Safety in Numbers

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Introduction

The concept of safety in numbers (SiN) when applied to cycling is widely accepted. However when the same argument is presented in support of motorcycling, the response, in the author's experience is that the evidence is "not compelling". This report attempts to compare the evidence for and against the concept when applied to cycling and motorcycling. The arguments for increasing the numbers of cyclists on the road (modal share) would intuitively seem to make sense for powered two wheelers, but is there evidence to support this?

Initial research into existing reports on SiN quickly demonstrates that there is a vast imbalance of consideration of the subject. Reports are easy to find for cycling, but virtually non-existent for motorcycling. What information that can readily be found for motorcycling tends to relate to the practice of group riding and is thus irrelevant to the concept being considered, that of safety in relation to overall modal share.

Correlation and Causal Link – The evidence to date

It is important to note that a correlation between modal share and casualties does not imply a causal link.

The concept of SiN is usually attributed to the work of R J Smeed who in 1949 proposed the relationship is an empirical rule. Smeed's Law proposes that increasing traffic volume (an increase in motor vehicle registrations) leads to an increase in fatalities per capita, but a decrease in fatalities per vehicle.

In 2003 a report "Safety in numbers: more walkers and bicyclists, safer walking and bicycling" [1] by Jacobson first identified the phenomenon with respect to cycling. He summarised the findings saying, 'More riders, fewer crashes; fewer riders, more crashes'. Jacobsen suggested that 'adaptation in motorists' behaviour' was the most plausible explanation. For example, when there are a lot of cyclists on the road, drivers take more notice of them and adapt their behaviour accordingly. This places the assumption that drivers of motorised vehicles are 'to blame' for injuries to cyclists.

In its report "Safety in numbers in England" [2] the Cyclists' Touring Club (CTC), now using the trading name Cycling UK, provide three potential causal factors:

1. Drivers grow more aware of cyclists and become better at anticipating their behaviour.

2. Drivers are also more likely to be cyclists themselves, which means that they are more likely to understand how their driving may affect other road users.

3. More people cycling leads to greater political will to improve conditions for cyclists.

In January 2005 a TfL Central London Congestion Charging Scheme impact monitoring report [3], reported:

"The numbers of powered two-wheelers and pedal cycles involved in accidents have decreased, by 8 percent and 7 percent respectively, despite a combined increase of 15 percent in numbers of these entering the zone since charging. Similarly there has been a decrease in the number of pedestrian casualties involved in accidents."

The full Third Annual Report [4] published later in 2005 confirmed "Most noticeable was the decrease in the involvement of pedal cycles and powered two-wheelers despite the significant increase in the numbers of these observed in traffic counts. Further analysis indicates that the reduction in involvement of powered two-wheelers and chargeable vehicles (including cars, lorries and vans) after the introduction of the scheme was significantly greater within the charging zone than across the rest of London."

This would seem to rule out most possible causes other than prevalence of both transport modes for reduced collisions beyond the overall trend due to the proximity of the control group and reasonable assumption that all other safety interventions would be consistent within and immediately adjacent to the congestion zone area in the same time period.

A 2014 paper “Safety in numbers: Target prevalence affects the detection of vehicles during simulated driving: Beanland, Lenné & Underwood” [5] supported the notion that increasing the prevalence of visual search targets makes them more salient, and consequently easier to detect.

Interestingly the experiment using a driving simulator to investigate whether target prevalence effects influence the detection of other vehicles while driving, used motorcycles and buses as the target vehicles, with prevalence being manipulated both within and between subjects: Half of the subjects experienced a high prevalence of motorcycles with a low prevalence of buses, and half experienced a high prevalence of buses with a low prevalence of motorcycles.

Consistent with the hypotheses, drivers detected high-prevalence targets faster than low-prevalence targets for both vehicle types. This finding supports a causal link and also the suggestion that the SiN argument applies to any transport mode.

A 2016 Norwegian paper “Safety in numbers for cyclists – conclusions from multidisciplinary study of seasonal change in interplay and conflicts: Fyhri et al” [6] used seasonal variation in cycling prevalence to study the SiN phenomena. This report suggested a short term effect as a result of a steep rise in numbers in spring, but an apparent counter effect resulting from an influx of inexperienced and risk taking cyclists through the season resulting in car drivers finding themselves “surprised” by cyclists in traffic late in the season.

