RURAL ROAD SAFETY – A QUESTION OF SPEED?

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1. INTRODUCTION

Rural road accidents are a major issue in relation to casualty reduction on Scotland's roads. According to police recorded road accident data for Scotland, the number of people killed or seriously injured in road accidents in 2005 reduced by 39 percentage points compared with the average between 1994 and 1998 (Scottish Executive, 2005). However, the fall in all casualties was greater for built-up roads and the number of fatalities declined at a much slower rate on non-built-up (rural) roads.

Presently there are fewer casualties on rural roads (42% of total casualties in 2005), but a higher proportion of people that are killed (72% of total fatalities in 2005) and the majority of people seriously injured (53%) are involved in accidents on roads in non-built-up areas. Specific action needs to be taken to reduce the number of casualties on rural roads.

Car-users account for over 70% of all those killed or seriously injured on non-built-up roads and most car occupant fatalities occur on non-built-up roads. Additionally, non-built-up A-roads and B-roads have the highest accident rate per vehicle kilometre in Scotland and most rural accidents on single carriageways occur on A-roads in 60 mph speed limits away from junctions. Single vehicle accidents account for one third of all rural single carriageway accidents (Scottish Executive, 2005; Hamilton & Kennedy, 2005; Hopkin & Morris, 2007).

Against this background, the Scottish Government and Road Safety Scotland (RSS) commissioned research from TNS System Three, the Transport Research Institute (TRi) and the Transport Research Laboratory (TRL) to learn more about rural road accidents, driving behaviour on such roads and attitudes to driving on rural roads (Collins, Eynon, MacLeod, Stradling, Crinson, Scoons, Broughton, in press). This multi-stage, sequential project included an analysis of STATS 19 data (a national system used by police reporting officers for recording contributory factors for road accidents), a survey of rural car drivers and focus groups with young, male rural car drivers. For the purposes of this research a rural road was defined as: *"A road that is outside of towns and has a speed limit of 50 miles an hour or more, but is not a motorway or dual carriageway".*

Initial analysis of the STATS 19 data showed that speed was an important factor in rural road accidents, particularly when associated with loss of control. Loss of control was the factor recorded most often, in 32% of serious, and 45% of fatal rural road accidents. There were two speed-related factors in the STATS 19 list: travelling too fast for the conditions and exceeding the speed limit. When accidents where both speed codes were recorded are combined, excessive speed, though not necessarily above the speed limit, was a factor in 22% of serious and 33% of fatal accidents. Both loss of control and travelling too fast for the conditions were recorded more often in accidents on rural than urban roads.

Additionally, travelling too fast for the conditions was the factor most often listed in combination with loss of control, in 26% of serious accidents and 29% of fatal accidents. This confirms that loss of control is strongly associated with excessive speed, which may or may not be above the speed limit.

The car driver survey thus included, inter alia, questions about exceeding the speed limit, speed selection and speed adjustment on rural roads in greater detail. This is the focus of the current paper.

2. METHODOLOGY

The survey fieldwork took place between 8th June and 9th August 2007. 1020 adults aged 17 or over who had driven a car on a rural road in the past 12 months were interviewed face-to-face in their own homes. Interviewee selection was conducted using a random location methodology throughout Scotland, including the Highlands and Islands.

The survey was conducted using computer-assisted personal interviewing (CAPI) for the interviewer-administered section of the questionnaire and computer-assisted self-interviewing (CASI), after initial practice, for the self-completion section which included questions relating to drivers' self-reported speeding.

Sampling

In order to ensure that those who drove most frequently on rural roads were represented in the sample, 50% of the interviews took place in urban areas and 50% in rural areas[1]. Of the 75 sample points, 38 were in urban areas and 37 in rural areas. First, areas in Scotland were stratified by the number of cars and vans and also by NUTS2[2] region and the 6-fold urban/rural classification. This ensured a representative coverage of Scotland and also that areas with reasonable numbers of cars and vans were included. Census Output Areas[3] (OAs) were then randomly selected with probability proportional to the number of cars and vans. A locating address was selected randomly within the chosen OAs. Those addresses were used as the starting points for random routes. The over-sampling of rural areas was corrected for in the analysis, where the data was weighted back to match the true distribution of Scotland's population between urban and rural areas (i.e. 30% in rural areas, 70% in urban areas).

Calls were made at different times and days with at least 50% in the evening and at the weekend to further ensure 'difficult to reach groups' were included.

