



Fit to Drive

8th International Traffic Expert Congress
08 to 09 May, 2014
Warsaw

Drivers' behavioural responses to red-light-cameras

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The problem (at signalized intersections)

- Red light running (Garber et al., 2007)
 - Side crashes
 - Severe injuries
- Speeding (Aarts & van Schagen, 2006)
 - Higher crash risk
 - Aggravating injuries



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Solution?

Red light cameras

Combined speed and red light cameras

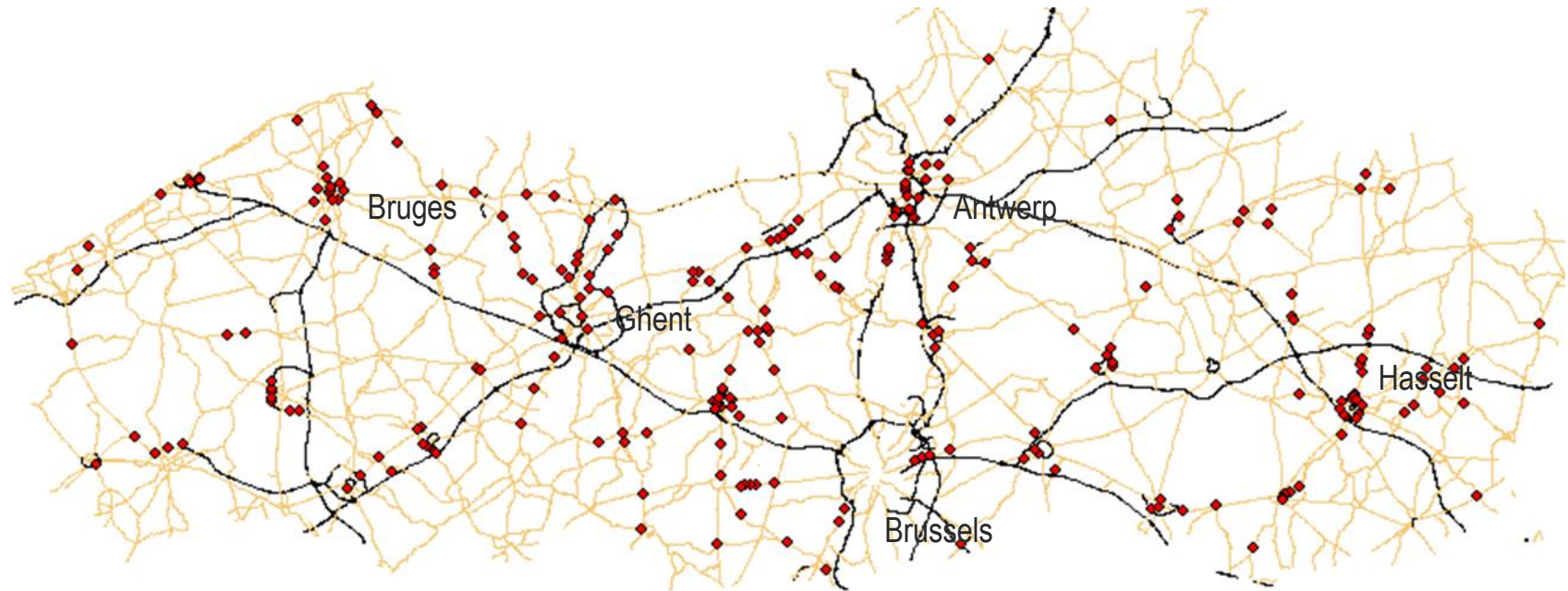




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Effects on crashes? Effects on behaviour?





Effects on crashes (Høye, 2013; De Pauw et al., 2014)

	All types of crashes	Side crashes	Rear-end crashes
Injury + PDO* crashes	+6% ¹	-13% ¹	+39% ¹
* = property damage only			
Injury crashes	-13% ¹ +5% ²	-33% ¹ -6% ²	+19% ¹ +44% ²
Severe injury crashes	-14% ²	-24% ²	-

bold = significant at the 5%-level

¹ Høye, A. (2013). Still red light for red light cameras? An update. *Accident Analysis & Prevention*, 55, 77–89.

² De Pauw, E., Daniels, S., Brijs, T., Hermans, E., & Wets, G. (2014). To brake or to accelerate? Safety effects of combined speed and red light cameras. *Journal of Safety Research*



Thus

- Red light cameras (tend to) reduce (severe) injury crashes
- Red light cameras cause increases in rear-end collisions

Problem?

