The Influence of Active Road Studs on Safe Driving Behaviour

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Presentation content:

- **Background & Aims**
- **Methods**
- **Results**
- **Conclusions**

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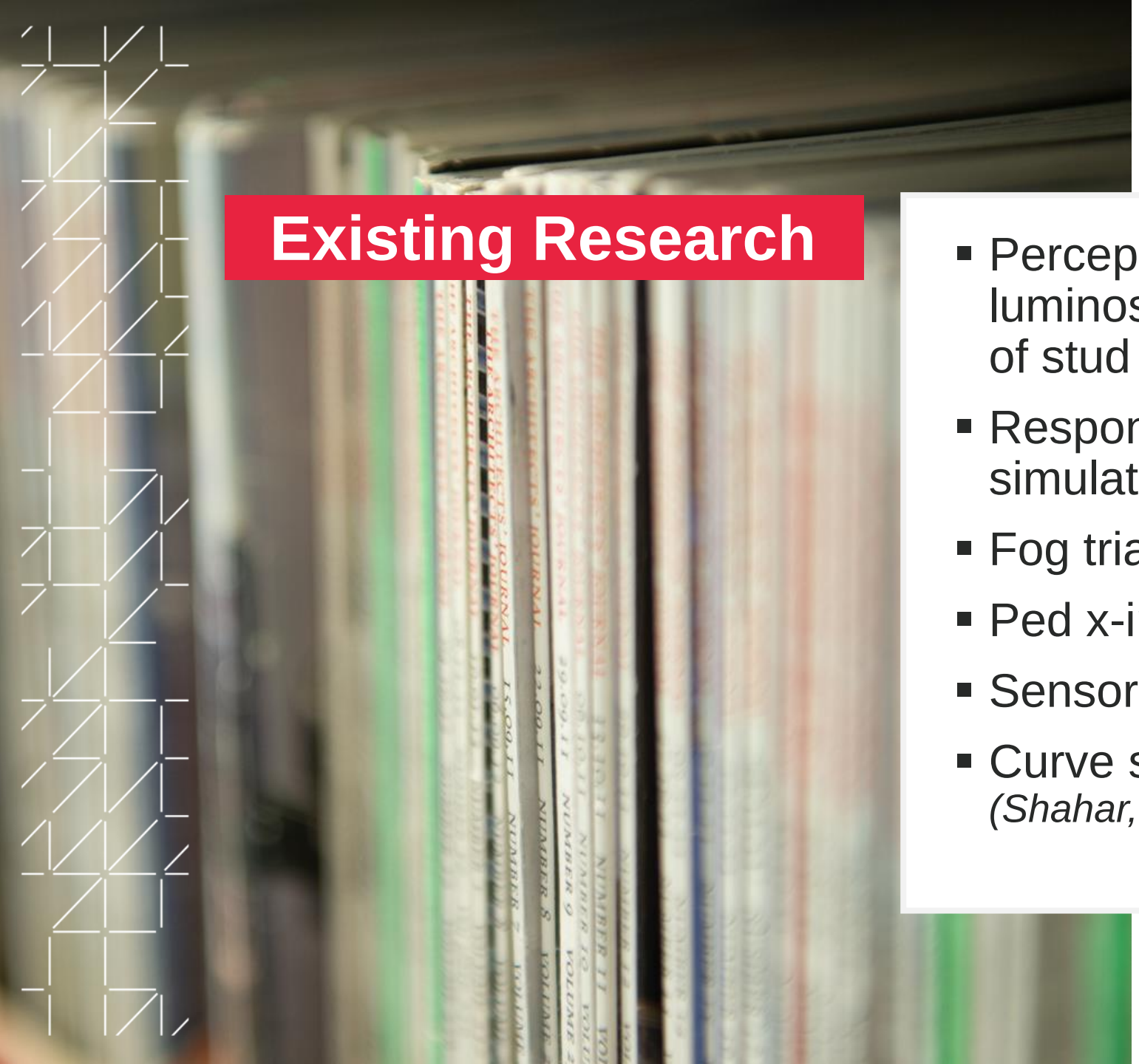
Background and Aims

Traditional Road Studs

Active Road Studs



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Existing Research

- Perception of colour, luminosity, spacing and height of stud *(Bacelar, 2004)*
- Response of drivers in simulator *(Reed, 2006)*
- Fog trials *(Highways Agency, 2008)*
- Ped x-ing trials *(Karkee, 2010)*
- Sensor trials *(Lamb et al, 2015)*
- Curve simulation response *(Shahar, 2018)*

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What is the influence of active road studs on safe driving behaviour in real world conditions, with a specific emphasis on junctions?

Do users perceive a different level of safety with active road studs at junctions?

A1 Grantshouse - Lamberton

METHOD

Self-reporting user survey

VARIABLES

User demographics
Confidence
Infrastructure
Lighting

TESTING

Chi-square
Thematic analysis

Does the installation of active road studs influence the speed of drivers approaching junctions?

A1 Grantshouse - Lamberton

METHOD

Speed survey

VARIABLES

Speed
Lighting
Road factors

TESTING

T-test
Linear regression

A7 Boleside

METHOD

Speed survey

VARIABLES

Speed
Lighting

TESTING

Chi-square test of independence

Does the positioning of vehicles and compliance with lane markings at junctions change with active road studs?

A720 Sheriffhall Roundabout

METHOD

Before and after survey

VARIABLES

Lane changes
Lighting
Surface condition
Traffic flow

TESTING

Z-test
Logarithmic regression

Does any change in driver behaviour because of active road stud installation result in a change to collision rate at junctions?

