Changing speed limits

10th January 2013, Perth

Dr Neale Kinnear
Principal Psychologist

Table of contents

Speed and accidents

Simple physics

The relationship

- With an impact speed of 50mph, the likelihood of death for the car occupants is about 20 times that for an impact at 20mph (IIHS, 1987)
- Common Rule of Thumb*:

1% increase in mean speed =

2% increase in injury accidents rate

3% increase in severe accident rate

4% increase in fatal accident rate

- Variable depending on road type, speed variability and environment (Elvik et al., 2004)

* Nilsson (1990); Aarts & van Shagen (2006)

The purpose of speed limits

- **To Enhance Safety**

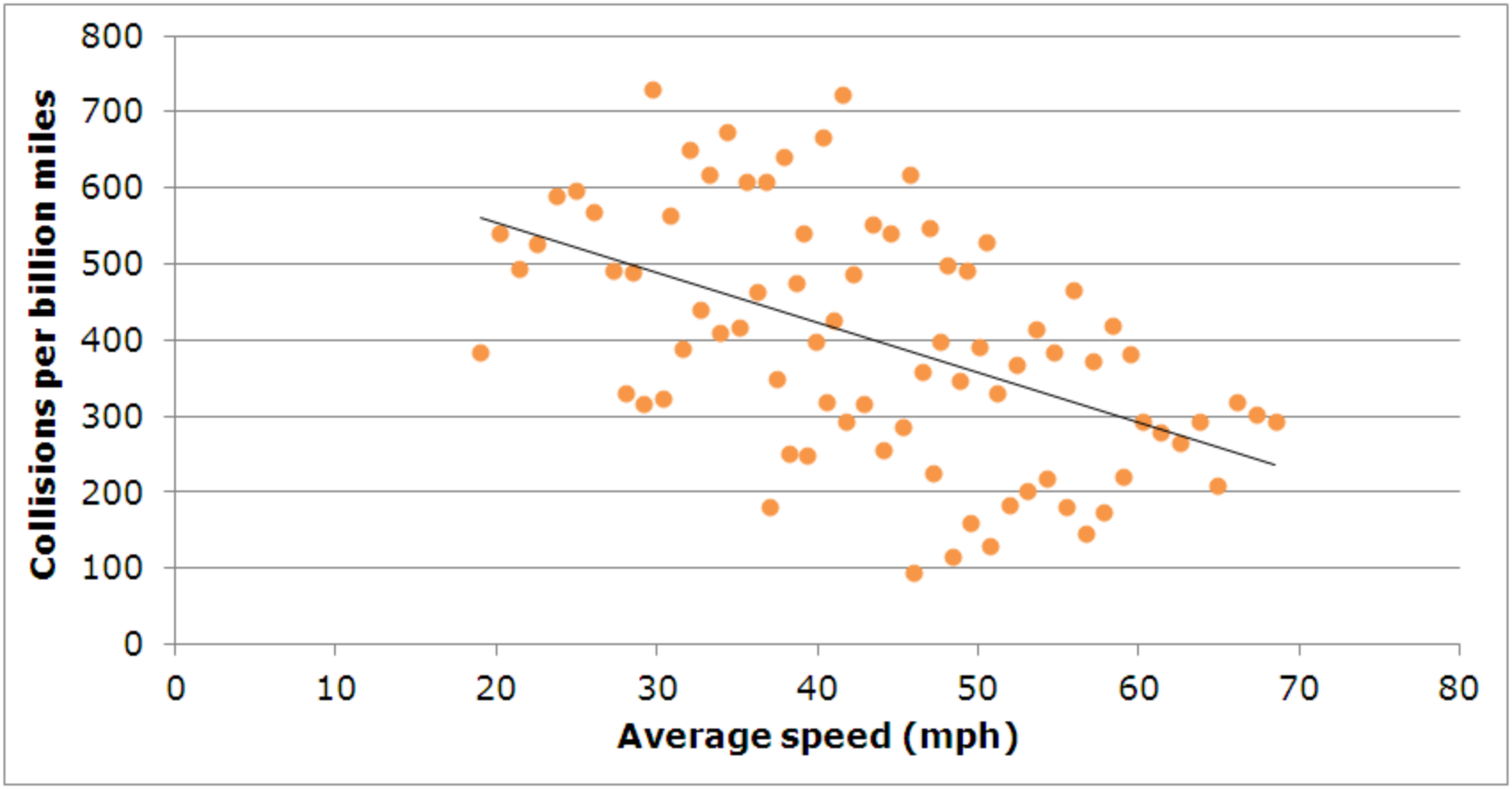
  The primary purpose of speed limits is to enhance safety by reducing the risks imposed by drivers' speed choices. The aim is to reduce disparities in speeds and reduce the potential for vehicle conflicts.

