Pedestrians' preferences regarding signalised crossings, footbridges, and underpasses

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Abstract

This paper reports the results of a survey to understand the preferences of pedestrians towards using different types of crossing facilities. Participants were first asked to indicate how comfortable they felt using different types of crossings. Footbridges and underpasses were systematically rated below signalised crossings. Participants were then presented with a scenario where crossing the road at their current location was impossible and were asked to choose between walking additional times to reach certain types of facility or avoid crossing the road altogether. The analysis of the choices using a mixed logit model found that participants chose staggered signalised crossings, footbridges, and underpasses, if the walking times to those crossings were respectively 1.1, 4.6, and 4.1 minutes shorter than the times to access straight signalised crossings. On average, participants only chose to avoid crossing the road if the straight signalised crossings were located at least 20.7 minutes away. Older participants required greater reductions and participants who walk to work required smaller reductions in walking time in order to use facilities other than straight crossings. The values obtained were slightly smaller and not always statistically significant when using a conditional logit formulation. The study provides information that is useful for policy decisions about the frequency of provision and the type of pedestrian facilities provided to cross busy roads.

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1. Introduction

The major shift from non-motorised to motorised forms of urban transport that occurred in the 20th century throughout the world has led to several economic, social and environmental problems. Transport and urban planners have increased their efforts to rehabilitate the cities for pedestrians during the present century, but they are constrained by the legacy of a road network that excludes or limits non-motorised modes of transport (Illich 1974). In fact, roads are often a barrier for the movement of pedestrians because of the risk and unpleasantness of crossing to the other side (Appleyard *et al.* 1981). However, solutions such as the reduction in traffic levels or speeds may not always be feasible, especially in the case of roads that are crucial for the accessibility of private and public transport users and where there are no alternative routes. In these cases, the construction or improvement of pedestrian crossing facilities are possible alternative solutions to reduce the barrier effect of roads for pedestrians.

However, the effectiveness of crossing facilities for improving the ease of crossing busy roads depends on their characteristics. There is evidence that some types of facilities are generally disliked by pedestrians and can even aggravate the barrier effect (James *et al.* 2005). The assessment of schemes to improve road crossings requires, therefore, the estimation of the benefits that pedestrians will derive from them.

This paper is an output of the Street Mobility and Network Accessibility project being conducted at University College London to develop tools to reduce barriers to walking that are caused by busy roads. These tools include methods to understand the incidence of those barriers and their impact on people's health and wellbeing, and methods to develop and assess solutions to mitigate those barriers. These solutions include the set of facilities available for pedestrians wishing to cross the road.

A survey was developed to estimate preferences for different types of crossing facilities and acceptable walking times to access them. The survey was implemented in two sites in the United Kingdom, one in London and another in Southend-on-Sea, in areas around busy roads that lack a sufficient number of pedestrian crossings. This paper reports the results of two exercises included in this survey: a question where participants rated four different types of crossings and a series of questions where they chose between different alternative crossing facilities and varying walking times to access them.

The rest of the paper is organised as follows. Section 2 is a brief review of the theoretical and empirical background for this study. Section 3 describes the study area and the sampling process. Sections 4 and 5 report the results of the rating and stated preference exercises in the main survey, and Section 6 concludes the paper.