3. MAIN FINDINGS

3.1 Exceeding the speed limit on rural roads

Speeding behaviour on rural roads was compared to that on two other road types. Following recent work on a DfT project on speeding drivers (Stradling et al, 2007), respondents in the driver survey were asked how frequently (on a six-point scale, from most days to never) they had driven in the last three months on three types of roads with different speed limits: a road in a built-up area with a 30mph limit; a rural road with a 60mph limit; and a dual carriageway with a 70mph limit. They were then asked how often in the last three months they had breached the speed limit on each road type, by varying amounts. The responses of the 784 drivers (77% of respondents) who had driven on all three road types in the last three months are reported in Table 3.1.

Table 3.1 Reported frequencies of driving on, and exceeding the speed limit on, three road types within the last three months

Base: All who had driven (at least rarely) on all road types in last 3 months (784)

Row percent How often have you …	Most days	3-5 times a week	Once or twice a week	Once or twice a month	Rarely	Never
Driven in a built-up area where there is a 30mph limit	79.1	10.7	6.0	2.0	2.2	-
Driven at 35mph in a 30mph limit	23.3	8.0	12.2	5.9	30.7	19.8
Driven at 40mph in a 30mph limit	7.5	2.9	5.4	3.8	30.0	50.4
Driven at 50mph or more in a 30mph limit	1.7	0.9	0.9	0.9	10.2	85.5
Driven on a single carriageway road where there is a 60mph limit	39.3	14.8	18.6	14.0	13.3	-
Driven at 70mph on a single carriageway road	5.7	4.1	7.3	6.9	28.8	47.2
Driven at 80mph or more on a single carriageway road	1.1	0.6	1.5	1.9	15.3	79.5
Driven on a dual carriageway where there is a 70mph limit	26.5	9.9	19.3	22.2	22.1	-
Driven at 80mph on a dual carriageway	4.0	2.4	7.3	9.1	28.7	48.6
Driven at 90mph or more on a dual carriageway	0.6	0.3	1.3	1.8	16.3	79.7

Twice as many (79%) had driven most days on a road in a built-up area with a 30mph limit than had driven on a rural road with a 60mph limit (39%). Just over a quarter (27%) had driven most days on a dual carriageway. Two percent reported rarely driving on a 30mph road, 13% rarely driving on a rural road and 22% rarely driving on a dual carriageway.

On 30mph roads, 20% of respondents reported never driving at 35mph, half never driving at 40mph, and 86% never driving at 50mph. On 60mph rural roads, half reported never driving at 70mph and 4 in 5 never driving at 80mph. On dual carriageways, half reported never driving at 80mph and 4 in 5 never driving at 90mph.

The total number of speed limit exceeds (out of a potential 7, as indicated in the table above) was computed for each driver. Table 3.2 shows the distribution of this measure. 1 in 8 drivers (13%) said they had, within the last 3 months, not exceeded the speed limit at all. A further 35% reported one or two exceeds. 50 drivers (6%) reported having exceeded the speed limit in all seven situations. There was thus a large variation in compliance with speed limits amongst this sample of Scottish car drivers.

Table 3.2 Distribution of total number of reported speed limit exceeds (0-7)
Base: All who had driven (more often than ‘never’) on all three road types (784)

Number of speed limit exceeds	Percent (%)*
None	13
1	17
2	18
3	15
4	14
5	11
6	7
7	6
Total	100

*Numbers do not add to 100 due to rounding

A univariate ANCOVA analysis was undertaken, with residence as factor, and age and gender as covariates. The analysis shows that drivers residing in urban areas tended to break the speed limit more in town; drivers residing in rural areas tended to break the speed limit more on dual carriageways; and there was no significant difference between urban and rural dwellers on single carriageway rural A-roads. Age and gender made a statistically significant difference in all comparisons, with male drivers and young drivers being less compliant.

3.2 Three Speeding Driver Clusters

Cluster analysis is a statistical technique that groups respondents together based on shared characteristics (in this case speeding behaviours). Responses were cluster analysed using k-means analysis in SPSS. This resulted in three clusters based on the extent to which drivers exceeded the speed limit in different situations. Car drivers in the first cluster were termed 'Compliants' and tended to not break the speed limit. Those in the second cluster were termed 'Exceeders' and tended to break the speed limit by 10mph, but not by more. The third cluster consisted of drivers termed 'Excessives' who routinely broke the speed limit by larger amounts.

Table 3.3 summarises the results from this analysis showing the number of respondents sorted into each cluster and the proportions within each cluster who rarely or never exceeded each limit. Just over half the sample, 55%, fell in Cluster 1 (Compliants), a third (32%) in Cluster 2 (Exceeders) and 1 in 8 (13%) in Cluster 3 (Excessives).

