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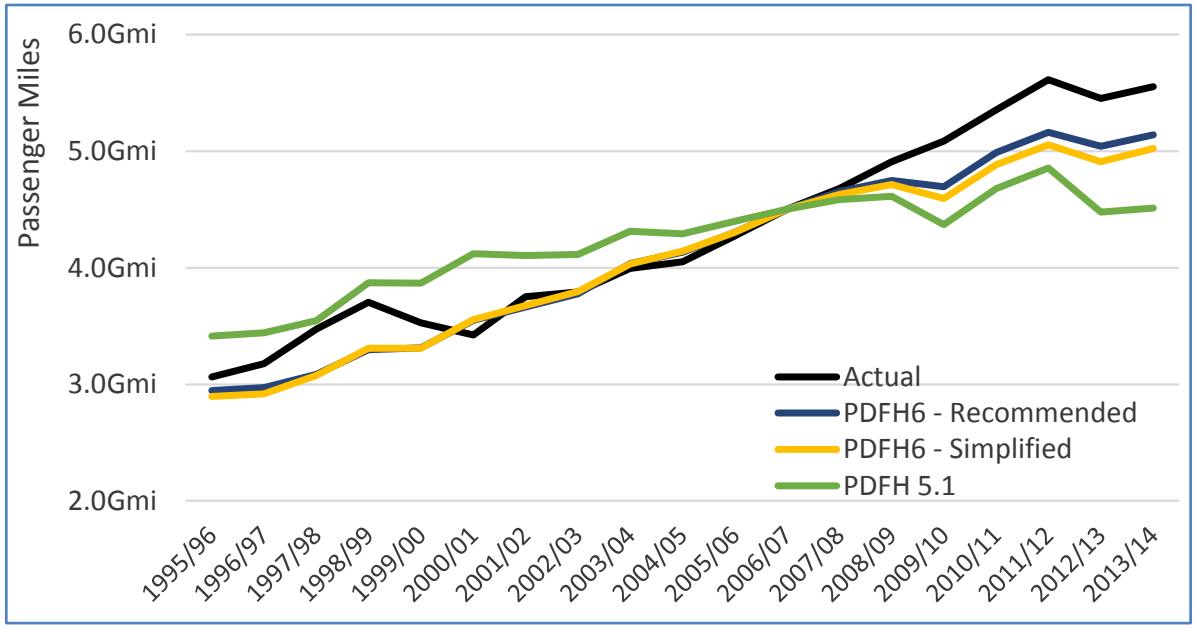

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The valuation of community severance caused by busy roads

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Introduction

The presentation discussed a project carried out at University College London (UCL), which was a collaboration between the Department of Public Health, the Bartlett School of Planning, and the Centre for Transport Studies. The work was funded by the EPSRC, ESRC, and AHRC, with a follow-up study funded by the EU CREATE project (Congestion Reduction in Europe).

The main objectives of the work were:

- to increase understanding of residents' perceptions and priorities for addressing Community Severance (CS) on busy main roads;
- to develop questionnaire tools to measure CS at the individual level;
- to measure local access and walkability;
- to analyse the impact of CS on wellbeing and other social outcomes;
- to develop a CS index for busy roads; and
- to obtain estimates of the values to residents and the local economy of reducing CS.

A key motivator for the work was to attempt to link the severance index to monetary values.

Overview of methodology

The work carried out was multidisciplinary, incorporating a wide range of methodologies as part of the UCL Street Mobility project: video surveys, street audits, spatial analysis, participatory mapping workshops, household surveys and stated preference (SP) surveys.

The methods were developed using case studies for four urban locations where a main road runs through a local community: Seven Sisters Road (London), Finchley Road (London), Queensway (Southend-on-Sea) and Stratford Road (Birmingham). Each community was engaged via informal street mapping, in-depth interviews and participatory mapping workshops. The process involved local community groups, and aimed to talk with residents about the neighbourhood, and the ways in which living near a main road affected their lives.

Street audits and video surveys allowed the UCL team to understand better how people move through the area on foot, including use of informal or formal crossing points, and main desire line movements. The Bartlett school then developed a model of walkability (potential for walking) across the area, which was related to residential density, land use mix, accessibility to public transport and the spatial connectedness for movements on foot (measured by space syntax techniques). Community severance (CS) can occur in areas where the level of walkability is high, but walking flows are low relative to what would be expected from the walkability model, because of the barrier effect of motorised traffic on pedestrian movements.

Household surveys were further used to understand local travel patterns, the socio-demographics of the area, and in particular to establish a wellbeing scale.

