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20mph Research Study

Supporting Technical Appendix

Residents' and drivers' questionnaires - Logistic regression analysis

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Report by Atkins, AECOM, and Professor Mike Maher (UCL)

Quality information

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Table of Contents

1. Introduction

The overall objective of the regression analysis is to gain an insight into what factors (represented by so called independent variables) influence the following key outcome-related research questions (represented by so called dependent variables) using the data collected from the residents and driver surveys, and site visits:

- Research Q6: Do drivers, residents and local workers support 20mph speed limits?
- Research Q5: Do drivers and riders comply with 20mph speed limits?
- Research Q7a: Do 20mph speed limits achieve their objectives - speed?
- Research Q7b: Do 20mph speed limits achieve their objectives - perceptions of environment and safety?
- Research Q7c: Do 20mph speed limits achieve their objective - mode shift?
- Research Q7d: Do 20mph speed limits achieve their objectives – driver assessment of risk?
- Research Q9: Do outcomes of 20mph speed limits vary according to road type?
- Research Q12: What effect is there on traffic volumes within the scheme itself and on neighbouring roads?

In particular, the regression analysis seeks to understand:

- how outcomes such as level of support, compliance with limit, and change in speed vary amongst different groups and in different types of areas; and
- to test for association between variables identified as causal factors in the logic maps developed for the three different types of 20mph limit-only schemes (area-wide residential, small scale residential, and city centre).

It should be noted however, that the regression models are ***testing for association only, rather than causality***.

The data collected from the residents and driver surveys, and site visits, is of the following forms:

- Respondent characteristics - Demographic characteristic and driving style (e.g. propensity to speed);
- Characteristics of the area;
- Attitudinal and behavioural statements - These cover both attitudes that respondents have towards 20mph limts, and perceived behaviours resulting from the introduction of 20mph limits, of both themselves and others. These statements can be both things we are trying to explain (dependent variables) and things we are using to explain (independent variables).

For each research question of interest, we have developed suitable hypotheses to be tested from the logic maps, and identified which variables can be used to as dependent and independent variables to test these.

As the dependent variables have been defined as binary variables, that is either in a category or not, (see Table 1 for the dependent variable categories) we have used logistic regression rather than simple regression.

The models have been run separately for residents and drivers. ‘Residents’ are those living on a 20mph surveyed road. Some may also be drivers. ‘Drivers’ are those living outside the 20mph survey area, but who drive through the area. ‘Drivers’ were intercepted at parking locations on the edge of the 20mph area.

The general form of the regression model is summarised below.

Logistic Regression Formula
The logistic regression models we have estimated are of the general form:

$$P(Y) = \frac{1}{1+e^{-a+b_1X_1+b_2X_2+.....+b_nX_n}}$$

Where:

P(Y) is the **dependent variable – the probability of an event occuring** – what we are trying to explain.

X1, X2, Xn are the **independent variables** – what we are using to explain.

B1, B2, Bn are the **estimated parameters** – which show the importance of each independent variable in explaining the dependent variable.

a is a **constant** which picks up other effects not contained in the model.

Further information about the dependent and independent variables included in the regression models is provided below (**Sections 2 and 3, and Appendix B**). Further detail on the modelling approach and a description of the model outputs is provided in **Sections 4 and 5**. The results of the regression analysis are presented in **Section 6.**

2. Dependent Variables

The dependent variables are those things we are trying to explain. The dependent variables are based on the attitudinal statements, where the responses are Agree or Disagree (for example Do you think that the 20mph limit is beneficial for local residents).

The regression analysis seeks to explain the associated characteristics of those who have a defined behaviour or attitude - usually whether they agree with a statement or not. In defining the dependent variables we have set these to be **1** where the **attitude or behaviour is as specified** and to be **0** if **not as specified or don't know**. Missing data has been excluded from the analysis. Given our interest in modelling those who agreed with a statement, whether they disagreed or did not know was not of key importance.

The dependent variables are therefore binary i.e. 0 = Disagree or 1 = Agree, and hence the appropriate type of regression was be logistic regression (rather than simple regression).

A list of potential dependent variables was initially produced for each Research Question. The list was then reviewed at a workshop with the Department for Transport, based on reference to the logic maps developed for the wider study, and separate driver and residents correlation matrices for the identified dependent variables. Where appropriate, one dependent variable only was then identified for each Research Question, to provide focus to the analysis. For Research Questions 7a and 7b, it was felt necessary to identify two dependent variables to fully address the question, but for all other questions, one dependent variable has been identified.

Table 1: Research questions and associated dependent variables

Model	Dependent variable	Drivers /Residents?
Q6. Do drivers, residents and local workers support 20mph speed limits?		
1	What is your overall view now on whether the street should have a 20mph speed limit? - Good idea	Drivers
2	What is your overall view now on whether the street should have a 20mph speed limit? - Good idea	Residents
Q5. Do drivers and riders comply with 20mph speed limits?		
3	I comply with the 20mph speed limit most of the time on this street/ in this area - Agree/ Strongly Agree	Drivers
4	I comply with the 20mph speed limit most of the time on this street/ in this area - Agree/ Strongly Agree	Residents
Q7a. Do 20mph speed limits achieve their objectives and other wider outcomes? – Speed		
5	The average speed of vehicles has reduced - Agree/ Strongly Agree	Drivers
6	The average speed of vehicles has reduced - Agree/ Strongly Agree	Residents
7	Fewer vehicles are driving at excessive speeds for the area - Agree/ Strongly Agree	Drivers
8	Fewer vehicles are driving at excessive speeds for the area - Agree/ Strongly Agree	Residents
Q7b. Do 20mph speed limits achieve their objectives and other wider outcomes? – Perceptions of environment and safety (for walking and cycling)		
9	The introduction of the 20mph limit provides a safer environment for walking and cycling - Agree/ Strongly Agree	Residents
10	The introduction of the 20mph limit provides a more pleasant environment for walking and cycling - Agree/ Strongly Agree	Residents
Q7c. Do 20mph speed limits achieve their objectives and other wider outcomes? – Mode shift		
11	Keeping traffic below 20mph makes it more likely that I will walk to local places rather than use the car - Agree/ Strongly Agree	Residents
12	Keeping traffic below 20mph makes it more likely that I will walk to local places rather than use the car - Agree/ Strongly Agree	Residents
Q7d. Do 20mph speed limits achieve their objectives and other wider outcomes? – Driver assessment of risk		
13	The 20mph limit increases drivers' awareness of potential risks and hazards (e.g. cyclists, children playing) - Agree/ Strongly Agree	Drivers
14	The 20mph limit increases drivers' awareness of potential risks and hazards (e.g. cyclists, children playing) - Agree/ Strongly Agree	Residents
Q9. Do outcomes of 20mph speed limits vary according to road type?		
-	Analysis based on dependent variables for Research Questions 7a to 7d.	-
Q12. What effect is there on traffic volumes within the scheme itself and on neighbouring roads?		
15	I avoid driving/ riding on this street/ in this area if possible since the introduction of 20mph limits - Agree/ Strongly Agree	Drivers

3. Independent Variables

The regression models attempt to explain differences in the dependent variable in terms of the following types of independent variables:

- respondent characteristics (demographic characteristics and driving style);
- characteristics of the area;
- behaviour and attitudinal statements.

3.1 Respondent characteristics

Demographic Variables

The following demographic data were used:

- Age;
- Gender;
- Work status;
- Socio Economic Group;
- Gross Household Income;
- Ethnic Status;
- Whether person is a driver;
- Number of vehicles in household;
- Percentage of children under 17 in household

Driving Style

Drivers were asked how often they take part in particular driver behaviours and these questions were used to explain variations in the dependent variables. Responses were collected using a 5 point scale: nearly all the time, frequently, quite often, hardly ever, or never:

- Drive faster than intended;
- Exceed speed limit on a motorway by more than 10mph;
- Exceed speed limit on a 30mph road by more than 5mph;
- Exceed speed limit on a 20 mph road by more than 5mph;
- Exceed speed limit in a 20mph zone by more than 5mph; or
- Avoid streets with a 20mph speed limit.

3.2 Characteristics of the area

Table 2 below shows the variables that describe the characteristics of the areas. These variables have generally been grouped into categories. This is because some of the data relates to a much wider area than the small number of streets under consideration so caution must be taken about spurious levels of accuracy. This is why categories have been used. However for 'Accidents' and 'Proportion of the population under 17' we have modelled these as continuous variables.

Table 2: Characteristics of the area/sampled roads

Variable	Levels
Indices of multiple deprivation	Calculated value or Low, Medium, High
% of population under 17	Continuous variable based on household survey
'Before' Accidents (total casualties per road km)	Continuous variable source - see below
Road Width (sampled roads)	Narrow, Medium, Wide
Distance from Road to House (sampled roads)	Short, Medium, Long
Green space (sampled roads)	Low, Medium, High
Land use	Residential only, Mixed (residential, retail, leisure, business), School (residential and school, i.e. school located within survey area)
Signage	On limit change only, Repeater signs, Other additional signage (e.g. electronic warning)
Wider area	20mph zones, 20mph limits, Mixed
On-road parking	Low, Medium, High

Interpretation of results relating to area characteristics

Most of the above characteristics are represented by one value for each case study. Results may therefore represent locational differences, rather than area characteristics. **This will need to be taken into account when interpreting results.**

Note on Pre-implementation Accident Data

The accident data was provided by Atkins (Technical Note – DfT 20 mph Research Baseline Accident/Casualty Data for Case Study Areas from Nicola Newman to Jo Christensen date 21st April 2016). This Note contained four accident variables (per road km) –

- total casualties,
- total accidents,
- total KSI (killed and seriously injured); and
- total pedestrian/cycle casualties (killed, seriously injured and slight).

For each case study, the data presented covers the 6 years prior to each scheme implementation date (based on the nearest quarter year) in order to remove the impact of any regression to the mean bias.

We initially tried using these the accident variables as discrete variables (low medium and high) but when we checked they were highly correlated with other area based variables. We then included accident variables as continuous variables. But on checking the correlations we found them very highly correlated with each other. Consequently we have used only one of these variables in the analysis – this was total casualties per road km. We chose this because it had the widest range of values.

Scheme Area and Typologies

The scheme area and typology was represented in the models by a series of dummy (0/1) variables (one for each area), and for each typology which identifies which area the surveys were carried out in.

However, there was an issue in including area in the model because each would have been highly correlated with the local characteristics of the area for example road width, green space, number of accidents. Consequently we could either include these variables or area but not both in the same model. We took the view that it would be better to include these variables rather than the area, as it is the differences between the areas that we are trying to explain through these variables. **Scheme Area and Scheme Typology were not therefore included as a variables.**

3.3 Behaviour and Attitudinal Variables

The residents and driver datasets contain a large number of agree/disagree statements (32 in the residents' survey, 24 in the drivers' survey) which were used to determine the outcomes and impacts of the 20mph speed limits. As explained earlier they were used as both dependent and independent variables.

Table 1 above identifies the statements used as dependent variables for each of the Research Questions of interest. Appendix B shows which statements have been used as independent variables for each of the Research Questions.

4. Modelling Approach

We used multiple regression where all possible independent variables that may influence the dependent variable were included at the same time (subject to those not being highly correlated with each other), rather than simple regression approach where only one independent variable is included each time, in order to avoid omitted variable bias.

The first stage of the analysis was to check the correlation matrix for the dependent variables and independent variables. This showed which independent variables were correlated with each other and highlighted possible correlation, or multi-collinearity issues. Where two variables are highly correlated it means they are telling us similar things.

Where two variables are highly correlated ($r>0.8$) either one can be excluded but it is arbitrary as to which one is dropped. We therefore adopted a systematic approach to estimating the models.

For each model we ran a single model using all the appropriate independent variables. We then reviewed the model output and reviewed those parameters that were not statistically significant - that is had a significance level (p) value (which measures the probability of the true value actually being zero) of greater than 5% or 0.05. We did this in an iterative manner, by excluding those that were least significant and had the highest p value (for example, over 0.8 first), and rerunning the model. We then excluded those variables that had the next highest p value for example 0.7 and we re-ran the model again. This process of excluding the least statistically significant and re-running the model continued until all remaining variables had a p value of less than 0.05, and so were significant at the 5% level. We adopted this approach for all of the 15 models estimated.

5. Model Outputs

The purpose of the regression modelling was to show how important each of the independent variables are in explaining the variation in the dependent variables under consideration. The models are binary models which seek to explain the dependent variable which takes one of two values 1 or 0.

In an ordinary regression model the **(B) coefficient** measures the amount that the dependent variable changes from a unit change in the independent variable. This can be negative or positive which indicates whether the variable is a barrier or enabler to the dependent variable respectively.

However in a logistic regression the B coefficient measures the change in the log odds of the dependent variable or the odds ratio. So rather than report the estimated B coefficients, which is more difficult to interpret, we have reported the **odds ratio** instead. The odds ratio is calculated as (exp(B)), which measures the change in odds resulting from a unit change in the dependent variable. See below for an interpretation of this.

