered owner of the vehicle within 14 days of the violation (“RCW 46.63.170”).

All of the Seattle systems are provided by American Traffic Solutions (ATS) and include a high resolution still-frame camera, a video camera, and a vehicle sensing device that activates the cameras (“City of Seattle Traffic Safety Camera Pilot Project: Final Evaluation Report”). The still-frame camera captures two pictures of the offending vehicle and the video captures a more complete picture of the situation, which helps to determine whether or not a citation is warranted. A citation is warranted when one photograph taken shows a vehicle behind the stop line while the light is red and the second photograph shows the same vehicle in the intersection while the light is still red (“City of Seattle Traffic Safety Camera Pilot Project: Final Evaluation Report”).

Therefore, a vehicle has run a red light only when it enters the intersection, i.e. crosses the stop line, after the signal has turned red and continues through the intersection.

Errors can occur in the system so a review process is required to reduce the number of false citations issued. The information is reviewed first by ATS then by the Seattle Police Department against criteria established by SPD (“City of Seattle Traffic Safety Camera Pilot Project: Final Evaluation Report”). If the reviewers deem that the infraction has met the criteria, then a citation will be issued within 14 days to the registered owner who then has 18 days to pay the fee. Citations for red light camera infractions are treated as parking violations under Washington State Law so that the violations are not a part of the registered owner’s driving record (“RCW 46.63.170”).

The cost of the camera violation, however, is equal to the cost of a red light violation given by a police officer, \$124.00.

Red Light Camera Usage in Portland, Oregon

The City of Portland began its red light camera program in October 2001 and installed six red light cameras at five intersections around Portland. After October 2007, the city installed four new cameras at four other intersections (see Appendix B). All of the intersections selected were chosen due to a significant crash history credited to red light running (Burchfield 4). In their own analysis, Portland found that injury crashes as well as the severity of crashes have reduced in intersections with red light camera enforcement (Burchfield 6). Portland also recently awarded a 5 year contract to their current provider, Affiliated Computer Systems, that would include the installation of 5 new cameras in the first two years of the contract, bringing the total to 16 RLCs (Davis).

Oregon State has no law preventing traffic cameras from photographing the driver of the vehicle, unlike Washington, resulting in a more positive identification of the driver. Since drivers can sometimes be identified from the photographs, the driver of the vehicle at the time of violation can be issued the citation rather than the registered owner of the vehicle, if they are different (“Chapter 810”). Similar to Washington state, on the other hand, the citation must be issued within a certain time period after the violation. While Washington allows 14 days, however, Oregon State Law requires that the citation be mailed within 10 days of the citation (“Chapter 810”). The registered owner or driver of

the vehicle is then given 30 days from the citation mail date to pay the fee (“Chapter 810”).

The Portland red light cameras are provided by Affiliated Computer Systems (ACS) and have a slightly different setup and equipment from what ATS provides for Seattle. Ten of the eleven RLCs that Portland has are wet film cameras that take a still frame picture of the offending vehicle (Davis). The photo also contains a data bar that shows the time and speed of the vehicle at the time of the offense (Davis). The other camera, installed at SE 96th and Foster, is a dual-digital camera that also takes video of the scene (Davis). The triggers for all of the wet cameras are inductor-loop triggers while the digital camera uses an overhead radar as the trigger that also measures the speed of the vehicle (Davis). A citation is warranted under the same circumstances as in Washington, when a vehicle fails to stop at the stop line when the signal is red and continues through the intersection. Drivers must stop at a yellow light if they are able to do so safely, but intersections with the cameras give the driver the full yellow time to cross the stop line (Davis).

As with Seattle and most other red light camera programs, Portland also has a review process due to the possibility of camera or system error. The violations are initially collected by the camera vendor and reviewed for photo clarity and gender match, then input into an electronic citation that also includes DMV/driver information (Davis). These citations are then put into a queue that police officers from the traffic division access daily and review the citations for legitimate violations (Davis). If they decide a violation has occurred, a citation is mail to the registered owner within 10 business days. In Oregon, red light running violations, whether seen by police officers or by cameras,

are considered moving violations and are part of a driver's record. In Multnomah County, the fine for a violation is \$287.00 (Davis).

Red Light Camera “Costs and Benefits”

Benefits of Red Light Cameras

Red light running is a major problem around the world and it is extremely dangerous. The Insurance Institute for Highway Safety estimates 22 percent of all traffic collisions in the United States are due to red light running (Harris). Red light cameras have been used to try to reduce these numbers and they have potential to be or have proved to be beneficial in several ways.