- **The Basis for Enforcement**

  A related function of speed limits is to provide the basis for enforcement and sanctions for those who drive at speeds excessive for conditions and endanger others.

- "**Speed limits should be evidence-led and self-explaining** and seek to reinforce people's assessment of what is a safe speed to travel. They should encourage self-compliance. Speed limits should be seen by drivers as the maximum rather than a target speed." DfT (2012)

Relationship between average speed and collision rate



Relationship between average speed and collision rate

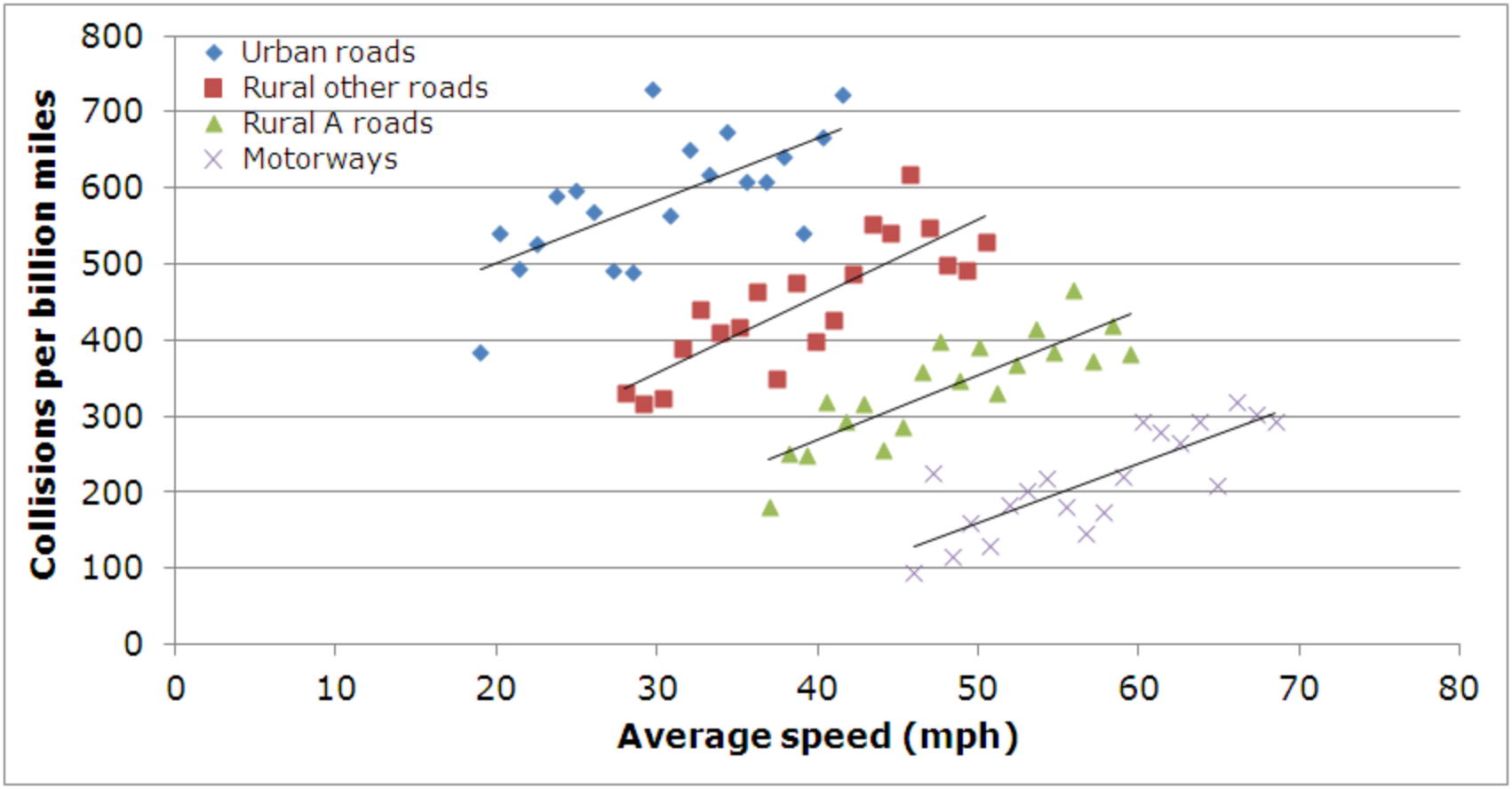


Table of contents

A summary of the evidence on the costs and benefits of speed limit reduction

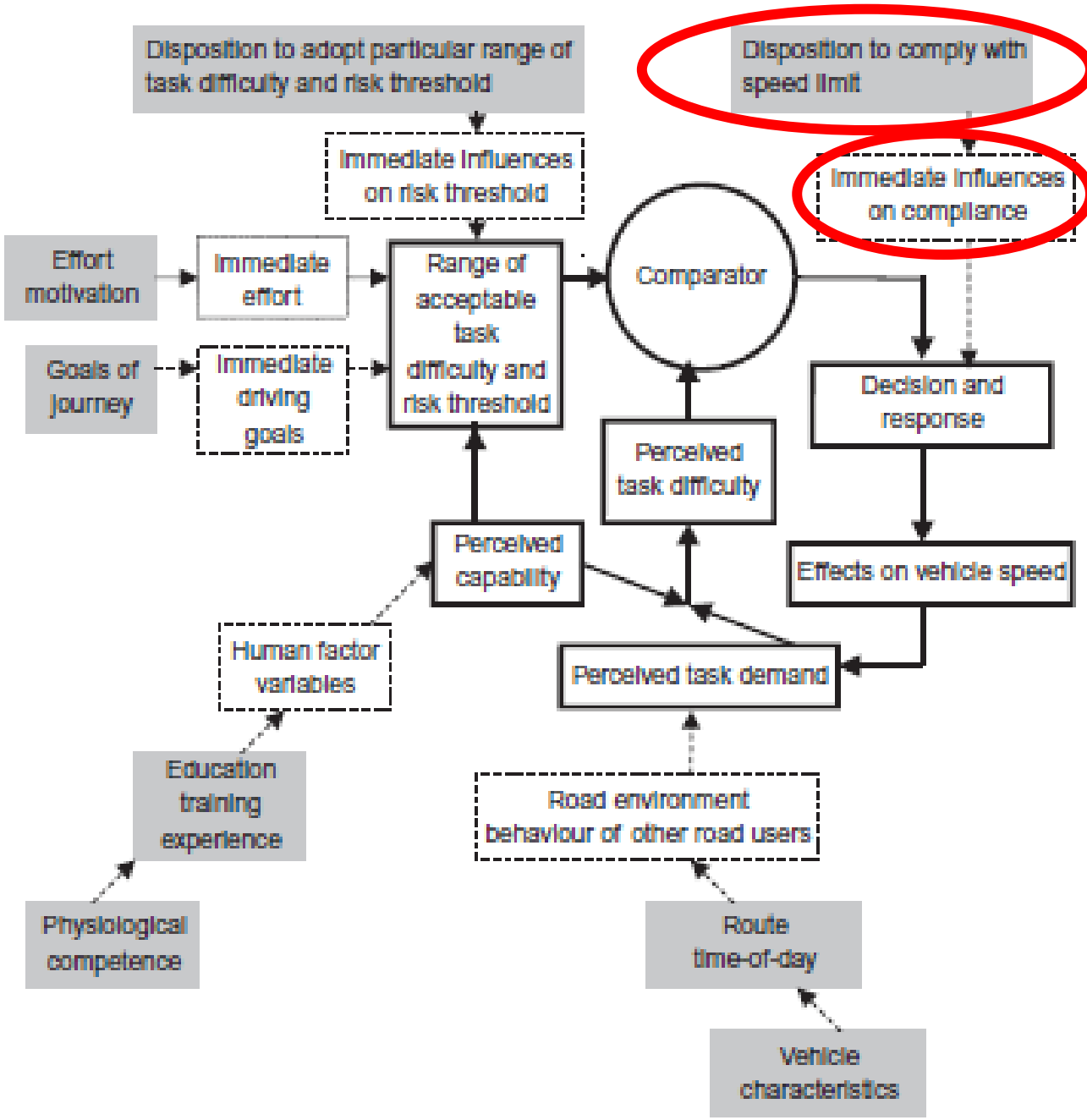
Lawton, Charman, Kinnear, Ainge et al., (2012)

"Reducing a speed limit alone typically results in a change in average speed of as little as a quarter of the change in speed limit"

Evaluation for the Edinburgh Centre for Carbon Innovation, p2

Task Difficulty Homeostasis

Fuller et al. (2008)



What stops drivers driving faster?