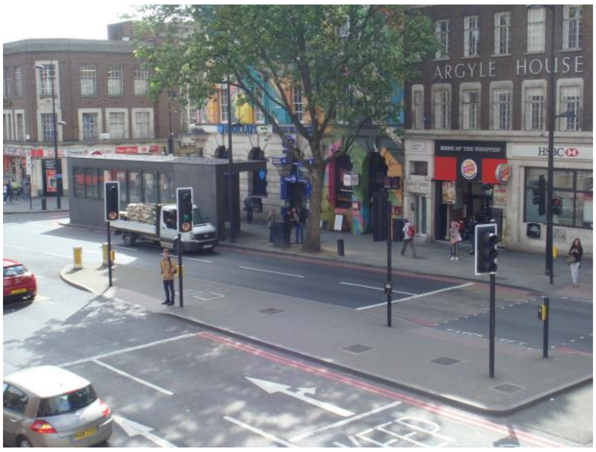
2. Background

The decisions taken by pedestrians about when, where, and how to cross a busy road usually involve a trade-off between safety and convenience. People often cross the road away from designated pedestrian facilities because that is the fastest and most direct way for them to cross. Signalised crossings (Figure 1a, 1b) are safer than informal crossings, but may involve detours and delays to the trip due to additional waiting and walking times. This is especially the case of staggered crossings, where the crossing is completed in two stages and the crossings on each side of the road are not aligned (Figure 1b).

Non-surface crossings, such as footbridges and underpasses, are generally safe in terms of vehicle-pedestrian collisions but are almost universally disliked, due to the time and effort required to use them, and to issues of personal security (Figure 1c, 1d). This is confirmed among many others in the studies of James *et al.* (2005) in the United Kingdom, Mfinanga (2014) in Tanzania, and Tao *et al.* (2010) in China. Some groups such as females and the elderly are particularly averse to using non-surface crossings, especially at night time.

Figure 1: Types of crossing facilities

(a) straight signalised crossing



(b) staggered signalised crossing

(c) footbridge

(d) underpass

Despite the advantages and disadvantages of each type of facility, in practice the use of a particular facility may be explained by the lack of better alternatives (Sinclair and Zuidgeest 2015) or the location of the crossing options relative to the direction of the trip (Yannis *et al.* 2007).

The extensive literature on pedestrian crossing behaviour has used a wide variety of methods, including questionnaires and interviews (Bernhoft and Carstensen 2008), video surveys (Sisiopiku and Akin 2003), pedestrian tracking (Papadimitriou 2012), GIS analysis (Lassarre *et al.* 2012), and experiments (Granié *et al.* 2014). Advances in choice modelling techniques have increased the use of stated preference surveys to estimate pedestrians' preferences for crossing locations and facilities. In this type of surveys, participants are asked to choose from hypothetical alternatives, defined by several attributes. The choices are then related to the attribute levels using statistical models, from which the willingness to accept marginal changes in the attributes can be derived (Ben-Akiva and Lerman 1985).

Stated preference surveys can be applied to elicit preferences among alternative measures that might be provided to improve the ease of crossing the road. The most radical and most effective of these measures is to build a road tunnel, so that pedestrians can walk 'over' the road, at grade. This scenario was studied by Grisolía and López (2015), who modelled the preferences for burying a road taking into consideration the cost of the project and the types of land use on the surface (paved square or garden) and the existence of street furniture and CCTV. The ease of crossing can also be improved by traffic calming measures or by the reallocation of road space. For example, Garrod *et al.* (2002) estimated preferences for traffic calming measures in terms of reductions in traffic speed, noise, aesthetics, and time to cross the road. Choice modelling has also been used to estimate preferences for interventions such as shared space (ITS and Atkins 2011, Kaparias *et al.* 2012) and improvements in pedestrian infrastructure at roundabouts (Perdomo *et al.* 2014). Information about the type of crossing facility can also be included as an attribute in wider models of pedestrian route choice that take into account elements such as the crossing situation and the monetary cost of interventions (Hensher *et al.* 2011).

However, for a given individual, preferences are determined not only by the crossing situation and the characteristics of the crossing facility, but also by the distance to access them. For example, Sisiopiku and Akin (2003) found that the decision to cross a road in a particular location depends on its position in relation to the origin and destination of the trip. Walking distance has also been included in some studies of choices of pedestrian crossing situations. Meltofte and Nørby (2013) derived people's trade-off values between the number of lanes, traffic characteristics, and distance to the nearest crossing facility. Cantillo *et al.* (2015) also modelled the choices between crossing the road informally and using signalised crossings and footbridges further away, taking into account the walking distance to these two facilities, delay, road traffic flow, and whether the participant is travelling with children. The study found that longer distances to facilities increase the probability of crossing informally, especially where the alternative required the use of a footbridge. However, age, gender, educational qualification levels, and the circumstances of the trip are also relevant factors.