Odds Ratio Interpretation

For example if the estimated **parameter B**, is equal to plus 1.5, then exp(B) would be 4.48. This means when the independent variable changes by one unit the odds that the case can be predicted to be in category =1 of the dependent variable **increases** by a factor of around 4.5, controlling for the other variables in the model. So if this was a parameter for the independent variable (male) this would mean males are 4.5 times **MORE** likely than females to exhibit this behaviour.

Conversely if the estimated parameter B is equal to minus 1.5, then exp(B) would be 0.222. This is less easy to interpret so we calculate 1/exp(B) which gives a result of 4.48. This means when the independent variable changes by one unit the odds that the case can be predicted to be in category =1 of the dependent variable **reduced** by a factor of around 4.5, controlling for the other variables in the model. So if this was a parameter for the independent variable (aged over 60) this would mean people who are over 60 years of age are 4.5 times **LESS** likely than those who are aged less than 60 to exhibit this behaviour.

Also associated with each **B parameter** is a **significance level (p)**. This is the probability that the estimated parameter is really zero, so gives an indication of whether the relationship is a true relationship as discussed earlier. Usually a 5% significance level is taken as the cut off so we are saying there is less than a 5% chance of the parameter really being 0. We have not reported significance levels here but these are available if required. However, to re-iterate, **only variables that had a statistically significant association with the appropriate dependent variables have been included in the model.** In order to be included, variables had to be significantly different from zero (p or significance level of less or equal to 5%).

Table 3 below summarises the models estimated. It shows:

- Model title;
- Dependent Variable being tested (where dependent variable category=1);
- Total number of observations;
- Percentage choosing dependent variable =1 (Agree) as opposed to 0 (disagree)
  For example, for Model 1, 1188 respondents provided a response to the statement "I am more likely to drive below the speed limit in this area since the introduction of the 20mph limit"; of which 784 agreed and 404 did this giving a percentage choosing agree of 66%;
- Rho Squared (measure of goodness of fit (=1-(LL(0)/LL(M)), where LL(0) = Initial Log Likelihood and LL(M) = Final Log Likelihood;
- Cox + Snell R squared - This another pseudo goodness of fit measure calculated by SPSS;
- Nagelkerke R Squared – this another pseudo goodness of fit measure calculated by SPSS.

Table 3 Model Summary

Model	Dependent variable	N	% Agreeing	Rho-sq	Cox + Snell	Nagel-kerke
1	What is your overall view now on whether the street should have a 20mph speed limit? - Good idea (Drivers)	1188	66	0.213	0.24	0.331
2	What is your overall view now on whether the street should have a 20mph speed limit? - Good idea (Residents)	1182	74	0.384	0.413	0.55
3	I comply with the 20mph speed limit most of the time on this street/ in this area - Agree/ Strongly Agree (Drivers)	1212	82	0.261	0.216	0.356
4	I comply with the 20mph speed limit most of the time on this street/ in this area - Agree/ Strongly Agree (Residents)	1209	69	0.270	0.312	0.416
5	The average speed of vehicles has reduced - Agree/ Strongly Agree (Drivers)	1226	27	0.016	0.018	0.026
6	The average speed of vehicles has reduced - Agree/ Strongly Agree (Residents)	1883	22	0.038	0.039	0.06
7	Fewer vehicles are driving at excessive speeds for the area - Agree/ Strongly Agree (Drivers)	1252	28	0.012	0.014	0.02
8	Fewer vehicles are driving at excessive speeds for the area - Agree/ Strongly Agree (Residents)	1971	23	0.034	0.036	0.055
9	The introduction of the 20mph limit provides a safer environment for walking and cycling - Agree/ Strongly Agree (Residents)	1871	59	0.124	0.154	0.208
10	The introduction of the 20mph limit provides a more pleasant environment for walking and cycling - Agree/ Strongly Agree (Residents)	1874	51	0.115	0.148	0.197
11	Keeping traffic below 20mph makes it more likely that I will walk to local places rather than use the car - Agree/ Strongly Agree (Residents)	1160	16	0.071	0.06	0.103
12	Keeping traffic below 20mph makes it more likely that I will cycle to local places rather than use the car - Agree/ Strongly Agree (Residents)	1056	9	0.120	0.071	0.155
13	The 20mph limit increases drivers' awareness of potential risks and hazards (e.g. cyclists, children playing) - Agree/ Strongly Agree (Drivers)	1225	62	0.131	0.166	0.221
14	The 20mph limit increases drivers' awareness of potential risks and hazards (e.g. cyclists, children playing) - Agree/ Strongly Agree (Residents)	1813	41	0.191	0.228	0.307
15	I avoid driving/ riding on this street/ in this area if possible since the introduction of 20mph limits - Agree/ Strongly Agree (Drivers)[1]	1236	8	0.090	0.05	0.115

Rho squared or **goodness of fit, also referred to as the Log Likelihood Index** shows how well the model explains the variability of the dependent variable. This measure is based on the initial and final log likelihoods LL(0) and LL(M). Rho-Squared is comparable with the R^2 statistic in a linear regression model. However, the interpretation of what constitutes a high goodness of fit is less clear with Rho squared. For example, the maximum value of Rho Squared is influenced by the shares of each alternative, as shown in the following extract from the ALOGIT V3.8 (a specialist LOGIT modelling statistics package). The manual makes clear:

"It is difficult to give 'rules of thumb' for comparing Rho Squared values between differing models. In some cases, low values (0.05 - 0.10) can be considered to be good, whereas other choice situations can be modelled better, giving Rho Squared values of 0.40 or higher. In general, the simpler the choice that is to be explained, i.e. the smaller the number of alternatives, the higher the Rho Squared that can be expected. Experience is the only reliable guide."

Table 3 shows the goodness of fit as measured by the Rho Squared statistic for each model. From our experience of developing this type of model over a large number of years **a Rho Squared statistic of 0.10 is regarded as acceptable and a value of over 0.20 is regarded as a good fit.**

[1] Note that drivers were interviewed on the periphery of the 20mph area.

Most models have a rho squared of more than 0.10 so are reasonable in terms of goodness of fit. Some of the models perform less well especially 5, 6, 7 and 8 which have quite low goodness of fit statistics.

We have also reported two other pseudo goodness of fit statistics provided by SPSS – Cox and Snell R squared and Nagelkerke R squared. These are calculated differently so give different results but generally lead to similar conclusions about the goodness of fit of the models.

Where the goodness of fit is high this means a high proportion of the variability in the dependent variable is explained, which is good. On the other hand a low goodness of fit means less of the variability in the dependent variable is explained so there may be other variables that maybe influencing the dependent variable which are not included in the model. Where there is less variability in the dependent variable this can also be harder to explain by the model.

6. Presentation of Results

For each research question we firstly outline the results based on the odds ratios, for each dependant variable considered. This is calculated from the B parameter, and is described in more detail in Section 5. Results are presented in order of impact. Those variables which have a bigger impact are presented first.

We then go through each of the associated hypothesis comments on whether there is evidence to support these, and make an overall assessment about the validity of each of the hypotheses.

Finally we summarise the key results.

Interpretation
In reporting the results rather than repeat the dependent variable every time this has been highlighted at the top of the table. So the interpretation for the first variable in Model 1: Those who 'agree' The 20mph limit was beneficial for the local residents' are…7.6 x more likely than those who 'do not agree' to think it is a good idea for the street to have a 20mph speed limit.

Reference case for green space, distance from road, road width variables – For these variables we have three levels of response Low/Short/Narrow, Medium and High/Long/Wide. The highest level is taken as the base so we have estimated parameters for Low/Short/Narrow and Medium.

In some of the models the Low/Short/Narrow parameter is significant but the medium parameter is not so this becomes part of the base; so the base is Medium and High/Long/Wide.

In some of the models the Low/Short/Narrow parameters and the Medium parameter are significant so the base is High/Long/Wide.

In some of the models the Medium parameter is significant but the Low/Short/Narrow parameter is not so this becomes part of the base; so the base is Low/Short/Narrow and High/Long/Wide.

We have made clear in the model tables what the base is for each variable.

7. Q6: Do drivers, residents and local workers support 20mph speed limits?

7.1 Purpose of the regression analysis

To understand how levels of support vary amongst different types of areas; rather than to test specific processes or linkages in the logic map. Residents and drivers have been modelled separately. Indirect residents (i.e. those living on parallel 30mph streets) have not been included in the regression analysis.

7.2 Statistically significant independent variables, based on odds ratio

The tables below identify the statistically significant independent variables, based on odds ratios. Those variables which have a bigger impact are presented first.

Model 1 – What is your overall view now on whether the street should have a 20mph speed limit? (Drivers)

Drivers ***…to think it is a good idea for the street to have a 20mph speed limit.***				
Independent variable type	**Independent variable description**	**Statistically significant relationship, based on log / odds ratio**		
Characteristics of the area	Road width	Those from an area where roads were of narrow width are…	6.1 x **less**	likely than those from areas where they were medium or wide…
Propensity to speed	'How often do you find yourself exceeding a 20mph speed limit by more than 5mph?'	Those who 'frequently' do so are…	5.6 x **less**	likely than those who 'do not' frequently do so…
Attitudinal	'The speed limit increases drivers' awareness of potential risks and hazards'	Those who 'agree' are…	4.6 x **more**	likely than those who 'do not agree'…
Characteristics of the area	IMD	Those from an area with a lower IMD score (less deprived) are…	3.5 x **less**	likely than those from areas with the higher IMD scores (most deprived)…
Attitudinal	'There are less vehicles driving at excessive speeds in the area'	Those who 'agree' are…	1.8 x **more**	likely than those who 'do not agree'…
Characteristics of the area	Distance	Those from an area where the distance from house to road was of middle length are…	1.6 x **less**	likely than those from other areas…
Characteristics of the area	Casualties	If the number of casualties per KM of road goes up by 1, the odds of thinking it is a good idea for the street to have a 20mph limit goes up by a factor of 1.7 (70%).		

Model 2 – What is your overall view now on whether the street should have a 20mph speed limit? (Residents)

Residents ***…to think it is a good idea for the street to have a 20mph speed limit.***				
Independent variable type	**Independent variable description**	**Statistically significant relationship, based on odds ratio**		
Attitudinal	'The introduction of the 20mph speed limit on the street had made it a more desirable place to live'	Those who 'agree' are…	4.4 x **more**	likely than those who 'do not agree'…
Attitudinal	'The 20mph limit was beneficial for the local residents'	Those who 'agree' are…	3.5 x **more**	likely than those who 'do not agree'…
Socio-demographic characteristics	Number of cars	Those with three cars per household are…	3.2 x **less**	likely than those with no cars…
Propensity to speed	'How often do you find yourself exceeding a 20mph speed limit by more than 5mph?'	Those who 'frequently' do so are…	3.2 x **less**	likely than those who 'do not' frequently do so…
Characteristics of the area	Greenspace	Those from an area with a low amount of greenspace are…	3.0 x **more**	likely than those from an area with a higher(medium or high) amount of greenspace…
Characteristics of the area	Distance from road centre to houses	Those from an area where the distance from house to road was shortest are…	3.0 x **less**	likely than those from areas it was longest…
Characteristics of the area	Distance from road centre to houses	Those from an area where the distance from house to road was of middle length are…	2.8 x **less**	likely than those from areas it was longest…
Attitudinal	'The 20mph limit is beneficial for cyclists and pedestrians'	Those who 'agree' are	2.5 x **more**	likely than those who 'do not agree'…
Socio-demographic characteristics	Number of cars	Those with two cars per household are…	1.8 x **less**	likely than those with no cars…
Socio-demographic characteristics	Number of cars	Those with one car per household are…	1.5 x **less**	likely than those with no cars…

7.3 Assessment of hypotheses (What is your overall view now on whether the street should have a 20mph speed limit?)

Hypothesis		Drivers	Residents	Overall assessment
Respondent characteristics				
i	Levels of support are higher amongst certain gender-age-affluence groups.	*YES among those in more deprived (high IMD) areas.* *Those from less deprived (lower IMD) less likely to agree.* *Other variables (age, gender, car ownership) not significant.*	*YES among non-car owning households.* *Car owners less likely to agree. Increases with number of cars.* *Other variables (gender, age, IMD) not significant.*	*YES (partially). The results show higher levels of support amongst drivers in more deprived area, and non-car owning residents. However, the results are not consistent across the two datasets.* ***Age** was not found to be a significant factor in either dataset.*
ii	Levels of support for case study scheme are higher amongst drivers who typically comply with speed limits	*YES* *Those who frequently exceed 20mph by more than 5mph are less likely to agree.*	*YES* *Those who frequently exceed 20mph by more than 5mph are less likely to agree.* *Other variables not significant.*	*YES. Perhaps not surprisingly, both drivers and residents who frequently found themselves exceeding a 20mph speed limit by more than 5mph were far less likely to think the limit was a good idea than those who did not frequently speed.*
iii	Levels of support are higher amongst those who drive through the area on a regular basis	*Tested variable not significant.*	*Tested variable not significant.*	*Tested variable not significant. No evidence to support this hypotheses.*
Characteristics of area				
iv	Levels of support are higher in areas where there are 20mph limits or zones nearby	*Tested variable not significant.*	*Tested variable not significant.*	*Tested variable not significant. No evidence to support this hypotheses.*
v	Levels of support are higher in areas where there are a high proportion of children living	*Tested variable not significant.*	*Tested variable not significant.*	*Tested variable not significant. No evidence to support this hypotheses.*
vi	Levels of support are higher in areas where the roads are narrow, the distance from the road to the houses is small, and there is limited open space	*INCONCLUSIVE. Those with 'medium' width roads more likely to agree than those in areas with narrow or wide roads.* *Variables relating to distance from road to house not significant.*	*Variables relating to road width not significant.* *NO. Those where distance from road to houses is short or middle are less likely to agree.*	*INCONCLUSIVE. Overall results for both drivers and residents are inconclusive, with some conflicting findings for both groups.* *Drivers in areas with narrow or wide roads are less supportive than those in areas with medium width roads. But there is no significant variability in levels of support amongst drivers based on the distance from the road to the*