First, red light cameras, at least in theory, make intersections safer. They are intended to reduce the number of vehicle running red lights, thus reducing the number of collisions in intersections due to RLR. Different studies have produced differing results, however, so it is unclear if they do in fact improve safety. Assessments of data from Fairfax, Virginia and Oxnard, California showed a 40 percent drop in RLR violations, while a long-term study from Australia found that the “installation of the RLC at [various] sites did not provide any reduction in accidents” rather they experienced increased collisions (“Q&As: Red Light Cameras”; Andreassen i). In general, however, most studies see some kind of reduction whether it is in number of violations, collisions, injuries, or a specific type of collision.

While it is not definitive that RLCs improve safety and reduce accidents, they are extremely effective for traffic enforcement. Red Light cameras eliminate the need for officers to be present to enforce signal laws. Police have many responsibilities, and while red light running is dangerous and is a serious problem, police are often required for other

enforcement needs. In addition, police officers are not able to be everywhere at once, but the cameras are working each intersection 24 hours a day, 7 days a week. Red light cameras are also a much safer way to enforce traffic laws. In many places, police officers must follow a vehicle through the red light in order to stop them, which is extremely dangerous (“Q&As: Red Light Cameras”). Seattle and Portland are two of these places that require the police officer to follow the offending vehicle through the red light in order to issue a ticket (Quinn; Davis).

The concept of “halo” intersections is another potential benefit of red light cameras. The idea is that the cameras will have a “halo effect” on surrounding or nearby intersections where red light cameras are not installed. This too has had mixed results. Seattle’s data for halo intersections “shows no consistent pattern...either positive or negative relationships with trends at nearby intersections” (“City of Seattle Traffic Safety Camera Program: Year II Evaluation Report”). Kingsport, Tennessee, on the other hand, claims to have seen a halo effect and drivers slowing down at other intersections on account of RLCs at other locations (Lane). Just like overall effectiveness, however, the data is not conclusive.

Red light cameras are providing some benefits to the locations and cities using them, but there are no conclusive results, as of now, that confirm most of the assumed benefits or the degree to which they are helping. Evidence supports both sides, but, at least in some instances, red light cameras have made improvements and caused reductions in violations and collisions.

Issues with Red Light Cameras

Several problems and challenges also exist with red light cameras. First of all, privacy laws can make operation and citation difficult. Some states, like Washington, do not allow photos to be taken of the driver of the vehicle. Since the registered owner can claim they were not driving, even if they were driving, and get the charge dropped, the cameras are not really being as effective as they potentially could be. Not that this is a common occurrence, but it is a possibility and a flaw in the system. Other states, like Oregon, however, are permitted to take photographs of the driver, allowing for higher success of captured violators.

Another problem is the high cost of leasing and operating red light cameras. While the total cost varies based on the camera provider as well as the specific contract and equipment needs, the cameras are still rather pricey. A typical camera and its installation costs approximately \$100,000 (“Q&As: Red Light Cameras”). Cities will often end up paying more than this, however, since the camera providers can claim a percentage of each citation issued as well as collect a monthly fee (George). These additional charges are entirely based on the company, the city or jurisdiction, and the contract between the two entities. In the case of Washington State, it is illegal to pay the camera vendor for anything other than “the value of the equipment and services provided or rendered in support of the system, and may not be based upon a portion of the fine or civil penalty imposed or the revenue generated by the equipment” (“RCW 46.63.170”). This is not the case everywhere though so red light cameras can end up costing a jurisdiction a fortune to install and operate.

Two more issues with the cameras are that the violations require additional screening as well as the potential for drastic reductions in revenue. Every photograph taken by the cameras must first be reviewed based on certain criteria. Often there is a small division of the police department responsible for checking each picture to verify the vehicle information and whether or not the vehicle is in violation (“Q&As: Red Light Cameras”). While this process is necessary for the system to function properly, at least one person must be paid to check each photo and all citations must be issued within a certain period of time. The revenue generated by the cameras is often more than enough to cover the cost of the review, but if the process gets backlogged it could result in a large loss of revenue depending on how long it takes to fix it. As for reductions in revenue, a couple of jurisdictions have found that the cameras are essentially too effective. Dallas, Texas shut down a quarter of the cameras they had in 2008 because there were fewer and fewer “ticketable violations and ever-shrinking revenue from fines”; the cameras were not even able to support themselves (Johnson). Drivers seem to be paying attention to the cameras, at least in certain areas, causing municipalities across the country to reconsider using red light cameras (Johnson). It is good if violations are decreasing, one of the intentions of the cameras in the first place, but many jurisdictions rely on traffic fines to feed into their budgets, so it can be a problem, depending on how you look at it. As with everything, red light cameras have both advantages and disadvantages, and sometimes it is just a matter of opinion.