Table 3.3 Percent Rarely or Never exceeding each limit within each clusters
Base: All who had driven on all three road types in the last 3 months (784)

Within the last three months, how often have you … [% rarely or never]	C1 Compliants	C2 Exceeders	C3 Excessives
N = 784	430	254	100
% of sample	55%	32%	13%
Driven at 35 in a 30 limit	91.9	-	2.8
Driven at 40 in a 30 limit	99.1	71.6	11.4
Driven at 50 or more in a 30 limit	99.8	97.7	71.2
Driven at 70 on a single-carriageway A road	89.5	77.7	17.0
Driven at 80 or more on a single-carriageway A road	99.3	98.5	67.3
Driven at 80 on a dual carriageway	89.9	78.1	28.6
Driven at 90 or more on a dual carriageway	99.5	98.5	77.1

Table 3.4 shows there were statistically significant differences in cluster membership by area of residence, gender, age and experience of having a near miss on a rural road, but not rural RTA involvement, in the last 12 months.

Drivers residing in rural areas were more likely to belong to the Compliants (60% of rural dwelling compared to 50% of urban dwelling drivers). There were twice as many male (17%) as female (9%) Excessives, though the fact that 1 in 11 female drivers were excessive speeders should not be overlooked. Membership of the Excessives cluster also dropped sharply with age, from 29% of the 17-24 year-old group to none of the 75+ group. Again, it should not be overlooked that while 70% of the oldest group (75+), are speed limit compliant, 30% are not. Excessives were also more likely to have experienced a near miss[4] on a rural road within the last 12 months (32% of Excessives compared with 21% of 'Exceeders' and 18% of Compliants). Numbers for accidents on rural roads within the last 12 months were small and did not show statistical significance.

Table 3.4 Further ways in which the clusters differed
Base: All who had driven on all three road types in the past 3 months (784)

Row %	C1 Compliants	C2 Exceeders	C3 Excessives
% of sample**	55%	32%	13%
Urban *	50	36	14
Rural	60	29	12
Male *	52	32	17
Female	58	33	9
17-24 *	39	31	29
25-34	50	30	20
35-44	50	35	15
45-54	50	38	12
55-64	63	31	6
65-74	73	26	1
75+	70	30	nil
Near miss on a rural last 12 months *	18	21	32
Accident on a rural last 12 months (ns)	3	1	4

* Statistically significant difference (at 95% level)
ns denotes a non-significant difference
**Numbers may not add to 100 due to rounding

On all three road types Excessives admitted to speeding more often than the Exceeders, who exceeded the speed limit more often than the Compliants. While the Excessives also reported driving more often than the Exceeders, who drove more often than the Compliants, on all three types of road, detailed examination of the data (Collins et al, in press) concluded that differences in speeding behaviour were independent of differences in driving frequency.

3.3 Speed selection on rural roads

The following section focuses particularly on speed choice on rural roads. Lee (2006) showed that a variety of road features, such as bends in the road or the road being visually 'closed' by features such as trees or walls, can cause drivers to slow down. With this in mind, respondents in the driver survey were shown a series of six photographs depicting the following road types:

- A straight open road in good weather
- A straight open road in bad weather
- A bendy open road in good weather
- A bendy open road in bad weather
- A straight road in the dark
- A bendy 'closed' road (i.e. with trees and hedges on either side of the road) in good weather

For each picture respondents were asked what speed in miles per hour they would normally drive at on that stretch of road and what speed they felt was the fastest they could go on that stretch of road that would put them right at the edge of their safety margins. Respondents were told prior to seeing the pictures that they would be asked both of these questions and it was intended that this would encourage them to differentiate between their 'typical' and 'maximum' speeds.

The mean typical and maximum speeds were calculated for each road type. These, along with 95% confidence intervals[5] are shown in descending order of speed in Tables 3.5 and 3.6.

Maximum speeds always equalled or exceeded typical speeds. Across all road types, the average maximum speed was 10% higher than the average typical speed. However, the overall pattern across the photographs was the same when considering both driving speeds. For both their typical and maximum speeds, drivers, on average, would drive fastest on a straight open road, followed by a straight road in bad weather, a bendy open road, a bendy road in bad weather, a straight road in the dark and, finally, a closed bendy road.