		Variables relating to open space not significant.	*YES. Those with limited green space are more likely to agree.*	*houses, or the amount of green space.* *Residents showed high levels of support in areas with limited open space (as expected), but lower levels of support in areas where the where the distance from the road to houses is short or medium (contrary to expectations). There was no significant variability in levels of support in areas with different road widths.* *The impact of the road environment on levels of support is likely to vary between drivers and residents, as the two groups use and relate to the roads in a different way.* *In practice levels of support are likely to reflect a combination of these factors, and other environmental variables, which cannot easily be captured in this type of regression analysis.* *Finally, it should be noted that the above characteristics are represented by one value for each case study, so the results may reflect other locational differences, rather than just the above factors.*
vii	Levels of support are higher in areas where there are schools or high pedestrian activity (e.g. retail, or leisure)	*Tested variable (land use) not significant*		*Tested variable not significant. No evidence to support this hypotheses.*
viii	Levels of support are higher in areas where there are higher levels of accidents	*YES. Where casualties higher more likely to agree*	*Tested variable not significant*	*YES (drivers only). Support amongst drivers was found to increase as the number of (before) casualties per km of road increases. However, interestingly, there was no evidence of a similar trend amongst residents.*
Behavioural / attitudinal statements				
x	Levels of support are higher in areas where there has been a higher level of consultation and engagement prior to implementation	*Tested variable not significant*	*Tested variable not significant*	*Tested variable not significant. No evidence to support this hypotheses.*

xi	Which attitudinal statements are associated with high levels of support? (Levels of support are higher in areas where positive outcomes are perceived to have been delivered, and lower in areas where negative outcomes are perceived to have been delivered)	*Speed* *Those who agree that there are less vehicles driving at excessive speed more likely to agree.* *Driver assessment of risk* *Those who think 20mph limit increases driver awareness of risk more likely to agree.* *Other variables not significant.*	*Perceptions of environment and safety* *Those who think 20mph beneficial for local residents more likely to agree.* *Those who think 20mph beneficial for pedestrian and cyclists more likely to agree.* *Those who agree that 20mph limit has made it a more desirable place to live more likely to agree.* *Other variables not significant.*	*Traffic volume outcomes* *Tested variable not significant. No evidence of association.* *Speed* *Positive association (drivers). Higher levels of support associated with drivers who perceive that there are less vehicles driving at excessive speed.* *Perceptions of environment and safety* *Positive association (drivers and residents).* *Levels of support were also significantly higher amongst residents who perceive the limit to be beneficial to local residents (3.5 times), beneficial to pedestrians and cyclists (2.5 times), and to have made the street a more desirable place to live (4.4 times).* *Driver assessment of risk* *Positive association (drivers). Support nearly three times higher amongst drivers who agreed the speed limit increased drivers' awareness of potential hazards and risks.* *Mode shift* *Tested variable not significant. No evidence of association.* *Impact on local economy* *Tested variable not significant. No evidence of association.*

7.4 Summary of Findings

Drivers in areas where the roads were of narrow width were significantly less likely than those from areas where they were wider to think it is a good idea for the street to have a 20mph limit. On the other hand, **drivers** from areas where the distance from house to road was of middle length were less likely to think it was a good idea than those from areas where the distance was different.

Drivers in less deprived areas were significantly less likely to think it as a good idea than those from more deprived areas. Those who frequently speeded were less likely to think it was a good idea than those who do not, whilst those who agreed that the limit increased drivers' awareness of potential risks and hazards and that there were less vehicles driving at excessive speeds in the area were more likely than those that didn't agree to think it is a good idea to have a 20mph speed limit.

Residents who felt the limit was beneficial for local residents were significantly more likely to support the limit than those who didn't. Those who felt the limit made the street a more desirable place to live were over 4x more likely than those who didn't to think the 20mph limit was a good idea.

Residents from areas where the distance from road to house was shorter or of middle length were less likely to think the 20mph limit was a good idea, whilst those in areas with a low amount of greenspace were significantly more likely to support the limit compared to those in areas where there was more greenspace.

Those **residents** with between 1-3 cars in their household were less likely to support the limit than those with either no car in their household.

8. Q5: Do drivers and riders comply with 20mph speed limits?

8.1 Purpose of the regression analysis

To understand how levels of compliance vary amongst different groups and in different types of areas; rather than to test specific processes or linkages in the logic map. Residents and drivers have been modelled separately.

8.2 Statistically significant independent variables, based on odds ratio

The tables below identify the statistically significant independent variables, based on odds ratios. Those variables which have a bigger impact are presented first.

Model 3 – I comply with the 20mph speed limit most of the time on this street/ in this area (Drivers).

Drivers ***…to comply with the 20mph speed limit most of the time on this street/area.***				
Independent variable type	**Independent variable description**	**Statistically significant relationship, based on odds ratio**		
Characteristics of the area	Greenspace	Those from an area with a low amount of greenspace are…	5.1 x **more**	likely than those from an area with a higher (medium or high) amount of greenspace…
Propensity to speed	'How often do you find yourself exceeding a 30mph speed limit by more than 5mph?'	Those who 'frequently' do so are…	4.8 x **less**	likely than those who 'do not' frequently do so…
Attitudinal	'20mph is an appropriate speed for this street'	Those who 'agree' are…	4.8 x **more**	likely than those who 'do not agree'…
Characteristics of the area	Road width	Those from an area where roads were narrow are…	4.2 x **less**	likely than those from other areas with medium or wide road widths…
Characteristics of the area	Distance from road centre to houses	Those from an area where the distance from house to road was of middle length are…	4.2 x **less**	likely than those from areas it was longest…
Characteristics of the area	Distance from road centre to houses	Those from an area where the distance from house to road was shortest are…	4.1 x **less**	likely than those from areas it was longest…
Attitudinal	'What is your overall view no on whether the street should have a 20mph speed limit?'	Those who think it is a 'good idea' are…	2.4 x **more**	likely than those who do not think it is a 'good idea'…
Characteristics of the area	Land use	Those from an area where land use was mixed are…	1.6 x **less**	likely than those from other areas…
Attitudinal	'There is sufficient signage to inform road users that a 20mph speed limit applies'	Those who 'agree' are…	1.4 x **more**	likely than those who 'do not agree'…

Model 4 – I comply with the 20mph speed limit most of the time on this street/ in this area (Residents).

Residents ***…to comply with the 20mph speed limit most of the time on this street/area.***				
Independent variable type	**Independent variable description**	**Statistically significant relationship, based on odds ratio**		
Characteristics of the area	Greenspace	Those from an area with a medium amount of greenspace are…	16.9 x **less**	likely than those from other areas with low or high greenspace…
Characteristics of the area	Distance from road centre to houses	Those from an area where the distance from house to road was of middle length are…	6.6 x **less**	likely than those from other areas where the distance is short or long…
Characteristics of the area	Road width	Those from an area where roads were of medium width are…	6.3 x **more**	likely than those from areas where roads were widest…
Characteristics of the area	Road width	Those from an area where roads were narrow are…	5.0 x **more**	likely than those from areas where roads were widest…
Characteristics of the area	Index of Multiple Deprivation (IMD)	Those from an area with a medium IMD score are…	3.3 x **less**	likely than those from areas with higher IMD scores (more deprived)…
Characteristics of the area	Index of Multiple Deprivation (IMD)	Those from an area with a lower IMD score (less deprived) are…	3.0 x **less**	likely than those from areas with higher IMD scores (more deprived)…
Propensity to speed	'How often do you find yourself exceeding a 30mph speed limit by more than 5mph?'	Those who 'frequently' do so are…	2.1 x **less**	likely than those who 'do not' frequently do so…
Attitudinal	'20mph is an appropriate speed for this street'	Those who 'agree' are…	2.1 x **more**	likely than those who 'do not agree'…
Characteristics of the area	Land use	Those from an area where land use was mixed are…	2.0 x **more**	likely than those from other areas…
Propensity to speed	'How often do you find yourself driving faster than you intended to?'	Those who 'frequently' do so are…	2.0 x **less**	likely than those who 'do not' frequently do so…
Attitudinal	'There is sufficient signage to inform road users that a 20mph speed limit applies'	Those who 'agree' are…	1.6 x **more**	likely than those who 'do not agree'…

8.3 Assessment of hypotheses (Do drivers and riders comply with the speed limit?)

Hypothesis		Drivers	Residents	Overall assessment
Respondent characteristics				
i	Levels of compliance are higher amongst certain gender-age-affluence groups	*Tested variables not significant.*	*YES among those in more deprived (High IMD) areas.* *Those from less deprived (low or medium IMD) less likely to agree.* *Other variables (gender, age, car ownership) not significant.*	*YES (partially). The results show higher levels of reported compliance in more deprived areas.* ***Gender, age, and car ownership** were not found to be a significant factors in either dataset.*
ii	Levels of compliance in case study area are higher amongst drivers who typically comply with speed limits	*YES* *Those frequently exceeding 30mph speed limit by 5 or mph less likely to agree.* *Other variables not significant.*	*YES* *Those frequently exceeding 30mph speed limit by 5 or mph less likely to agree.* *Those frequently driving faster than they intend are less likely to agree.* *Other variables not significant.*	*YES.* *Residents and drivers who frequently exceed a 30mph speed limit by more than 5mph and residents who frequently find themselves driving faster than they intended to were less likely to comply with the 20mph limit in these areas.*
iii	Levels of compliance are higher amongst those who drive through the area on a regular basis	*Tested variable not significant*	*Tested variable not significant*	*Tested variable not significant. No evidence to support this hypotheses.*
Characteristics of area				
iv	Levels of compliance are higher in areas where there are a high proportion of children living	*Tested variable not significant*	*Tested variable not significant*	*Tested variable not significant. No evidence to support this hypotheses.*
v	Levels of compliance are higher in areas where the roads are narrow, the distance from the road to the houses is small (narrow verges / short gardens), and there is limited open space – creating a confined environment.	*NO. Drivers less likely to comply where roads are narrow.* *NO. Drivers less likely to comply where distance from road to house short or medium.*	*YES. Residents more likely to comply where roads are narrow or medium width.* *INCONCLUSIVE. Drivers less likely to comply where distance from road to house is medium as opposed to short or long.*	*INCONCLUSIVE. Overall results for both drivers and residents are inconclusive, with some conflicting findings for both groups.* *Compliance amongst drivers is associated with areas with limited green space (as hypothesized), but not narrow road widths or narrow verges / short gardens.*

		YES. Drivers more likely to comply in areas where there is limited green / open space.	*Drivers less likely to comply where there is medium green space, rather than 'little' or 'a lot'.*	*Compliance amongst residents (who drive) is associated with narrow or medium width roads, but not narrow verges / short gardens or limited open space.* *In practice levels of compliance are likely to reflect a combination of these factors, and other environmental variables, which cannot easily be captured in this type of regression analysis.* *In addition, it should be noted that the above characteristics are represented by one value for each case study, so the results may reflect other locational differences, rather than just the above factors.*
vi	Levels of compliance are higher in areas where there are schools or high pedestrian activity (e.g. retail, or leisure)	*NO. Where land use is mixed, drivers are less likely to comply.*	*Tested variable (land use) not significant*	*No evidence to support this hypotheses.*
Behavioural / attitudinal statements				
vii	Levels of compliance are higher in areas where 20mph is seen an appropriate speed and levels of support are higher	*YES* *Higher levels of compliance amongst those who agree 20mph is an appropriate speed.* *Higher levels of compliance amongst those who agree 20mph is a good idea.*	*YES* *Higher levels of compliance amongst those who agree 20mph is an appropriate speed.*	*YES.* *Higher levels of compliance are associated with drivers and residents who agree 20mph is an appropriate speed, and drivers who agree 20mph is a good idea.*
viii	Levels of compliance are higher in areas where it is perceived that there is clear and sufficient signage	*YES* *Higher levels of compliance amongst those who agree that there is sufficient signage.*	*YES* *Higher levels of compliance amongst those who agree that there is sufficient signage.*	*YES* *Higher levels of compliance are associated with drivers and residents who agree that there is sufficient signage.*

8.4 Summary of findings

Drivers who said they were likely to comply with the speed limit most of the time, were most likely to also agree that 20mph was an appropriate speed for the street, that the limit was appropriate to the street and that there was sufficient signage to indicate that a 20mph speed limit applied. They were also less likely to frequently find themselves exceeding a 30mph speed limit by more than 5mph.