Also in 2016 Road Safety Analysis Limited report “Safety in Numbers for Cyclists in England: Measuring the Effect” [7] highlights the difficulties of defining the effect, and defining the following variables that require study:

- Road or lane width and whether or not cyclists are traveling on those lanes or have separate lanes
- Speed limits
- Visibility – especially on country or urban roads
- Road safety culture and attitudes to cyclists
- Length of segregated cycle paths, and on-road cycle lanes per 1,000 km of road or per 1,000 km of cycling trips
- Highway condition
- Segregation of cycle lanes/paths

The report analysis concludes that “In towns and cities of high risk and low levels, the potential for risk reductions is greatest; although the absolute risk to ‘new’ cyclists will be much higher than in areas of low risk and high rates”

In November 2016 the Motorcycle Industry Association released its third edition of the its safety and transport policy document “Realising The Motorcycling Opportunity; A motorcycle safety and transport policy framework” [8] This document reported “when motorcycle use increases to 10% of the vehicle stock, sharp falls in casualties start to occur.” In the UK powered two wheelers account for 4% of the vehicle stock and there are 2.91 fatalities per 10,000 registered machines (based on 2012/13 figures). In Belgium 10% of the stock are PTW’s and fatality rates are 2.02 per 10,000 machines, but in Italy 16% of the stock are PTW’s but fatalities are just 1.28 per 10,000 machines.

Comparison of PTW Ownership and Fatalities

	Population (Million)	PTW share of stock	PTW fatality/10k PTWs
UK	64	4%	2.91
France	64	6%	3.90
Slovenia	2	6%	2.71
Portugal	11	8%	3.62
Poland	39	10%	1.96
Belgium	11	10%	2.02
Hungary	10	11%	2.00
Germany	81	11%	1.33
Netherlands	17	12%	0.66
Austria	8	12%	1.15
Spain	47	15%	0.85
Czech Republic	11	15%	0.91
Italy	60	16%	1.28
Greece	11	33%	1.03

(Source: International Road Traffic and Accident Database, OECD – to 2012/13)

According to the MAIDS study [9], about 70% of the main causes of accidents in the event of a collision are attributable to the driver of the second vehicle failing to spot the motorcycle.

The Motorcycle Safety Foundation report “National Agenda for Motorcycle Safety” [10] states: “Research shows drivers who also ride motorcycles and those with family members or close friends who ride are more likely to observe motorcyclists and less likely to collide with them (*Brooks,* 1990).” The natural extension would thus be that greater numbers of riders will lead to a reduced number of cases of drivers failing to observe motorcyclists.

Objectives

The objective of our analysis is to establish whether there is statistical evidence to support the premise that Safety in Numbers is a phenomenon that is applicable to motorcycles, whether any effect is comparable to the reported effect for cyclists, and to explore any possible causes for variation between the two transport modes, should it exist.

Data Sets

Modal Share

In order to determine modal share we have used DfT traffic count data available at

https://www.dft.gov.uk/traffic-counts/ .

The available datasets provide comprehensive traffic count data for all local authorities for major roads, plus also sample data for minor roads. We have used the traffic volume data in thousand vehicle miles. It should be noted that pedal cycles are not counted in the "all motor vehicles" field. The method used to determine the modal share was therefore (mode/all motor vehicles + pedal cycles) to give a modal share for all motorised and non-motorised vehicles.

In order to calculate a representative figure for modal share across all roads, major and minor, we have combined the data for major and minor roads applying a weighting to account for the variation in major and minor roads ratio by road length for each LA. The ratio of minor and major road was determined from the DfT data at

https://www.gov.uk/government/statistics/road-lengths-in-great-britain-2017

Casualties

DfT casualty statistics for Reported KSI casualties by region, local authority and road user type, England, RAS30043

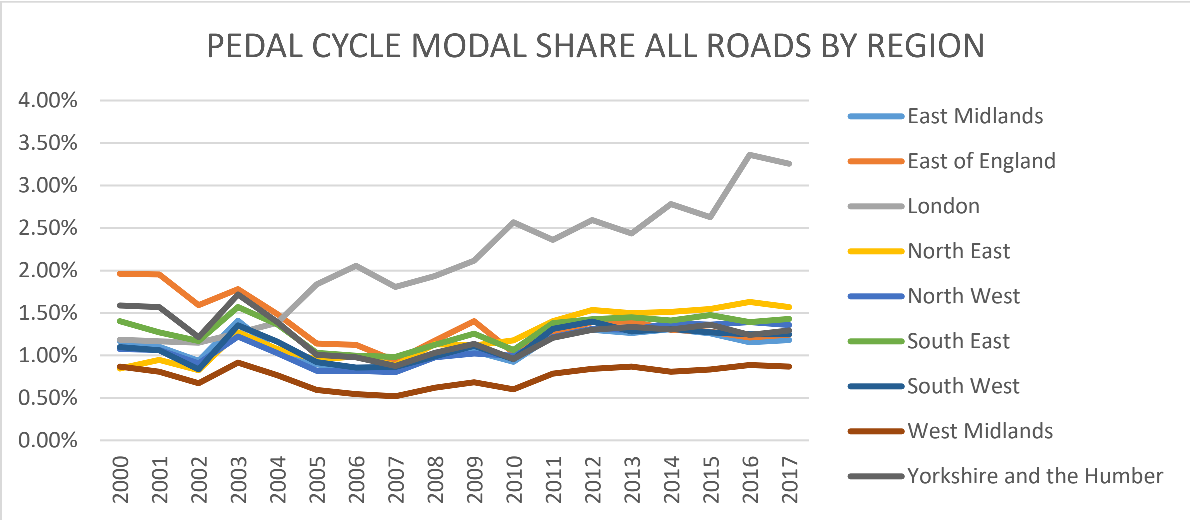
https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/743632/ras30034.ods