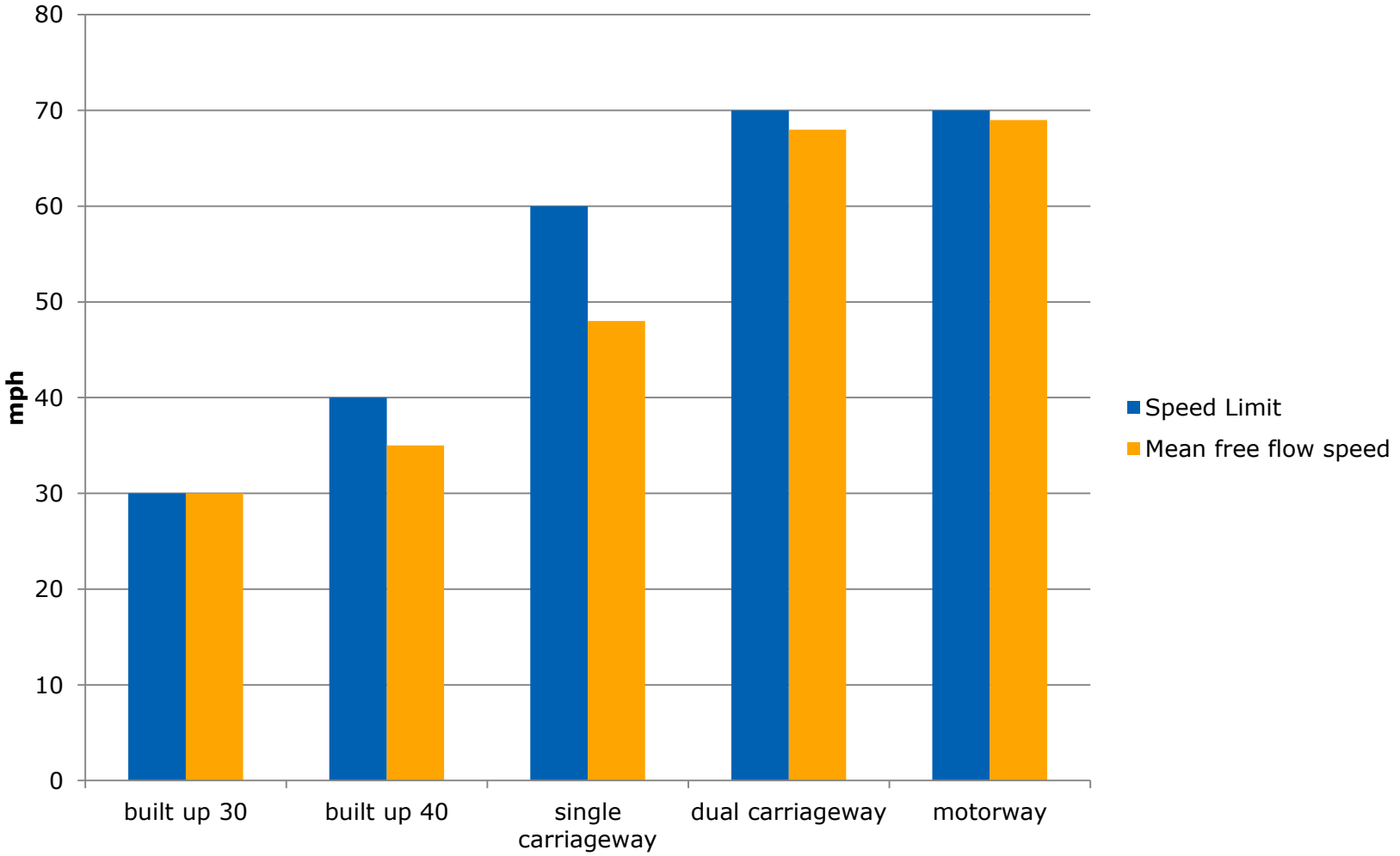
HUSSAR (2008)

...because the driving task would feel more risky
...because the car would feel uncomfortable
...because an offence might be committed
...because of social pressure from passengers and other vehicles

"And again it was on the motorway, nobody else about, did it [high speed] for a couple of minutes, stopped whenever there was anything looking like it was getting too close. Just a bit too much sensory input for me, and a little bit too quick, even though feels like an empty road, it doesn't feel comfy"

"I think your body knows you're outside your comfort zone. It just registers something and you say 'back again' instantly, to whatever speed you're comfortable"

Free Flow Speeds 2011 – Mean speeds



Percentage of cars exceeding the speed limit

	Built up 30 mph	Built up 40 mph	Single carriage-way 60 mph	Dual carriage-way 70 mph	Motor-way 70 mph
HUSSAR (2008)	33%		23%	34%	
DfT (2008)	49%		9%	45%	
DfT (2011)	47%	23%	8%	41%	49%