Drivers in areas where the roads were narrow were less likely to comply with the speed limit, contrasting greatly with residents in areas where the roads were narrow or of medium width who were significantly more likely to comply compared to those in areas where the roads were wider. In contrast, both **drivers and residents** in areas where the distance from house to road was of middle distance were less likely to comply with the limit.

Residents in areas of low to medium IMD scores were less likely to comply with the 20mph limit. **Residents** who said they were likely to comply with the 20mph limit most of the time were most likely to live in an area with a medium to narrow width road and in an area of mixed land use. Again, similar to drivers, **residents** who frequently exceed a 30mph speed limit by more than 5mph and who frequently find themselves driving faster than they intended to were less likely to comply with the 20mph limit in these areas.

9. Q7a: Do 20mph speed limits achieve their objectives and other wider outcomes?

9.1 Purpose of the regression analysis

To understand how perceived changes in speed vary in different types of areas; rather than to test specific processes or linkages in the logic map. Residents and drivers have been modelled separately.

Two dependent variables are modelled, to capture different aspects of speed outcomes:

- The average speed of vehicles has reduced (Agree / Strongly agree)
- Less vehicles are driving at excessive speeds for the area (Agree / Strongly agree)

The results for residents are considered most relevant, as they expected to have a better overview of speeds in the area than residents.

9.2 Statistically significant independent variables, based on odds ratio

The tables below identify the statistically significant independent variables, based on odds ratios. Those variables which have a bigger impact are presented first.

Model 5 – The average speed of vehicles has reduced (Drivers)

Drivers ***…to think the average speed of vehicles has reduced.***				
Independent variable type	**Independent variable description**	**Statistically significant relationship, based on odds ratio**		
Characteristics of the area	Index of Multiple Deprivation (IMD)	Those from an area with a lower IMD score (less deprived) are…	2.3 x **more**	likely than those from areas with higher IMD scores (more deprived)…
Characteristics of the area	Distance from road centre to houses	Those from an area where the distance from house to road was of medium are…	2.1 x **less**	likely than those from other areas where the distance is short or long)…
Socio-demographic	Aged 35-59	People aged 35-59 are…	1.4 x **more**	likely than people of other ages…

Model 6 – The average speed of vehicles has reduced (Residents)

Residents ***…to think the average speed of vehicles has reduced.***				
Independent variable type	**Independent variable description**	**Statistically significant relationship, based on odds ratio**		
Characteristics of the area	Distance from road centre to houses	Those from an area where the distance from house to road was shorter are…	3.7 x **less**	likely than those from other areas where the distance is medium or long…
Characteristics of the area	Road width	Those from an area where roads were narrow are…	2.7 x **less**	likely than those from other areas with medium or wide road widths…
Characteristics of the area	Index of Multiple Deprivation (IMD)	Those from an area with a lower IMD score (less deprived) are…	2.5 x **more**	likely than those from areas with higher IMD scores (more deprived)…
Characteristics of the area	Greenspace	Those from an area with a low amount of greenspace are…	1.9 x **more**	likely than those from other areas with medium or high green space
Socio-demographic	Aged 17-34	People aged 17-34 are…	1.5 x **more**	likely than people aged 60+…

Socio-demographic	Number of cars	Those with one car per household are…	1.4 x **more**	likely than those with any other amount of cars…
Socio-demographic	Aged 35-59	People aged 35-59 are…	1.3 x **more**	likely than people aged 60+.

Model 7 – Less vehicles are driving at excessive speeds for the area (Drivers). ***Drivers*** ***…to agree that less vehicles are driving at excessive speeds for the area.***				
Independent variable type	**Independent variable description**	**Statistically significant relationship, based on odds ratio**		
Characteristics of the area	Distance from road centre to houses	Those from an area where the distance from house to road was shortest are…	2.0 x **less**	likely than those from areas where the distance was longest…
Characteristics of the area	Greenspace	Those from an area with a low amount of greenspace are…	1.8 x **more**	likely than those from other areas with medium or high greenspace…
Characteristics of the area	Distance from road centre to houses	Those from an area where the distance from house to road was of middle length are…	1.8 x **less**	likely than those from areas where the distance was longest…
Characteristics of the area	Index of Multiple Deprivation (IMD)	Those from an area with a medium IMD score are…	1.5 x **less**	likely than those from other areas…
Socio-demographic characteristics	Age 35-59	Those aged 35-59 are…	1.4 x **more**	likely than people of other ages…

Model 8– Less vehicles are driving at excessive speeds for the area (Residents). ***Residents*** ***…to agree that less vehicles are driving at excessive speeds for the area.***				
Independent variable type	**Independent variable description**	**Statistically significant relationship, based on odds ratio**		
Characteristics of the area	Distance from road centre to houses	Those from an area where the distance from house to road was shortest are…	3.9 x **less**	likely than those from areas where the distance was medium or long…
Characteristics of the area	Index of Multiple Deprivation (IMD)	Those from an area with a lower IMD score (less deprived) are…	3.2 x **more**	likely than those from areas with higher IMD scores (more deprived)…
Characteristics of the area	Road width	Those from an area where roads were narrow are…	2.0 x **less**	likely than those from areas with medium or wide roads…
Characteristics of the area	Greenspace	Those from an area with a low amount of greenspace are…	1.6 x **more**	likely than those from other areas with medium or high greenspace…
Socio-demographic characteristics	Number of cars	Those with one car per household are…	1.5 x **more**	likely than those with any other amount of cars…
Characteristics of the area	Index of Multiple Deprivation (IMD)	Those from an area with a medium IMD score are…	1.3 x **more**	likely than those from areas with higher IMD scores (more deprived)…

Note – As highlighted in Section 5, Models 5 to 8 have quite low goodness of fit (rho-squared) statistics.

9.3 Assessment of hypotheses (Do 20mph speed limits achieve their objectives relating to speed?)

Hypothesis		Drivers	Residents	Overall assessment
Respondent characteristics				
	Variation in perceptions of speed outcomes across gender-age-affluence groups *Not of direct relevance to this Research Question, but kept in (following suggestion from DfT) for consistency and to control for any effects upon the dependent variables.*	*Drivers aged 35-59 more likely than other age groups to agree that the average speed of vehicles has reduced and fewer vehicles are driving at excessive speeds.* *Perceptions also found to vary by level of deprivation.* *Other variables (gender, car ownership) not significant.*	*Residents aged 17-34 and 35-59 more likely than those aged 60+ to agree that the average speed of vehicles has reduced and fewer vehicles are driving at excessive speeds.* *Residents with one car per household, more likely than those with none or two+, to agree that the average speed of vehicles has reduced.* *Perceptions also found to vary by level of deprivation.*	*Results suggest that perceptions vary by age, with drivers and residents aged 35-59 most likely to perceive speeds to have reduced.* *There is also some variation in perceptions amongst those with different car ownership and from areas with different levels of deprivation.*
Characteristics of area				
i	Positive speed outcomes occur where the roads are narrow, the distance from the road to the houses is small, and there is limited open space.	*No significant relationship between road width and likelihood of agreeing that the average speed of vehicles has reduced, or that fewer vehicles are driving at excessive speeds.*	*NO. Residents in areas with narrow roads are less likely to agree that the average speed of vehicles has reduced, or that fewer vehicles are driving at excessive speeds.*	*INCONCLUSIVE. Overall results for both drivers and residents are inconclusive, with some conflicting findings for both groups.* *<u>Change in average speed</u>* *Drivers who agreed that the average speed of vehicles has reduced, were more likely to be from areas with a small or large (rather than moderate) road centre-house distance (partially supporting the hypothesis). But, the results show no significant variation by road width or amount of open space.* *Residents who agreed that the average speed of vehicles has reduced, were less likely to be from areas with narrow roads or short road centre-house distances (contradicting the hypothesis); but were more likely to be from areas with limited green space (supporting the hypothesis).* *<u>Change in excessive speeding</u>* *Drivers who agreed that fewer vehicles are driving at excessive speeds, were more likely to be from*
		YES (partially). Drivers in areas where the distance from road to house is moderate were less likely to agree that the average speed of vehicles has reduced. *NO. Drivers in areas where the distance from road to house is short or moderate were less likely to agree that fewer vehicles are driving at excessive speeds.*	*NO. Residents in areas where the distance from road to house is shorter are less likely to agree that the average speed of vehicles has reduced, or that fewer vehicles are driving at excessive speeds.*	
		No significant relationship between amount of open space and likelihood of agreeing that the average speed of vehicles has reduced. *YES. But drivers in areas with limited green space were more likely to agree*	*YES. Residents in areas with limited green space were more likely to agree that the average speed of vehicles has reduced, and more likely to agree that fewer vehicles are driving at excessive speeds.*	

		that fewer vehicles are driving at excessive speeds.		*areas with a larger road centre-house distance (contradicting the hypothesis), or with limited green space (supporting the hypothesis). However, the results show no significant variation by road width.* *Residents who agreed that fewer vehicles are driving at excessive speeds, were less likely to be from areas with narrow roads or short road centre-house distances (contradicting the hypothesis); but were more likely to be from areas with limited green space (supporting the hypothesis).* *<u>Additional comments</u>* *As highlighted in previous sections, the influence of the road environment is likely to reflect a combination of these factors, and other environmental variables, which cannot easily be captured in this type of regression analysis.* *In addition, it should be noted that the above characteristics are represented by one value for each case study, so the results may reflect other locational differences, rather than just the above factors.*
ii	Positive speed outcomes occur where there are schools or high pedestrian activity (e.g. retail, leisure).	*Tested variable (land use) not significant.*	*Tested variable (land use) not significant.*	*Tested variable not significant. No evidence to support this hypotheses.*

9.4 Summary of findings

Drivers who were more likely to agree the average speed of vehicles had reduced, were likely to be from less deprived areas and aged 35-59, with **residents** also more likely to be from less deprived areas, aged 17-59, have one car per household and live in an area where roads were wider, greenspace was lower and the distance from house to road was longer.

Those agreeing that less vehicles were driving at excessive speeds were similar to those agreeing that the average speed of vehicles had reduced. **Drivers** who agreed that less vehicles were driving at excessive speeds were most likely not to be from an area with a medium IMD score, between the ages of 35-59 and live in an area with low amounts of greenspace where the distance from road to house was long. However, **residents** were more likely to be from an area with a low or medium IMD score, with wide roads and long distances between houses and the road. They were also likely to have one car per household and live in an area with a low amount of greenspace.

10. Q7b: Do 20mph speed limits achieve their objectives and other wider outcomes? – Perceptions of environment and safety (for walking and cycling)

10.1 Purpose of the regression analysis

To examine whether there is an association between perceived changes speed and perceptions about the attractiveness of the area (environment and safety) for walking and cycling, as assumed in the logic map. The analysis also looks at whether perceptions about the environment vary by respondent type and in different types of areas. These factors can be viewed as potentially having a moderating impact on the main logic map process, however, it was agreed that they should be modelled as separate independent variables rather than as an interaction variable.

Two dependent variables are modelled, to capture different aspects of the environment:

- The introduction of the 20mph limit provides a safer environment for walking and cycling (Agree / Strongly agree).
- The introduction of the 20mph limit provides a more pleasant environment for walking and cycling (Agree / Strongly agree).

The model relates to residents only, as the dependent variables were not collected for drivers.

10.2 Statistically significant independent variables, based on odds ratio

The tables below identify the statistically significant independent variables, based on odds ratios. Those variables which have a bigger impact are presented first.

Model 9 – The introduction of the 20mph limit provides a more pleasant environment for walking and cycling (Residents).

Residents ***…to agree that the introduction of the 20mph limit provides a more pleasant environment for walking and cycling.***				
Independent variable type	**Independent variable description**	**Statistically significant relationship, based on odds ratio**		
Attitudinal	'Less vehicles are driving at excessive speeds for the area'	Those who 'agree' are…	4.2 x **more**	likely than those who do not 'agree'…
Characteristics of the area	Road width	Those from an area where roads were narrow are…	3.7 x **less**	likely than those from other areas with medium or wide roads…
Characteristics of the area	Greenspace	Those from an area with a medium amount of greenspace are…	2.3 x **less**	likely than those from other areas with low or high greenspace…
Characteristics of the area	Index of Multiple Deprivation (IMD)	Those from an area with a lower IMD score (less deprived) are…	2.2 x **less**	likely than those from areas with higher IMD scores (more deprived)…
Characteristics of the area	Land use	Those from an area where land use was mixed are…	2.1 x **less**	likely than those from other areas…
Characteristics of the area	Distance from road centre to houses	Those from an area where the distance from house to road was shortest are…	1.8 x **more**	likely than those from areas where the distance was longest…
Attitudinal	'The average speed of vehicles has reduced'	Those who 'agree' are…	1.8 x **more**	likely than those who do not 'agree'…
Characteristics of the area	Distance from road centre to houses	Those from an area where the distance from house to road was of medium length are…	1.8 x **less**	likely than those from areas where the distance was longest…

Model 10 – The introduction of the 20mph limit provides a safer environment for walking and cycling (Residents).

