

RAPTOR: Software Application for Predicting Collision Hotspots and Evaluating Site-based Road Safety Interventions

Dr. Neil Thorpe and Dr. Lee Fawcett,

School of Civil Engineering and Geosciences and School of Mathematics and Statistics, Newcastle University

Road Safety GB conference

Joining the dots: How data delivers insight and innovation

Birmingham, 2nd March, 2017

Background

2003: Northumbria Safety Camera Partnership

- Site selection, data reporting to DfT, site evaluation

2006/08: Health impacts study of mobile safety cameras

- Focus on actual scheme effects after confounding effects of RTM and trend
- Algorithms for evaluating interventions

2010: Focus on 'research impact'

2012: Industrial collaboration with PTV Group

- Development of hotspot prediction algorithms

2015: Implementation in software applications

2017: Software now accessible to practitioners

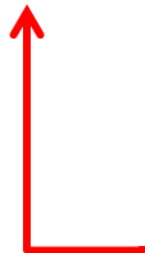
Perceived safety
problem at a
location(s) on the
road network
(hotspot
identification)



Implement
intervention
strategy



Monitor
impact
(scheme
evaluation)

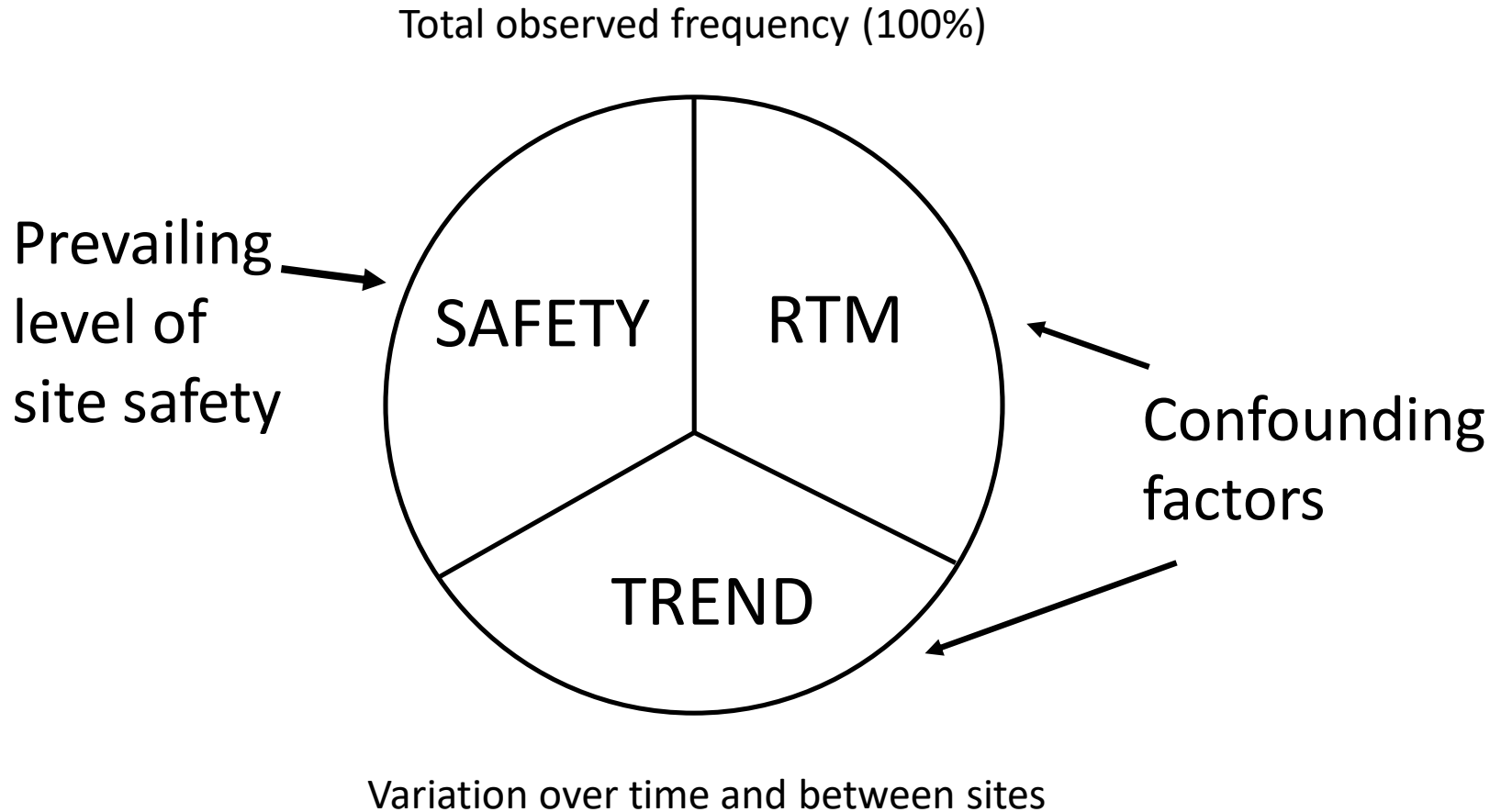


COLLISION DATA

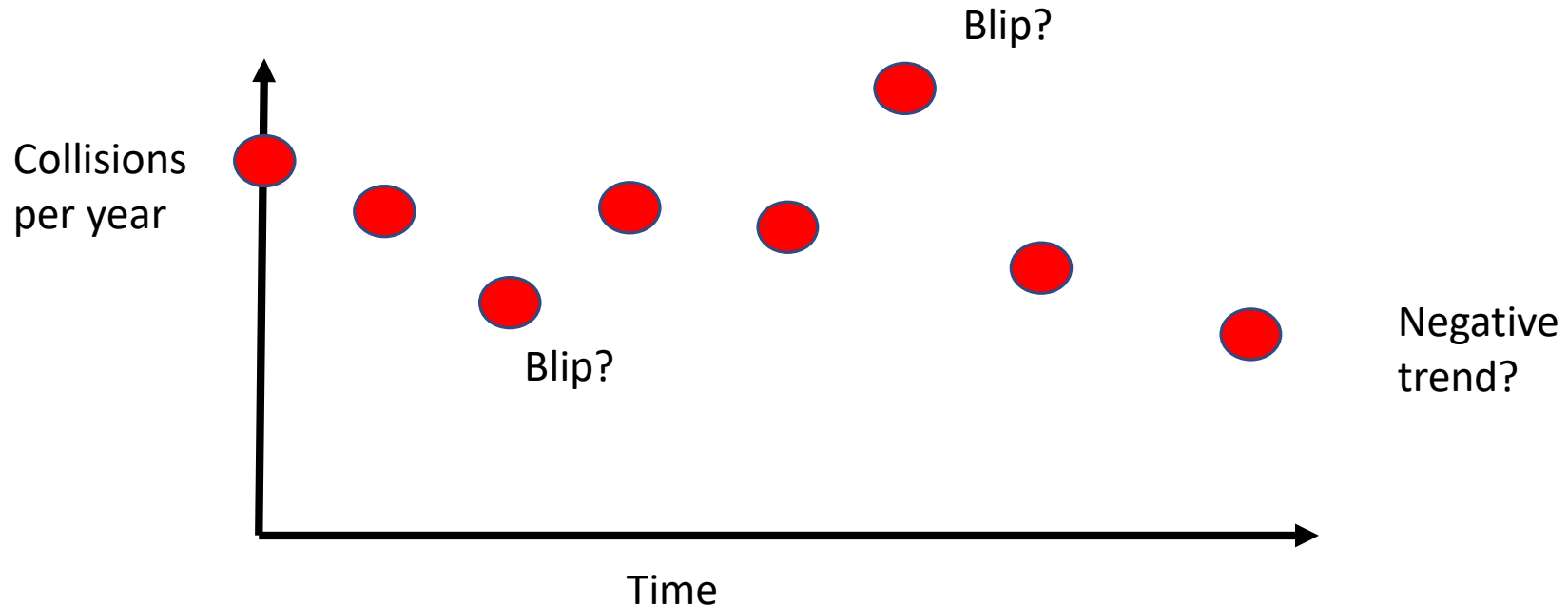


...but prone to confounding
factors of regression-to-
mean and general accident
trends