Table of contents

HUSSAR (2008) Speeder types

	Compliant	Moderate	Excessive
% of respondents	52%	33%	14%
Relationship with speed limits	Largely speed limit compliant	Regularly speed moderately but hardly ever excessively	Regularly speed over 10mph over the speed limit
Opportunistic	28%	78%	93%
Reactive	2%	8%	34%
Both reasons	2%	7%	33%
Male	48%	56%	85%
Age	Mainly older	⟷	Mainly younger

Reasons for speeding

HUSSAR (2008)

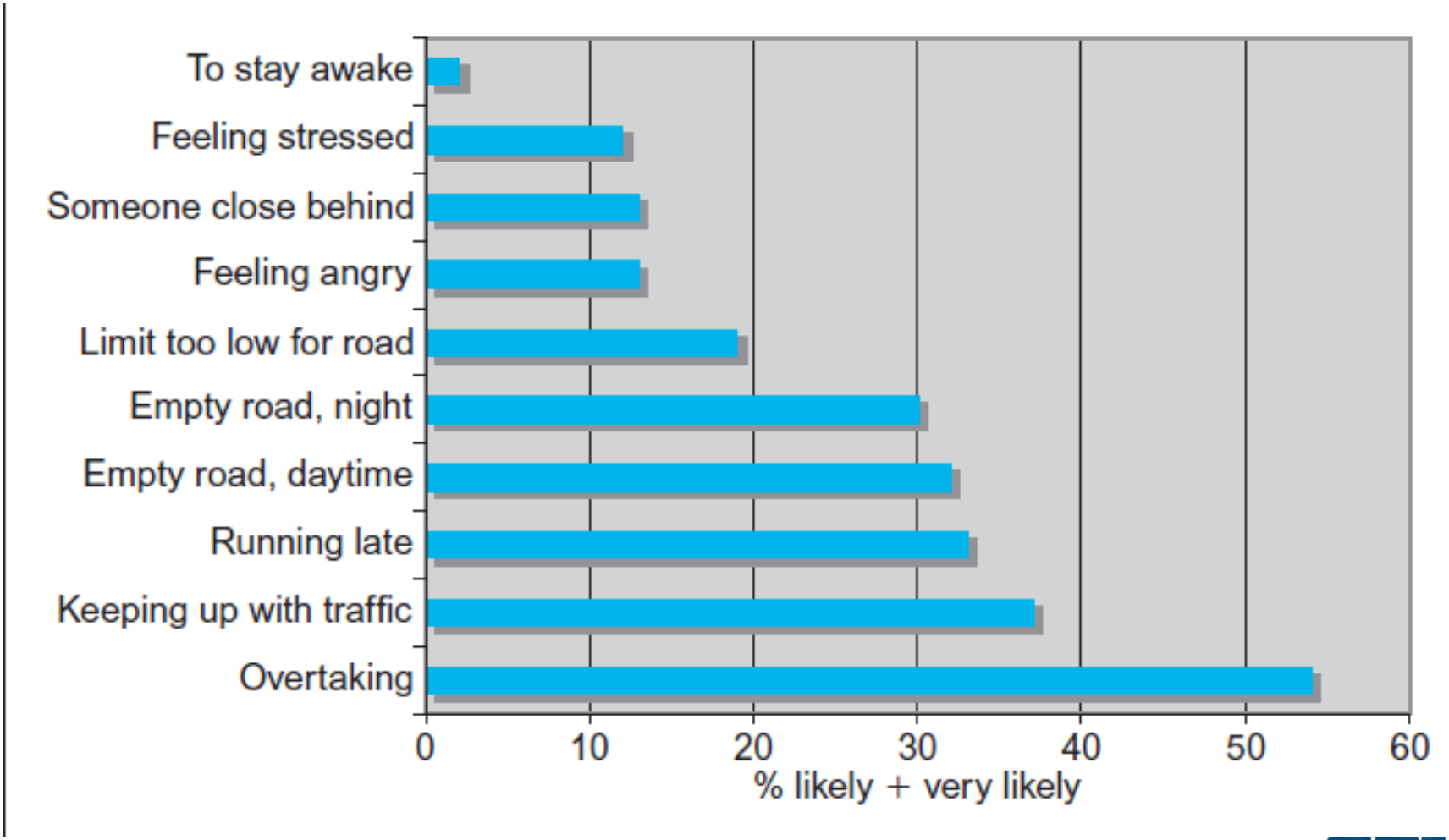
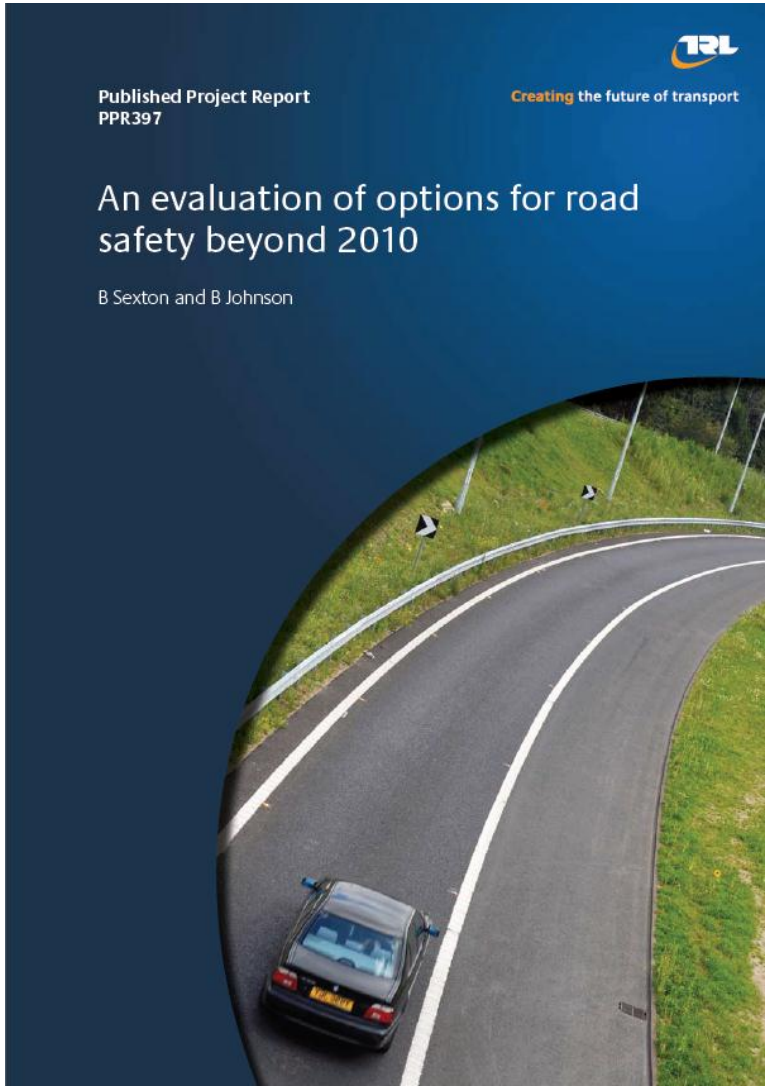