Residents ***…to agree that the introduction of the 20mph limit provides a safer environment for walking and cycling.***				
Independent variable type	**Independent variable description**	**Statistically significant relationship, based on odds ratio**		
Attitudinal	'Less vehicles are driving at excessive speeds for the area'	Those who 'agree' are…	4.0 x **more**	likely than those who do not 'agree'…
Characteristics of the area	Road width	Those from an area where roads were narrow are…	3.9 x **less**	likely than those from other areas with medium or wide roads…
Characteristics of the area	Index of Multiple Deprivation (IMD)	Those from an area with a lower IMD score (less deprived) are…	3.4 x **less**	likely than those from areas with higher IMD scores (more deprived)…
Attitudinal	'The average speed of vehicles has reduced'	Those who 'agree' are…	2.8 x **more**	likely than those who do not 'agree'…
Characteristics of the area	Greenspace	Those from an area with a medium amount of greenspace are…	2.3 x **less**	likely than those from other areas with low or high greenspace…
Characteristics of the area	Distance from road centre to houses	Those from an area where the distance from house to road was of medium length are…	2.3 x **less**	likely than those from areas where the distance was longest…
Characteristics of the area	Distance from road centre to houses	Those from an area where the distance from house to road was shortest are…	2.3 x **more**	likely than those from areas where the distance was longest…
Characteristics of the area	Land use	Those from an area where land use was mixed are…	2.2 x **less**	likely than those from other areas…
Characteristics of the area	Index of Multiple Deprivation (IMD)	Those from an area with a medium IMD score are…	3.4 x **less**	likely than those from areas with higher IMD scores (more deprived)…

10.3 Assessment of hypotheses (Do 20mph speed limits achieve their objectives relating to perceptions of environment and safety for walking and cycling?)

Hypothesis		Residents
Respondent characteristics		
i	Perceptions are more positive amongst certain gender-age-affluence groups	*YES. Among more deprived groups.* *Residents living in moderate / highly deprived (Model 9) or highly deprived areas (Model 10) were more likely to agree that the introduction of the 20mph limit had provided a more pleasant environment and safer environment for walking and cycling.*
Characteristics of Area		
ii	Positive perceptions of quality and safety of the environment for walking and cycling occur where the roads are narrow, the distance from the road to the houses is small, and there is limited open space.	*INCONCLUSIVE. Overall results are inconclusive.* *NO. In terms of road width. Residents living in areas with narrow roads were less likely to have positive perceptions about the quality of the environment (Models 9+10).* *YES. In terms of distance from road to house. Residents living in areas with short distances were more likely to have positive perceptions. Although, residents living in areas with medium distances were less likely to have positive perceptions than those living in areas with long distances.* *INCONCLUSIVE. In terms of open space. Residents living in areas with a medium amount of green space were less likely (than those with more or less green space) to have positive perceptions about the quality of the environment (Models 9+10).* *As highlighted in previous sections, the influence of the road environment is likely to reflect a combination of these factors, and other environmental variables, which cannot easily be captured in this type of regression analysis.*
iii	Reduction in (perceived) average and excessive speeds leads to positive perceptions about the quality and safety of the environment for walking and cycling	*YES* *Residents who agree that the average speed of vehicles has reduced, or that fewer vehicles are driving at excessive speeds, are more likely to have positive perceptions about the quality of the environment for walking and cycling (Models 9+10).*
Behavioural / attitudinal statements		
iv	Positive perceptions of quality and safety of the environment for walking and cycling occur where there are schools or high pedestrian activity (e.g. retail, or leisure)	*NO* *Those living in mixed land use (residential/retail/leisure and business areas) were less likely to have positive perceptions about the quality of the environment for walking and cycling agree (Models 9+10).*

There is a high level of similarity between the results for Models 9 and 10.

10.4 Summary of findings

Models 9 and 10 show how **drivers and residents** who agree that less vehicles are driving at excessive speeds for the area and that the average speed of vehicles has reduced, are more likely to agree the 20mph limit provides both a safer and a more pleasant environment for walking and cycling.

The demographics of **residents** who agree with both of the above statements in the models are very similar, being less likely to live on a narrow road where the distance from house to road is short in less deprived areas.

The models suggest **residents** feel a reduction in the speed of vehicles leads to a safer and more pleasant environment for both walking and cycling.

11. Q7c: Do 20mph speed limits achieve their objectives and other wider outcomes? – Mode shift

11.1 Purpose of the regression analysis

To examine whether there is an association between perceptions about the attractiveness of the area for walking and cycling, and the likelihood of walking and cycling, as assumed in the logic map. The analysis also looks at whether likelihood of walking and cycling varies by respondent type and in different types of areas. These factors can be viewed as potentially having a moderating impact on the main logic map process, however, it was agreed that they should be modelled as separate independent variables rather than as an interaction variable.

Two dependent variables are modelled, to capture different aspects of the environment:

- Keeping traffic below 20mph makes it more likely that I will walk to local places rather than use the car (Agree / Strongly agree).
- Keeping traffic below 20mph makes it more likely I will cycle to local places rather than use the car (Agree / Strongly agree).

The model relates to residents only, as the dependent variables were not collected for drivers.

11.2 Statistically significant independent variables, based on odds ratio

The tables below identify the statistically significant independent variables, based on odds ratios. Those variables which have a bigger impact are presented first.

Model 11 – Keeping traffic below 20mph makes it more likely that I will walk to local places rather than use the car (Residents).

Residents ***…to agree that keeping traffic below 20mph makes it more likely they will walk to local places rather than use the car.***				
Independent variable type	**Independent variable description**	**Statistically significant relationship, based on odds ratio**		
Characteristics of the area	Road width	Those from an area where roads were narrow are…	34.5 x **less***	likely than those from areas where roads are widest…
Characteristics of the area	Distance from road centre to houses	Those from an area where the distance from house to road was shorter are…	3.2 x **less**	likely than those from areas where the distance was longer…
Characteristics of the area	Road width	Those from an area where roads were of medium width are…	3.1 x **less**	likely than those from areas where roads are widest…
Attitudinal	'The 20mph limit provides a safer environment for walking and cycling'	Those who 'agree' are...	2.3 x **more**	likely than those who do not 'agree'...
Characteristics of the area	Distance from road centre to houses	Those from an area where the distance from house to road was of middle length are…	2.1 x **less**	likely than those from areas where the distance was longest…
Characteristics of the area	Land use	Those from an area where land use was mixed are…	1.8 x **more**	likely than those from other areas…
Attitudinal	'Less vehicles are driving at excessive speeds for the area'	Those who 'agree' are…	1.6 x **more**	likely than those who do not 'agree'…
Characteristics of the area	Casualties	If the number of casualties per KM of road goes up by 1, the odds of them walking if traffic is below 20mph goes up by a factor of 3.2 (320%).		

**Note – Results double checked as odds ratio is very high. Tested correlation against the dependant variable, in case this was influencing results, but found that the correlation was not significant (0.086).*

Model 12 – Keeping traffic below 20mph makes it more likely I will cycle to local places rather than use the car (Residents).

Residents ***…to agree that keeping traffic below 20mph makes it more likely they will cycle to local places rather than use the car.***				
Independent variable type	**Independent variable description**	**Statistically significant relationship, based on odds ratio**		
Socio-demographic characteristics	Age 17-34	Those aged 17-34 are…	3.1 x **more**	likely than people aged 60+…
Characteristics of the area	Distance from road centre to houses	Those from an area where the distance from house to road was of middle length are…	2.9 x **more**	likely than those from areas where the distance was short or longest…
Attitudinal	'Less vehicles are using this street since the introduction of the 20mph limit'	Those who 'agree' are…	2.1 x **less**	likely than those who do not 'agree'…
Socio-demographic characteristics	Age 35-59	Those aged 35-59 are…	1.8 x **more**	likely than people aged 60+…

11.3 Assessment of hypotheses (Do 20mph speed limits achieve their objectives relating to mode shift?)

Hypothesis		**Residents**
Respondent characteristics		
i	Levels of mode shift are higher amongst certain gender-age-affluence groups.	*No significant variations in terms of propensity to walk (Model 11).* *YES. In terms of propensity to cycle. Those aged 17-34 and 35-59 are more likely than those aged 60+ to agree that keeping traffic below 20mph makes it more likely they will cycle to local places rather than use the car. (Model 12)*
Characteristics of area		
ii	Positive mode shift outcomes occur where there are schools or high pedestrian activity (e.g. retail, or leisure).	*YES. Those living in mixed land use areas were more likely (than those in other areas) to agree that keeping traffic below 20mph makes it more likely they will walk to local places rather than use the car. (Model 11)*
iii	Positive mode shift outcomes occur where the roads are narrow the distance from the road to the house is small and there is limited open space	*Propensity to walk NO.* *NO. In terms of road width. Residents living in areas with narrow or medium width roads were less likely to consider walking.* *NO. In terms of distance from road to house. Residents living in areas with short and medium distances were less likely to consider walking.* *Open space was not significant in terms of propensity to walk.* *Propensity to cycle INCONCLUSIVE* *Road width was not significant in terms of propensity to cycle.* *INCONCLUSIVE. In terms of distance from road to house and propensity to cycle. Residents living in areas with medium distances were more likely to consider cycling than those other areas.* *Open space was not significant in terms of propensity to cycle.*
iv	Positive mode shift outcomes are higher in areas where there are a high proportion of children living.	*NO* *Tested variable (proportion under 17) was not significant.*
v	Positive mode shift outcomes are higher in areas where there are higher levels of (before) accidents	*YES. In terms of propensity to walk. The level of (before) accidents have a very high positive impact on propensity to walk. Propensity to walk is higher in areas with higher levels of (before) casualties.*

		Accident rate was not found to be a significant variable in terms of propensity to cycle.
Behavioural / attitudinal statements		
vi	Positive mode shift is higher in areas where positive outcomes are perceived to have been delivered.	*<u>Traffic volume outcomes</u>* *No significant relationships were identified for propensity to walk.* *NO. In terms of propensity to cycle. Residents who agree that there less vehicles using this street since the introduction of the 20mph limit, are less likely to consider cycling.* *<u>Speed</u>* *YES. In terms of propensity to walk. Residents who agree that there are less vehicles driving at excessive speed, are more likely to consider walking.* *No significant relationships were identified for propensity to cycle.* *<u>Perceptions of environment and safety</u>* *YES. In terms of propensity to walk. Residents who agree that the 20mph limit provides a safer environment for walking and cycling, are more likely to consider walking.* *No significant relationships were identified for propensity to cycle.* *<u>Driver assessment of risk</u>* *Tested variable not significant. No evidence to support this hypotheses.*

11.4 Summary of findings

Model 11 indicates that **residents** who live in an area where the roads are narrow are far less likely to agree that keeping traffic below 20mph makes it more likely they will cycle to local places rather than use the car. Characteristics of the area, especially road width and distance from house to road, have a significant impact on **residents** likelihood to walk instead of use a car following the introduction of the 20mph limit, with those on narrower streets and in areas where the distance from house to road is shorter being less likely to do so. Safety is also an influencing factor, with those who agree that the limit provides a safer environment for walking and cycling 2.3x more likely to walk than use the car.

Model 12 shows that **residents** under the age of 60 are more likely to cycle instead of use the car than those over the age of 60.

12. Q7d: Do 20mph speed limits achieve their objectives and other wider outcomes? – Driver assessment of risk

12.1 Purpose of the regression analysis

To understand how perceived changes in driver assessment of risk vary amongst different respondents and in different types of areas.

Residents and drivers modelled separately.

12.2 Statistically significant independent variables, based on odds ratio

The tables below identify the statistically significant independent variables, based on odds ratios. Those variables which have a bigger impact are presented first.

Model 13 – The 20mph limit increases drivers' awareness of potential risks and hazards (e.g. cyclists, children playing) (Drivers).

Drivers ***…to agree that the 20mph limit increases drivers' awareness of potential risks and hazards.***				
Independent variable type	**Independent variable description**	**Statistically significant relationship, based on odds ratio**		
Attitudinal	'Less vehicles are driving at excessive speeds for the area'	Those who 'agree' are…	3.0 x **more**	likely than those who 'do not agree'…
Attitudinal	'The average speed of vehicles has reduced'	Those who 'agree' are…	2.2 x **more**	likely than those who 'do not agree'…
Characteristics of the area	Road width	Those from an area where roads were of medium width are…	1.8 x **more**	likely than those from other areas with short and wide roads…
Characteristics of the area	Land use	Those from an area where land use was mixed are…	1.6 x **less**	likely than those from other areas…
Characteristics of the area	Index of Multiple Deprivation (IMD)	Those from an area with a lower IMD score (less deprived) are…	1.4 x **less**	likely than those from areas with higher IMD scores (more deprived)…

Model 14 - The 20mph limit increases drivers' awareness of potential risks and hazards (e.g. cyclists, children playing) (Residents).