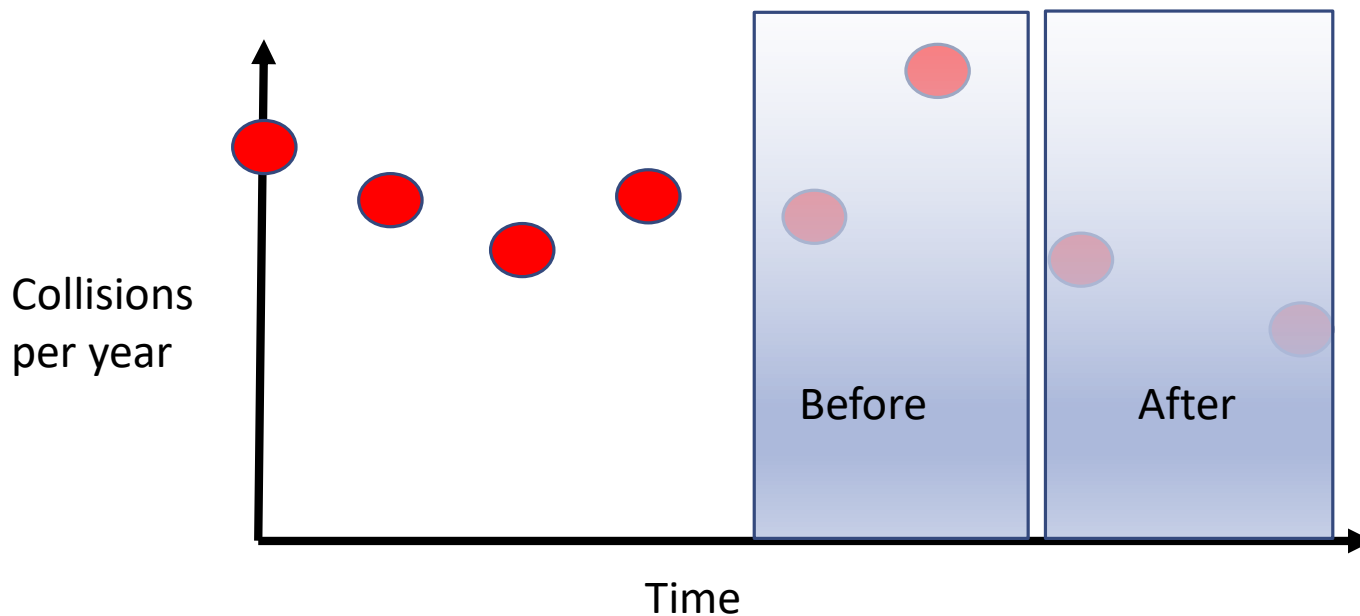
Observed counts at individual sites are due to....



Problems for evaluation and prediction (site selection)