The influence of main road traffic on reported wellbeing

The first reported results, based on 845 respondents interviewed in the four case study areas, related to the influence of main road traffic on subjective wellbeing. The scale used is the Warwick-Edinburgh Mental Wellbeing Scale (WEMWBS) (Stewart-Brown 2009), which ranges from a minimum of 7 to a maximum of 35. The average for the four case studies was 25.9, close to the national average of 26.1. 73 respondents perceived that the main road traffic was ‘heavy’, ‘fast’, and acted as a barrier to walking, and furthermore stated that they avoid the main road for that reason. These respondents had an average score of 23.5, significantly lower (at the 1% level) than the sample average.

Table 1 shows the results of a regression analysis to identify the factors causing the lower wellbeing.

Table 1: Regression analysis of factors causing lower wellbeing

	Coefficient	**Significance**		
		10%	**5%**	**1%**
Age 55-65	1.04		●	
Age 65-75	1.77			●
Female	-0.85		●	
Lives alone	-0.80	●		
University degree	1.61			●
Full-time work	0.88		●	
Health very good	1.63			●
Health bad	-2.00			●
Health very bad	-4.00			●
Neighbourhood capital	0.13			●
Perceive traffic on main road as heavy, and Perceive traffic volume on main road as fast, and Perceive traffic as a barrier to walking, and Avoids busy road because of traffic	-1.40		●	

Road condition and severance contribute negatively at a 5% confidence level, after controlling for other predictors of wellbeing such as age, gender, household composition, qualifications, employment status, neighbourhood capital and general health condition.

Valuing severance via Stated Preference Surveys

Three stated preference exercises were carried out to arrive at a valuation of severance. For these, two further London locations were used: the A4 in Hounslow (200 participants) and the A23 in Streatham (150 participants). Each featured a 3-lane dual carriageway, high traffic speeds and few crossing facilities.

Figure 1 shows Exercise 1, which sought to identify trade-offs between crossing the road directly, crossing at a neutral safe location (a covered road section, with the road passing below) and not making the trip. Respondents were given a range of road conditions for Option A, and timings to reach the crossing at Option B. This tested the willingness of the respondent to spend more time to avoid an inconvenient crossing point. Each respondent answered 10 questions.