A720 Sheriffhall Roundabout

METHOD

Swedish TCT
Crash trend analysis

VARIABLES

Conflicts
Recorded injury crashes
Lighting / surface

TESTING

Z-test
Chi-square

Methods

Case Study Locations

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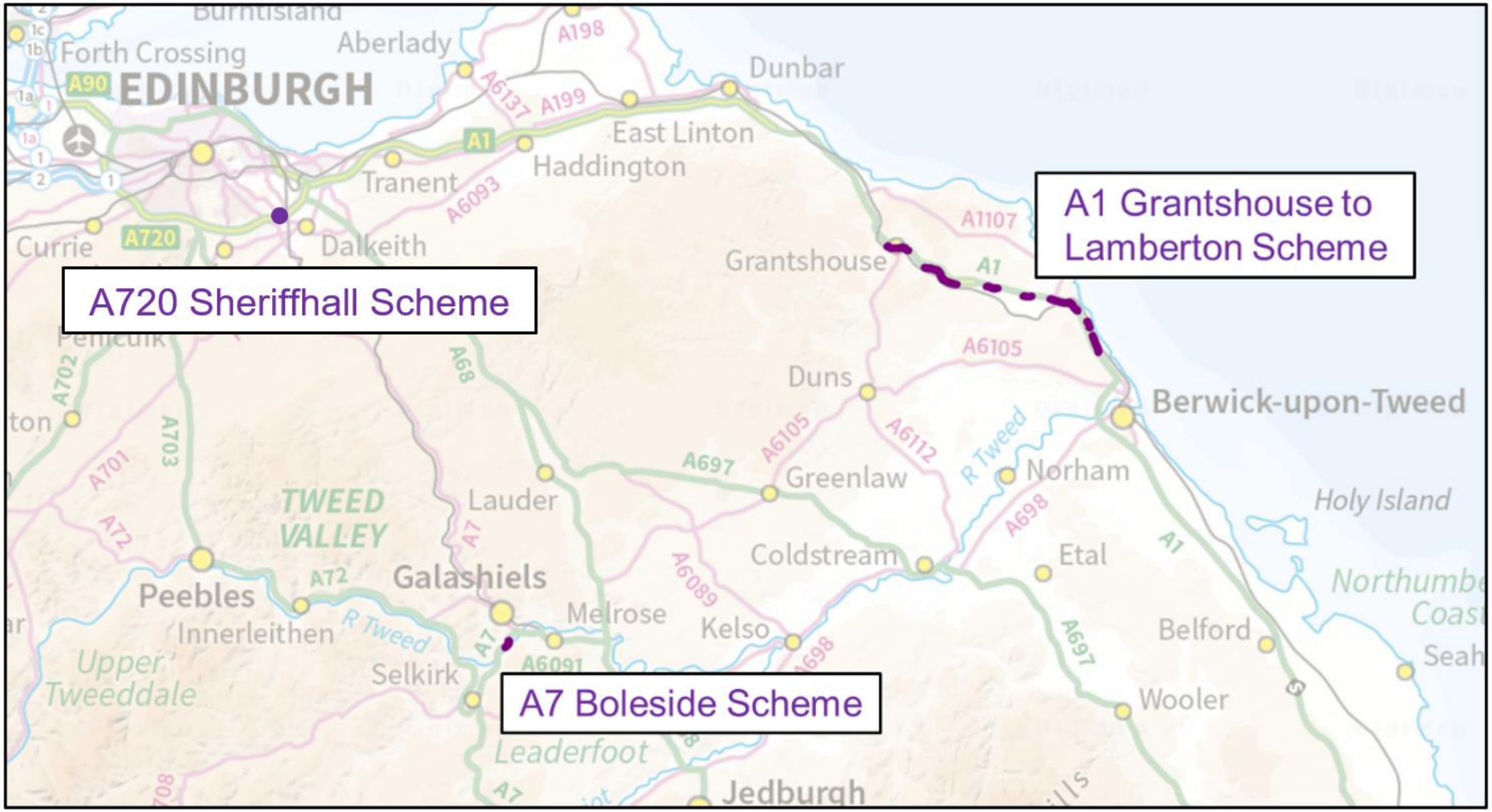

A1 / A7 Borders

A720 Sheriffhall

A720 Sheriffhall

- **Camera surveys**: no studs, 1yr after and 3yrs after
- Both **daytime** and **night time**
- Coverage over **full week**
- **Lane transgression analysis** using manual observation
- **Conflict study** using Swedish Traffic Conflict Technique
- **Datavyu** software used for incident coding

A1 Scheme

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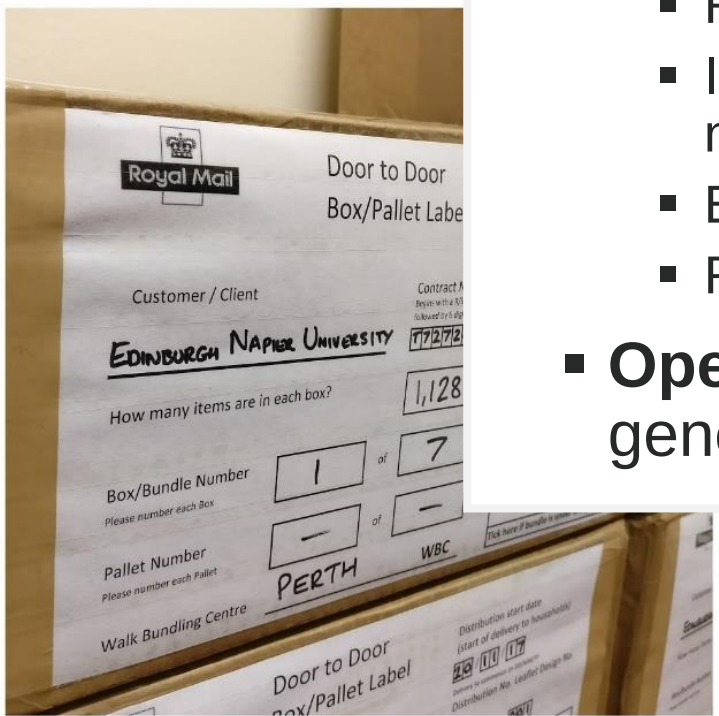
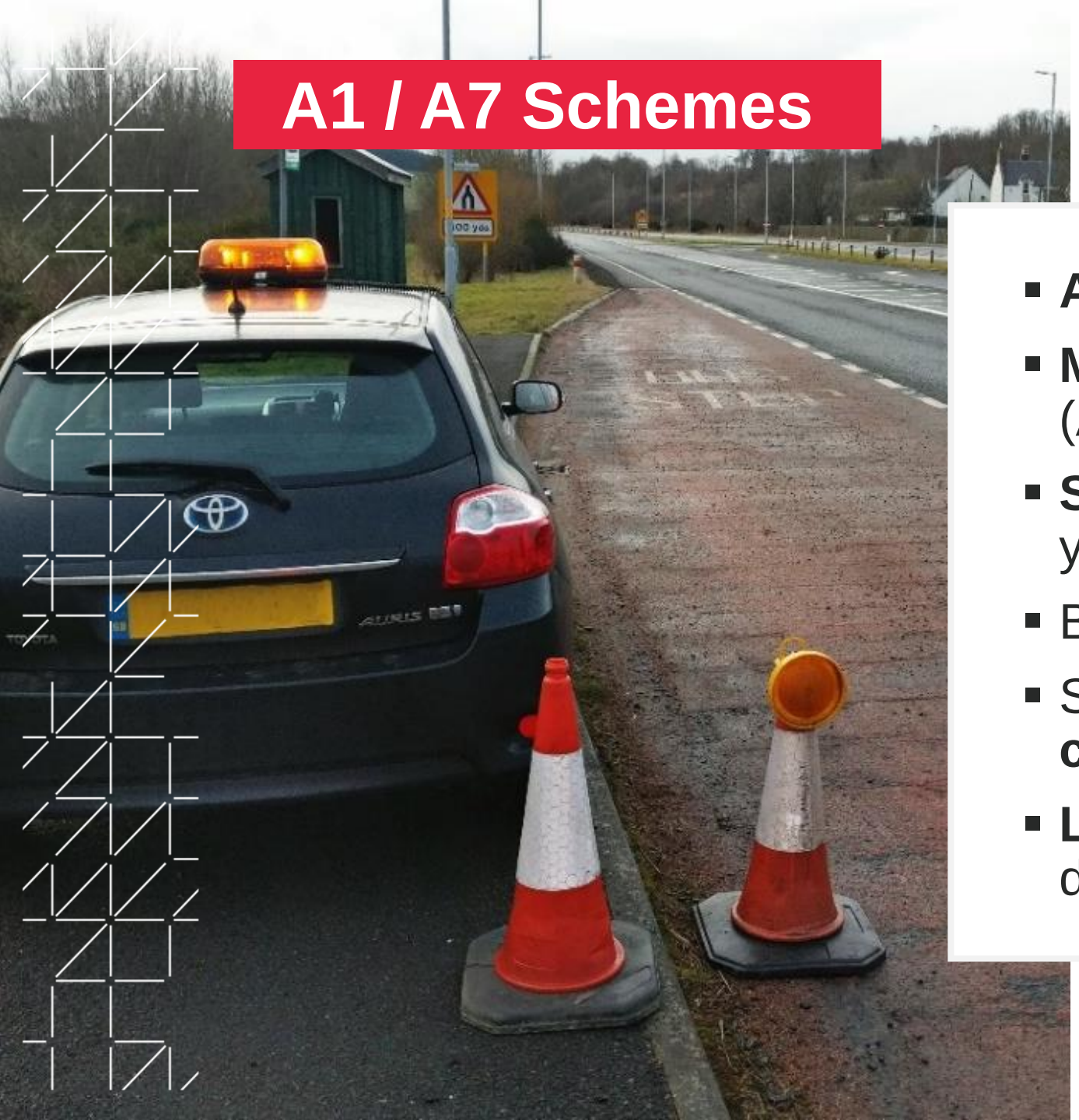