The present study builds on these developments, by estimating the trade-offs pedestrians make between the use of different types of crossing facility, walking times to access them, and the possibility of avoid crossing altogether.

3. Study areas, sampling, and questionnaire design

The main survey was conducted in two areas, one in London and the other in Southend-on-Sea, in the neighbourhoods surrounding major roads.

The London survey was conducted in the area around Finchley Road, a major arterial road with traffic levels comparable to those of some motorways in London. Crossing the road is particularly problematic in the 1km section between Swiss Cottage tube station and Finchley Road and Frognal overground station, where the road has 3 lanes for motorised traffic in each direction and guard railings or walls preventing pedestrians crossing away from designated crossing facilities. The existing pedestrian facilities along this section of the road included six staggered signalised crossings and two underpasses.

The Southend survey was carried out in the area around Queensway, a 2-lane per direction road with relatively small traffic levels (when compared with Finchley Road in London), but with a smaller number of formal pedestrian crossing facilities. The only facilities available for crossing the road were long and complex staggered signalised crossings, footbridges, and underpasses. A high proportion of pedestrians do not use these formal facilities and cross the road informally instead.

The surveys consisted of 100 computer-assisted interviews in each neighbourhood bordering the busy road, conducted in the second half of 2015. The samples in each site were based on quotas and were designed to have similar number of males and females and individuals aged below and over 50 years old. The composition of the overall sample in terms of demographic and socio-economic variables, frequency of crossing the road, and characteristics of the last walking trip (purpose, situation, and mobility restrictions) are described in detail in the second column of Table 1. The characteristics of the samples at the two sites are broadly similar, the only noticeable difference being a larger proportion of individuals with low income and with no qualifications in the Southend sample, compared to the London sample.

4. Rating exercise

In a first exercise, participants were asked to indicate how comfortable they feel crossing busy roads using different types of pedestrian crossings, shown on a card. The rating scale used ranged from 0 to 100, where a score of 0 represents a road with no crossing facilities and a score of 100 represents the case where the road is sunk and covered over.

Four types of facilities were shown: a straight and a staggered signalised crossing, a footbridge, and an underpass. Both footbridges and underpasses were represented with steps and ramps. The images had the same number of traffic lanes as in the main road at the relevant site, so that participants could relate the options shown to their own experience. Figure 2 shows an example of the questions presented in the London survey, showing a footbridge over a road with three lanes for motorised traffic in each direction.