Table of contents

Road safety options beyond 2010



Background

- 2008 – 2009
- Development of post 2010 road safety strategy
- Selection and prioritisation of future activity
- DfT Steering Group
- Options identified for further investigation
- Lots of unavoidable assumptions required

Research and politics

What was said	Justification
"Increasing the speed limit on motorways from 70 to 80 miles per hour for cars, light vans and motorcycles could provide hundreds of millions of pounds of benefits for the economy..." *DfT Press Release, 03/10/2011*	• Vehicles (and roads) have got safer since the current speed limit was set in 1965. • Safety is not the only consideration – there are hundreds of millions of pounds per year to be had from savings in travel time. • As 49% of motorists break the speed limit – it would 'restore moral legitimacy of the system'.

Increase the motorway speed limit to 80mph and improve compliance using average speed cameras

Costs and assumptions

- Large scale media campaign required
- Some sign replacement required
- Significant installation cost
- Maintenance & ongoing administration
- Increase in fuel duty
- All other vehicle speed restrictions remain in place (e.g. HGVs)
- Achieves full compliance
- 2.4mph increase in average speed

Impact on road users

- 18 additional lives lost per year
- 64 more serious injuries
- 363 more slight injuries
- Emissions increase (2% CO_2; 2% NO_x)
- Fuel consumption increase (2%)
- Decrease in journey time (4.1 minutes per hour)
- Net financial benefit of £1,251m over 10 years

NB journey time calculation does not include those currently exceeding 70mph as it is an illegal benefit

Reduce the national motorway speed limit to 60mph and improve compliance using average speed cameras

Costs and assumptions

- Large scale media campaign required
- Some sign replacement required
- Significant installation cost
- Maintenance & ongoing administration
- Reduction in fuel duty
- All other vehicle speed restrictions remain in place (e.g. HGVs)
- Achieves full compliance

Impact on road users

- 94 lives saved per year
- 371 fewer serious injuries
- 2,376 fewer slight injuries
- Significant emission reductions (7% CO_2; 10% NO_x)
- Fuel consumption decrease (7%)
- Increase in journey time (6.8 mins per hour)
- Net loss of £7,577m over 10 years

Maintain the national motorway speed limit at 70mph and improve compliance using average speed cameras