Residents ***…to agree that the 20mph limit increases drivers' awareness of potential risks and hazards.***				
Independent variable type	**Independent variable description**	**Statistically significant relationship, based on odds ratio**		
Characteristics of the area	Distance	Those from an area where the distance from house to road was shortest are…	4.7 x **more**	likely than those from areas where the distance was longest…
Attitudinal	'Less vehicles are driving at excessive speeds for the area'	Those who 'agree' are…	4.3 x **more**	likely than those who 'do not agree'…
Attitudinal	'The average speed of vehicles has reduced'	Those who 'agree' are…	4.0 x **more**	likely than those who 'do not agree'…
Characteristics of the area	Greenspace	Those from an area with a medium amount of greenspace are…	3.2 x **less**	likely than those from other areas with low or high greenspace…
Characteristics of the area	Distance	Those from an area where the distance from house to road was of middle length are…	2.7 x **more**	likely than those from areas where the distance was longest…
Characteristics of the area	IMD	Those from an area with a medium score are…	2.1 x **more**	likely than those from areas with higher IMD scores (more deprived)…
Characteristics of the area	Road width	Those from an area where roads were of medium width are…	1.9 x **more**	likely than those from other areas with narrow and wide roads…

12.3 Assessment of hypotheses (Do 20mph speed limits achieve their objectives relating to driver assessment of risk?)

Hypothesis		Drivers	Residents	Overall Assessment
Respondent characteristics				
i	Risk and hazard awareness is greater among drivers of certain gender-age-affluence groups	*YES among those in less deprived (low IMD) areas less likely to agree that the 20mph limit increases drivers' awareness of potential risks and hazards.* *Other variables (gender, age, car ownership) not significant.*	*INCONCLUSIVE. Those from moderately deprived (medium IMD) areas are more likely to agree that the 20mph limit increases drivers' awareness of potential risks and hazards.* *Other variables (gender, age, car ownership) not significant.*	*YES (partially). The results show higher levels of agreement amongst drivers in more deprived areas. However, other variables were not significant.* ***Age** was not found to be a significant factor in either dataset.*
Characteristics of Area				
ii	Risk and hazard awareness is greater where there are schools or high pedestrian activity (eg retail or leisure)	*NO. Drivers in areas with mixed land use were less likely to agree that the 20mph limit increases drivers' awareness of potential risks and hazards.*	*Tested variable (land use) not significant.*	*No evidence to support this hypotheses.*
iii	Risk and hazard awareness is greater where the roads are narrow, the distance from the road to houses is small and there is limited open space	*INCONCLUSIVE. In terms of road width.* *Drivers in areas where roads are medium width (as opposed to narrow or wide) are more likely to agree.*	*INCONCLUSIVE. In terms of road width.* *Residents in areas where roads are medium width (as opposed to narrow or wide) are more likely to agree.*	*INCONCLUSIVE. Overall results are inconclusive.*
		Distance from road to house not found to be a significant variable.	*YES. Residents in areas where distance from road to house is short or medium are more likely to agree.*	
		Open space not found to be a significant variable.	*INCONCLUSIVE. In terms of open space.* *Residents in areas with medium green space are less likely to agree.*	
iv	Risk and hazard awareness is greater where there is adequate signage.	*Tested variable not significant.*	*Tested variable not significant.*	*Tested variable not significant. No evidence to support this hypotheses.*

Behavioural / attitudinal statements				
v	Risk and hazard awareness is greater in areas where speeds are perceived to have reduced	*YES.* *Drivers who agree 'less vehicles are driving at excessive speed' and 'average speed has reduced' were more likely to agree that the 20mph limit increases drivers' awareness of potential risks and hazards.*	*YES.* *Residents who agree 'less vehicles are driving at excessive speed' and 'average speed has reduced' were more likely to agree that the 20mph limit increases drivers' awareness of potential risks and hazards.*	*YES.* *Both drivers and residents who agree 'less vehicles are driving at excessive speed' and 'average speed has reduced' were more likely to agree that the 20mph limit increases drivers' awareness of potential risks and hazards.*

12.4 Summary of findings

Both **drivers and residents** who felt fewer vehicles were driving at excessive speeds and the average speed of vehicles had reduced were more likely to agree that the 20mph limit in creases drivers' awareness of potential risks and hazards. Respondents who agreed were more likely to be either **drivers** who were in a more deprived area where roads were of medium width and where the land use was not mixed, or **residents** from an area where the distance from road to house was not long and where the roads were of medium width.

14. Q9: Do outcomes of 20mph speed limits vary according to road type?

14.1 Purpose of the regression analysis

To understand how outcomes vary according to road type.

14.2 Assessment of hypotheses

The impact of road type on compliance, speeds, perceptions of the environment for walking and cycling, mode shift, driver assessment of risk, and avoidance of 20mph limit roads is assessed elsewhere in this report. However, the findings are re-presented below for ease of reference.

Hypothesis		Overall Assessment
Compliance		
i	Levels of compliance are higher in areas where the roads are narrow, the distance from the road to the houses is small (narrow verges / short gardens), and there is limited open space – creating a confined environment.	*INCONCLUSIVE. Overall results for both drivers and residents are inconclusive, with some conflicting findings for both groups.* *Compliance amongst drivers is associated with areas with limited green space (as hypothesized), but not narrow road widths or narrow verges / short gardens.* *Compliance amongst residents (who drive) is associated with narrow or medium width roads, but not narrow verges / short gardens or limited open space.*
Speed outcomes		
ii	Positive speed outcomes occur where the roads are narrow, the distance from the road to the houses is small, and there is limited open space.	*INCONCLUSIVE. Overall results for both drivers and residents are inconclusive, with some conflicting findings for both groups.* *Change in average speed* *Drivers who agreed that the average speed of vehicles has reduced, were more likely to be from areas with a small or large (rather than moderate) road centre-house distance (partially supporting the hypothesis). But, the results show no significant variation by road width or amount of open space.* *Residents who agreed that the average speed of vehicles has reduced, were less likely to be from areas with narrow roads or short road centre-house distances (contradicting the hypothesis); but were more likely to be from areas with limited green space (supporting the hypothesis).* *Change in excessive speeding* *Drivers who agreed that fewer vehicles are driving at excessive speeds, were more likely to be from areas with a larger road centre-house distance (contradicting the hypothesis), or with limited green space (supporting the hypothesis). However, the results show no significant variation by road width.* *Residents who agreed that fewer vehicles are driving at excessive speeds, were less likely to be from areas with narrow roads or short road centre-house distances (contradicting the hypothesis); but were more likely to be from areas with limited green space (supporting the hypothesis).*
Perceptions of environment and safety for walking and cycling		
iii	Positive perceptions of quality and safety of the environment for walking and cycling occur where the roads are narrow, the distance from the road to the houses is small, and there is limited open space.	*INCONCLUSIVE. Overall results are inconclusive.* *NO. In terms of road width. Residents living in areas with narrow roads were less likely to have positive perceptions about the quality of the environment (Models 9+10).* *YES. In terms of distance from road to house. Residents living in areas with short distances were more likely to have positive perceptions. Although, residents living in areas with medium distances were less likely to have positive perceptions than those living in areas with long distances.* *INCONCLUSIVE. In terms of open space. Residents living in areas with a medium amount of green space were less likely (than those with more or less green space) to have positive perceptions about the quality of the environment (Models 9+10).*

Mode shift		
iv	Positive mode shift outcomes occur where the roads are narrow the distance from the road to the house is small and there is limited open space	*Propensity to walk* *NO.* *NO. In terms of road width. Residents living in areas with narrow or medium width roads were less likely to consider walking.* *NO. In terms of distance from road to house. Residents living in areas with short and medium distances were less likely to consider walking.* *Open space was not significant in terms of propensity to walk.* *Propensity to cycle* *INCONCLUSIVE* *Road width was not significant in terms of propensity to cycle.* *INCONCLUSIVE. In terms of distance from road to house and propensity to cycle. Residents living in areas with medium distances were more likely to consider cycling than those other areas.* *Open space was not significant in terms of propensity to cycle.*
Driver assessment of risk		
v	Risk and hazard awareness is greater where the roads are narrow, the distance from the road to houses is small and there is limited open space	*INCONCLUSIVE. Overall results are inconclusive.*
Effect on traffic volumes within the scheme itself and on neighbouring roads		
vi	Decrease in vehicle presence higher where the roads are narrow, the distance from the road to the houses is small, and there is limited open space	*INCONCLUSIVE. In terms of roadwidth.* *In areas where roads are medium width (as opposed to narrow or wide), drivers are less likely to avoid driving/ riding through 20mph street.* *NO. In terms of distance from road to houses.* *In areas where the distance from road to houses is shorter, drivers are less likely to avoid driving/ riding through 20mph street.* *Open space not found to be a significant variable.*

14.3 Summary of findings

In general, the evidence is inconclusive.

As highlighted in other sections, the influence of the road environment is likely to reflect a combination of road width, distance to houses, open space and other environmental variables, which cannot easily be captured in this type of regression analysis.

In addition, it should be noted that the above characteristics are represented by one value for each case study, so the results may reflect other locational differences, rather than just the above factors.

15. Q12: What effect is there on traffic volumes within the scheme itself and on neighbouring roads?

15.1 Purpose of the regression analysis

To test for association between route choice and driver frustration (assumed in logic map); and to understand how route choice varies amongst different respondents and different types of areas.

Data modelled for drivers only. Dependent variable not collected for residents.

15.2 Statistically significant independent variables, based on odds ratio

The tables below identify the statistically significant independent variables, based on odds ratios. Those variables which have a bigger impact are presented first.

Model 15 – I avoid driving/ riding on this street/ in this area if possible since the introduction of 20mph limits (Drivers).

Drivers ***…to avoid driving/ riding on this street/ in this area if possible since the introduction of the 20mph limit.***				
Independent variable type	**Independent variable description**	**Statistically significant relationship, based on odds ratio**		
Characteristics of the area	Distance from road to house	Those from an area where the distance from house to road was shortest are…	4.3 x **less**	likely than those from areas where the distance was medium or long
Attitudinal	'20mph is frustrating for drivers'	Those who 'agree' are…	3.8 x **more**	likely than those who 'do not agree'…
Characteristics of the area	Index of Multiple Deprivation	Those from an area with a lower IMD score (less deprived) are…	3.7 x **more**	likely than those from areas with higher IMD scores (more deprived)…
Characteristics of the area	Road width	Those from an area where roads were of medium width are…	3.2 x **less**	likely than those from other areas with narrow or wide roads…
Characteristics of the area	Land use	Those from an area where land use was mixed are…	2.4 x **less**	likely than those from other areas…

15.3 Assessment of hypotheses (What effect is there on traffic volumes within the scheme itself and on neighbouring roads?)

Hypothesis		Drivers
Respondent characteristics		
i	Decrease in vehicle presence (due to avoidance of 20mph limit) higher amongst certain affluence groups.	*YES Among those in less deprived (Low IMD) areas. Drivers in lower IMD (less deprived) areas, more likely to avoid driving/ riding through 20mph street.* *Other variables (gender, age, car ownership) not significant.*
Characteristics of area		
ii	Greater decrease in vehicle presence higher where there are schools or high pedestrian activity (e.g. retail, or leisure).	*NO. Drivers in areas where land use is mixed, are less likely to avoid driving/ riding through 20mph street.*
iii	Decrease in vehicle presence higher where the roads are narrow, the distance from the road to the houses is small, and there is limited open space	*INCONCLUSIVE. In terms of roadwidth.* *In areas where roads are medium width (as opposed to narrow or wide), drivers are less likely to avoid driving/ riding through 20mph street.*
		NO. In terms of distance from road to houses. *In areas where the distance from road to houses is shorter, drivers are less likely to avoid driving/ riding through 20mph street.*
		Open space not found to be a significant variable.
Behavioural / attitudinal statements		
iv	Association between route choice and driver frustration	*POSITIVE ASSOCIATION. Those who agree 20mph is frustrating for drivers are more likely to avoid driving/ riding through 20mph street.*

15.4 Summary of findings

Drivers who find the limit frustrating are far more likely to avoid driving in the 20mph area than those who don't find it frustrating, as are those from a less deprived area. Also less likely to avoid if distance from house to road is shorter or roads are medium width or land use is mixed.

Appendix A – Correlation between dependent variables

Appendix A: Correlation between dependent variables

Table 1 All Data

Model	Dependant Variable Description	Dependant variable number	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Q6-1	Should have 20mph	1	1														
Q6-2	Change back to 30mph	2	-.579**	1													
Q5-1	Likely to drive at/ below speed limit	3	.084**	-.051**	1												
Q5-2	Likely to drive slower	4	.167**	-.116**	.239**	1											
Q5-3	Comply with 20mph most of time	5	.117**	-.061**	.307**	.621**	1										
Q7A-1 & Q9-1	Average speed of vehicles reduced	6	.170**	-.112**	.061**	.186**	.106**	1**									
Q7A-2 & Q9-2	Less driving at excessive speed	7	.188**	-.127**	.074**	.182**	.113**	.658**	1**								
Q7B-1	Safer environment to walk and cycle	8	.225**	-.234**	-.299**	-.027	-.121**	.154**	.159**	1							
Q7B-2	More pleasant environment to walk and cycle	9	.231**	-.237**	-.267**	-.014	-.101**	.160**	.183**	.842**	1						
Q7B-3	Beneficial walk and cycle	10	.273**	-.284**	-.334**	-.056**	-.203**	.117**	.124**	.828**	.750**	1					
Q7C-1	Safer for cyclists and pedestrians	11	.114**	-.120**	-.111**	-.025	-.108**	.139**	.128**	.350**	.371**	.314**	1				
Q7C-2	More people cycling	12	.111**	-.109**	-.107**	-.015	-.090**	.124**	.108**	.314**	.334**	.299**	.686**	1			
Q7C-3	More likely to walk than use car	13	.085**	-.089**	-.113**	.128**	.014	.066**	.071**	.249**	.241**	.263**	.170**	.194**	1		
Q7D	Increased awareness	14	.252**	-.186**	.167**	.232**	.181**	.354**	.359**	.124**	.140**	.099**	.071**	.071**	.052**	1	
Q12	Less vehicles using the street	15	.040*	.003	.037*	.056**	.021	.265**	.234**	.049**	.053**	.044**	.123**	.097**	.049**	.104**	1

**. Correlation is significant at the 0.01 level (2-tailed).

*. Correlation is significant at the 0.05 level (2-tailed).