Table 3.5 Typical mean speeds (mph) for each road type
Base: All responding to each picture in the main survey (see brackets for number)

	Mean	95% Confidence Limits	
Straight open (1019)	53.5	52.9	54.1
Straight bad weather (1016)	45.6	45.0	46.2
Bendy open (1019)	42.4	41.8	43.0
Bendy bad weather (1018)	42.0	41.4	42.6
Straight dark (1015)	39.4	39.4	38.8
Bendy closed (1018)	37.4	36.8	38.0

Table 3.6 Maximum mean speeds (mph) for each road type
Base: All responding to each picture in the main survey (see brackets for number)

	Mean	95% Confidence Limits	
Straight open (1019)	59.1	58.5	59.8
Straight bad weather (1019)	50.4	49.7	51.0
Bendy open (1019)	47.1	46.5	47.8
Bendy bad weather (1019)	46.3	45.7	47.0
Straight dark (1017)	43.6	42.9	44.2
Bendy closed (1019)	41.8	41.2	42.5

Statistical tests revealed that when considering driving at their normal speed, respondents said they would drive at a significantly different speed on every road type, with the exception of bendy open roads and bendy roads in bad weather, where their mean stated speeds did not significantly differ. So, bad weather does not appear to lead to additional speed reduction on a bendy, open road, in the same way as it does on an open, straight road. When considering driving at their maximum possible speed, respondents said they would drive at significantly different speeds on every road type.

Further comparisons showed that:

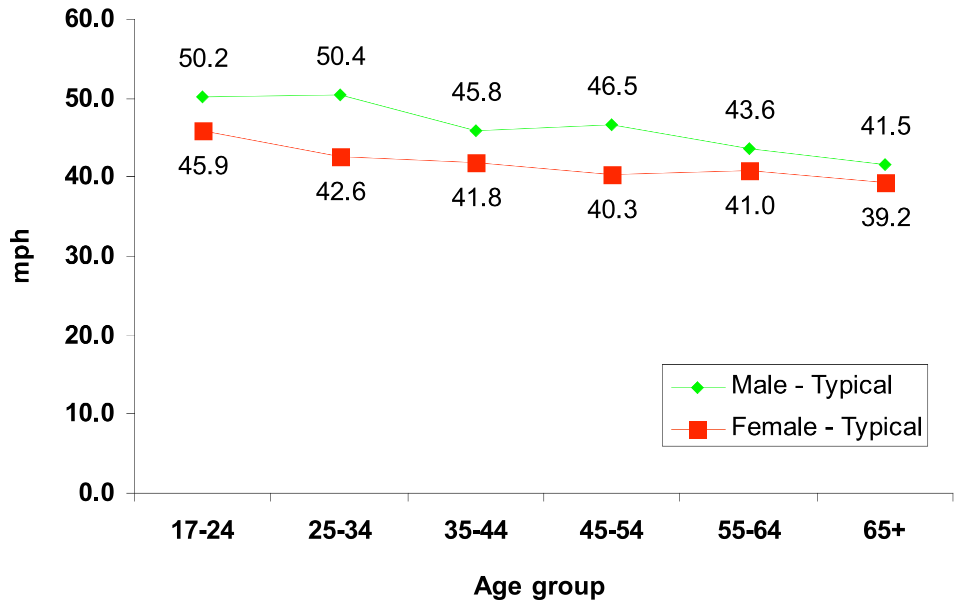
- on the straight open road both typical and maximum speeds reduced by 36% from daylight conditions to darkness
- on the straight open road both typical and maximum speeds reduced by 14% from good weather conditions to bad weather conditions
- under good weather conditions both typical and maximum speeds were 25% slower on the open bendy road than the open straight road
- under bad weather conditions both typical and maximum speeds were 8% slower on the open bendy road than on the open straight road
- on bendy roads, in daylight and with good weather conditions, both typical and maximum speeds were 13% lower for the closed bend than the open bend

As will be demonstrated below, respondent characteristics also had important effects on the speeds they drove at. However, statistical tests showed that this was not affected by the type of road driven on. For example, this means that although men and women drove at significantly different speeds, they did this on every road type. This allows the mean speeds reported by different driver types to be considered independently of road type.

Figure 3.1 shows the mean typical speeds reported by men and women at each age group. There was a significant effect of gender, with men stating they would drive at higher speeds on average at every age group. There was also a significant effect of age, with reported mean speeds falling as age increased for every road type. Additionally, there was a significant interaction between age and gender, with the difference in the mean speeds reported by men and women decreasing as age increased. In other words, men report driving faster than women but, as both groups get older, there is less difference in the speeds at which they report driving.