The Measure of Effectiveness

What does “effectiveness” mean?

Effectiveness is the biggest question surrounding red light cameras. Are the cameras successful in reducing the number of intersection collisions? Are intersections safer with the cameras? Are the cameras reducing the severity of collisions as well as injuries? All of these are questions regarding the effectiveness of red light cameras and ones that cannot be easily answered without the context of “effectiveness”.

The most prominent issue with effectiveness is what results prove the cameras work or do not work. There are essentially two sides to this issue. First, one side believes that if the data shows a decrease in the severity of the crashes, i.e. angle collisions are reduced, then the cameras are effective, regardless of what else the data may show. The other side believes that even if the severity of the crashes is reduced, but there is an increase in total or rear end collisions, then the cameras are not effective. Because of these two opposing views, it is impossible to determine a clear cut classification for whether or not the cameras are effective or not; it all depends on how an individual views the data and the situation.

The Federal Highway Administration Study

The Federal Highway Administration (FHWA) performed a red light camera study in 2000, which is accepted as the most comprehensive study regarding RLCs. The study looked at data from seven jurisdictions with red light camera programs: El Cajon, San Diego, and San Francisco, CA; Howard County, Montgomery County, and Baltimore, MD; and Charlotte, NC (“Safety Evaluation”). A summary of the results from the study are shown in Table 1.

Table 1. Combined results for seven jurisdictions

	Right-Angle Crashes		Rear End Crashes	
	Total Crashes	Definite injury	Total crashes	Definite injury
EB estimate of crashes expected in the after period without RLC	1,542	351	2,521	131
Count of crashes observed in the after period	1,163	296	2,896	163
Estimate of percentage change (standard error)	-24.6 (2.9)	-15.7 (5.9)	14.9 (3.0)	24.0 (11.6)
Estimate of the change in crash frequency	-379	-55	375	32

Note: A negative sign indicates a decrease in crashes

(“Safety Evaluation of Red-Light Cameras—Executive Summary”)

As shown above, the study found that the number of angle crashes decreased by about 25 percent, while rear end collisions increased by about 15 percent (“Safety Evaluation”). The FHWA findings are fairly consistent with other studies that were performed prior to this one (“Safety Evaluation”). However, based on the ambiguity in the meaning of effectiveness, these results do not really give a clear answer. The FHWA believes that their results show that the cameras are effective because they reduce the severity of collisions, and thus the severity of injuries. For some people, however, since

the total number of collisions was shown to increase, they do not believe that the cameras are effective.

Other Studies

Many other studies have been performed looking at the effectiveness of red light cameras other than the FHWA study, but have produced mixed results. Some studies support the FHWA findings that the severity of crashes decreased, but rear-end crashes increased. Others show no change or an increase in any or some types of collisions.

A study performed by the Virginia Department of Transportation in 2005 supports the FHWA study with an increase in rear-end crashes and a decrease in red light running crashes (Garber “The Impact”). Another Virginia DOT study from 2007 also supports the FHWA study, again with a decrease in red light running related crashes and an increase in rear-end collisions (Garber “An Evaluation” 30-31). A 2003 study from Ontario, Canada found a decrease in angle crashes and an increase in rear-end collisions at red light camera intersections (“Evaluation of the Red Light Camera” III). These represent a few of the most comprehensive studies that support the FHWA study and show a decrease in at least one type of collision.

Other studies performed do not support the FHWA study and have far less positive results. A 2005 study in Washington D.C. showed a significant increase overall, doubling the total number of crashes between 1998 and 2005, increasing injury and fatal crashes by 81%, and increasing angle collisions by 30% during the time frame (Wilber).

A 2004 North Carolina A&T University study found no change in angle collisions and a large increase in rear-end collisions (Burkey 46). The 1995 Australian Road Research Board study essentially found no demonstrated value in red light cameras as an effective countermeasure to reducing red light running collisions (Andreassen i). One other study with contradicting results is a 1995 Monash University study from Australia. This study found that there was no difference in observed rates of red light running between camera and non-camera intersections (Kent).

