



MONASH University
Accident Research Centre

A centre within the Monash University Injury Research Institute

Crash Effects of the Queensland Camera Detected Offence Program

Stuart Newstead & Max Cameron
2013 Road Safety Research Policing & Education Conference



Background & Aims

- The Queensland Camera Detected Offence Program (CDOP) covers management and operation of all modes of camera based traffic enforcement in Queensland including:
 - mobile speed camera program
 - red light camera program
 - fixed spot speed cameras
 - point to point cameras (future)
 - combined speed and red light cameras (future).
- Study Objective:
 - design evaluation framework to measure CDOP effects on crash frequency, severity and social costs to the community
 - applied framework to estimate the effects of the CDOP during 2008.

Literature Review: Camera Sphere & Mechanism of Effect

CDOP Element	Sphere of Influence	Mechanism of Influence
Red Light (Retting, Ferguson, & Hakkert, 2003)	Localised to intersection where camera is placed	Primary: placement of camera and associated signage Secondary: infringement notice issue
Combined Speed and Red Light (intersection) (ARRB, 2005 ; Cameron & Delaney, 2006 ; Elvik, 1997 ; Gains, 2005 ; Wilson, Willis, Hendrikz, Le Brocque, & Bellamy, 2010)	Localised to intersection where camera is placed	Primary: placement of camera and associated signage Secondary: infringement notice issue
Spot Speed (midblock) (Brinson, 2002)	Localised to site of camera location within a 1-3 km radius	Primary: placement of camera and associated signage Secondary: infringement notice issue
Point to point average speed (A77SG, 2007, 2008 ; Keenan, 2002)	Localised to the road length covered by the point to point system up to 1km upstream of the start of the length and up to 10km downstream of the length	Primary: placement of camera and associated signage Secondary: infringement notice issue
Mobile Speed (overt) (S. Newstead & Cameron, 2003a ; S. V. Newstead, 2006)	Localised to the site of operation (1km in urban areas, 5km in rural areas*) with possible secondary effects generalised over space	Primary: definition of a site of operation and placement of camera Secondary: infringement notice issue
Mobile speed (covert) (Cameron, Cavallo, & Gilbert, 1992 ; S. V. Newstead, Mullan, & Cameron, 1995 ; Rogerson, Newstead, & Cameron, 1994)	Generalised in space over the region of operation, with some secondary localised effects around the camera site	Primary: infringement notice issue Secondary: definition of a site of operation and placement of camera

Evaluation Framework Design

- Quasi Experimental
 - ‘Treatment’ area defined from hypothesised area of influence derived from literature
 - Comparison area defined based on relevant matching criteria to control for confounding influences
- Overlap of influence from CDOP elements accommodated by matching overlap in defined comparison areas
- Discrete analysis for each CDOP element produces
- 3-5 years prior crash history to minimise RTM effects
- Estimates of crash and crash cost savings associated with the camera installation by police region and crash severity combined to produce state-wide estimates

Evaluation Design: Fixed Cameras

CDOP Fixed Element	Hypothesised Sphere of Influence	Matching Criteria for Comparison Sites
Red Light & Combined Speed and Red Light (intersection)	At the intersection of installation Secondary restriction to target crash DCA types	<ol style="list-style-type: none"> 1. Statistical Local Area (SLA) 2. Intersection control 3. Intersection geometry 4. Speed Limit 5. Divided or undivided Road 6. Number of lanes 7. Matching by overlay of mobile camera sites (within the same proximity of mobile speed camera sites)
Spot Speed (midblock)	Same road as the camera is installed on within a 1km distance from the camera site	<ol style="list-style-type: none"> 1. Statistical Local Area (SLA) 2. Speed Limit 3. Divided or undivided Road 4. Number of lanes 5. Proximity of mobile speed camera sites
Point to Point average speed	Primary: the length of road within the PtP camera system Secondary: the length of road from each end of the PtP site to 5km from this point (for divided roads the halo only include the lanes outbound from the PtP site in each direction)	<ol style="list-style-type: none"> 1. Statistical Local Area (SLA) 2. Speed Limit 3. Divided or undivided Road 4. Number of lanes 5. Proximity of mobile speed camera sites

Evaluation Design: Mobile Cameras

- Refinement of the evaluation framework previously applied to the mobile camera program in Queensland
 - Treatment areas
 - within a 1km radius of speed camera zone (built up areas)
 - within a 4km radius from the camera zone (open road areas)
 - Comparison areas: areas outside treatment areas
 - matched by police region, broad speed zone
- Analysed stratified by police region, broad speed zone

Statistical Methods

- Fixed CDOP elements
 - Aggregate crash counts in before and after periods
 - Before and after period defined for each camera site and matching comparison area
 - Negative Binomial regression analysis employed
- Mobile camera program:
 - Time series crash data
 - Before and after study periods defined by introduction of mobile camera program (January 1997)
 - Negative Binomial Generalised Estimating Equation (GEE) employed to accommodate the inherent inter-correlation between observations in the time series of crash data.