Figure 3.1 Mean typical speeds by gender and age combined for all road types

Base: All respondents in the main survey (1020)



Although, as discussed above, maximum speeds always exceeded typical speeds, the same overall pattern of significant differences was evident when different groups considered the maximum speeds they believed they could safely drive at (see Collins et al, in press).

Mean speeds also differed significantly dependent on the respondent's social grade, with the average stated speed across all 6 road types decreasing with social grade. This was true both for mean typical speeds (AB: 44.8mph; C1: 44.1mph; C2: 43.8mph; DE: 41.2mph) and for mean maximum speeds (AB: 49.7mph; C1: 48.7mph; C2: 48.2mph; DE: 46.0mph). Again, the effect of social grade on speed did not differ with road type.

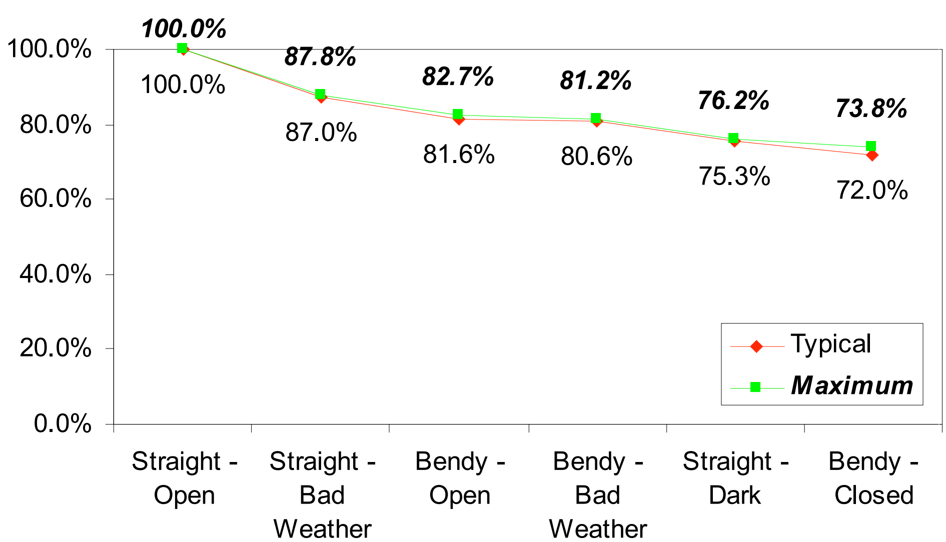
3.4 Speed Adjustment on Rural Roads

In addition to looking at the absolute speeds driven at on each road type, a key issue was the relationship between these speeds. This is of particular interest because one of the main factors contributing to accidents on rural roads, as discussed above, is travelling too fast for the conditions. It follows that the amount a driver adjusts their speed in response to the conditions could be an important indication of their likelihood of being involved in an accident.

One way to index this is to take the fastest speed at which respondents say they drive (in this case their speed on a straight open road) as 100% and measure all other speeds as a proportion of this. In other words if a respondent drove at 100mph on a straight open road and at 50mph on a bendy closed road, their speed on a bendy closed road could be seen as being 50% of their highest speed. As, with one exception (bendy open vs. bendy bad weather) there were significant differences between the typical and maximum speeds drivers stated they would drive at on each different road type, it follows that there are significant differences in the amount drivers would slow down for each road type.

Figure 3.3 shows the proportion of the highest ('straight open road') speed that respondents said they would drive at on each road type. There was very little difference in the proportion of the highest typical and maximum speeds at which they said they would drive for each road type, suggesting that respondents were taking the pictured road conditions into account to an equal extent when making both of their speed judgements.

Figure 3.3 Proportion of their highest typical and maximum speeds (on straight open roads) that respondents would drive at for each road type
Base: All respondents in the main survey (1020)



As the greatest differences in speed were seen in gender and age, the following analysis concentrates on these variables. Tables 3.7 and 3.8 show the proportion of the highest speed at which respondents of different ages said they drive at on each road type.