Figure 1: Stated Preference Exercise 1

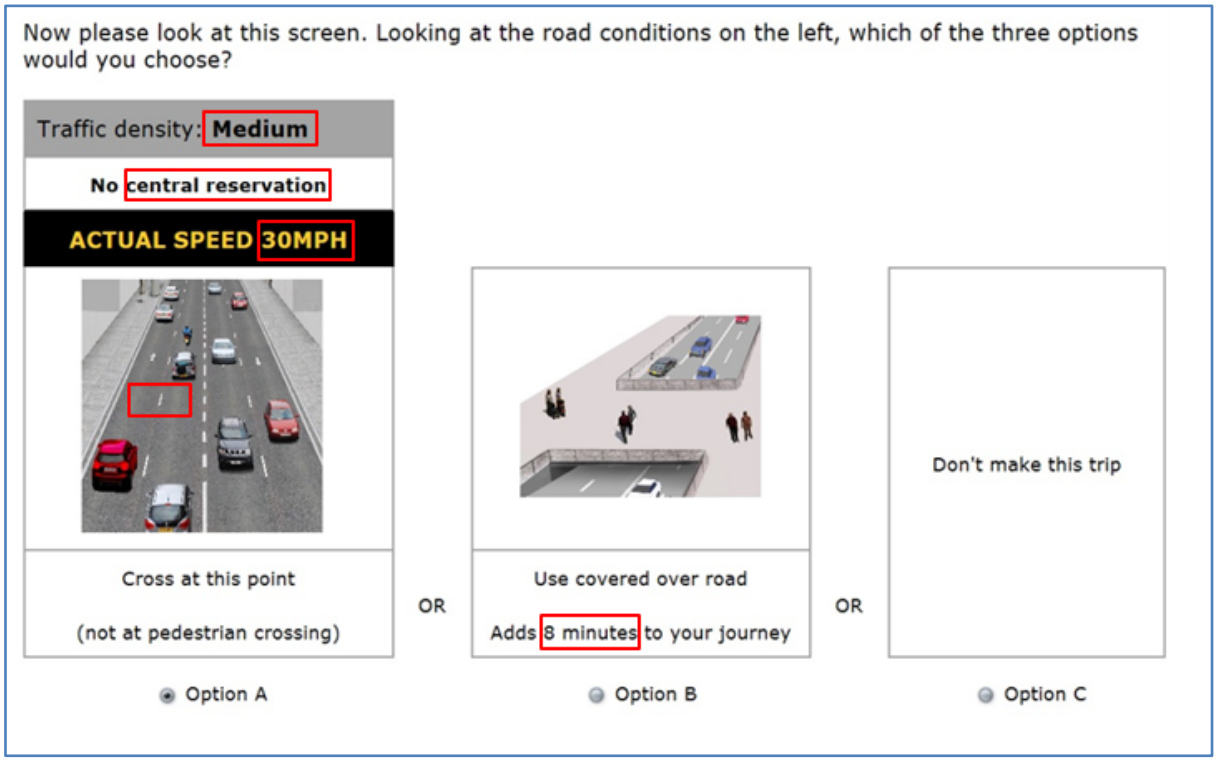


Figure 2 shows Exercise 2, which added a further option of using a crossing facility of various types, in addition to the existing options of a covered road or not making the trips. This tested the relative attractiveness of different crossing types. Each respondent was given 8 different scenarios.

Figure 2: Stated Preference Exercise 2

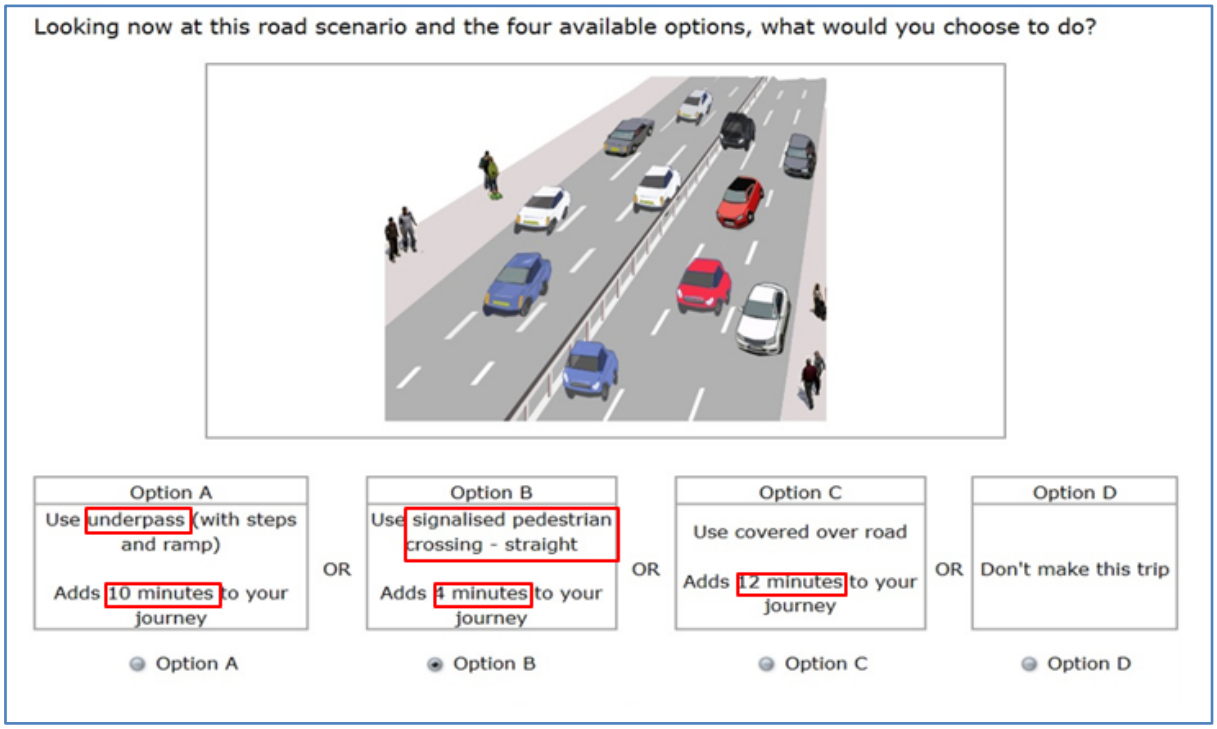
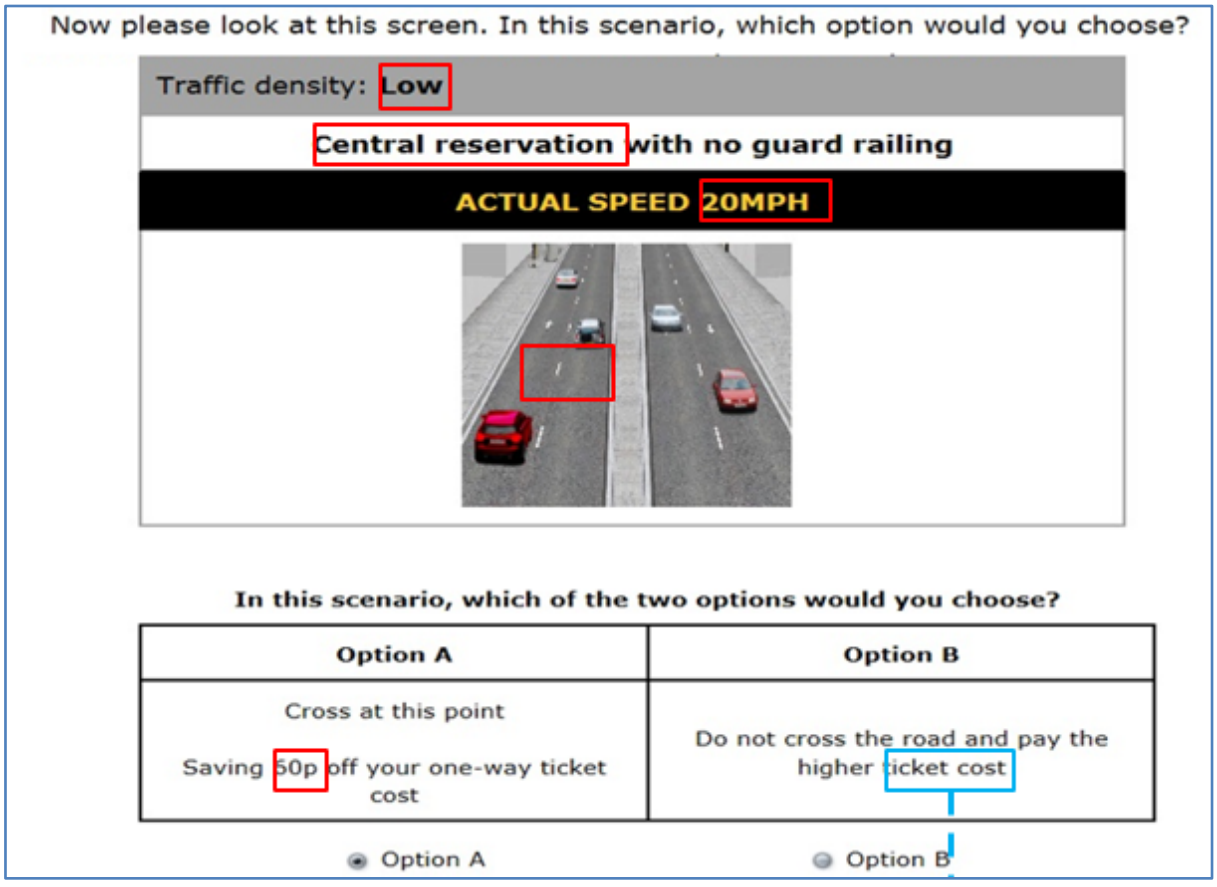