Costs and assumptions

- Large scale media campaign required
- Significant installation cost
- Maintenance & ongoing administration
- Reduction in fuel duty
- All other vehicle speed restrictions remain in place (e.g. HGVs)
- Achieves full compliance

Impact on road users

- 37 lives saved per year
- 138 fewer serious injuries
- 817 fewer slight injuries
- Emission reductions (3% CO_2; 4% NO_x)
- Fuel consumption reduction (3%)
- Increase in journey time (3 minutes per hour)
- Net financial benefit of £1,251m over 10 years

NB journey time savings not included in financial calculation as excess speed is currently an illegal benefit

Reducing the national speed limit on single carriageway roads from 60mph to 50mph

Costs and assumptions

- Large scale media campaign required
- Cost of installing new signs and replacing others where necessary
- All other vehicle speed restrictions remain in place (e.g. HGVs)

Impact on road users

- 260 lives saved per year
- 1,045 fewer serious injuries
- 3,011 fewer slight injuries
- Slight emission reductions
- Slight fuel consumption decrease
- Increase in journey time (4%)
- Net financial loss of £149m over 10 years

Table of contents

Differential Speed Limits

Speed limits on derestricted single carriageway roads in non built-up areas

Vehicle Type	Speed Limit (mph)
Cars & motorcycles (including car-derived vans up to 2 tonnes maximum laden weight)	**60**
Cars towing caravans or trailers (including car-derived vans and motorcycles)	**50**
Buses, coaches and minibuses (not exceeding 12 metres in overall length)	**50**
Goods vehicles (not exceeding 7.5 tonnes maximum laden weight)	**50**
Goods vehicles (exceeding 7.5 tonnes maximum laden weight)	**40**

Differential Speed Limits

Why have DSLs for HGVs?

For	Against
▪ Greater mass increases energy and momentum = longer braking distances ▪ Take longer to slow down ▪ Cause more damage and involved in more serious crashes ▪ DSLs help to offset these differences ▪ Empirical evidence hasn't been found to conclusively support arguments against	▪ More interactions, more overtaking ▪ Frustration leading to risky overtaking? ▪ Higher seating position promotes earlier anticipation of on-road events? ▪ DSLs therefore not required and / or actually increase risk ▪ Empirical evidence hasn't been found to conclusively support arguments for

An absence of evidence isn't the same as evidence of absence

HGV speed limits and the A9(T)

Related research completed to date

Research	Key findings
Review of international literature regarding HGV Differential Speed Limits and speed limit changes	• Literature quality poor • Limited and complicated evidence for or against DSLs • No universal consensus • Each case should be considered individually • Any change needs to be carefully evaluated
Review of the relationship between frustration and overtaking	• Frustration leading to (dangerous) overtaking is widely assumed but limited evidence to support this • However, psychology can provide theoretical underpinnings for such a relationship • Driving for work may increase likelihood to accept risk
Continued on next slide…	

HGV speed limits and the A9(T) cont…

Related research completed to date

Research	Key findings
Evaluation of HGV speed limit increase for the UK (DfT)	• HGVs>7.5t involved in fewer single vehicle accidents but more overtaking accidents than HGVs<7.5t • However, fatal accidents when overtaking HGVs>7.5t tonnes rare • Significantly more fatal and serious injury accidents involving HGVs>7.5t than HGVs<7.5t • Overtaking would require significantly greater time and distance
Modelling and accident analysis of increasing enforcement and HGV speed limit on A9(T)	• Ave. speed enforcement would result in: reduction in ave. speed, increase in journey times, reduction in desire to overtake, reduction in accidents • Safety benefit from enforcement is offset when HGV speed limit increased

Methodology

- Microsimulation modelling (SIAS Ltd)
  - Based on 80km route on A9(T) between Dalwhinnie and Moy
  - Models a 24hr period at 2010 traffic levels
  - Data from ATCs used to model flow by time-of-day, time-of-week, season, vehicle types, platoons, headway
  - Data from A77(T) SPECS instalment used to model effect of average speed enforcement
- Accident analysis (TRL)
  - Uses output from modelling for changes in traffic flow, average speed and speed distribution
  - Calculations based on well established and accepted equations of the relationship between speed and accident rate (i.e. Elvik and Taylor)

Findings of the Microsimulation modelling

- The introduction of average speed enforcement:
  - Reduction in average speed of 6 mph (all vehicles)
  - Increase in journey times of around 2 minutes
  - Reduction in the desire to overtake of 7%
  - Results for summer months similar but slightly more pronounced
- Enforcement plus HGV(>7.5t) speed limit increase to 50mph:
  - Reduction in average speed of 4 mph (all vehicles)
  - Increase in journey times of around 1 minute
  - Reduction in the desire to overtake of 13%
  - Improvement in operational performance
  - Reduced platoon lengths and more consistent headways
  - Reduced speed distribution