Figure 2: Example of question in the rating exercise

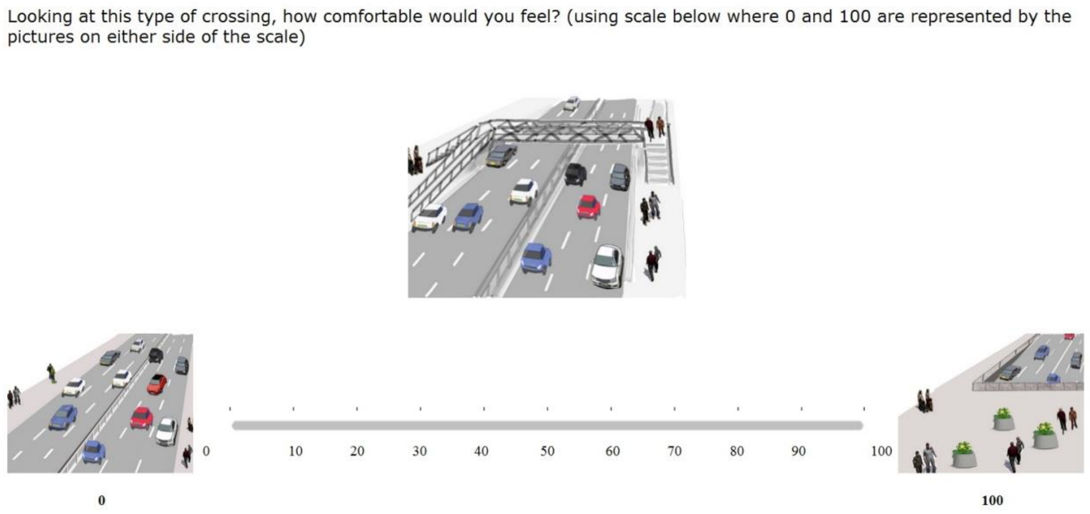


Figure 3 shows the rating values for the four types of crossing for the two samples combined, in ascending order. Surface crossings (straight and staggered signalised crossings) were systematically rated above footbridges and underpasses. The ratings of staggered signalised crossings tend to be higher than those of straight crossings and the ratings of footbridges higher than those of underpasses. The figure also shows that collectively participants used the whole range of values available, from 0 to 100%, for all four crossings.

Figure 3: Rating values for each type of crossing, in ascending order

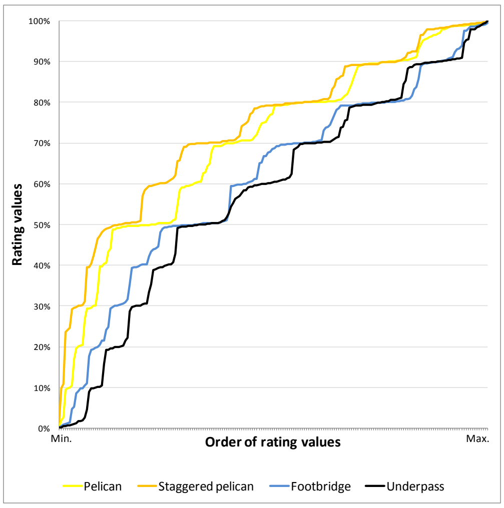


Table 1 presents descriptive statistics for the ratings of the four facilities and Table 2 shows the number of times the facilities were ranked in each position (from 1st to 4th) in the ordered ratings of each participant. The results confirm that the ratings of footbridges and underpasses were lower on average than the ratings of signalised crossings and were also the least comfortable crossing types for most participants (63 and 74 participants respectively). Staggered crossings were rated slightly higher than straight crossings, and footbridges were rated slightly higher than underpasses.

Table 1: Rating exercise: descriptive statistics

	Straight	Staggered	Footbridge	Underpass
Average	70	74	61	58
Standard deviation	24	21	26	28
Median	78	79	69	60

Table 2: Rating exercise: number of times facilities were ranked in the 1st, 2nd, 3rd, and 4th position

	Straight	Staggered	Footbridge	Underpass
Highest ranked	71	73	28	44
Second highest ranked	55	77	48	22
Third highest ranked	36	36	61	60
Lowest ranked	38	14	63	74