Figure 3 shows Exercise 3.

Figure 3: Stated Preference Exercise 3



Exercise 3 focused on the monetary value of crossing, by giving the option of crossing the road (without any crossing facility or option to walk to a covered section) to save money on a purchase, or not crossing the road and paying more. This relates directly to the (negative) valuation of crossing at a point where severance occurs.

The choices were modelled with mixed logit models so that the log odds of choosing an option are related with the values of the attributes presented in that option. The ratio between the coefficients representing the characteristics of the road or crossing facilities and the coefficients of walking time or saving can then be interpreted as willingness to walk and to pay to avoid crossing the road.

Table 2: results of Exercise 1 (n=262)

	Coefficient	**Willingness to walk (minutes)**	**Utility relative to Option C**	**Significance**		
				10%	**5%**	**1%**
Time	-0.42		0.04			●
Option A (cross)	0.37					
Lanes=2	-1.78	4.2	0.19			●
Lanes=3	-3.81	9.0	0.40			●
No reservation	-2.79	6.6	0.30			●
Density=medium	-1.38	3.3	0.15			●
Density=high	-4.30	10.2	0.46			●
Speed=20	-1.44	3.4	0.15			●
Speed=30	-2.26	5.4	0.24			●
Speed=40	-3.59	8.5	0.38			●
Option C (Don't make the trip)	-9.43	22.3				●

Table 3: results of Exercise 2 (n=350)