- **Questionnaire survey** delivered to 10,817 households
- **Question topics**:
  - Demographic information
  - Levels of driver confidence
  - Reasons for travel
  - Importance of road features at night
  - Effects of the active road stud
  - Reasons for views on the stud
- **Open ended question** on general views

A1 / A7 Schemes



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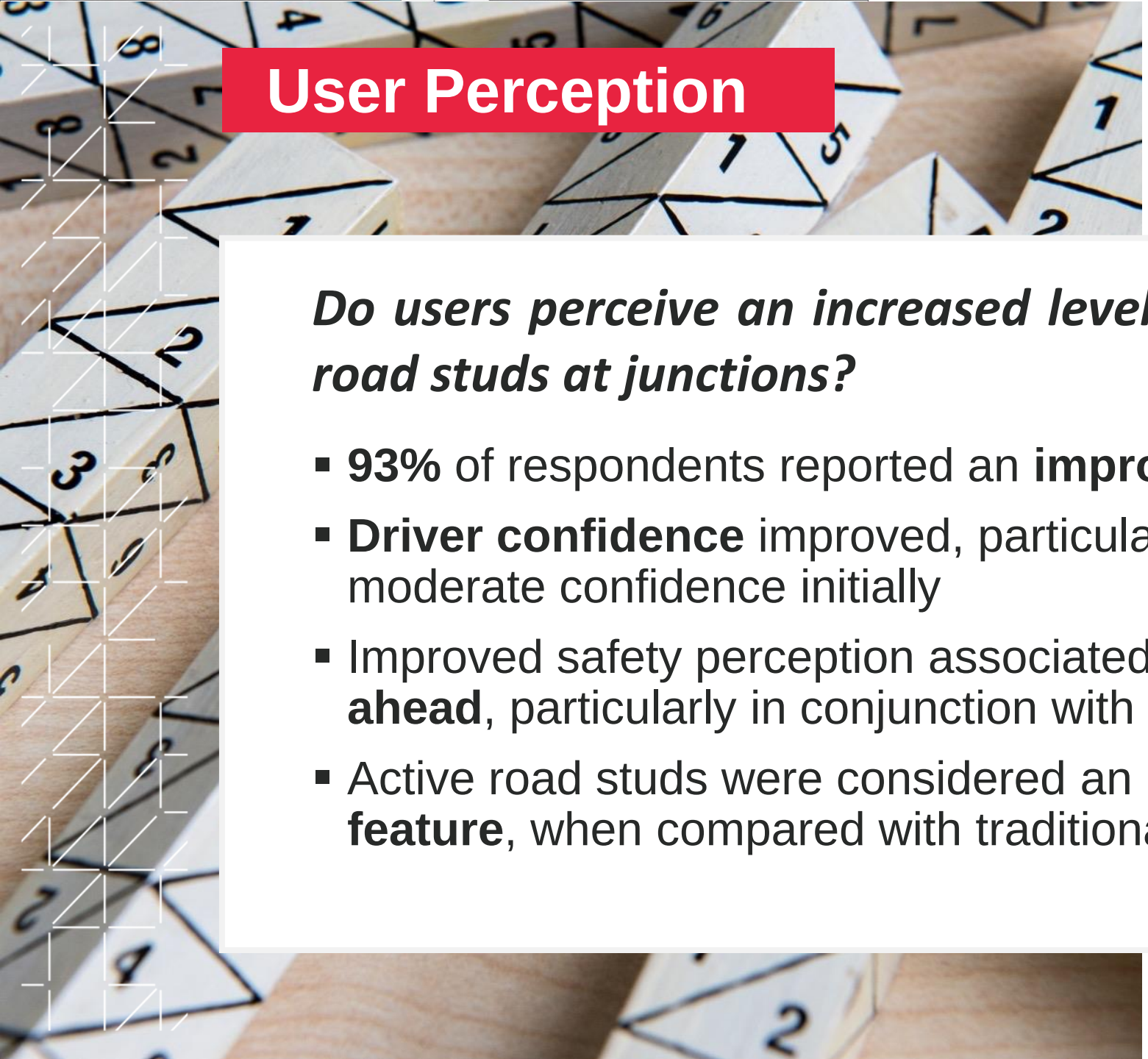
- **ATC Radar** surveys (A7)
- **Manual** spot speed surveys (A1)
- **Scenarios:** No studs, after, 2 yrs after installation
- Both **daytime** and **night time**
- Surveys undertaken in **neutral conditions**
- **Linear regression model** developed – features vs speed

Results



User Perception

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Do users perceive an increased level of safety with active road studs at junctions?