- “rear-end” effect might undermine resulting effect
- Public support decreases



But what do drivers do?

- Follow-up research
 - Before and after observations at 2 RLC intersections
 - Driving simulator study



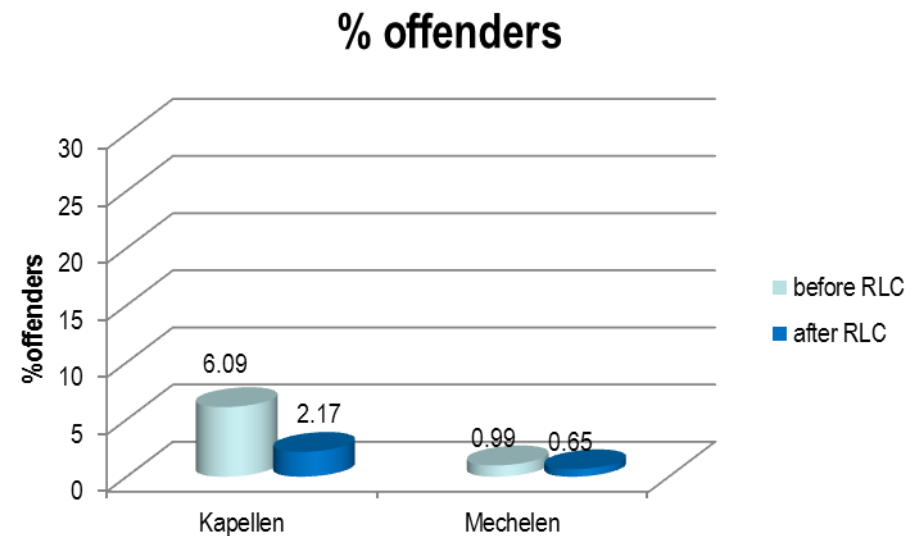
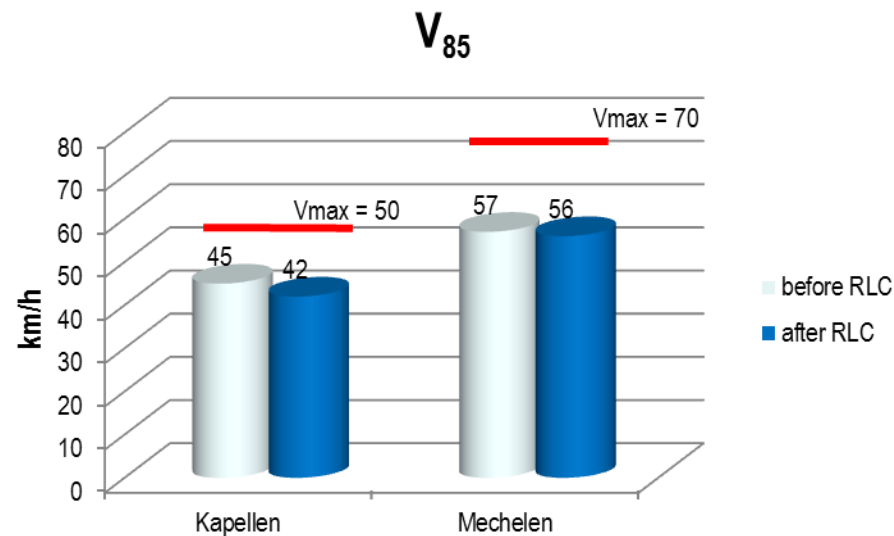
Real-world observations

- Before and after observations at 2 RLC intersections (Kapellen + Mechelen)
- 2 video camera's
- Analysis of video footage (so far 1 location): 24 h before, 24 h after
- Observation of:
 - Vehicle speeds
 - Red/green/yellow light crossing
 - Choices in dilemma zone
 - Rear- end conflicts



Observations - Preliminary results (1)

- ⇒ Effects on speeds and speed offences
- ⇒ Simple before/after comparison
- ⇒ Decreases of V_{85} and speed offences





Observations - Preliminary results (2)

Phase	Before RLC N=4478	After RLC N=4571	X ²	p
Red	9 (1)	4 (1)	2,030	0,154
Yellow	143 (3)	123 (2)	2,002	0,157
Green	4326 (96)	4444 (97)	2.872	0.090