High correlations between the dependent variables for

Q5 - likely to drive slower and comply with 20mph most of time

Q7A/Q9 (same dependent variables) - average speed of vehicles reduced and less driving at excessive speed

Q7B safer environment for walking & cycling and more pleasant environment for walking & cycling and beneficial for walkers & cyclists

Q7C safer for cyclists & pedestrians and more people cycling

Table 2 Correlation Between Dependent Variables – Drivers Data

Model	Dep Var description	Dep Var	Dvno	1	2	3	4	5	6	7	14	15
Q6-1	should have 20mph	DepXqa2L	1	1								
Q6-2	change back to 30mph	ChngBack	2	-.652**	1							
Q5-1	likely to drive at/below speed limit	drvbelow	3	.206**	-.205**	1						
Q5-2	likely to drive slower	drvslow	4	.296**	-.297**	.234**	1					
Q5-3	comply with 20mph most pf time	drvcomply	5	.370**	-.387**	.254**	.418**	1				
Q7A-1 & Q9-1	av speed of vcls reduced	DepXqc1b	6	.150**	-.107**	.086**	.234**	.118**	1*			
Q7A-2 & Q9-2	less driving at excessive speed	DepXqc1c	7	.183**	-.142**	.107**	.251**	.129**	.637**	1*		
Q7D	increased awareness	DepXqc1f	14	.378**	-.311*	.190**	.265**	.247**	.255**	.284**	1	
Q12	Less vcls using street	Xqc1aAgre	15	-0.008	.077**	0.048	0.042	0.035	.243**	.183**	0.033	1
		**. Correlation is significant at the 0.01 level (2-tailed).										
		*. Correlation is significant at the 0.05 level (2-tailed).										

High correlations between the dependent variables for

Q6-1 should have 20mph and change back to 30mph (negative)

Q7A & Q9 av speed of vehicles reduced and less driving at excessive speed

Table 3 Correlation Between Dependent Variables – Residents Data

Model	Dep Var description	Dep Var	Dvno	1	2	4	5	6	7	8	9	10	11	12	13	14	15
Q6-1	should have 20mph	DepXqa2L	1	1													
Q6-2	change back to 30mph	ChngBack	2	-.507**	1												
Q5-2	likely to drive slower	drvslow	4	.119**	-.057*	1											
Q5-3	comply with 20mph most of time	drvcomply	5	.045*	0.014	.660**	1										
Q7A-1 & Q9-1	av speed of vcls reduced	DepXqc1b	6	.208**	-.148**	.161**	.090**	1**									
Q7A-2 & Q9-2	less driving at excessive speed	DepXqc1c	7	.211**	-.143**	.149**	.101**	.685**	1**								
Q7B-1	safer environ walk & cycle	Rqd3cAgr	8	.309**	-.266**	.160**	.162**	.293**	.310**	1							
Q7B-2	more pleasant env walk & cycle	Rqd3dAgr	9	.309**	-.273**	.151**	.147**	.283**	.327**	.765**	1						
Q7B-3	beneficial walk & cycle	Rqd3bAgr	10	.417**	-.367**	.147**	.075**	.255**	.279**	.707**	.612**	1					
Q7C-1	safer for cyclists & pedestrians	Rqd3eAgr	11	.135**	-.130**	0.028	-0.036	.200**	.188**	.273**	.301**	.221**	1				
Q7C-2	more people cycling	Rqd3fAgre	12	.131**	-.115**	0.039	-0.015	.179**	.161**	.231**	.261**	.207**	.669**	1			
Q7C-3	more likely to walk than use car	DepRqe1	13	.094**	-.082**	.233**	.129**	.101**	.110**	.137**	.139**	.146**	.123**	.150**	1		
Q7D	increased awareness	DepXqc1f	14	.241**	-.188**	.176**	.071**	.399**	.409**	.354**	.344**	.356**	.141**	.139**	.115**	1	
Q12	Less vcls using street	Xqc1aAgre	15	.088**	-.077**	.059**	-0.003	.277**	.276**	.103**	.102**	.106**	.178**	.140**	.074**	.132**	1
		**. Correlation is significant at the 0.01 level (2-tailed).															
		*. Correlation is significant at the 0.05 level (2-tailed).															

High correlations between the dependent variables for

Q5 likely to drive slower and comply with 20mph most of time

Q7A & Q9 average speed of vehicles reduced and less driving at excessive speed

Q7B safer environment for walking & cycling and more pleasant environment for walking & cycling and beneficial for walkers & cyclists

Q7C safer for cyclists & pedestrians and more people cycling

Appendix B – Hypothesis to be tested and associated dependent and independent variables

Appendix B: Hypotheses to be tested, and associated dependent and independent variables

Q6. Do drivers, residents and local workers support 20mph speed limits			
Dependent variable	**Respondent characteristics**	**Characteristics of area**	**Behaviour / attitudinal statements**
What is your overall view now on whether the street should have a 20mph speed limit? (B3, A3, A2). Xqa2	**Hypothesis: Levels of support are higher amongst certain gender-age-affluence groups.** Independent Variables to be tested: • *Respondent's Gender Xqd2, Age Xqf1, Car ownership Rqf7, Socio-Economic Group Rqf4, household income Rqf5, and Index of Multiple Deprivation for area.* **Hypothesis: Levels of support for case study scheme are higher amongst drivers who typically comply with speed limits.** Independent Variables to be tested: • *Driving style - How often do you:* - *Find yourself driving faster than you intend to. Xqf6a* - *Exceed the speed limit on a motorway by more than 10mph. Xqf6b* - *Exceed the speed limit on a 30mph road by more than 5mph. Xqf6c* - *Exceed the speed limit on a road with a 20mph limit by more than 5mph. Xqf6d* - *Exceed the speed limit on a road with a 20mph zone by more than 5mph. Xqf6e* **Hypothesis: Levels of support are higher amongst those who drive through the area on a regular basis** Independent Variables to be tested: • *How often do you drive/ride on this street? (Driver questionnaire only) (at least weekly, less often than weekly) Dqe4*	**Hypothesis: Levels of support are higher in areas where there are a high proportion of children living.** Independent Variables to be tested: • *Proportion aged < 17 (or number of children in household from residential data) – One value per case study area popunder17* **Hypothesis: Levels of support are higher in areas where the roads are narrow, the distance from the road to the houses is small, and there is limited open space.** Independent Variables to be tested: • *Road width (narrow, med, wide) – One value per case study area Roadwidth* • *Distance from road to house (short, medium, long) – One value per case study area Distance* • *Green spaces (10%, 25%, 50%, 75%) – One value per case study area Greenspace* **Hypothesis: Levels of support are higher in areas where there are schools or high pedestrian activity (e.g. retail, or leisure)** Independent Variables to be tested: • *Type of area: residential only (residential), school and residential (school) or residential, retail, leisure and business (mixed) – One value per case study area. Areas coded as 'school' contain a school within the sample area. Landuse*	**Hypothesis: Levels of support are higher in areas where there has been a higher level of consultation and engagement prior to implementation.[2]** Independent Variables to be tested: • *Before the 20mph speed limit was introduced to this street, do you recall receiving any information about this, for example, leaflets or letters saying why it was happening? Rqa1 * How well were the aims and objectives of the scheme presented? Rqa3* **Which attitudinal statements are associated with high and low levels of support?** Independent Variables to be tested: *Traffic volumes* • *There are less vehicles using this street (% agreeing). Xqc1a* *Speed* • *The average speed of vehicles has reduced (% agreeing). Xqc1b* • *Less vehicles are driving at excessive speeds for the area (% agreeing). Dqc1c, Xqc1c* *Perceptions of environment and safety* • *Drivers are more considerate to pedestrians (% agreeing). Rqd1_d* • *Drivers are more considerate to cyclists (% agreeing). Rqd1_e* • *It is safer to drive on this street / in this area since the intro of the 20mph limit (% agreeing). Dqc1d* • *The 20mph limit is beneficial for any cyclists*

		<u>Hypothesis:</u> Levels of support are higher in areas where there are higher levels of before accidents Independent Variables to be tested: • *Before accident data (six years prior to implementation) – Total casualties per road km (STATS19 data). Data provided by Atkins (see Note on Accident Data in Section 3 of report.* **<u>Hypothesis:</u> Levels of support are higher in areas where there are 20mph limits or zones nearby (Moved from respondent characteristics column)** Independent Variables to be tested: *20mph limits or zones nearby – One value per case study area (Coded based on site survey, if any other zones or limits or were seen in the vicinity of the survey area – 20mph limit nearby, 20mph zone nearby, or mix of 20mph limits and zones nearby). Widerarea*	*and pedestrians (% agreeing). Rqd3_b, Dqc2b, Dqc2c* • *The introduction of the 20mph limit provides a safer environment for walking and cycling (% agreeing). Rqd3_c* • *The introduction of the 20mph limit provides a more pleasant environment for walking and cycling (% agreeing). Rqd3_d* • *You see more children playing out since the introduction of the 20mph limit. Rqd4_a* • *Since the 20mph limit was introduced more people are generally out and about on the street than previously. Rqd4_b* • *The introduction of the 20mph speed limit on this street has made it a more desirable place to live. Rqd4_c* • *The street now provides a safer environment for children Rqd4_e* *<u>Driver assessment of risk</u>* • *The 20mph limit increases drivers' awareness of potential risks and hazards (e.g. cyclists, children playing) (% agreeing). Xqc1f* *<u>Mode shift</u>* • *You see more people walking on this street since the 20mph limit was introduced (% agreeing). Rqd3e* • *You see more people cycling on this street since the 20mph limit was introduced (% agreeing). Rqd3f* *<u>Impact on local economy</u>* • *The introduction of 20mph speed limit on this street means that people are less likely to use the local shops and amenities, as drivers are avoiding the 20mph limit (% agreeing). Rqd4_d*

Q5. Do drivers and riders comply with 20mph speed limits			
Dependent variable	**Respondent characteristics**	**Characteristics of area**	**Driver behaviour / attitudinal statements**
I comply with the 20mph speed limit most of the time on this street/ in this area (E1D, D2B, D1B). Xqd1b	**Hypothesis: Levels of compliance are higher amongst certain gender-age-affluence groups.** Independent Variables to be tested: • *Respondent's Gender Xqd2, Age Xqf1, Car ownership Rqf7, Socio-Economic Group Rqf4, household income Rqf5, and Index of Multiple Deprivation for area.* **Hypothesis: Levels of compliance in case study area are higher amongst drivers who typically comply with speed limits.** Independent Variables to be tested: • *Driving style - How often do you:* - *Find yourself driving faster than you intend to. Xqf6a* - *Exceed the speed limit on a motorway by more than 10mph. Xqf6b* - *Exceed the speed limit on a 30mph road by more than 5mph. Xqf6c* **Hypothesis: Levels of compliance are higher amongst those who drive through the area on a regular basis** • *How often do you drive/ride on this street? (Driver questionnaire only) (at least weekly versus less often than weekly-variable levels combined from 5 or more days a week, 2 to 4 days a week, once a week, less than once a week but more than once a month, once a month, less often) Dqe4*	**Hypothesis: Levels of compliance are higher in areas where there are a high proportion of children living.[2]** Independent Variables to be tested: • *Proportion aged < 17 (or number of children in household from residential data) – One value per case study area popunder17* **Hypothesis: Levels of compliance are higher in areas where the roads are narrow, the distance from the road to the houses is small, and there is limited open space. Most relevant.** Independent Variables to be tested: • *Road width (narrow, med, wide) – One value per case study area Roadwidth* • *Distance from road to house (short, medium, long) – One value per case study area Distance* • *Green spaces (10%, 25%, 50%, 75%) – One value per case study area Greenspace* **Hypothesis: Levels of compliance are higher in areas where there are schools or high pedestrian activity (e.g. retail, or leisure).** Independent Variables to be tested: • *Type of area residential only (residential), school and residential (school) or residential, retail, leisure and business (mixed) – One value per case study area. Areas coded as 'school' contain a school within the sample area. Landuse*	**Hypothesis: Levels of compliance are higher in areas where 20mph is seen an appropriate speed and levels of support are higher.** Independent Variables to be tested: • *What is your overall view now on whether the street should have a 20mph speed limit? Xqa2* • *20mph is an appropriate speed for this street (% agreeing). Xqa4d* *Above variables may be very strongly correlated with dependent variable, and obscure other associations; however, will be useful to test as relates to logic map.* **Hypothesis: Levels of compliance are higher in areas where there is clear and sufficient signage.** Independent Variables to be tested: • *There is sufficient signage to inform road users that a 20mph speed limit applies. Xqb1a* • *Traffic calming measures (e.g. road humps, speed activated signs) should be introduced to increase awareness of the speed limit / encourage compliance. Xqb1b*