- **93%** of respondents reported an **improvement**
- **Driver confidence** improved, particularly for those with moderate confidence initially
- Improved safety perception associated with **clarity of road ahead**, particularly in conjunction with headlight glare
- Active road studs were considered an **important road feature**, when compared with traditional measures

User Perception

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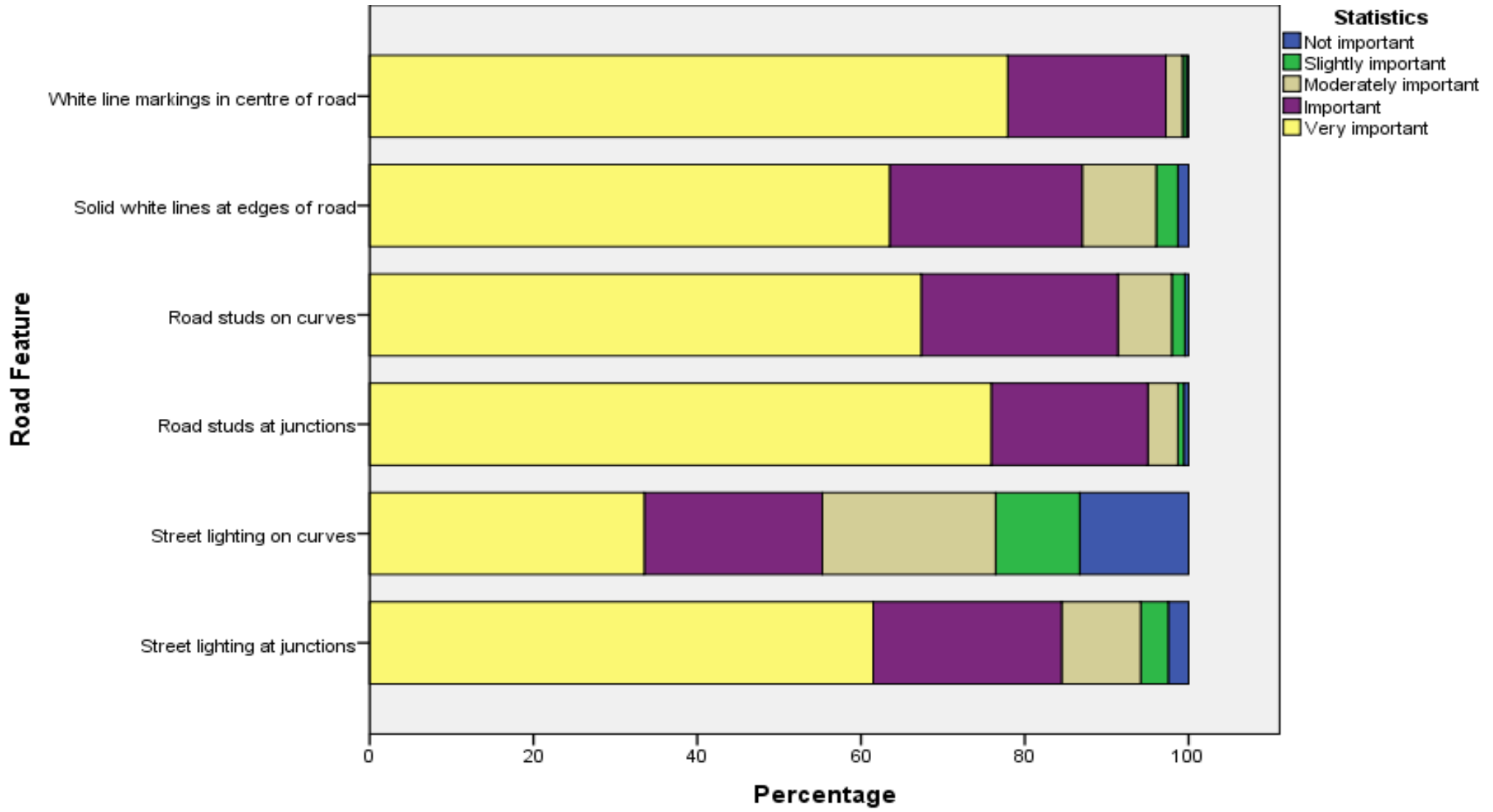