⇒ less red or yellow light running

⇒ Separate analyses:

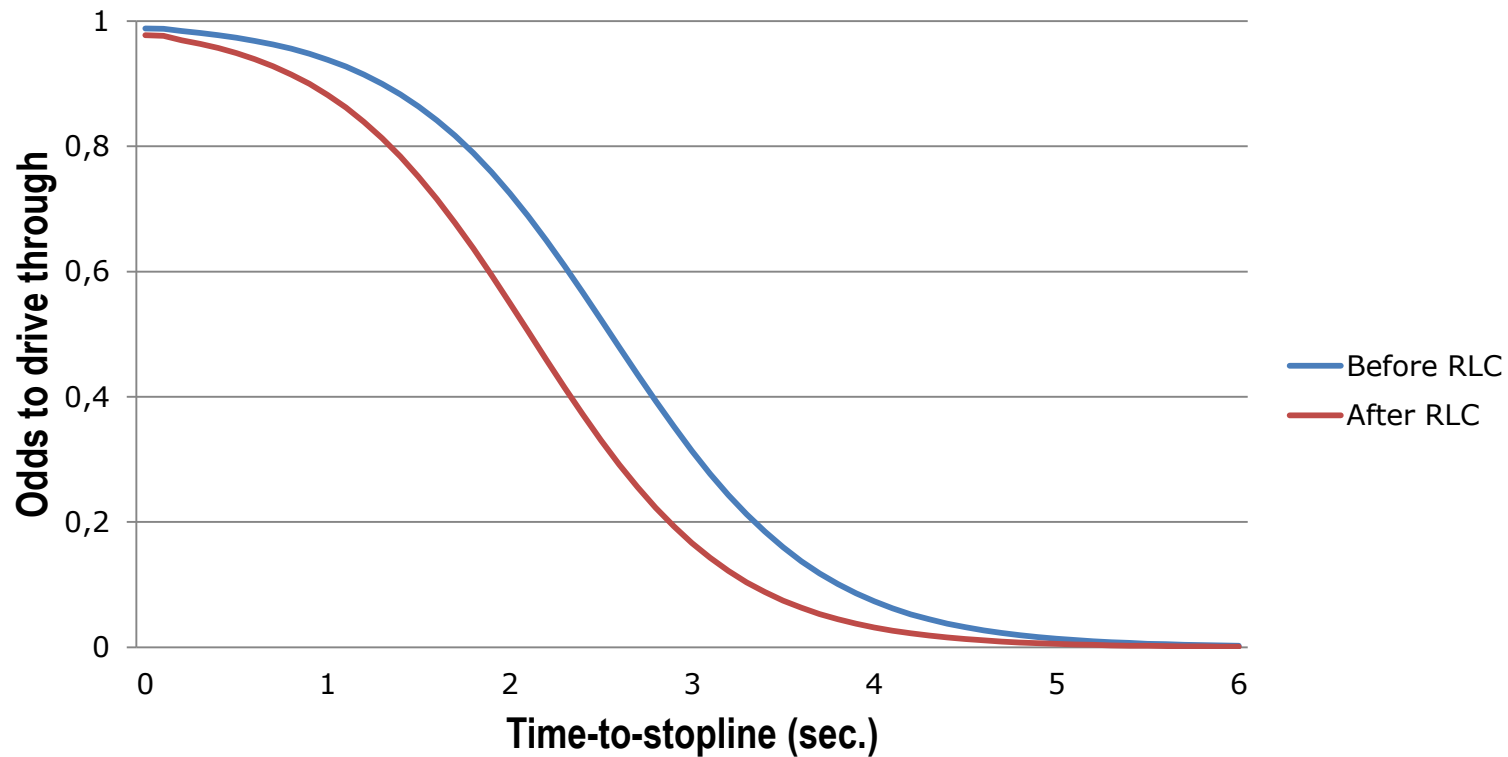
⇒ only effects in direction straight ahead