A9(T) Speed limit change alone: Impact on the number of accidents

	Speed limit for HGVs > 7.5 tonnes								
	40mph Baseline			**50mph Increase 1**			**60mph Increase 2**		
	% HGVs faster than 50mph= 54%			% HGVs faster than 50mph= 74%			% HGVs faster than 50mph= 86%		
	Fatal	*Serious*	*Slight*	*Fatal*	*Serious*	*Slight*	*Fatal*	*Serious*	*Slight*
No change in enforcement	No change			+5%	+3-4%		+7%	+3-4%	

A9(T) Enforcement alone: Impact on the number of accidents

	Speed limit for HGVs > 7.5 tonnes		
	40mph Baseline		
	Fatal	*Serious*	*Slight*
No change in enforcement	No change		
Average speed camera enforcement	-36%	-25%	-11%

A9(T) Enforcement and speed limit change: Impact on the number of accidents

	Speed limit for HGVs > 7.5 tonnes					
	40mph Baseline			50mph Increase 1		
	Fatal	*Serious*	*Slight*	*Fatal*	*Serious*	*Slight*
No change in enforcement	No change			+5%	+3-4%	
Average speed camera enforcement	-36%	-25%	-11%	-27%	-18%	-8%

Enforcement and speed limit change: Impact on the number of accidents

	Speed limit for HGVs > 7.5 tonnes								
	40mph Baseline			50mph Increase 1			60mph Increase 2		
	Fatal	*Serious*	*Slight*	*Fatal*	*Serious*	*Slight*	*Fatal*	*Serious*	*Slight*
No enforcement	No change			+5%	+3-4%		+7%	+3-4%	
Average speed camera enforcement	-36%	-25%	-11%	-27%	-18%	-8%	-23%	-15%	-7%

Speed limit change alone: All injury accidents and financial cost

	Speed limit for HGVs > 7.5 tonnes					
	40mph		50mph		60mph	
	All injury accidents	*Cost change per km per year*	*All injury accidents*	*Cost change per km per year*	*All injury accidents*	*Cost change per km per year*
No enforcement	No change		+4%	+£3,000-4,000	+5-6%	+£3,500-4,500

A9(T) Enforcement and speed limit change: All injury accidents and financial cost

	Speed limit for HGVs > 7.5 tonnes			
	40mph		50mph	
	All injury accidents	*Cost change per km per year*	*All injury accidents*	*Cost change per km per year*
No enforcement	No change		+4%	+£3,000-4,000
Average speed camera enforcement	-16%	-£23,692	-12%	-£17,801

A9(T) Enforcement and speed limit change: All injury accidents and financial cost

	Speed limit for HGVs > 7.5 tonnes					
	40mph		50mph		60mph	
	All injury accidents	*Cost change per km per year*	*All injury accidents*	*Cost change per km per year*	*All injury accidents*	*Cost change per km per year*
No enforcement	No change		+4%	+£3,000-4,000	+5-6%	+£3,500-4,500
Average speed camera enforcement	-16%	-£23,692	-12%	-£17,801	-9.5%	-£14,693

Key influences on crash risk

Increasing HGV speed limits

Increasing crash risk	Decreasing crash risk
▪ Higher speeds for ALL motorists in the absence of enforcement. ▪ Increased workload on the driver. ▪ Collision severity, especially when involving HGVs, will increase. This is likely to result in more injury accidents/increased severity of injuries/fatalities. ▪ More time and space required for overtaking	▪ Increased headway ▪ Reduced platoon length ▪ Reduction in the number of overtaking manoeuvres ▪ Less variation in speed between vehicles

- ❑ Enforcement is required to reduce average speeds if increasing HGV speed limits is to be considered.
- ❑ Factors influencing a reduction in crash risk are reliant on drivers behaving like the data in the modelling and relies on the assumptions being accurate.

Table of contents

Summary

- There is a simple relationship between speed, accident rate and accident severity
- The relationship between speed limits and accidents is mediated by this but is more complex because of:
  - Driver behaviour and compliance
  - Speed variation
  - Vehicle types
- A9(T) is a unique road with unique characteristics
- Modelling and accident analysis has attempted to take account of all possible measurable factors but limitations need to be considered
- What should we do next?

Thank you

Presented by Dr Neale Kinnear
Principal Psychologist

Tel: 01344 77 0101
Email: nkinnear@trl.co.uk