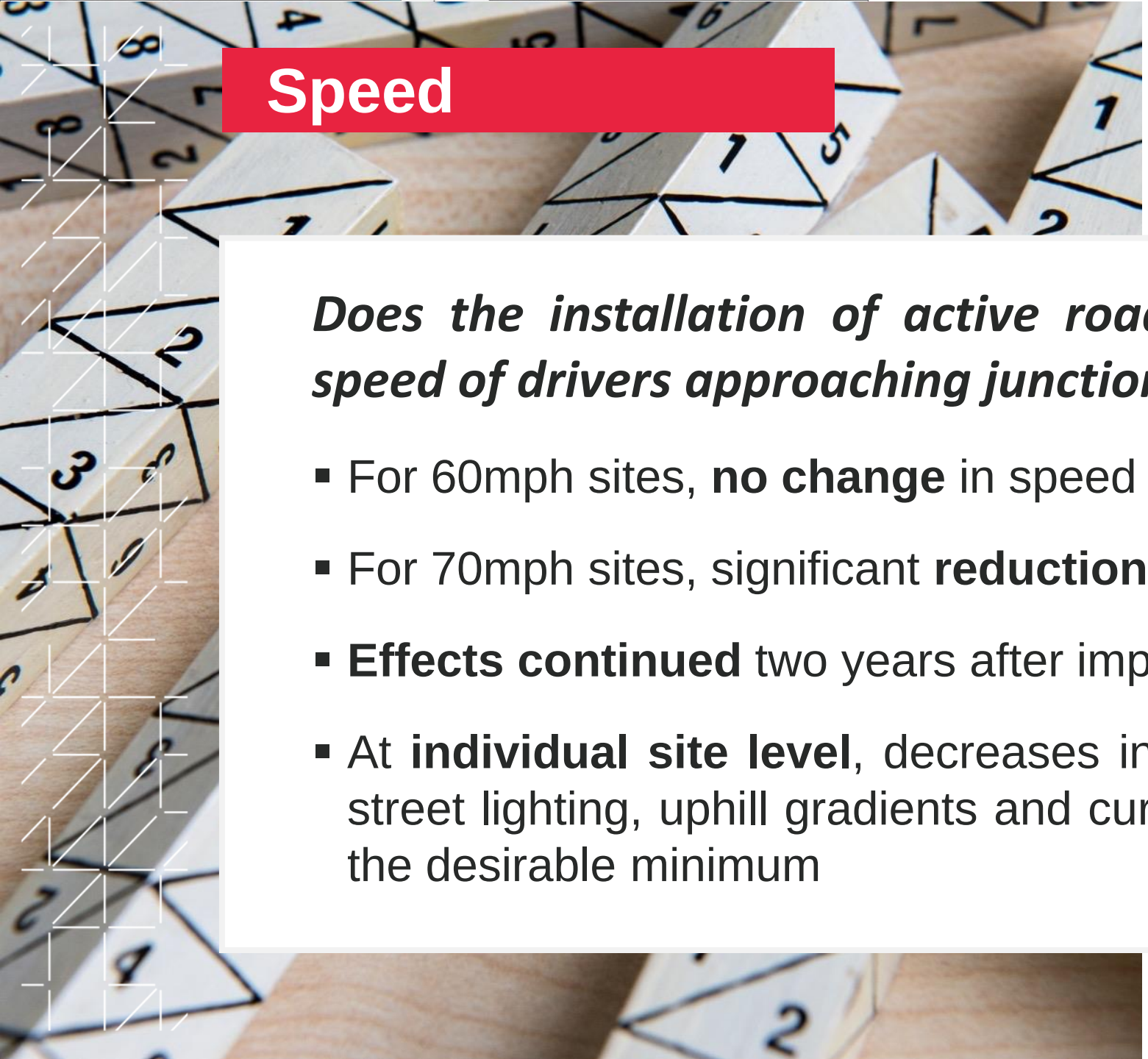

Speed

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Does the installation of active road studs influence the speed of drivers approaching junctions?

- For 60mph sites, **no change** in speed found
- For 70mph sites, significant **reduction** in speed found
- **Effects continued** two years after implementation
- At **individual site level**, decreases in speed associated with street lighting, uphill gradients and curves will radii lower than the desirable minimum

Regression Model

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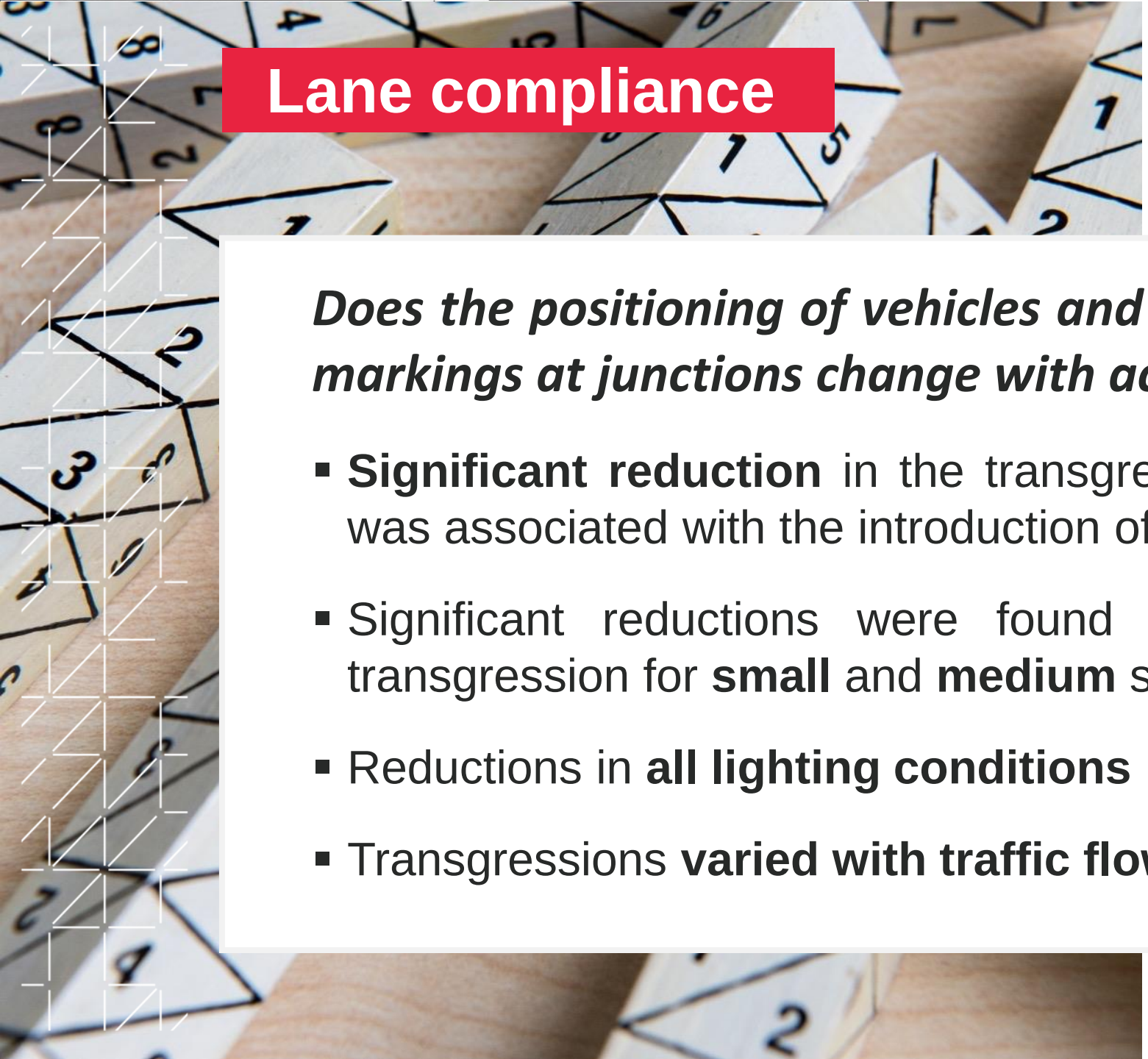
Table 9. Linear Regression Model.