⇒ sign. difference for trucks, not for other road users



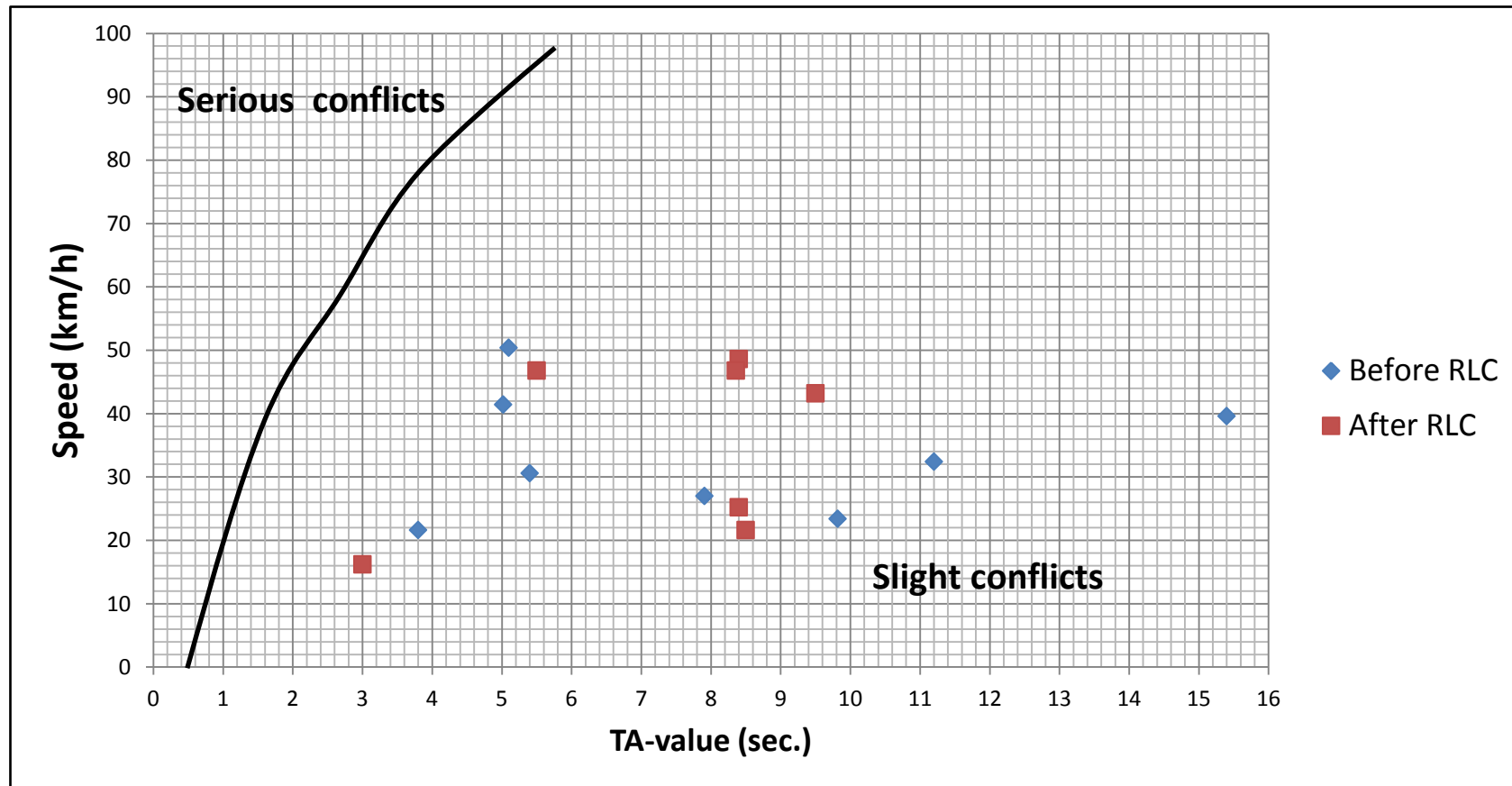
Observations - Preliminary results (3)

Dilemma zone





Observations - Preliminary results (4)





Observations - Preliminary conclusions

- ⇒ Speed reduction + reduction of speed offences
- ⇒ Less red or yellow running
- ⇒ Shift of dilemma zone to higher probability of stopping if yellow
- ⇒ No observable effect on conflicts



Driving simulator study

- Evaluation stop/go decisions, driving and looking behaviour at RLC-intersections
- One RLC-intersection (Kapellen) rebuilt in simulator
- 63 participants
- Tested conditions:
 - RLC intersection
 - RLC intersection + warning sign (RLCWS)
 - Control intersection