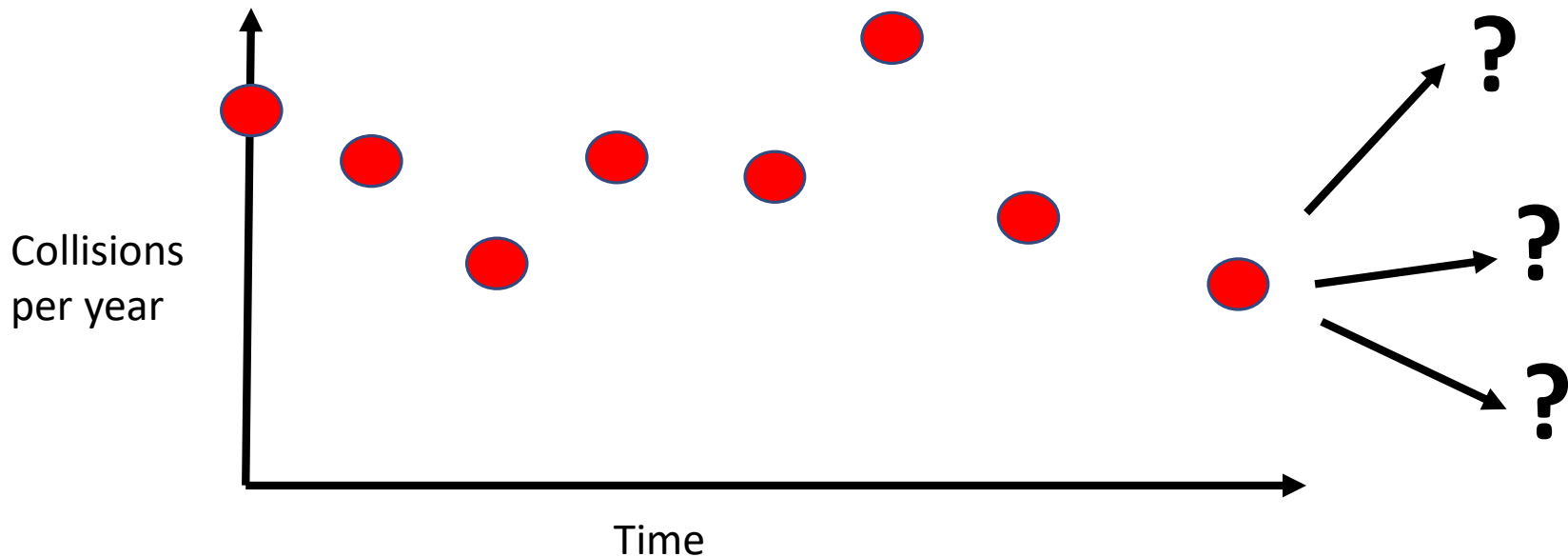


Problems for evaluation



- How much of any observed change is due to:
- Our scheme?
 - RTM?
 - Trend?

Problems for prediction (site selection)



Accounting for RTM and Trend

RTM

- Ignore it – assume it don't exist
- Four Time Period (FTP) method
- Bayesian techniques (Empirical or Full)

Trend

- Ignore it
- Network-wide and site-specific trends
- Recent observations versus observations further back in time

Why are confounding factors a problem?

Cause 'noise' in the collision count data

For hotspot identification:

- False positives: identifying and treating sites as hotspots when they are not – collision rate would have reduced anyway; an issue of 'wasted' resources
- False negatives: not treating a genuinely unsafe site; impact for future collision rates

For scheme evaluation:

- Believing that our schemes are being more effective than they actually are – value for money issues and 'misguided' future decisions

Key features of RAPTOR Package

Three key functions:

- Hotspot prediction
- Scheme evaluation
- (Contributory factors analysis)