Variable Description	Regression Coefficients	
	60 mph PSL n = 6299	70 mph PSL n = 2886
1. Constant	65.089 [a]	55.348 [a]
2. Darkness indicator (1 if dark; 0 otherwise)	0.593 [a]	1.238 [a]
3. Active Road Stud indicator (1 if present; 0 otherwise)	—	−0.877 [b]
4. 2 + 1 carriageway indicator (1 if present; 0 otherwise)	0.982 [a]	—
5. Street lighting indicator (1 if present; 0 otherwise)	−6.166 [a]	—
6. Junction indicator (1 if present; 0 otherwise)	—	—
7. Merge indicator (1 if present; 0 otherwise)	9.320 [a]	—
8. Average approach gradient (%; up gradient +ve; down gradient -ve)	−0.285 [a]	—
9. Average half-width (metres)	−2.277 [a]	0.614 [b]
10. Desirable minimum curve indicator (1 if present; 0 otherwise)	—	—
11. One-step relaxation curve indicator (1 if present; 0 otherwise)	−3.455 [a]	—
12. Two-step relaxation curve indicator (1 if present; 0 otherwise)	−4.352 [a]	—
13. Distance since enforcement camera (with flow) (km)	−0.103 [b]	—
14. Distance since enforcement camera (any direction) (km)	2.640 [a]	—
15. Length of treated approach (km)	−0.703 [a]	1.819 [a]

— statistically insignificant variable (not included for estimation in model specification); [a] 0.99 level of confidence; [b] 0.95 level of confidence.



Lane compliance

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Does the positioning of vehicles and compliance with lane markings at junctions change with active road studs?

- **Significant reduction** in the transgression of lane markings was associated with the introduction of active road studs
- Significant reductions were found for all magnitudes of transgression for **small** and **medium** sized vehicles
- Reductions in **all lighting conditions**
- Transgressions **varied with traffic flow**

Lane compliance

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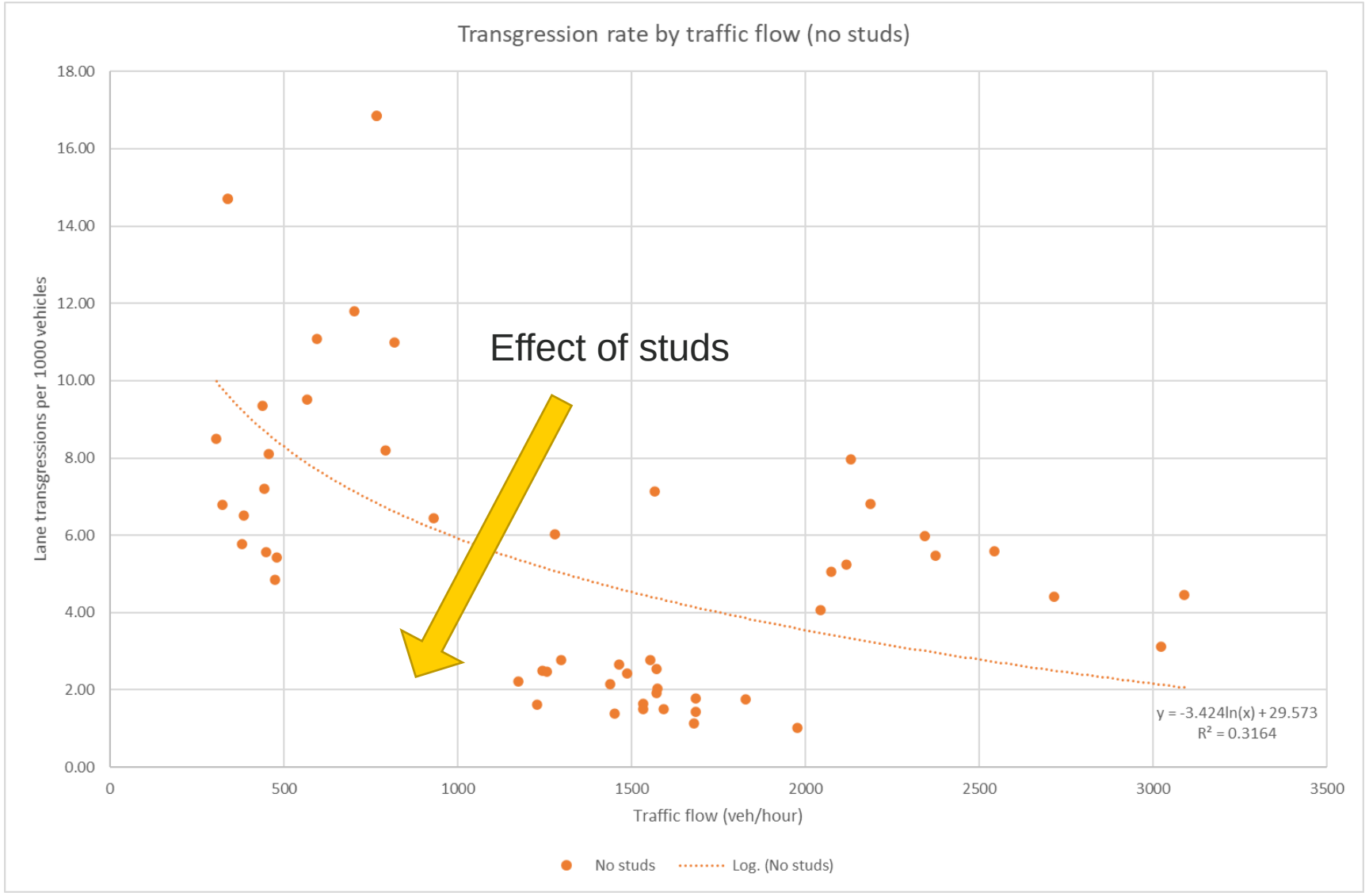