In order to create a meaningful measure that removes weighting between absolute numbers of casualties and regional populations we have calculated relative share of casualties between transport modes.

Findings

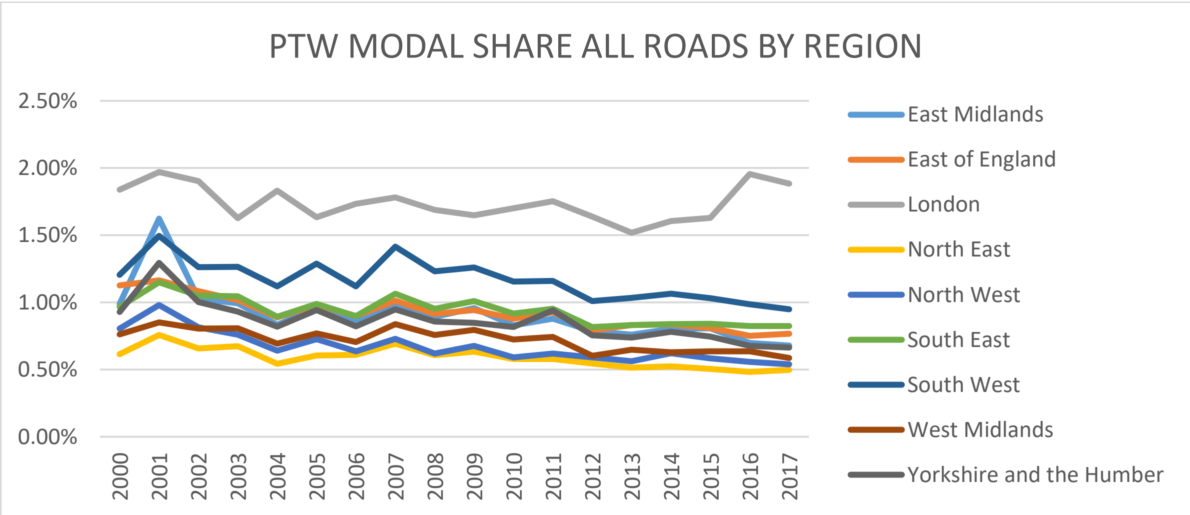
Cycle Modal Share

Modal share for cycling at a regional level shows a general if small upward trend from 2006. London clearly shows a much more pronounced upward trend with cycling modal share approximately three times higher than the rest of England. It is also noticeable that the West Midlands region has distinguishably lower levels of cycling compared to the other regions.