Many accept the results of the FHWA study to be typical for most red light camera systems. Several other studies support the FHWA's results, but there are also several that do not support their results and often show opposite effects. All of these studies do show that there is great variability in the success of red light cameras to reduce red light running collisions and improve safety. Location is a major factor and these studies suggest that it is possible for red light cameras to be an effective means to reduce red light running collisions, but it significantly depends on the location, the drivers, and the systems themselves. However, even if studies do show that some aspect of red light running collisions has improved, the ambiguity in what is considered to be effective still causes issues when interpreting the results. It will still depend on the individual and what they deem to be effective.

Red Light Camera Collisions: A Tale of Two Cities

Seattle, Washington

Seattle currently has plans for 30 red light cameras throughout the city. Only six of these cameras have been in operation long enough to have a reasonable amount of data to analyze. The four intersections with these six cameras include: Denny Way & Fairview Ave, 5th Ave & Spring St, Rainier Ave S & S Orcas St, and Roosevelt Way NE & NE 45th St. The Seattle Police Department (SPD) provided collision data for each of these intersections; however, the reports did not include information regarding the cause of the collision. The Washington State Department of Transportation (WSDOT) provided access to their online collision report viewer, which allowed for a review of all of the classified police reports to determine if the cause of the collision could be attributed to red light running. The summary table below (Table 2) was produced based on the information collected from the collision and police reports.

Table 2. Seattle RLC Intersection Data Summary

<u>Intersection</u>	<u>RLRs Before Install</u>	<u>RLRs After Install</u>	<u>Total RLRs</u>	<u>Total Collisions</u>	<u>% RLR of Total</u>	<u>Greater Before/ After</u>
Denny Way & Fairview Ave	19	10	29	47	62%	Before
5th Ave & Spring St	24	26	50	76	66%	After
Rainier Ave S & S Orcas St	9	2	11	78	14%	Before
Roosevelt Way NE & NE 45th St	12	2	14	40	35%	Before
Total	64	40	104	241	43%	Before

Not all of the red light cameras were installed at the same time, however, which results in inconsistent data. Because of this, data was considered for three years before installation and three years after the installation of each camera.

It is also important to look at the breakdown of the types of collisions at each intersection. Angle collisions and rear-end collisions are the two most crucial types when considering the effectiveness of red light cameras. They are also the two types most often analyzed in other red light camera studies. Table 3 contains data regarding these two types of collisions for each of the RLC intersections in Seattle.

Table 3. Collisions by Type for Seattle RLC Intersections

Intersection	Angle Collisions			Rear-End Collisions		
	Before	After	Greater	Before	After	Greater
5th Ave & Spring St	25	22	Before	0	0	Equal
Denny Way & Fairview Ave	20	13	Before	0	1	After
Rainier Ave S & S Orcas St	4	4	Equal	6	1	Before
Roosevelt Way NE & NE 45th St	13	3	Before	0	1	After
Total	62	42	Before	6	3	Before

The types of collisions were derived from the Seattle collision reports and the same time period of three years before and three years after installation was used for collision types as well. Data was only available through August 2009 for all intersections, however, so all of the data available, although less than three years after installation, is all that was used for the analysis of after installation collisions.

Portland, Oregon

Portland currently has nine cameras operational and plans to install five more throughout the city. The first cameras were installed in 2000 and the last one was installed in 2008 so most of the cameras have enough data for a comparative analysis. These intersections include: E Burnside & SE Grand Ave, NE Sandy Blvd & NE 39th St, W Burnside & NW 19th Ave, NE Broadway & NE Grand Ave, SW 4th Ave & SW Jefferson St, SE Stark St & SE 99th Ave, SE Stark St & SE 102nd Ave, and SE Washington St & SE 103rd Dr. The SE Grand Ave & SE Madison St intersection is not included in the analysis. The Oregon Department of Transportation (ODOT) provided collision reports for all of these intersections and, unlike the reports from the Seattle Police Department, they included information regarding the cause of the collision. Collisions determined to be caused by red light running were coded as such, counted, and compiled into the summary table below (Table 4).