Data

▪ *Crash Data*

- All police reported crashes: January 1992 to December 2008.
- Fields: comparison matching variables plus:
 - distance from & i.d. of 5 closest mobile speed camera sites
 - distance from & i.d. of 3 closest fixed spot speed camera sites
 - distance from & i.d. of the closest red light camera site

▪ *Camera Operations Data*

- 142 Red light cameras, 10 fixed spot speed camera installations:
 - site id, location, location characteristics, date camera became operational, direction facing.
- 2144 mobile speed camera zones:
- No PtP or combined speed & red light cameras in study period

▪ **Operations data geo-matched to crash data by TMR DAU**

Results: Red Light & Fixed Spot Speed

	Statistical Significance	Relative Risk (Camera Sites vs. Non Camera Sites)		
		R.R.	Lower 95% C.L.	Upper 95% C.L.
Red Light Camera Crash Effects				
All severities	<0.001	0.66	0.573	0.76
Serious Casualty (fatal + SI)	0.015	0.682	0.501	0.930
Minor Injury	0.000	0.613	0.498	0.754
Non Injury	0.001	0.702	0.574	0.858
Fixed Spot Speed Camera Crash Effects (3 Sites)				
All Crashes - All severities	.473	.834	.508	1.370

Results: Mobile Speed Cameras 2008

Severity	Stat Sig.	R.R.	95% LCL	95% UCL
Serious Casualty (fatal + SI)	.000	.775	.717	.837
Minor Injury	.000	.856	.796	.921
Non Injury	.000	.798	.724	.878
All Crashes	.000	.797	.756	.840

State-wide Effects by CDOP Element

Crash Severity	CDOP Element	Absolute Crash Savings	Crash Cost Saving
Serious Casualty	Red Light Camera	35.9	\$14,366,665
	Fixed Spot Speed Camera	0.6	\$61,788
	Mobile Speed Camera	1071.4	\$429,262,065
	Total	1107.9	\$443,690,518
Minor Injury	Red Light Camera	97.9	\$1,567,318
	Fixed Spot Speed Camera	1.6	\$162,720
	Mobile Speed Camera	1580.7	\$25,302,079
	Total	1680.2	\$27,032,117
Non Injury	Red Light Camera	51.4	\$556,337
	Fixed Spot Speed Camera	1.7	\$182,068
	Mobile Speed Camera	2677.1	\$29,004,535
	Total	2730.2	\$29,742,940
All Crashes	Red Light Camera	185.1	\$16,490,321
	Fixed Spot Speed Camera	3.9	\$406,576
	Mobile Speed Camera	5599.6	\$578,784,824
	Total	5788.6	\$595,681,721

Overall Percentage Crash Savings Attributable to the Queensland CDOP

Crash Severity	Total 2008 Crashes Observed (A)	Estimated 2008 CDOP Crash Savings (B)	Number of Crashes Expected in 2008 Without the CDOP (=A+B)	% of Expected Total 2008 Crashes Saved by CDOP =B/(A+B)
Serious Casualty	3590	1107.9	4697.9	23.6%
Minor Injury	7165	1680.2	8845.2	19.0%
Non Injury	8702	2730.2	11450.2	23.9%
All Crashes	19457	5788.6	25245.6	22.9%

Discussion

- Framework demonstrates ability to evaluate individual CDOP components and combine into a state-wide estimate of effectiveness
 - Accommodates overlap of camera types
- Robustness of evaluation different for different elements
 - Good: Red light, mobile speed
 - Marginal: Fixed spot speed
 - Not possible: Point to Point, Intersection speed & red light
- Framework has provision for new elements when they are installed and crash data become available
- Mobile camera effects slightly different from previous evaluation estimates
 - Different cost basis
 - More robust due to better comparison group matching

Discussion

- Strengths
 - Evaluation design
 - Close matching of comparison sites
 - Can accommodate new CDOP elements in future
 - Provides evaluation of each technology + global effectiveness estimates

- Weaknesses
 - Difficult to validate hypothesised areas of influence
 - Likely produces conservative estimates
 - No exposure data – can't test for crash migration
 - Delays in QLD crash data: post 2008 not available for study

Conclusions

- Study has developed an effective framework to evaluate the crash effects of the Queensland Camera Detected Offence Program
- CDOP associated with an overall 23% reduction in all police reported crashes and 24% reduction in fatal and hospitalisation crashes across Queensland in 2008
 - 2008 absolute crash savings (community crash costs):
 - over 5,700 crashes of all severities (\$600M)
 - over 1100 fatal and serious injury crashes (\$450M)
- Over 95% of the savings associated with the program derive from the mobile speed camera program, which is the CDOP technology that covers by far the largest proportion of the crash population in Queensland
 - Fixed cameras effective but sphere of influence relatively small

Acknowledgements



Queensland Government

Department of Transport and Main Roads

TMR Project Manager: Larissa Knight

Data supply: TMR Data Analysis Unit



Questions