Table 3.7 Proportion of highest typical speeds (on straight open roads) that respondents would drive at for each road type by age
Base: All respondents in the main survey (1020)

	Bendy - Closed	Straight - Dark	Bendy - Bad Weather	Bendy - Open	Straight - Bad Weather	Straight - Open
17-24	69.5%	73.9%	73.8%	76.6%	82.1%	100.0%
25-34	68.4%	77.3%	78.1%	77.0%	84.2%	100.0%
35-44	69.4%	74.1%	78.3%	79.1%	83.3%	100.0%
45-54	68.4%	71.9%	77.5%	79.3%	83.9%	100.0%
55-64	70.5%	72.2%	79.4%	81.4%	86.1%	100.0%
65+	73.8%	73.2%	80.5%	80.9%	90.1%	100.0%

When talking about their typical speeds (see Table 3.7), respondents in younger age groups tended to say that they would slow down more than respondents in older age groups. This suggests that they were at least aware of the need to adapt their driving to the road conditions. However it is important to note that even though young drivers said they would proportionately reduce their speed by a greater amount in response to more challenging road conditions, their absolute speeds for each road type remained significantly higher than those of older age groups. It appears, therefore, that although young drivers do adjust their speed for road layout and conditions, they do not do so sufficiently to compensate for their overall higher speed. In addition, one might speculate that these more extreme adjustments of speed may contribute to the loss of control often seen in rural road accidents, especially amongst young drivers.

When drivers considered the maximum speed they could drive at safely (see Table 3.8), there was a slightly different pattern by age. Those aged 35 to 54 years significantly differed in the proportion by which they said they would reduce their speed from all other age groups. Those in the younger and older age groups did not differ. The main reason for this change in pattern appears to be that the younger age groups (aged 17 to 34) did not believe they would reduce their speed as much in response to different road conditions when driving at their maximum possible speed. Given the overall higher maximum safe speeds given by younger drivers, this group's apparent lack of understanding of the need for speed adjustment in more challenging road conditions when driving at their maximum speed is particularly concerning.

Table 3.8 Proportion of highest maximum speeds (on straight open roads) that respondents would drive at for each road type by age
Base: All respondents in the main survey (1020)

	Bendy - Closed	Straight - Dark	Bendy - Bad Weather	Bendy - Open	Straight - Bad Weather	Straight - Open
17-24	72.8%	78.7%	77.5%	79.7%	83.4%	100.0%
25-34	71.0%	78.6%	79.6%	78.9%	86.5%	100.0%
35-44	68.4%	73.6%	78.1%	78.3%	81.9%	100.0%
45-54	69.3%	71.4%	76.8%	79.2%	83.6%	100.0%
55-64	71.8%	71.0%	78.5%	82.0%	86.8%	100.0%
65+	73.9%	72.8%	79.5%	80.9%	89.4%	100.0%

As Table 3.9 shows, there was a significant difference by gender in the proportionate reduction of both typical and maximum speeds in relation to highest speed. Women reduced their speed by a greater amount than men for every road type, at both typical and maximum driving speeds. Again it is important to note that men said they would drive significantly faster than women on every road type, and this was magnified by the fact that they tended to reduce their speed less, thus showing less sensitivity to the road conditions.

Table 3.9 Proportion of their highest typical and maximum speeds (on straight open roads) that respondents would drive at for each road type, by gender
Base: All respondents in the main survey (1020)

		Bendy - Closed	Straight - Dark	Bendy - Bad Weather	Bendy - Open	Straight - Bad Weather	Straight - Open
Typical	Male	72.5%	76.2%	80.2%	80.9%	86.7%	100.0%
	Female	67.1%	70.9%	76.5%	77.5%	83.4%	100.0%
Maximum	Male	72.9%	75.8%	80.0%	80.8%	86.5%	100.0%
	Female	68.3%	71.3%	76.5%	78.5%	83.7%	100.0%

It is also important to note that these two effects of age and gender significantly interact. This means that while men always slowed down proportionately less than women, this became more pronounced with age, so that men aged 65 and over adjusted their speed less than any other group.

3.5 Differences in speed selection by cluster

Drivers from the three clusters described in section 3.2 were compared on the typical and maximum speeds they nominated for the 6 photographs of road types. Table 3.10 gives the figures for typical speeds and Table 3.11 gives maximum speeds.

Table 3.10 Typical speeds on 6 road types by cluster membership
Base: All who had driven (more often than 'never') on all three road types (784)

Bendy/ Straight	Closed/ Open	Good/Bad Weather	Day/ Night	Compliants	Exceeders	Excessives
Straight	Open	Good	Day	52.25a*	54.99b*	62.17c*
Straight	Open	Bad	Day	44.59a	46.31a	52.97b
Bendy	Open	Good	Day	42.15a	43.59a	48.71b
Bendy	Open	Bad	Day	41.39a	43.21a	47.53b
Straight	Open	Good	Night	38.55a	40.71a	46.68b
Bendy	Closed	Good	Day	37.37a	38.30a	43.00b
			Average	42.72	44.52	50.18

*Means with different sub-scripts (a, b, c) differ at p<.05 on Student-Neuman-Keuls post-hoc tests[6]

For typical speeds, post-hoc statistical tests showed that the Compliants nominated the lowest typical speeds on all road types and the Excessives nominated the highest typical speeds on all road types. The Exceeders' typical speeds were indistinguishable from those of the Compliants, except on the straight open road, where they were statistically elevated.