Q7. Do 20mph speed limits achieve their objectives and other wider outcomes – a) Speed			
Dependent variable	**Respondent characteristics**	**Characteristics of area (see also Q9)**	**Driver behaviour / attitudinal statements**
The average speed of vehicles has reduced (% agreeing) (D1B, C1B). Xqc1b *Less vehicles are driving at excessive speeds for the area (% agreeing) (D1C, C1C) Xqc1c*	Independent Variables to be tested: • *Respondent's Gender Xqd2, Age Xqf1, Car ownership Rqf7, Socio-Economic Group Rqf4, household income Rqf5, and Index of Multiple Deprivation for area.* *Not of direct relevance to this Research Question, but kept in (following suggestion from DfT) for consistency and because, even if not of direct interest, by having these variables in the model we can control for their effects upon the dependent variables.*	**Hypothesis: Positive speed outcomes occur where the roads are narrow, the distance from the road to the houses is small, and there is limited open space.** Independent Variables to be tested: • *Road width (narrow, med, wide) – One value per case study area Roadwidth* • *Distance from road to house (short, medium, long) – One value per case study area Distance* • *Green spaces (10%, 25%, 50%, 75%) – One value per case study area Greenspace* **Hypothesis: Positive speed outcomes occur where there are schools or high pedestrian activity (e.g. retail, or leisure)[2]** Independent Variables to be tested: • *Type of area residential only (residential), school and residential (school) or residential, retail, leisure and business (mixed) – One value per case study area. Areas coded as 'school' contain a school within the sample area. Landuse*	

Q7. Do 20mph speed limits achieve their objectives and other wider outcomes – b) Perceptions of environment and safety (for walking and cycling)			
Dependent variable	**Respondent characteristics**	**Characteristics of area**	**Driver behaviour / attitudinal statements**
1. (Residents only) The introduction of the 20mph limit provides a safer environment for walking and cycling (% agreeing) (D3C). Rqd3_c *The introduction of the*	**Hypothesis: Perceptions are higher amongst certain gender-age-affluence groups. Socio-demographic characteristics added back in.** Independent Variables to be tested: • *Respondent's Gender Xqd2, Age Xqf1, Car ownership Rqf7, Socio-Economic Group Rqf4,*	*Indirectly covered above, as perceptions of the quality and safety of the environment for walking and cycling, is assumed to be an outcome of a reduction in average speeds / excessive speeds.* *However, a narrow road environment does not seem to be the most likely environment for increased walking and cycling, so worth re-testing hypothesis here.*	**Hypothesis: Reduction in (perceived) average and excessive speeds leads to positive perceptions about the quality and safety of the environment for walking and cycling.** Independent Variables to be tested:

20mph limit provides a more pleasant environment for walking and cycling (% agreeing) (D3D). Rqd3_d *Theory of Change assumes that improved perceptions about the quality and safety of the environment for walking and cycling, are an outcome of:* • *designation of the a reduction in average / excessive speeds (covered above);* • *real and perceived safety benefits;* • *the act of designating the area as a 20mph street.*	*household income Rqf5, and Index of Multiple Deprivation for area.*	**Hypothesis: Positive perceptions of quality and safety of the environment for walking and cycling occur where the roads are narrow, the distance from the road to the houses is small, and there is limited open space.** Independent Variables to be tested: • *Road width (narrow, med, wide) – One value per case study area Roadwidth* • *Distance from road to house (short, medium, long) – One value per case study area Distance* • *Green spaces (10%, 25%, 50%, 75%) – One value per case study area Greenspace* **Hypothesis: Positive perceptions of quality and safety of the environment for walking and cycling occur where there are schools or high pedestrian activity (e.g. retail, or leisure)** Independent Variables to be tested: *Type of area: residential only (residential), school and residential (school) or residential, retail, leisure and business (mixed) – One value per case study area. Areas coded as 'school' contain a school within the sample area. Landuse*	• *The average speed of vehicles has reduced (% agreeing). Xqc1b* • *Less vehicles are driving at excessive speeds for the area (% agreeing). Xqc1c*

Q7. Do 20mph speed limits achieve their objectives and other wider outcomes – c) Mode shift			
Dependent variable	**Respondent socio-demographic characteristics**	**Characteristics of area**	**Driver behaviour / attitudinal statements**
(Residents only) *Keeping traffic below 20mph makes it more likely that I will walk to local places rather than use the car (E1A).* *Keeping traffic below 20mph makes it more likely that I will cycle to local places rather than use the car (E1B).* *2.*	**Hypothesis: Levels of mode shift are higher amongst certain gender-age-affluence groups.** Independent Variables to be tested: • *Respondent's Gender Xqd2, Age Xqf1, Car ownership Rqf7, Socio-Economic Group Rqf4, household income Rqf5, and Index of Multiple Deprivation for area.* *3.*	**Hypothesis: Positive mode shift outcomes occur where there are schools or high pedestrian activity (e.g. retail, or leisure)[2]** Independent Variables to be tested: *Type of area: residential only (residential), school and residential (school) or residential, retail, leisure and business (mixed) – One value per case study area. Areas coded as 'school' contain a school within the sample area. Landuse* **Hypothesis: Positive mode shift outcomes occur where the roads are narrow, the distance from the road to the houses is small, and there is limited open space.** Independent Variables to be tested: • *Road width (narrow, med, wide) – One value per case study area Roadwidth* • *Distance from road to house (short, medium, long) – One value per case study area Distance* • *Green spaces (10%, 25%, 50%, 75%) – One value per case study area Greenspace* **Hypothesis: Positive mode shift outcomes are higher in areas where there are a high proportion of children living** Independent Variables to be tested: • *Proportion aged < 17 (or number of children in household from residential data) – One value per case study area Popunder17* **Hypothesis: Levels of support are higher in areas where there are higher levels of accidents** Independent Variables to be tested: • *Before accident data (six years prior to implementation) – Total casualties per road km (STATS19 data). Data provided by Atkins (see Note on Accident Data in Section 3 of report.*	**Hypothesis: Positive mode shift is higher in areas where positive outcomes are perceived to have been delivered.** *Traffic volumes* • *There are less vehicles using this street (% agreeing). Xqc1a* *Speed* • *The average speed of vehicles has reduced (% agreeing). Xqc1b* • *Less vehicles are driving at excessive speeds for the area (% agreeing). Xqc1c* *Perceptions of environment and safety* • *Drivers are more considerate to pedestrians (% agreeing). Rqd1_d* • *Drivers are more considerate to cyclists (% agreeing). Rqd1_e* • *The introduction of the 20mph limit provides a safer environment for walking and cycling (% agreeing). Rqd3_c* • *The introduction of the 20mph limit provides a more pleasant environment for walking and cycling (%*

			agreeing). Rqd3_d *Driver assessment of risk* • *The 20mph limit increases drivers' awareness of potential risks and hazards (e.g. cyclists, children playing) (% agreeing). Xqc1f*
Q7. Do 20mph speed limits achieve their objectives and other wider outcomes – d) Driver assessment of risk			
Dependent variable	**Respondent socio-demographic characteristics**	**Characteristics of area**	**Driver behaviour / attitudinal statements**
4. *The 20mph limit increases drivers' awareness of potential risks and hazards (e.g. cyclists, children playing) (D1F, C1F). Xqc1f*	**Hypothesis: Risk and hazard awareness is greater among drivers of certain gender-age-affluence groups.** Independent Variables to be tested: • *Respondent's Gender Xqd2, Age Xqf1, Car ownership Rqf7, Socio-Economic Group Rqf4, household income Rqf5, and Index of Multiple Deprivation for area.*	**Hypothesis: Risk and hazard awareness is greater where there are schools or high pedestrian activity (e.g. retail, or leisure) road to the houses is small, and there is limited open space.** Independent Variables to be tested: • *Type of area: residential only (residential), school and residential (school) or residential, retail, leisure and business (mixed) – One value per case study area. Areas coded as 'school' contain a school within the sample areaLanduse* **Hypothesis: Risk and hazard awareness is gre ater where the roads are narrow, the distance from the road to the houses is small, and there is limited open space.** Independent Variables to be tested: • *Road width (narrow, med, wide) – One value per case study area Roadwidth* • *Distance from road to house (short, medium, long) – One value per case study area Distance* • *Green spaces (10%, 25%, 50%, 75%) – One value per case study area Greenspace* **Hypothesis: Risk and hazard awareness is greater where there is adequate signage.** • *Adequacy of signage. Xqb1a*	**Hypothesis: Risk and hazard awareness is greater in areas where speeds are perceived to have reduced** • *The average speed of vehicles has reduced (% agreeing). Xqc1b* • *Less vehicles are driving at excessive speeds for the area (% agreeing). Xqc1c*

Q9. Do outcomes of 20mph speed limits vary according to road type? Why? (Physical characteristics only)			
Dependent variable	**Respondent socio-demographic characteristics**	**Characteristics of area**	**Driver behaviour / attitudinal statements**
Speed outcomes *The average speed of vehicles has reduced (% agreeing) (D1B, C1B). Xqc1b* *Less vehicles are driving at excessive speeds for the area (% agreeing) (D1C, C1C) Xqc1c* *Already addressed in Q7a.*	-	**Hypothesis: Greater decrease in areas where the roads are narrow, the distance from the road to the houses is small, and there is limited open space.** Independent Variables to be tested: • *Road width (narrow, med, wide) – One value per case study area Roadwidth* • *Distance from road to house (short, medium, long) – One value per case study area Distance* • *Green spaces (10%, 25%, 50%, 75%) – One value per case study area Greenspace*	-
Perceptions of environment and safety (for walking and cycling) *The introduction of the 20mph limit provides a safer environment for walking and cycling (% agreeing) (D3C). Rqd3_c* *The introduction of the 20mph limit provides a more pleasant environment for walking and cycling (% agreeing) (D3D). Rqd3_d* *Already addressed in Q7b.*	-	**Hypothesis: Greater decrease in areas where the roads are narrow, the distance from the road to the houses is small, and there is limited open space.** Independent Variables to be tested: • *Road width (narrow, med, wide) – One value per case study area Roadwidth* • *Distance from road to house (short, medium, long) – One value per case study area Distance* • *Green spaces (10%, 25%, 50%, 75%) – One value per case study area Greenspace*	-
Mode shift *Keeping traffic below 20mph makes it more likely that I will walk to local places rather than use the car Rqe1_a(E1A).*		**Hypothesis: Greater decrease in areas where the roads are narrow, the distance from the road to the houses is small, and there is limited open space.** Independent Variables to be tested: • *Road width (narrow, med, wide) – One value*	

Already addressed in Q7c.		*per case study area Roadwidth* • *Distance from road to house (short, medium, long) – One value per case study area Distance* • *Green spaces (10%, 25%, 50%, 75%) – One value per case study area Greenspace*	
Driver assessment of risk *The 20mph limit increases drivers' awareness of potential risks and hazards (e.g. cyclists, children playing) (D1F, C1F). Xqc1f* *Already addressed in Q7d.*		**Hypothesis: Greater decrease in areas where the roads are narrow, the distance from the road to the houses is small, and there is limited open space.** Independent Variables to be tested: • *Road width (narrow, med, wide) – One value per case study area Roadwidth* • *Distance from road to house (short, medium, long) – One value per case study area Distance* • *Green spaces (10%, 25%, 50%, 75%) – One value per case study area Greenspace*	

Q12. What effect is there on traffic volumes within the scheme itself and on neighbouring roads			
Dependent variable	**Respondent socio-demographic characteristics**	**Characteristics of area**	**Driver behaviour / attitudinal statements**
I avoid driving/ riding on this street/ in this area if possible since the introduction of 20mph limits (% agreeing). Dqd1d	**Hypothesis: Decrease in vehicle presence higher amongst certain gender-age-affluence groups.** Independent Variables to be tested: • *Respondent's Gender Xqd2, Age Xqf1, Car ownership Rqf7, Socio-Economic Group Rqf4, household income Rqf5, and Index of Multiple Deprivation for area.*	**Hypothesis: Decrease in vehicle presence higher where there are schools or high pedestrian activity (e.g. retail, or leisure)** Independent Variables to be tested: *Type of area: residential only (residential), school and residential (school) or residential, retail, leisure and business (mixed) – One value per case study area. Areas coded as 'school' contain a school within the sample area.*	**Test for association between route choice and driver frustration.** Independent Variables to be tested: • *0mph is frustrating for drivers. Dqc1e*

		Landuse **<u>Hypothesis:</u> Decrease in vehicle presence higher where the roads are narrow, the distance from the road to the houses is small, and there is limited open space.** Independent Variables to be tested: • *Road width (narrow, med, wide) – One value per case study area Roadwidth* • *Distance from road to house (short, medium, long) – One value per case study area Distance* • *Green spaces (10%, 25%, 50%, 75%) – One value per case study area Greenspace*	

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