Table 3: Rating exercise: average ratings per group

	Number of participants	Average ratings			
		Straight	Staggered	Footbridge	Underpass
Area					
London	100	70	73	59	53
Southend	100	70	75	64	63
Age					
18-34	58	69	76	66	61
35-50	49	72	79	67	68
51-65	47	70	71	57	55
65+	46	70	68	53	46
Gender					
Male	99	74	75	66	65
Female	101	67	72	56	51
Income					
<10k	23	62	63	58	44
10-20k	27	76	79	55	53
20-30k	35	72	73	66	61
30-40k	17	72	75	71	68
>40k	39	69	76	63	63
Number of cars					
None	106	68	74	61	56
One	76	72	74	61	61
Two or more	17	76	71	61	53
Employment					
Full-time work	76	73	77	66	64
Part-time work	26	68	79	67	63
Unemployed	18	58	70	65	61
Retired	53	72	69	51	45
Student	12	70	65	66	59
Qualifications					
Degree	70	70	71	60	56
Technical	76	70	76	61	59
None	51	71	74	64	61
Living in the area					
<1 year	17	64	63	62	56
1-4 years	36	78	76	63	64
5-19 years	67	64	77	64	63
>20 years	74	73	74	57	51
Frequency of crossing the road					
Most days	81	68	74	60	55
2-3 times a week	59	70	73	58	62
once a week	37	73	77	65	56
less than once a week	23	75	71	64	61
Trip purpose					
Work	38	71	79	65	62
Shopping	116	68	72	61	60
Visit family/friends	11	76	78	59	55
Leisure	21	81	76	62	51
Situation					
Alone	145	70	74	62	57
With another adult	33	73	73	61	60
With children	22	63	76	56	61
Mobility					
Full mobility	162	72	74	63	59
Restricted mobility	38	62	71	54	56

Table 5 disaggregates the average ratings according to the characteristics of the participants and their walking trips. Participants in the two areas gave similar ratings to signalised crossings but those in Southend gave higher ratings to footbridges and underpasses, compared to the London sample. The most relevant personal characteristics differentiating the ratings were age, gender, and income. On average, the older age group (over 65) gave the lowest ratings to staggered signalised crossings, footbridges, and underpasses. The difference is especially noticeable in the case of underpasses, which had an average rating of 58% for the whole sample and 46% for the older age group. The group aged 51-65 also gave lower ratings for footbridges and underpasses than younger groups. Females and participants in the lowest income group gave lower ratings to all four types of crossing comparing with the average values.

Participants who had a mobility restriction gave lower ratings than those with full mobility to all four types of facility. Those who walked for leisure or visiting friends and family on their last trip gave lower than average ratings to underpasses and those walking with children gave a low rating to footbridges. The frequency of crossing the road seems to have little impact on the rating values.

5. Stated preference exercise

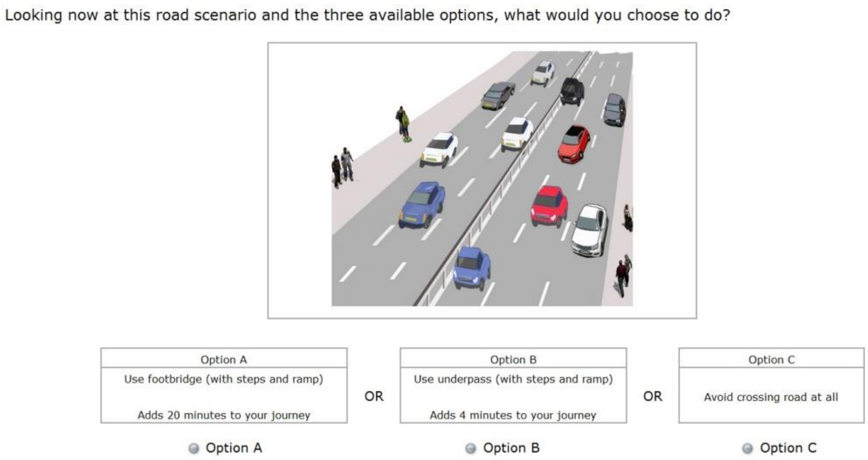
5.1. Design

The objective of the stated preference exercise was to estimate participants' willingness to walk in order to cross the road using specific types of crossing facilities. Participants were shown a scenario where crossing at the current location was impossible due to the presence of high traffic levels and guard railings in the middle of the road. Three options were then presented:

- Walk a specified time and use one of two types of crossing facility shown (options A and B).
- Avoid crossing the road altogether (option C)

The exercise consisted of six questions in the London survey and eight questions in the Southend survey. The types of crossing facility and the walking times in options A and B were systematically varied. The types of facility were the same as in the rating exercise (straight and staggered signalised crossings, footbridges, and underpasses). The time added to the journey ranged between 2 to 20 minutes, in 2 minute increments. Figure 4 shows an example of the questions, illustrating a choice between using a footbridge 20 minutes' walk away (Option A), an underpass 4 minutes away (Option B), and avoiding crossing the road altogether (Option C). An efficient design was used, which generates data that allows for the minimization of the standard errors of the parameter estimates (Rose and Bliemer 2009). The design was obtained using the *Ngene* software.