Table 3.11 Maximum speeds on 6 road types by cluster membership

Base: All who had driven (at least rarely) on all three road types in the past 3 months (784)

Bendy/ Straight	Closed/ Open	Good/Bad Weather	Day/ Night	Compliants	Exceeders	Excessives
Straight	Open	Good	Day	56.67a*	62.33b*	69.90c*
Straight	Open	Bad	Day	48.35a	52.35b	59.13c
Bendy	Open	Good	Day	45.96a	49.15b	55.25c
Bendy	Open	Bad	Day	44.90a	48.62b	53.87c
Straight	Open	Good	Night	41.93a	45.93b	52.18c
Bendy	Closed	Good	Day	40.91a	43.72b	48.72c
			Average	46.45	50.35	56.51

*Means with different sub-scripts (a, b or c) differ at $p<.05$ on Student-Neuman-Keuls post-hoc tests

For maximum speeds, post-hoc statistical tests showed that the Compliants nominated the lowest and the Excessives the highest maximum speeds on all road types. However, the Exceeders' maximum speeds were statistically higher than the Compliants, and lower than the Excessives on all 6 road types. This suggests that when driving on rural roads (other than straight, open roads in daylight and in good weather conditions), Exceeders differ in their belief about the maximum safe speed possible, though not in actual speed behaviour, from the Compliants.

This suggests that it may be possible to change some drivers' behaviour in relation to speed choice even without tackling underlying beliefs about safe speeds. However for a minority of drivers their belief in their ability to drive safely at high speed is accompanied by self-reported high typical driving speeds. We would argue that this group, in which young males are overrepresented, is most at risk of being involved in an accident. In large part this is due to a lack of awareness of a need to adjust their speed in response to challenging conditions and an over-inflated belief in their ability to drive at speed.

3.6 A model for predicting speed

A potential application of this data is through the use of regression analysis[7], to predict a driver's speed on a given road based on their speed on a straight open road. This analysis concentrates on the typical speed, as it is suggested that this is a more important measure for day-to-day driving than maximum speed. In addition, it is important to emphasise that this model is based on the speeds that drivers say they would drive at and not on any objective measurement of speed. Though this regression has been found to be statistically significant in its ability to predict speed in relation to the survey data, its application to real life situations may currently be limited. This model is therefore exploratory at this stage.

The regression model combines the effect of the road type (see Table 3.12) with the effects of gender and age, adjusted for the interaction between gender and age (see Table 3.13). The first table shows the ratios of mean typical speeds on each road type compared to the straight open road, which is shown as 1.0. The second table shows how these ratios differ depending on the demographic group of the driver, and is derived by calculating the proportionate decrease in speed (using the mean speed on all roads) of drivers in each demographic group compared with men aged over 65. This is the group that slows down the least overall and is shown as a ratio of 0.0 in the table.

Table 3.12 Speed adjustments compared with highest typical speed for each road type
Base: All respondents in the main survey (1020)

Road type	Ratio
Straight - Open	1.00
Straight - Bad Weather	0.87
Bendy - Open	0.82
Bendy - Bad Weather	0.81
Straight - Dark	0.75
Bendy - Closed	0.72

Table 3.13 Speed adjustments by age and gender for typical speeds
Base: All respondents in the main survey (1020)

	17-24	25-34	35-44	45-54	55-64	65+
Male	-0.061	-0.016	0.013	-0.013	0.001	0.000
Female	-0.029	-0.041	-0.062	-0.038	-0.019	-0.030

These ratios can be used as multipliers in the following formula:

predicted speed (road) =
*speed (open straight) * (road type ratio + age/gender ratio)*

For example, if a 37 year-old woman drives at 54.1mph on a straight open road (the mean speed for a 34 to 45 year-old female on that road type) the model predicts that she will drive at 40.5mph on a bendy road in bad weather[8]. In fact 40.7mph is the mean speed found in the survey for women of that age group on that road type. Similarly if an 18 year-old male drives at 63.9mph on a straight open road (the mean speed for a 17 to 24 year-old male on that road type), the model predicts that he will drive at 42.1mph on a bendy closed road[9]. In fact 44.8mph is the mean speed found in the survey for a man of that age group on a bendy closed road.