	Coefficient	Willingness to walk (minutes)	Utility relative to Option D	Significance		
				10%	5%	1%
Time	-0.56		0.04			●
Straight pelican	-0.98	1.7	0.08			●
Staggered pelican	-1.10	2.0	0.09			●
Footbridge	-3.10	5.5	0.25			●
Underpass	-3.74	6.7	0.30			●
Option D (Don't make the trip)	-12.54	22.4				●

Table 4: results of Exercise 3 (n=275)

	Coefficient	Willingness to pay (£)	Significance		
			10%	5%	1%
Saving	1.57				●
Lanes=2	-1.33	0.8			●
Lanes=3	-2.70	1.7			●
No reservation	-2.22	1.4			●
Density=medium	-0.90	0.6		●	
Density=high	-2.87	1.8			●
Speed=20	-0.75	0.5	●		
Speed=30	-1.48	0.9		●	
Speed=40	-2.48	1.6			●
Constant	1.68				●

Creating a severance index

The results of Exercises 1 and 2 were used to compile a "severance index" which rated locations from 0 (no severance), to 100 (complete severance, nobody will cross) based on road type, traffic conditions and crossing facilities available:

- A dual carriageway with a central reservation, low traffic and an average speed 10 mph has an index of 14, whereas with high traffic and no central reservation the index is 88.
- A staggered pelican crossing, footbridge and underpass have indices of 7, 19 and 23 respectively, consistent with common perception that footbridges are preferred to underpasses for personal security reasons.

The severance index for a location was further refined by taking into account the distance to the nearest crossing point.

- Where this distance was more than 10 minutes, only the conditions at the location were taken into account.
- Otherwise, the index was linearly interpolated between the value at the crossing point, and the value at an alternative (preferred) crossing point.

Combining the severance index and the regression models from the stated preference surveys made it possible to predict the pedestrian behaviour in different crossing scenarios, so that the probability of crossing, walking to an alternative crossing point, or not making the trip can be judged.

Figure 4 shows the results for a variety of scenarios.

Severance index and willingness to pay

The results of stated preference Exercise 3 could be used to relate severance to the willingness to pay to avoid crossing. This exercise yields a strong linear relationship shown in Figure 5.

Note that each point represents a type of road, which is defined by combinations of attributes (number of lanes, central reservation, traffic density, and traffic speed). The strong relationship is due to the fact that respondents have consistent preferences across exercises.