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Driving simulator study



Kapellen



Driving simulator study – stop/go decisions when yellow

N=63	Control	RLC	RLC+warning sign
Stop	11%	13%	30%
Go	89%	87%	70%



Driving simulator study – decelerations

	Control (n=7)	RLC (n=8)	RLC+warning sign (n= 19)
Mean deceleration	-2,83 m/s ²	-4,28 m/s ²	-3,45 m/s ²

Normal, comfortable braking deceleration ~ -3m/s² (Koppa, 2003)

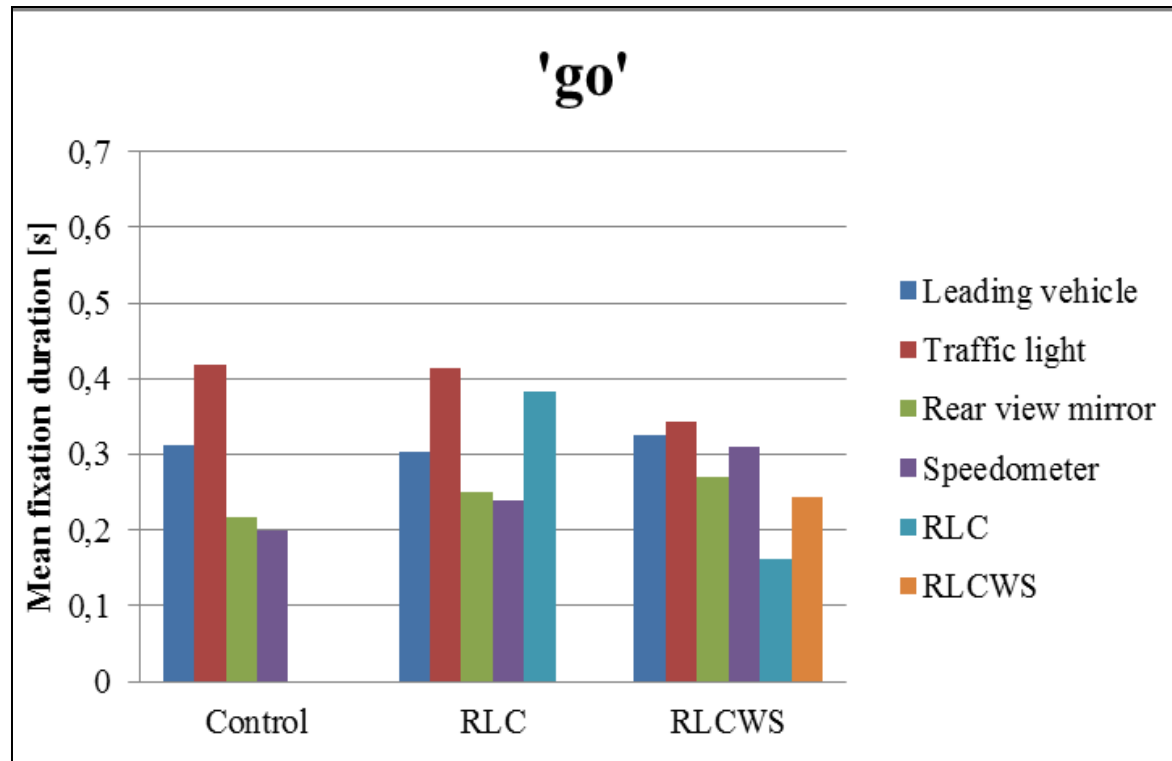


Driving simulator study – driving behaviour

- Simulator speed/acceleration data + Real-world time headways + Monte Carlo simulation
- Odds of rear-end conflicts
 - RLC vs. control: 6.42
 - RLCWS vs. control: 4.01
 - RLCWS vs. RLC: 0.62



Driving simulator study – looking behaviour





Driving simulator study – preliminary conclusions

⇒ RLC compared with control location:

⇒ Stronger decelerations when stopping

⇒ More rear-end conflicts

⇒ RLCWS compared with RLC:

⇒ More frequent stopping when yellow

⇒ Lower decelerations when stopping

⇒ Fewer rear-end conflicts



Conclusions

1. Red light cameras tend to reduce (severe) injury crashes
2. Red light cameras cause increases in rear-end collisions
3. Red light cameras influence road user behaviour: V_{85} reductions, fewer offences, shift in dilemma zone
4. Possible adverse effects of the presence of automated enforcement on road users behaviour: stronger decelerations, increase in rear-end conflicts (simulator).
5. Warning signs might reduce adverse effects somewhat, but effect is still highly unsure



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