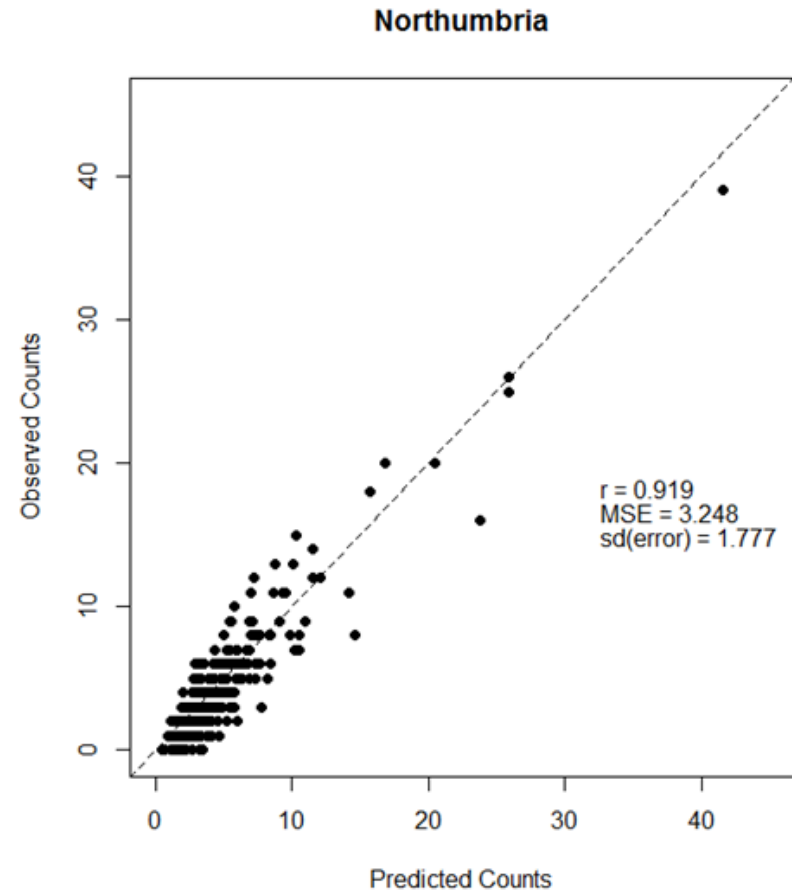
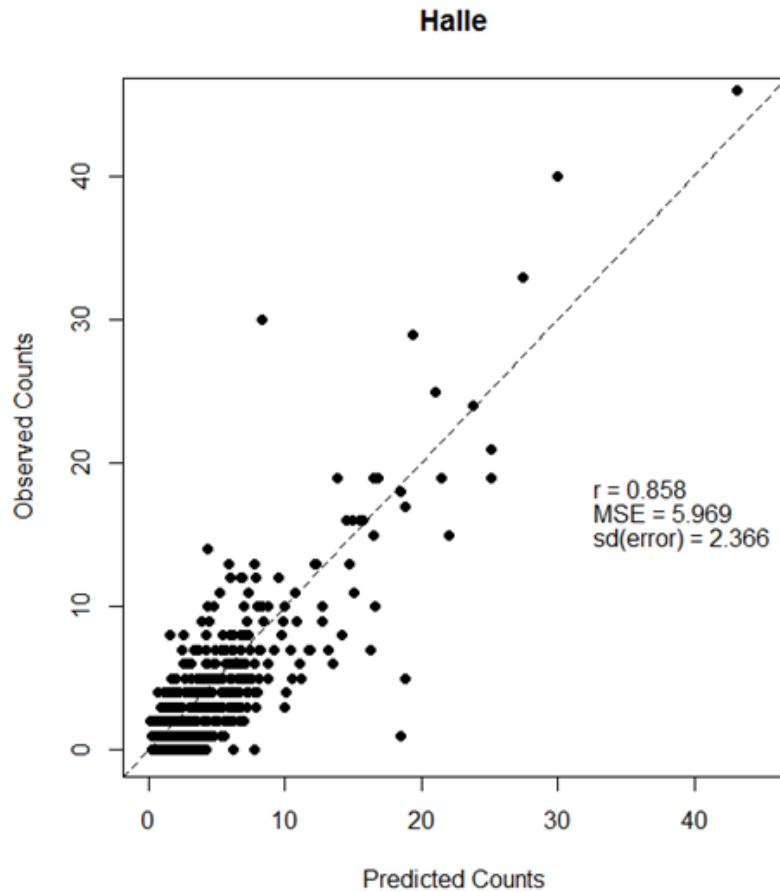
RTM

-
-

Trend

- Variance inflation (more weight on more recent observations)
- Weighted combination of network and site-specific trends

How good are the hotspot predictions?



RAPTOR Demonstration

Data requirements

- Hotspot prediction and scheme evaluation
- **Dependent variable:** Collision/casualty counts in discrete time periods (e.g. months, quarters or years) for each site
- **Independent variables:** Static site data (e.g. speed limit; road type; road class, urban/rural); dynamic site data (e.g. flow; average speeds) for each time period for each time period

Screenshots

If needed.....