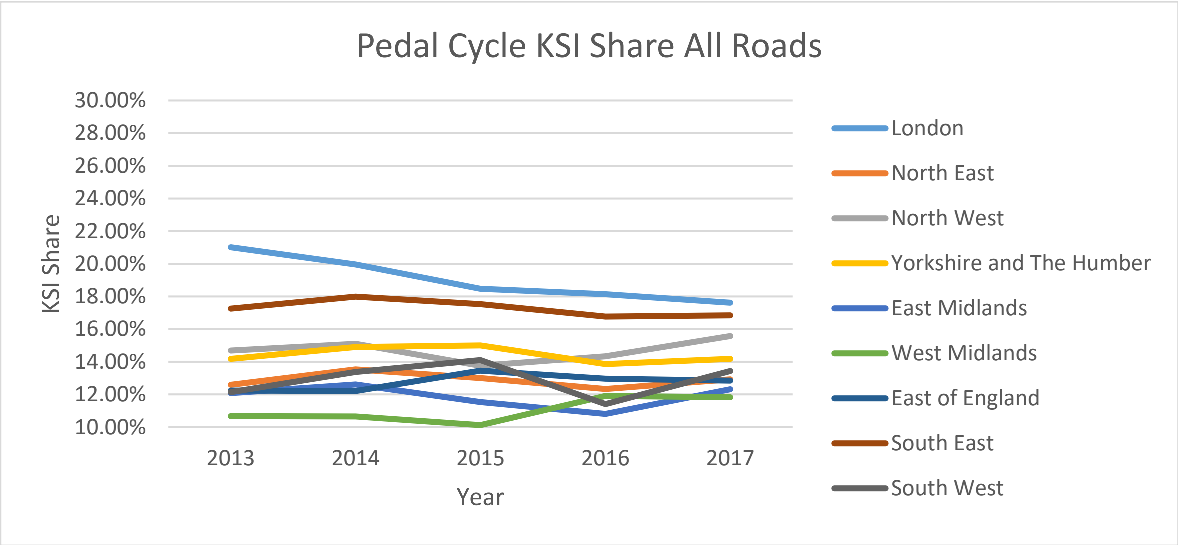
PTW Modal Share

In contrast to cycling, the transport mode has demonstrated a declining trend in terms of modal share. Once again we can see that the London region is distinct from other regions with a slower overall decline since 2000, and a short term upward trend from 2013. Given that the London Region shows a trend with an opposite sign to the other regions for the 5 year period 2013 – 2017, this is the region that we would expect to see the greatest evidence to support the safety in numbers theory for PTWs



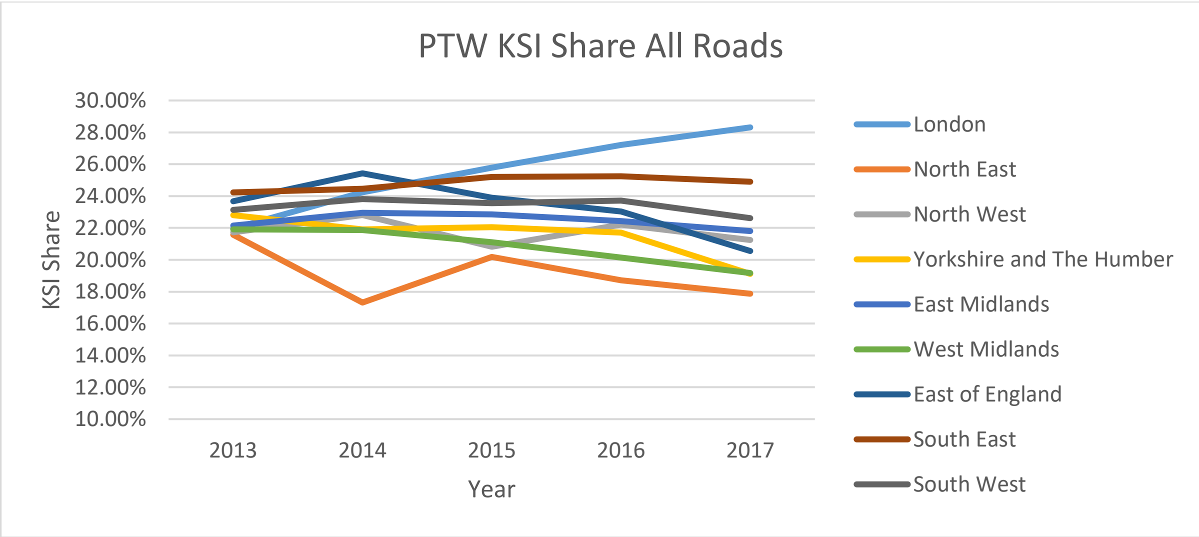
Pedal Cycle Casualties

The share of casualties for pedal cycles has been showing no major trend in any region other than London. The London region demonstrates a clear downward trend for share of KSI's