Table 4. Portland RLC Intersection Data Summary

<u>Intersection</u>	<u>RLRs Before Install</u>	<u>RLRs After Install</u>	<u>Total RLRs</u>	<u>Total Collisions</u>	<u>% RLR of Total</u>	<u>Greater Before/ After</u>
E Burnside & SE Grand Ave	16	16	32	77	42%	Equal
NE Sandy Blvd & NE 39th St	10	15	25	132	19%	After
W Burnside & NW 19th Ave	3	0	3	30	10%	Before
NE Broadway & NE Grand Ave	8	4	12	79	15%	Before
SW 4th Ave & SW Jefferson St	12	0	12	22	55%	Before
SE Stark St & SE 99th Ave	13	1	14	31	45%	Before
SE Stark St & SE 102nd Ave	18	2	20	40	50%	Before
SE Washington St & SE 103rd Dr	22	7	29	33	88%	Before
Total	102	45	147	444	33%	Before

Like Seattle, not all of the red light cameras were installed at the same time, so the data for each intersection is inconsistent. To rectify this and in order to compare with the Seattle data, data was considered for the three years prior to installation as well as the three years after installation for each camera. Summary tables considering all of the data provided by ODOT can be found in Appendix C. Several Portland red light cameras were not installed until after 2006, so there is less than three years of data following the installation. In these instances, all of the available data was used for analysis.

Types of collisions have also been analyzed for the city of Portland. Table 5 below provides a summary of the types of collisions at eight of the RLC intersections.

Table 5. Collisions by Type for Portland RLC Intersections

Intersection	Angle Collisions			Rear-End Collisions		
	Before	After	Greater	Before	After	Greater
E Burnside & SE Grand Ave	23	17	Before	13	11	Before
NE Sandy Blvd & NE 39th St	13	12	Before	7	23	After
W Burnside & NW 19th Ave	7	1	Before	1	2	After
NE Broadway & NE Grand Ave	10	7	Before	5	3	Before
SW 4th Ave & SW Jefferson St	17	1	Before	1	1	Equal
SE Stark St & SE 99th Ave	14	1	Before	2	1	Before
SE Stark St & SE 102nd Ave	16	2	Before	13	2	Before
SE Washington St & SE 103rd Dr	24	5	Before	0	1	After
Total	124	46	Before	42	44	After

The collision types were collected from the Portland collision reports and data was used from three years prior to and after installation. Several intersections that didn't have red light cameras installed until 2006 or later have less than three years following installation, but whatever was available was used for the analysis.

Analysis of Seattle and Portland Data

Seattle, Washington

Looking strictly at the numbers from the data, three of the Seattle intersections have shown a decrease in the total number of RLR collisions after the cameras were installed. One intersection, 5th Ave & Spring St, however, displayed an increase in red light running accidents after the cameras were installed.

Several considerations need to be made when looking at this data, however. First of all, while 5th & Spring did show an increase in collisions, this cannot not necessarily be attributed to a failure of the effectiveness of the red light cameras. There are some people who have speculated that the real issue at 5th and Spring is a geometric design problem (Quinn). The eastbound approach enters the intersection from a hill and it has been suggested that the steepness of the hill causes traffic signal sight distance issues. This has not been verified nor was this looked at in this analysis, but it should not be completely discounted as a possible explanation for the increase in collisions. Something else to consider is that the red light running collisions at Rainier Ave & S Orcas St only account for 14% of all collisions at the intersection, not a sizable percentage. The cameras did decrease the number of RLR collisions, but the low overall percentage suggests that RLR may not be a major issue at this intersection in the first place. It is also extremely important to be aware of the small number of incidence of collisions for each intersection. A small incidence of crashes reduces the accuracy of the results and presents the possibility that the results do not represent what is actually going on.

The numbers from the collision types show that three of the Seattle RLC intersections experienced a decrease in the number of angle collisions after installation and one intersection had equal angle crashes before and after. For rear-end collisions, one intersection showed a decrease after installation, two showed an increase, and one was equal before and after. Overall, it shows that there was a decrease in the severity of collisions and a slight increase in rear-end collisions. Once again, however, the incidence of collisions is very low so it is not possible to definitively determine if this truly is what is occurring or whether or not the cameras are effective. It appears that the results do support the findings of the FHWA study, but with such a low incidence of collisions, it is not for certain that the results are accurate. In most of the intersections, the change is small, often only differing by one, two, or three collisions. This too produces doubt regarding the accuracy of the results because it questions whether or not a change by only a few collisions really shows a trend.

Portland, Oregon

The data for the Portland intersections shows that six of the intersections experienced a decrease in the total number of RLR collisions after the cameras were installed, one intersection, E Burnside & SE Grand Ave, had equal collisions before and after camera installation, and one intersection, NE Sandy Blvd & NE 39th St, had an increased number of collisions after camera installation.