While it is clear that more work is required to make this an effective predictor of speed for all drivers on different road conditions, this model is a useful starting point in looking at these issues, and merits further development.

4. DISCUSSION AND CONCLUSIONS

Based on self-reported speeding, it was possible to define 3 clusters of drivers: Compliants, who tended not to break the speed limit; Exceeders, who tended to break the speed limit by 10mph but not more; and Excessives who routinely exceeded the speed limit by larger amounts. Younger drivers, male drivers and those who had had a near miss in the last 12 months were less compliant in their adherence to speed limits.

Drivers believed they would adopt different typical speeds and that different maximum safe speeds were possible on different road layouts. While the speeds nominated suggested that most drivers ranked the different road layouts in the same order of difficulty, younger drivers and male drivers gave higher absolute typical and maximum speeds than other drivers.

For both typical and maximum speeds, Compliants nominated the lowest and Excessives the highest speeds for all road types. Exceeders nominated higher speeds than Compliants in relation to maximum but not typical speeds. Thus they differed from Compliants in their belief about the maximum possible speed but not in their reported typical driving behaviour. This suggests that it may be possible to change some drivers’ behaviour in relation to speed choice even without tackling underlying beliefs about safe speeds. However for a minority of drivers their belief in their ability to drive safely at high speed is accompanied by self-reported high typical driving speeds. This ‘at risk’ group (in which young males are particularly prevalent) should be the main target of communications and educational messages.

The amount drivers reduced their speed in response to challenging road conditions also varied. There was a significant effect of age where younger drivers reporting their typical speed said they would slow down significantly more than older drivers (though their absolute speeds were still higher). This was not the case for maximum speeds, where younger drivers did not believe they needed to adjust their maximum possible speed as much for the road conditions. Higher absolute maximum speeds coupled with lack of understanding of the need for speed adjustment could be a deadly combination.

There was a significant effect of gender, where female drivers slowed down significantly more than male drivers. There was also a significant interaction between age and gender and therefore this gap widens with age.

Regression analysis showed that it was possible to model driver speeds based on age, gender and the type of road. This may be helpful in predicting which groups are most likely to have accidents and on what road types accidents are most likely to occur. This may be particularly valuable if coupled with actual observed rather than reported speed data. There may be applications of this model in terms of signage in dangerous areas (for example road signs in New Zealand give recommended speeds for particular bends, over and above the actual speed limit) and in targeting communications to at risk groups about specific situations.

NOTES

1. The definition of urban rural in this research is calculated using the Scottish Government 6 fold urban rural classification. The respondents' census Output Area[3] was mapped on to one of 6 classifications: 1) large urban areas; 2) other urban areas; 3) accessible small towns; 4) remote small towns; 5) accessible rural areas; 6) remote rural areas. This was then aggregated so data was classified as belonging to a respondent resident in either an urban (1-2) or rural (3-6) area.
2. The Nomenclature of Territorial Units for Statistics (NUTS) is a European Union standard method of geographic coding for referencing the administrative divisions of countries for statistical purposes. NUTS2 areas in Scotland are Eastern Scotland, Highlands and Islands, North Eastern Scotland and South Western Scotland.
3. Census Output Areas (OAs) are the lowest geographic level at which Census Statistics are released. In Scotland, this is an average of 55 addresses.
4. A 'near miss' was defined as an incident "where you felt that you came close to having an accident but avoided doing so. This could just involve you (for example a time where you skidded or misjudged a bend in the road and nearly collided with something or came off the road) or it could also involve nearly colliding with another vehicle or a pedestrian"
5. 95% confidence intervals are a statistical calculation, allowing for sampling error, of the speeds between which one can be 95% confident that the true mean speed lies on each road type for the population of drivers on rural roads.
6. The Student-Neuman-Keuls post-hoc test is a robust and conservative test of whether there are statistically significant differences between pairs of conditions (in this case: Compliants vs Exceeders; Compliants vs Excessives; Exceeders vs Excessives).
7. Regression analyses are methods of explaining or predicting the variability of a dependent variable using information about one or more independent variables. We used multiple linear regression, which attempts to model the relationship between two or more explanatory variables and a response variable by fitting a linear equation to observed data.
8. 40.5mph= 54.1 * (0.81+ -0.062)
9. 42.1mph= 63.9 * (0.72+ -0.061)

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