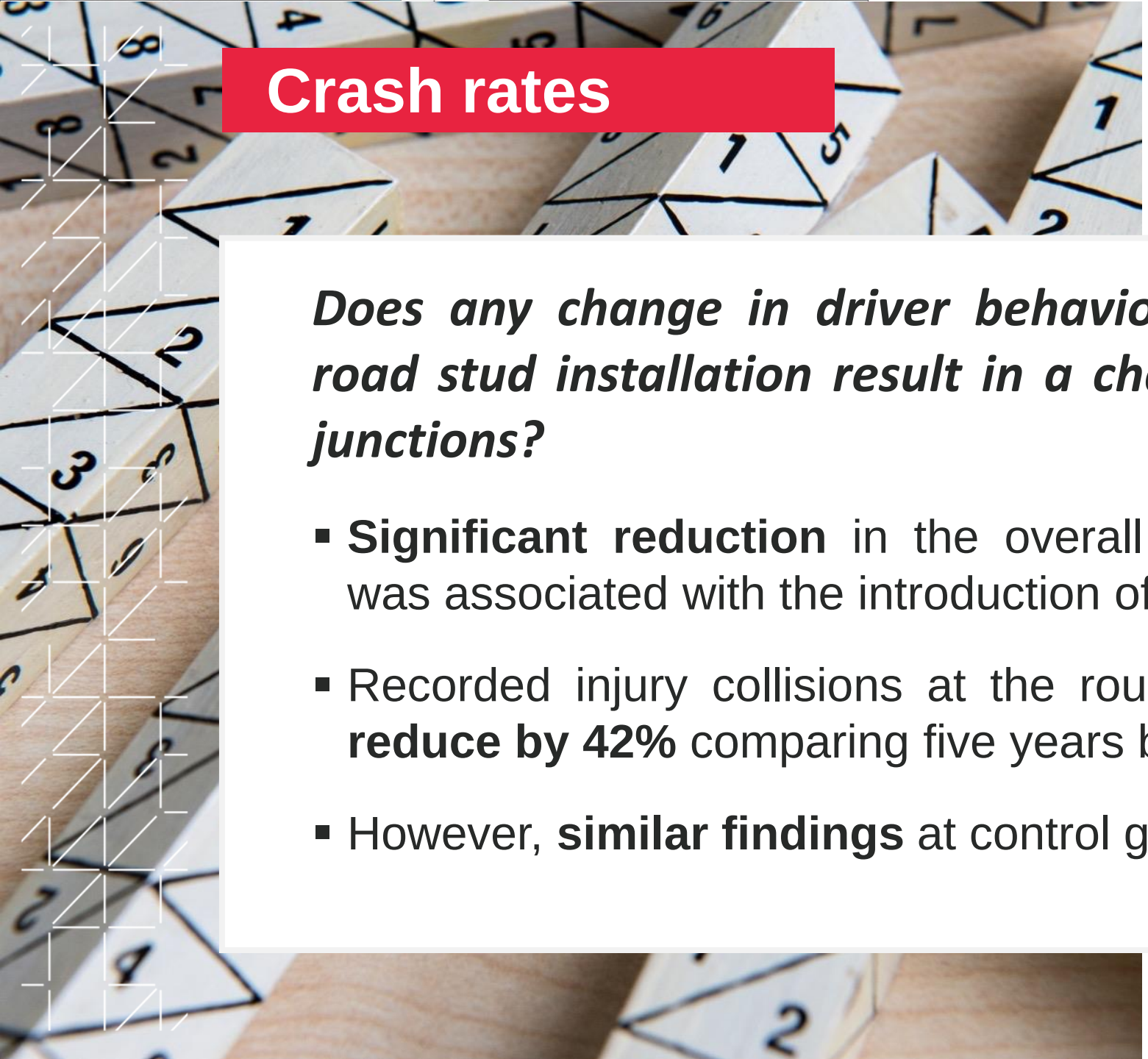

Crash rates

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Does any change in driver behaviour because of active road stud installation result in a change to crash rate at junctions?

- **Significant reduction** in the overall rate of traffic conflicts was associated with the introduction of the active road studs
- Recorded injury collisions at the roundabout were found to **reduce by 42%** comparing five years before and five after
- However, **similar findings** at control group roundabouts

Crash rates

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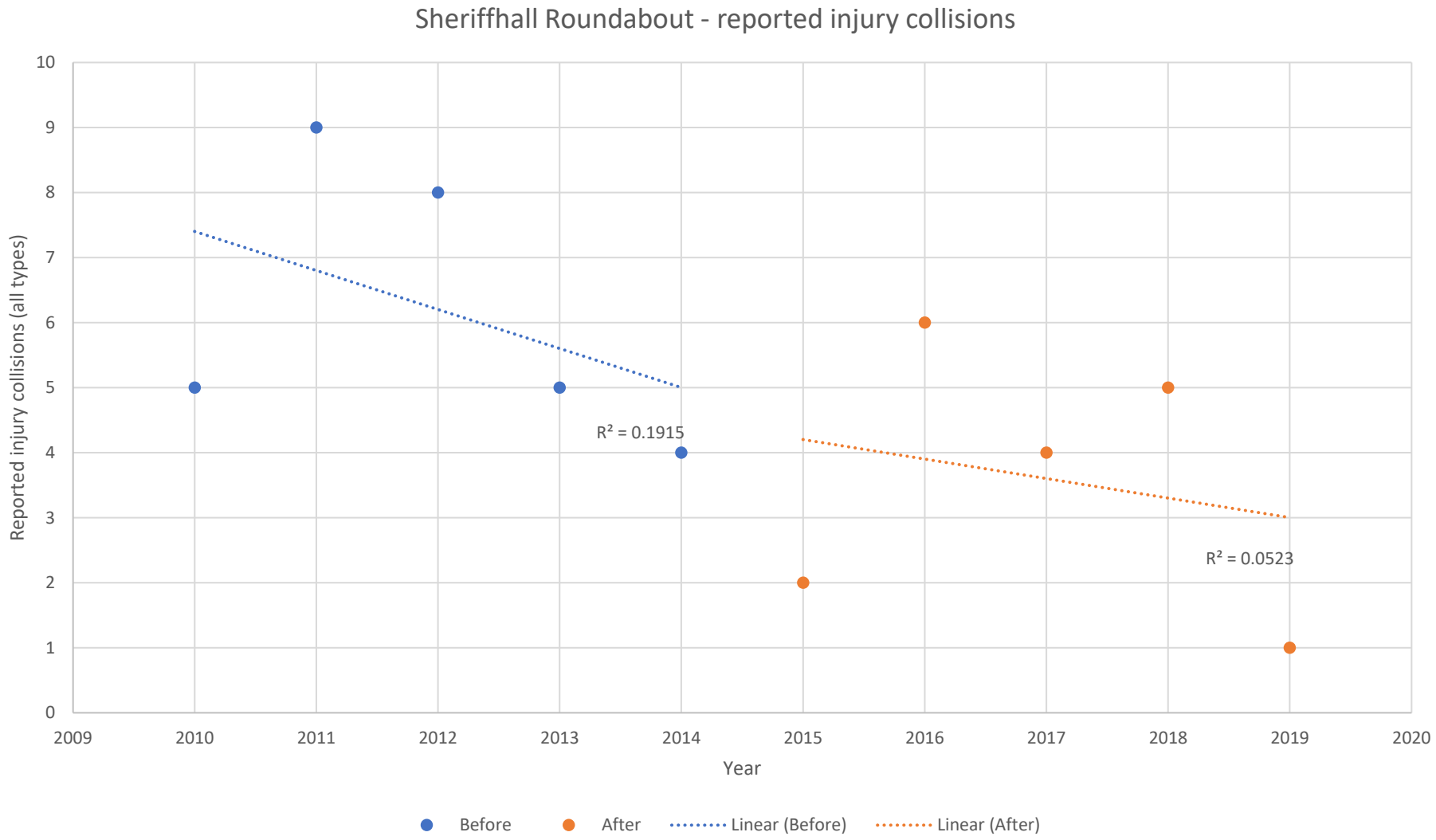