PTW Casualties

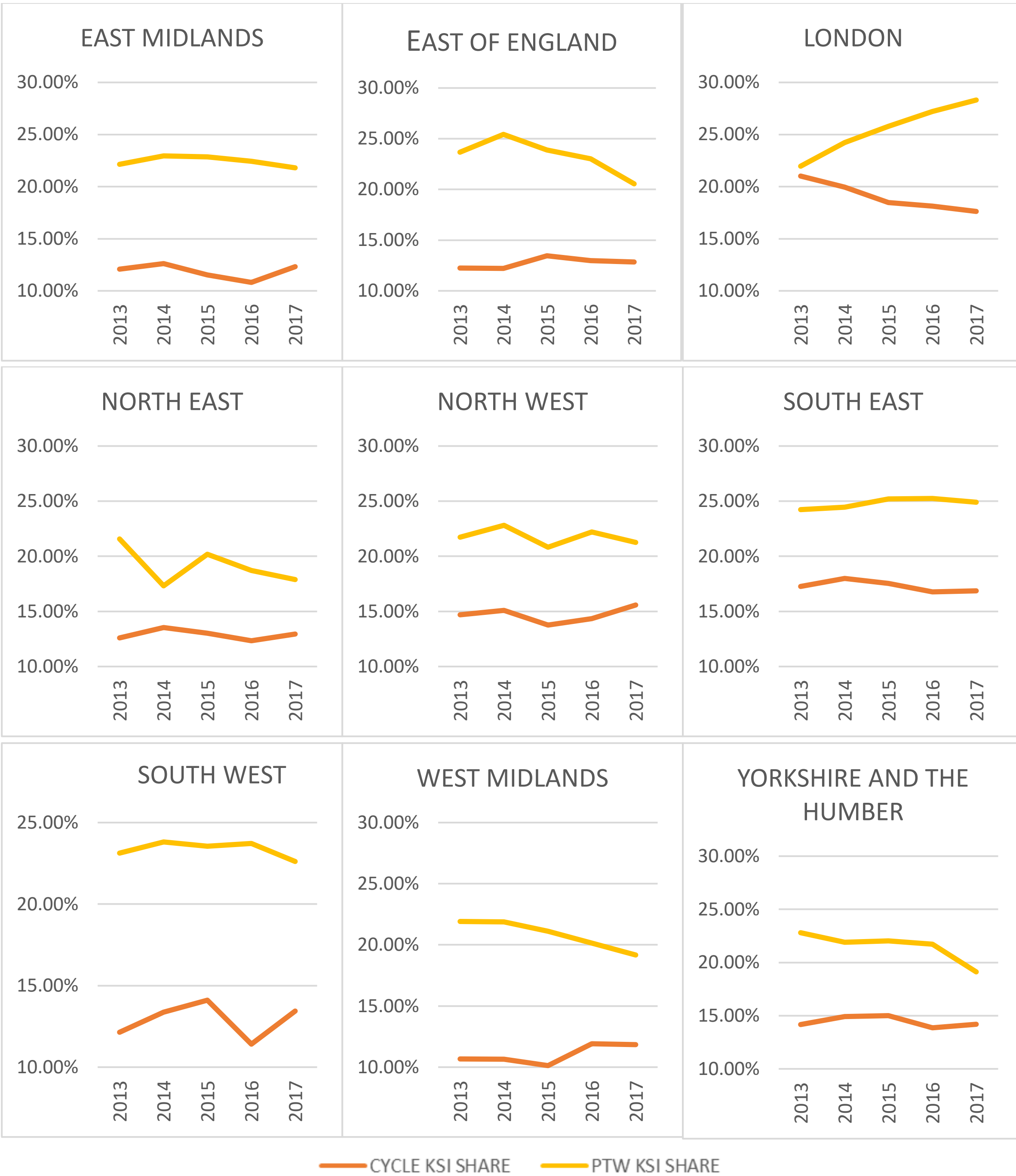
The share of casualties for PTWs has been showing no major trend in any region other than London. The London region demonstrates a clear upward trend for share of KSI's



Pedal Cycle and PTW Modal Share Comparison by Region 2013 - 2017

The comparisons show that there is little change in modal share for the two transport modes in any region except London where modal share has significantly increased for both modes across the selected timeframe.