Figure 4: Severance index and probability of crossing or trip

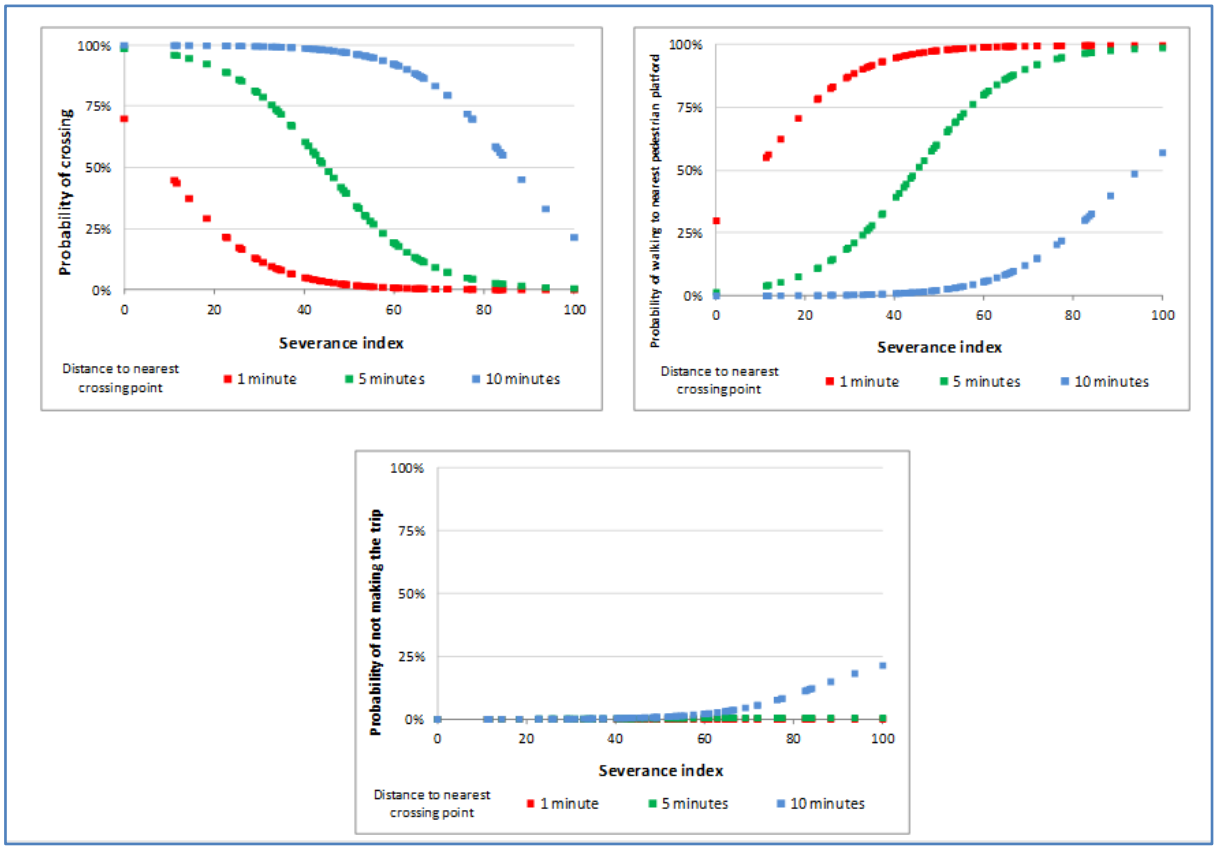


Figure 5: Severance index and willingness to pay

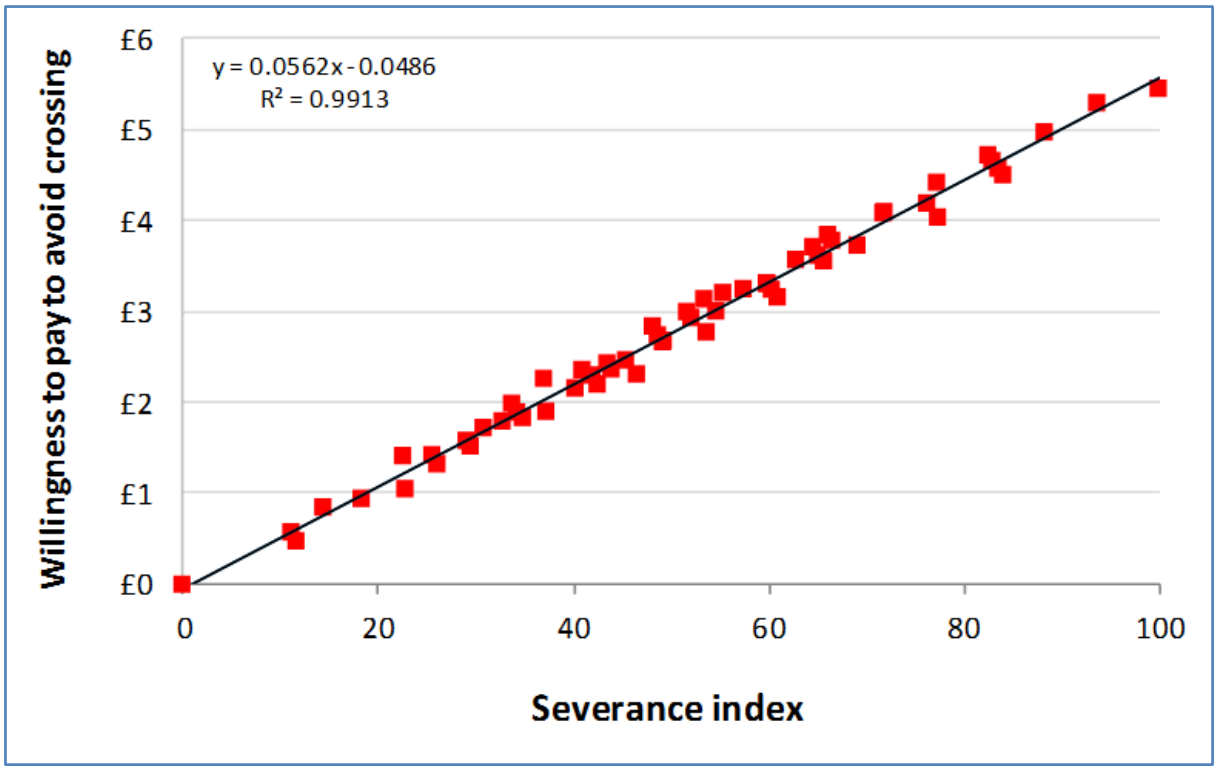
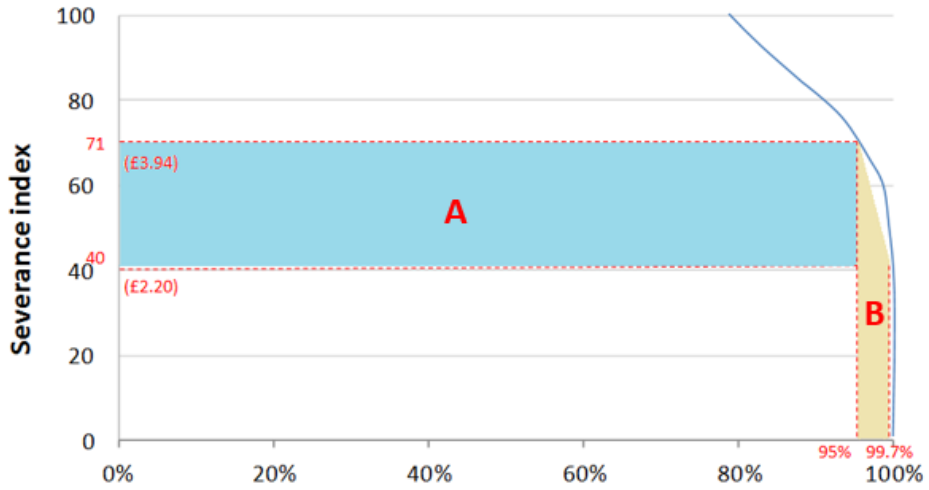