The data must be viewed in light of certain considerations, however. Similar to the Rainier Ave & S Orcas St intersection in Seattle, the RLR collisions at NE Sandy Blvd & NE 39th St account for only 19% of the total intersection collisions. This suggests that perhaps RLR collisions are not a major concern or at least are not the main cause of collisions at this intersection, despite a slight increase after camera installation. Two other intersections exhibit similar results including W Burnside & NW 19th Ave and NE Broadway & NE Grand Ave with 10% and 15% of total collisions attributed to RLR, respectively. RLR collisions may not be of major concern at these intersections either.

The data from the collision types for the Portland RLC intersections show a decrease in angle collisions at every intersection after installation. For rear-end collisions, four intersections showed a decrease in crashes, three showed an increase, and one had equal rear-end collisions before and after camera installation. Overall, the results exhibit a decrease in severity and a mix of results for rear-end collisions. This supports the FHWA study as far as a decrease in collision severity, but the rear-end collision results are only similar in a few of the intersections, not overall. The collision incidence is very low in Portland as well, which questions the results' accuracy. And in many of the cases, the differences between before and after installation are very small, only a few collisions.

Comparisons and Conclusions

The data shows that RLC intersections in both Seattle and Portland experienced a decrease in the severity of crashes shown by the decrease in angle collisions. Both cities' results support the finding shown in the FHWA study conducted in 2005. Rear-end collisions, on the other hand, do not seem to support the FHWA's findings. While Seattle did show a slight increase in rear-end collisions overall, the low incidence of collisions could be affecting the accuracy of the results. Portland showed mixed results for rear-end collisions in addition to low collision incidence so the results are inconclusive. As far as effectiveness, the results are also unclear. Since the severity results are fairly consistent with the FHWA study, except for low incidence of collisions, the same issues regarding effectiveness also apply to interpreting the Seattle and Portland data. The results can be viewed as either effective or not effective depending on which definition of effectiveness is used, i.e. whether or not any kind of increase is acceptable or not. Either way, however, there just is not enough collision data to conclusively determine if the cameras are effective or not. Speculations can be made regarding the current available data, but they are just speculation, not fact. An analysis with approximately ten years of data before and after installation is much more likely to yield results that can more accurately determine whether the cameras are effective or not. If this amount of data were available for this analysis, the interpretation of the results may have been more conclusive.

Another concern regarding the data and results is location. The wide array of results from the many studies conducted suggests that location and other related factors are significant considerations when determining red light camera effectiveness. As

discussed before, there are many studies that support that RLCs are effective at least in decreasing the severity of collisions and there are many others that support that RLCs provide no change or increase collisions. These studies were performed all over the United States, Australia, and Canada and show great variability across their results, which is likely largely due to location. Location plays a major role because each city or jurisdiction is different and has different people, kinds of drivers, ages of drivers, and intersection geometries. All of these things are more variables that affect how successful the cameras are and make it even more challenging to determine their effectiveness.

Red light camera effectiveness is a difficult characteristic to evaluate and it is made even more challenging by small amounts of collision data. The cameras appear to be successful in Seattle and Portland as far as reducing angle collisions, but this claim cannot be made with much certainty due to the low incidence of crashes during the time period. Other studies conducted do not provide much better conclusions since the results are rather contradictory with one another. It is possible, however, that red light cameras can be effective, but it depends greatly on the location at which they are used. Red light running is a major concern around the world and red light cameras are an option for trying to reduce the frequency with which they occur; however, there are a lot of problems, concerns, and uncertainties surrounding their use and effectiveness and, as of yet, no clear result has been achieved.

Conclusion

The analysis of the collision data is overall inconclusive. The low incidence of collisions makes it difficult to come to conclusions with any certainty. There appear to be some trends, but again due to the small amount of data, these are not necessarily representative of reality. If more data was available for analysis, the results would be more accurate and a conclusion could likely be reached. The small amount of data is a major concern for an analysis of red light camera effectiveness, but it not the only variable that can cause issues with results. Location is a crucial element to consider and be aware of when examining RLC effectiveness. It affects the types of drivers, the age of drivers, and many other aspects that can skew data in one direction or the other. Another concern is geometric design, as there is some speculation that poorly design intersections may cause sight distance issues that increase the incidence of red light running offenses. Evaluating red light camera effectiveness is also a highly subjective task that incorporates many variables. Red light cameras have the potential to reduce intersection collisions and reduce red light running, but it is just unknown whether or not this result will be achieved overall or whether or not it can be proven.