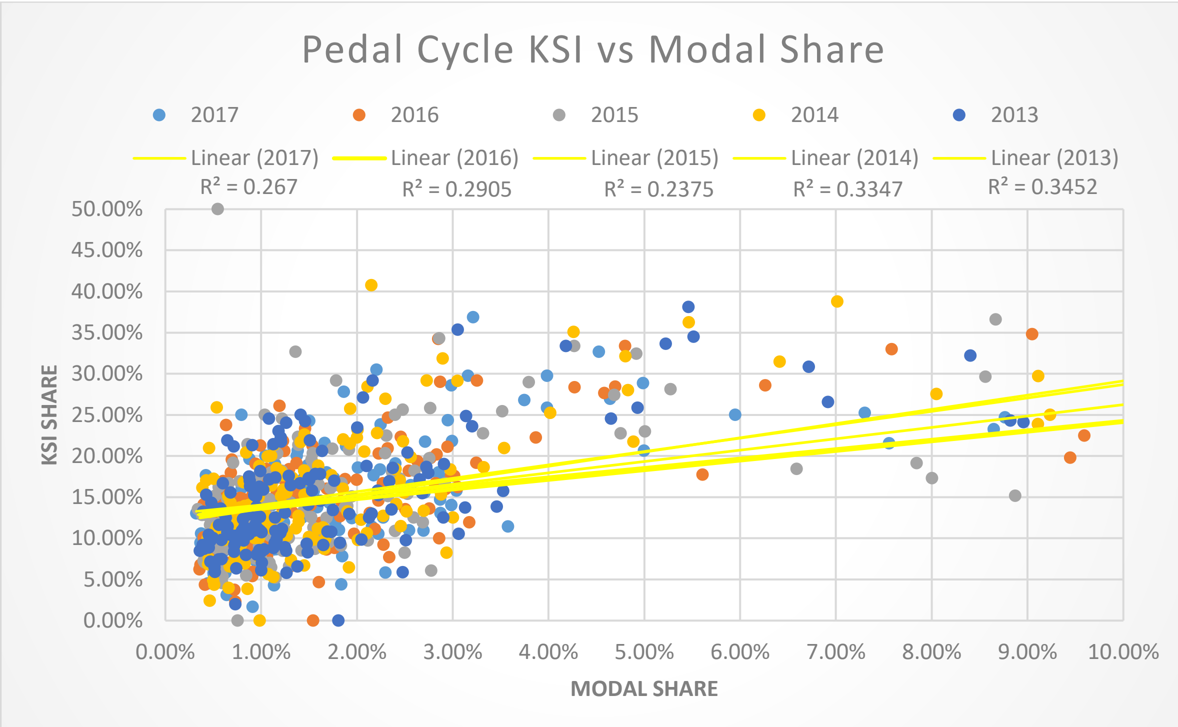
Pedal Cycle and PTW KSI Share Comparison by Region 2013 - 2017

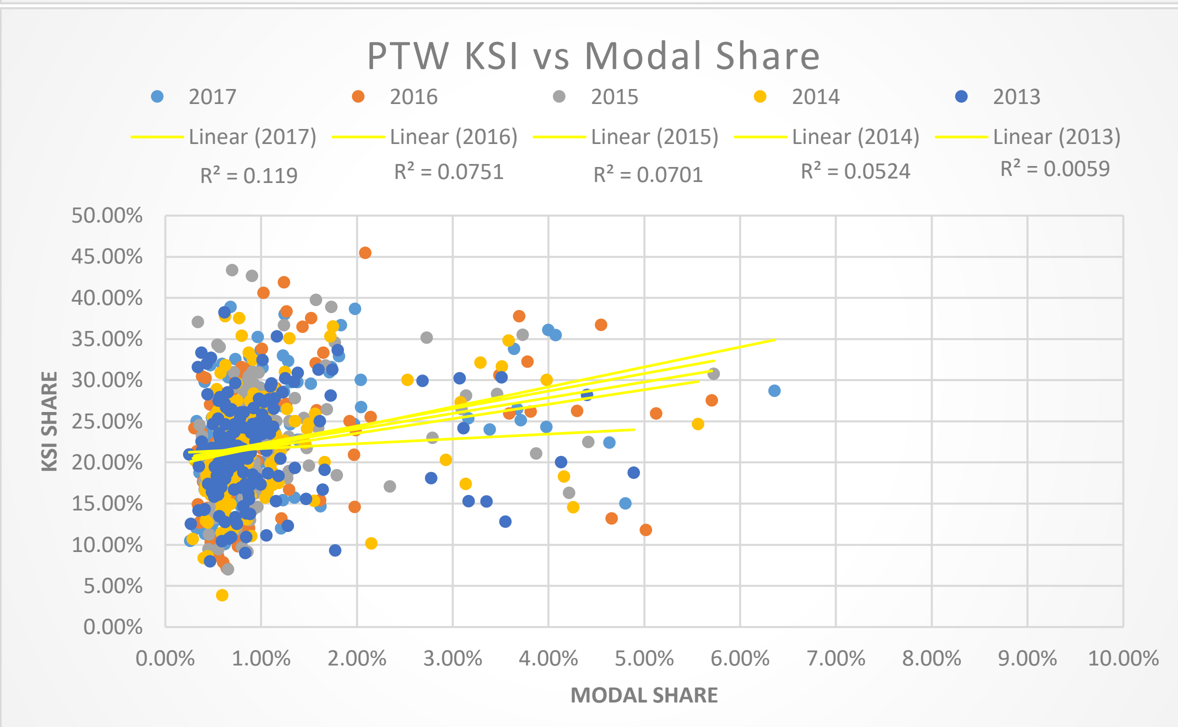


The comparisons show a small general trend towards convergence of KSI shares between the two transport modes, with London being a notable exception showing a large divergence from near equality in 2013 to the most significant difference in 2017.

KSI vs Modal Share Scatter Plots

The scatter plots below show data points for all Local Autorities across all 5 years (2013 – 2017)





Linear trend lines for both transport modes show a similar increasing KSI share as Modal Share increases. It is clear therefore that, for both modes and within the current range of modal share, a SiN effect is not sufficient to reduce the volume of casualties.