Conflicts

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Conclusions

Conclusions

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- Active road studs appear associated with a **positive influence** on driver confidence and road safety perception
- Concerns that providing increased visibility due to active road studs result in increased speed appear **unfounded**
- Active road studs may provide an **alternative to street lighting** in locations of economic or environmental challenges
- Active road studs may be associated with **improved lane discipline** at roundabouts
- Active road studs appear to be associated with **reduced vehicle conflicts,** but further work may be required to determine effect on crash rates

Further Reading

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energies

MDPI

Article

Solar-Powered Active Road Studs and Highway Infrastructure: Effect on Vehicle Speeds

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Abstract: Vehicle speeds have a direct relationship with the severity of road crashes and may influence their probability of occurrence. Solar-powered active road studs have been shown to have a positive effect on driver confidence, but their impact on vehicle speed in conjunction with other road features is little understood. This study aims to address this gap in knowledge through a case study of a 20 km section of a strategic major road featuring a variety of highway infrastructure features. Before-and-after surveys were undertaken at 21 locations along the route using manual radar speed measurement. Analysis of nearly 10,000 speed measurements showed no statistically significant change in mean speeds following the implementation of the road studs. Linear regression models are proposed for two different posted speed limits, associating road features with expected vehicle speed. The models suggest that vehicle speeds are chiefly influenced by merges, curves, gradients, and ambient light conditions. The findings of this study should provide confidence that active road studs may be implemented without a negative impact on speed-related safety. The work also provides further expansion of the evidence base describing the effect of highway infrastructure features on vehicle speeds.

Keywords: active road studs; highway infrastructure; vehicle speeds; road safety; road features

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1. Introduction

Road traffic crashes are the eighth leading cause of death globally with an estimated 1.35 million killed and 50 million injured each year [1]. Speed management has a long association with road safety and is enshrined within contemporary international road safety strategies such as the safe systems approach [2,3]. Such strategies are founded upon the basis that the consequences of crashes at higher speeds are a simple matter of physics: the greater the change in velocity, the greater the energy dissipation and, subsequently, the higher the severity of injury [4]. On this basis, understanding the relationships between drivers, vehicles, road infrastructure, and speed continues to be an important goal of road safety research.

Early case-control studies in speed research suggested that the greater the differential in the speed of a vehicle from the average of all the traffic, the higher the risk of a crash [5,6]. Self-reporting studies have also found that drivers found to be travelling faster are more likely to have a history of crashes [7]. More recent research has tended to look at the road level (including segments, sections, intersections, and corridors), rather than individual driver level, not least because of the difficulties of categorically associating speed as a causation factor in individual crashes [8]. The question then becomes one of how the frequency and severity of the crashes vary with mean speed, to which the answer has been extensively explored; before-and-after studies of measures, such as changes in the posted speed limit, traffic calming interventions, or increased enforcement have resulted in linear, power, and asymptotic relationships associating higher mean speeds with increased crash rates [9–14]. Therefore, from the point of view of the road designer, road features that result in unintended increases in mean speed are unlikely to be desirable.

sustainability

MDPI

Article

Active Road Studs as an Alternative to Lighting on Rural Roads: Driver Safety Perception

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Abstract: Drivers, particularly with increasing age, cite driving at night as being problematic and feeling unsafe. Ultimately this may result in self-regulation and avoidance, with potentially negative health effects. The issue is commonly mitigated through provision of street lighting, but with it comes cost, environmental impact, and other negative effects. Research has suggested that provision of LED Active Road Studs may be of assistance to drivers at night. However, it is not known how implementation of this measure affects driver confidence, as research to date has focused on observational study of actual driving behaviour. The present work addresses this gap in knowledge using data from 698 respondents to a questionnaire survey of households around a recently treated route. Overall, 72% reported an increase in confidence driving at night, with key reasons cited as increased preview time and reduced glare. A total of 80% of respondents believed the overall safety of the study route had improved. Underlying confidence was found to be lower in females, with confidence increasing with mileage driven. This study is the first to suggest the use of active road studs may increase driver confidence and provide increased travel opportunities, particularly where street lighting is impractical or undesirable in terms of sustainability.

Keywords: active road studs; street lighting; driver perception; road safety; human factors; rural roads; junctions; crash countermeasures

1. Introduction

Meta-analysis of the effect of road lighting across the world as an accident countermeasure has suggested that general overall reductions in fatal and injury collisions can be expected during hours of darkness [1–3]. Higher savings in injury collisions have been reported in countrywide studies, particularly in rural areas [4]. Furthermore, where lighting has been installed, a relationship between increasing luminance levels and decreasing night to day crash ratios has been identified [5]. An increased collision frequency at night has been shown to occur on longer links in the network, although it has been postulated that this may be down to other factors such as increased speed rather than lighting conditions [6]. Indeed, the presence of lighting may itself be counterproductive in this respect; drivers may compensate for the presence of road lighting on links in terms of increased speed or reduced concentration [7]. The impact of weather conditions in combination with lighting has also been shown to have an effect, suggesting collisions may be caused by an inability in drivers to adjust speed in accordance with degraded visual performance [8].

One road feature where there appears to be significant correlation between safety and lighting is at junctions. Studies have shown that unlit junctions have higher night to day crash ratios and greater injury severity than those that are fully illuminated or feature simple destination lighting [6,9–12]. However, it has been recognised that due to fewer drivers driving during hours of darkness, exposure is

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Thank you!

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