Bibliography

- Andreassen, David. "A long term study of Red Light Cameras and Accidents." Australian Road Research Board Ltd. Research Report ARR 261. February 1995. 29 June 2009 <<http://www.trafficticketguru.com/support-files/95aussiereyellowlights.pdf>>.
- Burchfield, Robert M. "Red Light Running Camera Program: Biennial Report." City of Portland. 2009. 15 July 2009. pp. 1-25.
- Burkey, Mark and Kofi Obeng. "A Detailed Investigation of Crash Risk Reduction Resulting from Red Light Cameras in Small Urban Areas." TheNewspaper.com. Urban Transit Institute. July 2004. 2 July 2009 <<http://thenewspaper.com/rlc/docs/burkeyobeng.pdf>>.
- "Chapter 810." Oregon State Legislature. Oregon State Law. 2007. 19 August 2009 <<http://www.leg.state.or.us/ors/810.html>>.
- "City of Seattle Traffic Safety Camera Pilot Project: Final Evaluation Report." Seattle Police Department. December 2007. 8 July 2009 <http://www.seattle.gov/police/publications/Special/Red_Light_Study_07.pdf>.
- "City of Seattle Traffic Safety Camera Pilot Project." Washington Traffic Safety Commission. 19 November 2007. 9 July 2009 <http://www.wtsc.wa.gov/documents/award_entries08/seattle_cameras.pdf>.
- "City of Seattle Traffic Safety Camera Program: Year II Evaluation Report." Seattle Police Department. December 2008. 28 June 2009 <http://www.seattle.gov/police/publications/Special/Red_Light_Study_II_Update.pdf>.
- Davis, Sgt. Todd. "Re: Red Light Camera Questions." Message to the author. 28 January 2010. E-mail.
- "Evaluation of the Red Light Camera Enforcement Pilot Project." TheNewspaper.com. Ontario Ministry of Transportation. December 2003. 2 July 2009 <<http://thenewspaper.com/rlc/docs/2003-ontario.pdf>>.
- Garber, Nicolas J. et al. "An Evaluation of Red Light Camera (Photo-Red) Enforcement Programs in Virginia: A Report in Response to a Request by Virginia's Secretary of Transportation." TheNewspaper.com. Virginia Department of Transportation. VTRC 05-R21. January 2005. 2 July 2009 <<http://thenewspaper.com/rlc/docs/05-vdot.pdf>>.

- Garber, Nicholas J. et al. "The Impact of Red Light Cameras (Photo-Red Enforcement) on Crashes in Virginia." TheNewspaper.com. Virginia Department of Transportation. FHWA/VTRC 07-R2. June 2007. 2 July 2009 <<http://thenewspaper.com/rlc/docs/2007/07-vdot2.pdf>>.
- George, Jason. "10 facts about red-light cameras." Chicago Tribune. 8 April 2009. 3 July 2009 <<http://archives.chicagotribune.com/2009/apr/08/local/chi-red-light-camera-08-apr08>>.
- Harris, Tom. "How Red-Light Cameras Work." HowStuffWorks.com. 2009. 2 July 2009 <<http://auto.howstuffworks.com/car-driving-safety/safety-regulatory-devices/red-light-camera.htm>>.
- Johnson, Alex. "Do red light cameras work too well?" MSNBC.com. 20 March 2008. 25 June 2009 <<http://www.msnbc.msn.com/id/23710970>>.
- Kent, S. et al. "Red Light Running Behaviour at Red Light Camera and Control Intersections." Monash University. Accident Research Centre. Report #73. 1995. 2 July 2009 <<http://www.monash.edu.au/muarc/reports/muarc073.html>>.
- Lane, Matthew. "Kingsport BMA debates slashing fines from red light cameras." TimesNews.net. 20 October 2009. 26 December 2009 <<http://www.timesnews.net/article.php?id=9017749>>.
- "Q&As: Red light cameras." Insurance Institute for Highway Safety. January 2009. 3 July 2009 <<http://www.iihs.org/research/qanda/rlr.html>>.
- Quinn, Mike. Personal interview. 16 July 2009.
- "RCW 46.63.170: Automated traffic safety cameras – Definition." Washington State Legislature. Washington State Law. 2007. 7 August 2009 <<http://apps.leg.wa.gov/RCW/default.aspx?cite=46.63.170>>.
- "Red Light Cameras." Silicon Imaging. Siliconimaging.com. 2 July 2009 <http://www.siliconimaging.com/red_light_cameras.htm>.
- "Red-Light-Camera-Springfield-Ohio.jpg." Photograph. Wikimedia Commons, 17 July 2006. Web. 1 March 2010. <<http://commons.wikimedia.org/wiki/File:Red-light-camera-springfield-ohio.jpg>>.
- "The Red Light Running Problem." National Campaign to Stop Red Light Running. 2009. 18 February 2010 <<http://www.stopedlightrunning.com/problem.htm>>.
- "Running a Red-light is a SNAP!" Photocop.com. 2 July 2009 <<http://www.photocop.com/red-light.htm>>.