Figure 5 combines severance from Exercise 1 and willingness to pay from Exercise 2. Both feature the same road attributes and values: the only difference is the type of trade-off respondents made (with walking time in Exercise 1 and with money in Exercise 2). The almost linear relationship means that respondents consistently prefer roads that are easier to cross, no matter what the trade-off is. They prefer to cross roads with one lane, rather than two, so are willing to walk further to cross in places with one lane, and to forego a cost saving to be able to cross in those places. The type of trade-off (walking time or money) does not affect much how respondents prioritise certain road conditions above others. Extensive sense-checking showed that this relation was not due to spurious data or methodology.

Using the results in policy work

Figure 6 shows how the benefit of reducing the severance index from 71 to 40 could be modelled.

Figure 6: Calculating the benefits of a lower severance index



Total benefit per trip

=A

reduced severance cost for existing trips

*=(£3.94-£2.20)*95% = £1.65*

+B

benefit of new trips

B=(£2.20 +0.5(£3.94-£2.20)) *(99.7%-95%) = £0.14*

=£1.79

The index and relationships can be used to assess policy interventions related to road crossings:

- Area A illustrates benefits to people already making the trip.
- Area B relates to new people who will cross.

UCL proposed that the whole of area B could be considered as benefit, rather than just the triangular area representing change (rule of a half).

Further work

Work continues on further case studies in Hereford and Hull, also including some variations in types of destination, and on revealed preference (RP) studies to validate the stated preference (SP).

Discussion

Peter Gordon (Editor, The Transport Economist) asked how the comparison between Revealed and Stated Preference would be undertaken. **The speakers** responded that this is still being determined. The approach will ask respondents about trip purpose, actual origin/destination points, and where they cross the road. This will allow a model of how route choices are influenced by the conditions at the different crossing points available. However, this does not quantify trips NOT being made. Some differences of RP compared with SP are expected: values of willingness to pay are generally lower.

John Cartledge (London TravelWatch) asked if the study distinguished between bridges and underpasses? Do people prefer the former to the latter? **The speakers** confirmed that underpasses were found to have higher severance value, and higher willingness to pay, as shown in Table 3 from Exercise 2.

Tim Elliot (Independent consultant) said that the study seemed to reflect perpendicular movements across a road, but people may be going somewhere further along road, and have a choice of crossing points without diverting. How does this affect results? **The speakers** agreed that the scenarios presented in the SP survey have the destination directly on the other side.

Nicola Balch (McGregor Coxall) asked if additional waiting time at staggered Pelican crossings influences what people do. **The**

speakers agreed that this waiting time is valued more than normal walking time, and this has been incorporated into the new case studies in Hereford and Hull. Someone queried the perception that the underpass created more severance than a footbridge: why is this, given that a footbridge is generally less accessible, and means a greater level change? **The speakers** ran focus groups before starting the design of the stated preference exercises. People generally disliked underpasses under all circumstances due to perceptions of security.