Figure 4: Example of question in the stated preference exercise



5.2. Econometric models

The participants' choices were analysed using econometric models. The data was reshaped so that each record captured the choice regarding each of the three options presented in each of the questions to each participant. This procedure generated a dataset with 4200 records.

The dependent variable is a dummy variable where 1 represents the case where the participant chose that option. The explanatory variables are the presented walking time, dummy variables for staggered signalised crossings, footbridges and underpasses (equal to 1 when an option included these facilities), and a dummy for the possibility of not crossing. Straight signalised crossings were treated as the "base value" and were thus omitted from the models.

Four alternative models were estimated. Models 1 and 3 include only the attributes presented to the participants (types of facility, walking time, and the "don't cross" option). Models 2 and 4 add interaction terms between the attributes and the characteristics of the participants and their most recent walking trip. Two types of specification were tested: mixed logit (Models 1 and 2) and conditional logit (Models 3 and 4).

In the mixed logit models (Models 1 and 2), the coefficients of all variables except walking time were assumed to be random (Ben Akiva and Bolduc 1996, McFadden and Train 2000). In this case, the utility of an option depends on the attribute levels and on the characteristics of the participants. The utility can be specified as follows:

$$U_{i,j} = \beta_j x_{i,j} + \varepsilon_{i,j}$$

where $U_{i,j}$ is the utility of alternative *i* for individual *j*, $x_{i,j}$ is a vector measuring the attributes of each alternative, β_j is a vector of parameters, and $\varepsilon_{i,j}$ is an error term that follows the Extreme Value Type I distribution. The parameters β_j are assumed to be random. The probability that individual *i* chooses alternative *j* is

$$P_{i,j} = \int L_{i,j}(\beta) f(\beta|\theta) d\theta$$

where $L_{i,j}$ is the probability of choice for a fixed value of β, defined as

$$L_{i,j}(\beta_i) = \frac{e^{\beta_i x_{i,j}}}{\sum_k e^{\beta_i x_{i,k}}}$$

In the conditional logit models (Model 3 and 4), the coefficients of all variables are assumed to be fixed across participants. In other words, the utility of an option depends only on the attribute levels. In the specification above, β is assumed to be fixed across all participants, and not random as in the mixed logit specification.

5.3. Results

Table 4 shows the estimated coefficients and significance levels of the variables in the four models.

The “don’t cross” and time coefficients are negative and significant in all models, which confirms that participants prefer to cross rather than not to cross the road, and prefer shorter to longer walking times.

In the models that only include the attributes presented in the exercise (models 1 and 3), the three coefficients for the types of crossing facilities have a negative sign, which means that participants prefer to use straight signalised crossings rather than staggered crossings, footbridges, or underpasses. In the mixed logit specification (Model 1), the coefficients of all three facilities are significantly different from zero. In the conditional logit, only the coefficient of underpasses is significant. It is worth noting that staggered crossings have a negative coefficient despite having been rated higher, on average, than straight crossings in the rating exercise, so there is a small degree of inconsistency in the participants' answers in the rating and stated preference exercises. The coefficients of the crossings that are not at grade (footbridges and underpasses) are higher, in absolute value, than the coefficient of staggered crossings, which confirms that on average people prefer at-grade crossings, as expected from the empirical studies reviewed in Section 2.