The trend line gradients show a declining share of casualties as modal share increases. This could be an indication of the SiN effect.

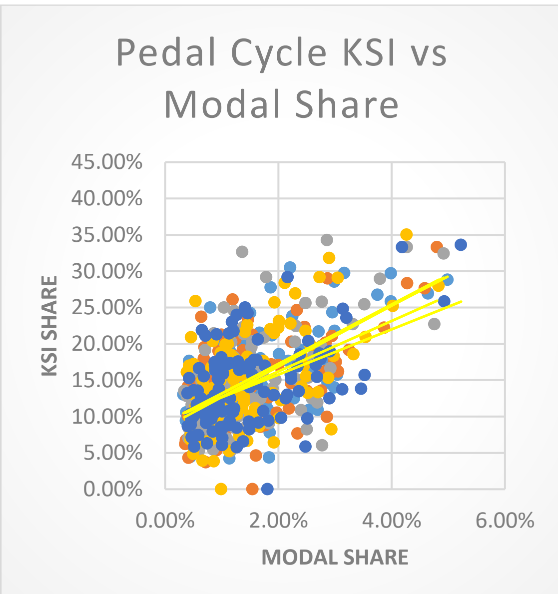
There is clearly a low correlation for both modes, with the correlation for pedal cycles being slightly stronger. We do note that from a timeline perspective correlation appears to be increasing for PTWs whilst at the same time decreasing for pedal cycles. The modal share range for cycling is also clearly larger than exists for PTW's.

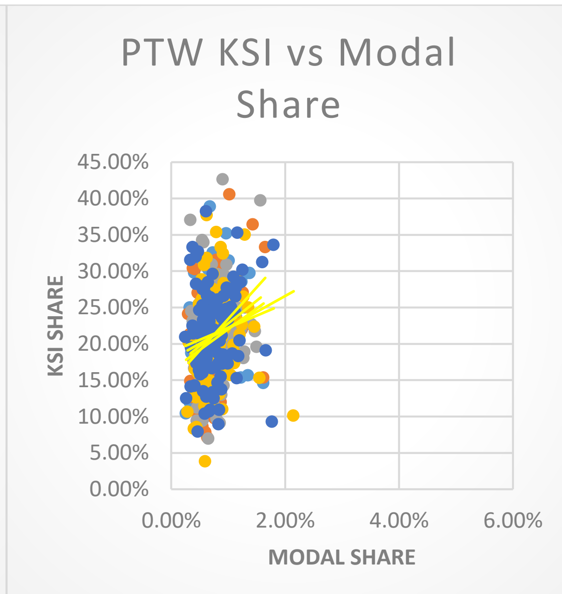
Discussion

With respect to the question of evidence to support the premise that SiN applies to motorcycles, it appears that on a purely statistical basis the evidence is not currently strong. While a correlation between increased modal share and decreased risk can be shown, the evidence from the London region would seem to confound the premise.

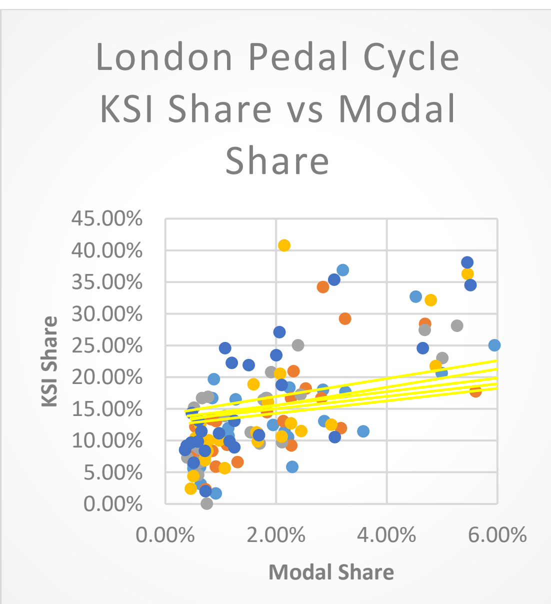
Given the number of causal variables in road traffic collisions it is perhaps un-surprising that correlation to any one causal factor will be weak, but the results for the London region appear to show an opposite effect.