Gregory Marchant (TEG) asked how traffic speed was represented, as it is difficult to deal with how it is perceived. **The speakers** said that videos of traffic had been shown to 75% of the sample in the Hereford and Hull studies, to see how results differed. Seeing the videos did not make a major difference to choices. It might be important that videos were taken from the perspective of pedestrians, at the same level as footway.

Dick Dunmore (Steer) asked if RP studies had explored using cameras or mobile phones to track detouring? **The speakers** said that, while reviewing video, following pedestrians across cameras, is labour intensive, mobile phone data is expensive or unavailable. **Nicola Balch** wondered if WiFi tracking could work?

Peter White (University of Westminster) asked if additional short motor journeys could be generated using local roads, with "no trip" becoming "no walk trip". **The speakers** said that it is possible that mode switch is part of the Option C "don't make the trip", but this has not been explored in this survey.

John Cartledge noted an example of residents catching a bus to travel one stop because of severance at a roundabout, and this was the only way to make the trip. **The speakers** mentioned an anecdote of a lady getting a bus to the next village and back just to cross the road. **John** asked if any account was taken of physical ability or disability such as use of buggy or wheelchair. **The speakers** said that all data was segmented by age, gender, disability, although the results shown are overall averages.

Tim Gent (Atkins) queried the R^2 of 0.99 in Figure 5: how large were the samples? **The speakers** said that the R^2 was for a relationship where the data points are road types. The severance index and the willingness to pay for each road type are based on the models for Exercise 1 and Exercise 2. The models were

estimated for 350 respondents, each seeing 8 scenarios. Both the Department for Transport (DfT) and the Highways Executive have audited the results and the high R^2. There has also been a test with random inputs to ensure that this results in a random result! Results from Hereford and Hull were less good, but the R^2s were still over 0.9, apparently because, as explained above, people have consistent preferences towards "better" roads, regardless of whether the alternative is to walk further or to forego a cost saving. Irrespective of the alternative, one lane is preferred to two lanes, low traffic is preferred to medium traffic, and so on.

Tim Elliot asked if the study considered change in density and speed of traffic when moving from two to three lanes. **The speakers** said that this had not been considered.

Tom Worsley (ITS Leeds) noted that the average benefit per new trip in Area B is higher than average benefit per existing user in Area A. Normally one would expect the benefit per user to be the same regardless. Is the justification for taking the whole of Area B that the cost of a new trip is zero? **The speakers** said that it was necessary to understand what people were doing with their time as an alternative to making the trip, but this would require an understanding of other options and their values. Several in attendance suggested that this "alternative use of time" is addressed by the rule of a half (only the triangular part of Area B should be taken as benefit), which should apply in this case as in all others.

Dominic Walley (Connected Economics) asked if the study had examined the behaviour of people suffering from community severance, which might be a way of assessing the economic value of connecting people to a wider community. **The speakers** said that literature exists in this area but is "pretty scatty". The approach can be used if trips are reducing social exclusion, but there is no obvious crossover in literature that can be used to connect this.

Nicola Balch wondered about the psychological impact of severance. **The speakers** said that this is partially captured in the relationship between severance and subjective wellbeing shown at the beginning of the talk. People affected by severance

tend to have lower wellbeing scores, after controlling for a series of other determinants of wellbeing.

Dominic Walley wondered about the next step. Would it be part of WebTAG, or used to re-evaluate the Generalised Cost of walking? **The speakers** said that the work is being carried out for the Highways Executive, but they are keen to incorporate it in work that they do, and are discussing it with DfT for possible use in WebTAG.

Tim Gent asked if the work could be used to show the benefits to communities of reducing traffic. **The speakers** said yes, but noted that this is not a simple linear relationship, because less traffic can mean higher speeds and therefore more severance.

Gregory Marchant wondered if the reality of severance is in fact a little more complex. For example, traffic lights create pulses of traffic, so people may wait for a gap rather than walking or diverting. **The speakers** suggested that this could perhaps be tested in future studies.

Andrew Price (Jacobs) asked if autonomous vehicles (AVs) would eliminate or create more severance. **The speakers** said that this was not clear. AVs could lead to more protection of road space and the reintroduction of guard rails to prevent jaywalking, resulting in more severance.

John Cartledge wondered if the method would have an application in railways, which were more of a source of severance. Could the approach be used for the removal of level crossings? **The speakers** had spoken to Network Rail, who had not been very interested, as the issue with railways is more of a problem of physical infrastructure.

Robert Barrass commented that there may have been severance in some areas for decades. It would be interesting to add a time dimension to see the impact over time with land use remaining the same.

Report by Tim Gent