Table 4: Stated preference models

	Mixed logit				Conditional logit			
	Model 1		Model 2		Model 3		Model 4	
	coeff.	p>|z|	coeff.	p>|z|	coeff.	p>|z|	coeff.	p>|z|
staggered	-0.40	0.06*	-0.47	0.02**	-0.07	0.62	-0.07	0.61
footbridge	-1.69	0.00***	-0.54	0.17	-0.23	0.14	0.09	0.64
underpass	-1.48	0.00***	-0.34	0.39	-0.55	0.00***	0.13	0.56
don't cross	-7.56	0.00***	-7.55	0.00***	-3.00	0.00***	-2.70	0.00***
time	-0.37	0.00***	-0.41	0.00***	-0.16	0.00***	-0.16	0.00***
Footbridge * age>50			-1.22	0.04**			-0.81	0.01***
underpass * age>50			-1.76	0.01***			-1.05	0.00***
underpass * female			-1.24	0.09*			-0.50	0.05**
don't cross * Southend			-3.56	0.00***			-0.94	0.01***
time * age>50			-0.10	0.02**				
time * work			-0.18	0.01**			-0.05	0.04**
n	4200		4200		4200		4200	
Log likelihood	-925		-846		-1246		-1193	
Pseudo R2	0.40		0.45		0.19		0.22	

Notes: Significance levels: *** 1%, ** 5%, * 10%.
Pseudo R^2 for mixed logit models= $1-\exp(LL)/\exp(LL_0)$, where LL is the log likelihood of the model and LL_0 is the log likelihood of a model with no explanatory variables.

Several of the interaction terms were found to be significant in models 2 and 4. The probability of choosing footbridges and underpasses is lower for participants aged above 50, which confirms the dislike of older pedestrians for using underpasses, found both in the rating exercise and in previous literature. The probability of females choosing underpasses is also lower than average. In both models 2 and 4, the coefficients of footbridges and underpasses become insignificant after adding the interaction terms of these variables with age and gender, which suggests that the type of crossing facility does not determine the choices for the overall population (i.e. they prefer to minimise walking time, regardless of crossing type), but only in the cases of older people and females.

The probability of not crossing the road is lower in the Southend sample than in the London sample, which could be explained by the greater availability of potential destinations on the same side of the busy road for pedestrians in London, or by the higher provision of public transport. It could also be influenced by the shorter crossing distances in Southend (i.e. four traffic lanes, compared to six lanes in London).

Participants who walked to work (in both models 2 and 4) and were aged above 50 (in model 2 only) were more sensitive to the walking time attribute (i.e. less prepared to walk for long times to reach a crossing facility). These results are also consistent with previous expectations. Older people are more prone to have physical limitations preventing them from walking longer distances and people who walk to work usually have tighter time restrictions, make the journey more frequently and have less scope for not making the trip when compared with people who walk for leisure, shopping, or visiting someone.

The other interaction terms tested were not found significant at the 10% level in the final model. These include interactions with variables such as gender, age below 35, income, length of residence in the area, frequency of crossing the road, and presence of mobility restrictions on the last walking trip. Interactions between the types of facility, their ratings in the rating exercise, and their distance to participants' homes were also insignificant.

5.4. Willingness to accept shorter walking times to use less attractive crossing facilities

The trade-offs values between walking times and the use of each type of facility or the "don't cross" alternative can be derived from the estimated econometric models. Those values are the ratios between the coefficient of the variables indicating the presence of each type of facility or the "don't cross" alternative and the coefficient of walking time.

Table 5 shows the estimated willingness to accept shorter walking times to use less attractive crossing facilities, or to avoid crossing altogether, compared with the base scenario of using straight crossings. The values can also be understood as the willingness to walk to use straight crossings, to avoid another type of facility or to be able to cross at all. Values were set to 0 in the cases where the coefficients of the relevant variable in the model are not statistically significant.