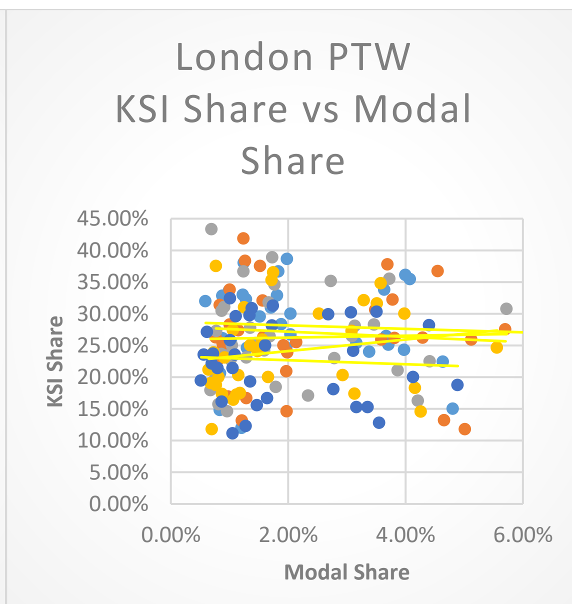
The scatter plots below show the Cycle/PTW comparison when ignoring the London results:





The scatter plots below show the Cycle/PTW comparison for London only:

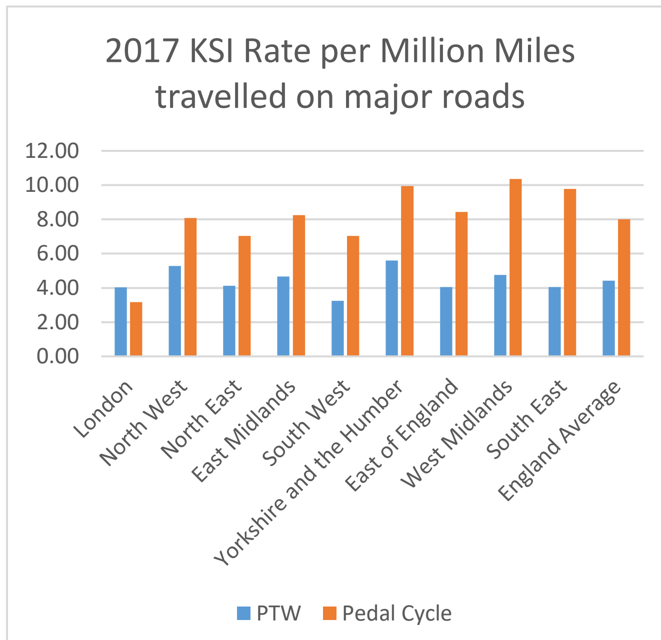




It is clear that there is a fundamental difference between what is happening in London in comparison with other regions. Firstly it can be seen that the range of the modal share for PTWs is far higher in London than in the rest of England. The broader range of modal share seems to show a more significant result for the SiN effect. The London results also show a far stronger effect for PTWs than for Pedal Cycles.

It is interesting to note that when using a measure of KSI's per million miles travelled, Pedal Cyclists fair worse than PTW riders in every region except London.

The below graph represents analysis of the DfT traffic count data for major roads and casualty data for all roads. We have been unable to separate casualty data for casualties by major and minor roads. Due to traffic count data for minor roads being inconsistent it is not possible to determine an accurate figure for distance travelled on all roads.



There are many possible causes for the anomalous results from London. It is beyond the scope of this work to study each possible cause, but we would recommend that this is made a priority. Amongst the possible causes that should be considered are:

- Narrowed lane widths resulting from increased segregated cycle lanes
- Inconsistency of policies such as access to bus lanes
- Unequal consideration of PTW safety in junction designs aimed to improve safety for cyclists and pedestrians
- Lack of parity of investment in road safety education for PTW riders
- High levels of delivery riders engaged in the gig economy in comparison with other regions.
- Changes in the age demographic of PTW riders in the region in comparison with other regions

Conclusions

Our analysis finds that whilst the statistical evidence for the theory of Safety in Numbers is weak, there is sufficient evidence to suggest that there is a positive impact on both cyclist and motorcyclist safety resulting from an increased prevalence in the transport mix. There is some evidence that the effect could be more beneficial for motorcyclists as opposed to cyclists at higher levels of modal share, but equally it is evident that the effect in isolation is insufficient to entirely overcome the vulnerability of either road user group.

Separation of data for London and the rest of England demonstrates a significant difference in outcomes. Outside of London the evidence appears to suggest a slightly more beneficial effect for pedal cyclists, whilst in London there is a clearer benefit to PTWs. This difference may simply be a clearer result from the wider range of motorcycle modal share data.

Our analysis suggests that policies resulting in an increased modal share for PTWs will reduce the level of risk for riders. Given that the largest changes in terms of PTW KSI share are occurring in the London Region and the negative nature of those changes, it is clear that there is an urgent need for research into the causes leading to this effect so that lessons can be learnt and casualties reduced.

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