“Safety Evaluation of Red-Light Cameras—Executive Summary.” Federal Highway Administration. FHWA-HRT-05-048. April 2005. 24 January 2010
<<http://www.tfhrc.gov/safety/pubs/05049/index.htm>>.

Wilber, Del Quentin and Derek Willis. “D.C. Red-Light Cameras Fail to Reduce Accidents.” The Washington Post. 4 October 2005. 2 July 2009
<<http://www.washingtonpost.com/wp-dyn/content/article/2005/10/03/AR2005100301844.html>>.

Appendices

APPENDIX A: List of Terms and Acronyms

- RLC – red light camera
- RLR – red light running
- SPD – Seattle Police Department
- WSDOT – Washington State Department of Transportation
- ODOT – Oregon Department of Transportation
- Red light running – when a vehicle enters an intersection and a red signal is displayed on the traffic control device
- Wet film cameras – non-digital, one-dimensional technology, takes still photo, physical film must be collected
- ATS – American Traffic Systems, Seattle RLC provider
- ACS – Affiliated Computer Systems, Portland RLC provider

APPENDIX B: RLC Intersections

Seattle Intersections (Existing and New)

- 5th Ave & Spring St
- Denny Way & Fairview Ave
- Rainier Ave S & S Orcas St
- Roosevelt Way NE & NE 45th St
- 14th Ave S & S Cloverdale St
- 15th Ave NW & NW Market St
- 9th Ave & James St
- Broadway & E Pine St
- Broadway E & E Olive Way
- NE 45th St & Union Bay Place
- Rainier Ave S & Massachusetts St
- 15th Ave NW & NW 80th St
- 23rd Ave E & E John St
- 35th Ave SW & SW Avalon Way
- 35th Ave SW & SW Thistle St
- 5th Ave NE & NE 80th St
- 6th Ave & James St
- Aurora Ave N & N 85th St
- Boren Ave & James St
- MLK Jr. Way S & S McClellan St
- Stone Way N & N 40th St

Portland Intersections (Existing Only)

- E Burnside & SE Grand Ave
- NE Sandy Blvd & NE 39th Ave
- SE Grand Ave & SE Madison St
- W Burnside & NW 19th Ave
- NE Broadway & NE Grand Ave
- SW 4th Ave & SW Jefferson St
- SE Stark St & SE 99th Ave
- SE Stark St & SE 102nd Ave
- SE Washington St & SE 103rd Ave
- SE Foster Rd & 96th Ave

APPENDIX C: Additional Data

Table 1. All Seattle Data – January 2003 through August 2009

<u>Intersection</u>	<u>RLRs Before Install</u>	<u>RLRs After Install</u>	<u>Total RLRs</u>	<u>Total Collisions</u>	<u>% RLR of Total</u>	<u>Greater Before/ After</u>
Denny Way & Fairview Ave	19	10	29	47	62%	Before
5th Ave & Spring St	24	26	50	76	66%	After
Rainier Ave S & S Orcas St	9	2	11	78	14%	Before
Roosevelt Way NE & NE 45th St	12	2	14	40	35%	Before
Total	64	40	104	241	43%	Before

Table 2. All Portland Data – January 1998 through December 2008

<u>Intersection</u>	<u>RLRs Before Installation</u>	<u>RLRs After Installation</u>	<u>Total RLRs</u>	<u>Total Collisions</u>	<u>% RLR of Total</u>	<u>Greater Before/ After</u>
E Burnside & SE Grand Ave	23	33	56	112	50%	After
NE Sandy Blvd & NE 39th St	14	20	34	165	21%	After
SE Grand Ave & SE Madison St	0	6	6	9	67%	After
W Burnside & NW 19th Ave	9	1	10	40	25%	Before
NE Broadway & NE Grand Ave	11	8	19	116	16%	Before
SW 4th Ave & SW Jefferson St	51	0	51	63	81%	Before
SE Stark St & SE 99th Ave	50	1	51	88	58%	Before
SE Stark St & SE 102nd Ave	79	2	81	133	61%	Before
SE Washington St & SE 103rd Dr	87	7	94	122	77%	Before
Total	324	78	402	848	47%	Before