Current and Future Demonstrations/Applications

- Northumbria (NSRI); Suffolk (cyclist collisions); North Yorkshire County Council and North Yorkshire Police
- Halle, Germany; National Technical University of Athens, Greece
- Florida Department of Transport (seasonal effects); Texas A & M University
- China and S Korea (via Monash University); Guyana Ministry of Public Infrastructure
- World Resources Institute (US, Mexico, Turkey, India, Brazil, China...)
- Abu Dhabi Police; University of Dammam, Saudi Arabia;
- Training courses in Rio, Brazil in 2015 and Bolivia, 2016 with WRI/PTV Group
- [On-line demo \(login required\)](#)
- [Software tool](#)

References



Early Example of Scheme Evaluation

Thorpe N, Fawcett L. (2012) 'Linking road casualty and clinical data to assess the effectiveness of mobile safety enforcement cameras: a before and after study.' *BMJ Open*, 2(6), e001304.

<http://bmjopen.bmj.com/content/2/6/e001304?ct>

Statistical Methodology

Fawcett, L.; Thorpe, N. (2013) Mobile safety cameras: estimating casualty reductions and the demand for secondary healthcare. *Journal of Applied Statistics* 40(11), 2385-2406

<http://www.tandfonline.com/doi/full/10.1080/02664763.2013.817547>

Fawcett, L.; Thorpe, N.; Matthews, J.; Kramer, K. (2017) A novel Bayesian hierarchical model for road safety hotspot prediction. *Accident Analysis & Prevention*, 99, pp.262-271.

<http://www.sciencedirect.com/science/article/pii/S0001457516304341>

Papers Aimed at Road Safety Practitioners

Slater, P.; Thorpe, N.; Fawcett, L. (2014) Getting Value for Money from Investment in Road Safety: Are we Evaluating our Schemes Correctly? Paper presented at the 12th Annual Transport Practitioners' Meeting, Session: Road Safety – the Future, London, 2014 (July)

Fawcett, L.; Matthews, J.; Kremer, K.; Thorpe, N.; Galatioto, F.; Hoffman, T.; Muench, A. (2015) Identifying Collision Hotspots using Time Series Analysis and Accounting for Regression to Mean Paper presented at the 13th Annual Transport Practitioners' Meeting, Session: Road Safety: Design Applications, London, 2015 (July)

References



Oral Presentations and Posters to Road Safety Academics, Practitioners and Policy Makers

Thorpe, N.; Fawcett, L.; Matthews, J.; Newman, K.; Kremer, K.; Ahuja, S. (2015) A software application for identifying future collision hotspots and evaluating road safety interventions while accounting for regression to mean and trend. 24th World Congress of the International Traffic Medicine Association, 16th-18th November, 2015, Doha, Qatar

Thorpe, N. (2014) Identifying Collision Hotspots and Evaluating Road Safety Schemes: Issues for Investment Decisions. Embarq International Road Safety Research and Training Workshop, 6th-10th October, Rio de Janeiro, Brazil

Thorpe, N. (2016) Issues with Interpreting Collision Data: How to Manage Confounding Factors when Identifying Collision Hotspots and Evaluating Road Safety Interventions WRI/PTV/Newcastle University International Road safety Research and Training Workshop, 28/11/16-2/12/16, Santa Cruz, Bolivia

Fawcett, L.; Matthews, J.; Kremer, K.; Thorpe, N.; Galatioto, F.; Muench, Road Safety Hotspot Prediction: A Study of the City of Halle, Germany. Poster presentation at the 95th Annual Meeting of the Transportation Research Board, January 2016, Washington DC.

Fawcett, L.; Matthews, J.; Kramer, K.; Thorpe, N. (2017) Road Safety Hotspot Prediction: Study of Halle, Germany. Poster presentation at the 96th Annual Meeting of the Transportation Research Board, January 2017, Washington DC

For further information and login
details:

Neil Thorpe

Neil.Thorpe@ncl.ac.uk

Lee Fawcett

Lee.Fawcett@ncl.ac.uk