Table 5: Willingness to accept shorter walking times to use less attractive crossing facilities, compared to use a straight signalised crossing (minutes)

	Mixed logit					
	Model 1	Model 2				
	All	All	Age>50	Female	Southend	Work
staggered	1.1	1.1	1.5			0.8
footbridge	4.6	0	5.7			0.9
underpass	4.1	0	5.2	3.9		0.6
don't cross	20.7	18.4	24.7		27.1	12.7

	Conditional logit					
	Model 3	Model 4				
	All	All	Age>50	Female	Southend	Work
staggered	0	0				0.3
footbridge	0	0	4.5			-0.4
underpass	3.5	0	5.8	2.2		-0.6
don't cross	19.0	17.0			22.9	13.1

Note: Values for subsets are shown only when they differ from the whole sample

On average, participants only avoid crossing if the walking times to access a crossing facility are at least 20.7 minutes (in the mixed logit model) or 19 minutes away (in the conditional logit model), as obtained from models 1 and 3 respectively. These average values are slightly smaller when accounting for demographic and other differences in the sample (models 2 and 4). Participants in the Southend sample only avoid crossing when the crossing facility is located farther away (27.1 or 22.9 minutes away, depending on the model) than in London. Participants who walked to go to work avoid crossing when the crossing facility is located 12.7 or 13.1 minutes away, depending on the model specification. This result is explained by the tighter time restrictions these participants face when they walk and not by a higher propensity to choose not to cross the road.

The values obtained for the three types of facilities (relative to the straight signalised crossing) are positive in all models in general and for almost all groups. This shows that participants only choose these facilities if they are nearer than straight signalised crossings. The magnitude of the values found for the three types of facility follow the order that was to be expected from the theory and previous literature. The walking time reduction required to choose a facility other than a straight crossing is higher when the alternative is a facility not at grade (footbridge or underpass) comparing with a facility at-grade (staggered crossing).

Older participants require longer walking time savings in order to use the other three types of facility (1.5 minutes in the case of staggered crossings and around 5 minutes in the case of footbridges and underpasses). This means that the general propensity of this age group for avoiding facilities other than straight crossings cancels out their greater sensitivity to walking time, as found in the econometric models. Females also require larger walking time savings in order to use underpasses (2.2 or 3.9 minutes, depending on the model). In all cases, the values are lower for participants who walk to work, due to the time restrictions they face compared with other participants. In the conditional logit, the values for footbridges and underpasses are negative, but low in absolute value (less than one minute).

6. Conclusions

This paper estimated preferences for the use of different types of road crossing facilities relating to busy roads in two urban areas, using a stated preference survey. In the first exercise, participants rated footbridges and underpasses systematically below signalised crossings, especially in the case of females and participants with mobility restrictions or in the older age group. The modelling of the choices among different alternatives for crossing facilities and walking time to access them revealed that participants choose staggered signalised crossings, footbridges, and underpasses only if these facilities are nearer than straight signalised crossings.

The results confirm evidence found in previous literature, such as the general dislike of crossing facilities that are not at grade, especially among older pedestrians. However, the use of a stated preference survey brings additional information, regarding the disutility of avoiding those facilities in terms of additional walking times. The values found for the additional walking times that people are prepared to walk to access straight signalised crossings (between around 1 to 6 minutes, depending on the alternative crossing, population group, and econometric model used) are a useful input for guiding engineering interventions that involve the construction of new crossing facilities, or the modification of existing ones. The values for the additional walking times above which participants prefer to avoid crossing the road altogether (between around 13 and 27 minutes) can also be used to map the areas around major roads where residents are unlikely to make trips across the road, as an indicator of the negative impacts of the road on accessibility and active travel.

The choice set available for a pedestrian in this survey contained only the use of designated crossing facilities and the option of not crossing. In most cases, the pedestrian also has the option of crossing the road in places without any facilities. Working Paper 08 in this series analyses pedestrians' decision to cross the road in those places, considering the attributes of the road (such as number of lanes and presence of a central reservation), the attributes of the traffic (such as volume and speed), the distance to the nearest safe place to cross, and the value of accessing a specific destination on the other side of the road.

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