Understanding geographic, demographic, and micro-level influences on travel choices – a discrete choice experiment

July 2024

Contents

Glossary

'Attribute(s)' – refers to characteristics of the things participants choose between in the discrete choice experiment (in this case, the routes participants chose between). The attributes included in this study were:

- **'Travel time'** – Time spent in transit.
- **'Additional time'** – Any extra time needed to complete the route.
- **'Cost'** – Costs or fees for the route.
- **'Chance of delays**' – Additional chance of delays over and above the predicted total trip time (i.e., travel time + additional time).

'Car club' – a car club allows you to hire a vehicle for a specific journey through an app (e.g. ZipCar) or using a membership card.

'Context' – refers to the contextual factors that were described to participants at the start of the discrete choice experiment. Participants were informed about three key factors:

- whether it is light or dark outside
- whether it is dry or raining
- whether it is important to arrive at the destination at a specific time or it does not matter when they get there

'Choice set' – refers to a single pair of options that participants choose between in the discrete choice experiment. The experiment as a whole consisted of multiple choice sets, each shown as a single question.

'Discrete choice experiment (DCE)' – a stated preference method that presents participants with a series of choices between pairs of options comprising pre-set 'attributes', each of which is described by one of several pre-set 'levels', and participants are asked to select their preferred option in each of the choices.

'Route(s)' – refers to a single option within a choice set (i.e., each choice set consisted of two routes).

'Rail' – a short-hand term used to refer to common modes of transport that rely on rails: including trams, trains, light rail, and metro. These modes were grouped into one mode in this DCE.

'Rental cycle' – A rental cycle allows you to hire a pedal cycle (including e-cycles) for a specific journey (e.g., through services like Lime Bike).

'Trip' – refers to the journey participants were asked to select a route for (i.e., participants had to choose between alternative routes for their trip).

Executive summary

Background

The Department for Transport (DfT) wants to achieve a sustainable transport network in which people can choose to travel in a way that meets their needs and preferences. To do this, it is working with local authorities and transport operators to improve all modes of transport and provide more people with access to sustainable travel options.

To inform further action to improve transport for the user and enable people to choose sustainable travel options, DfT needs to understand in as much detail as possible what the public's travel preferences are like, how different people and groups choose to travel, and what factors influence the choices people make. This research was commissioned to support this aim.

Methods

Verian carried out an online discrete choice experiment (DCE) with 2,400 participants from an online panel in 2024.

In the experiment, participants were asked to imagine they were planning for a short trip to visit a friend. They made a series of hypothetical choices between pairs of alternative routes, which differed in some or all of the following attributes:

- Mode of transport: walking/wheeling, private car, taxi, bus, rail (covering trams, trains, light rail, and metro), private cycle, rental cycle, and car club.
- Cost of the route.
- Time spent in transit.
- Any additional time spent (e.g., parking or waiting for a bus).
- Chance of delays: high, low.

For example, they could be asked to choose between a route with rental cycle which cost £2 for rental fee, took 30 minutes in transit and an additional 5 minutes to hire and (un)lock the bike, and had a high chance of delays, versus a route with private cycle which cost nothing, took 20 minutes in transit and an additional 2 minutes to park the bike, and had a low chance of delays. They could also choose not to travel if neither route was acceptable. To encourage participants to respond in a realistic fashion, the choices were shown in a mocked-up journey planner app, which would be familiar to many.

In addition to varying the trip attributes within participants, the DCE's instructions randomly varied the context in which the trip took place between participants. The contextual factors varied were:

- Weather: raining vs. dry.
- Light level outside: light vs. dark.
- Flexibility of arrival time: flexible vs. needing to arrive at a specific time.

Analysis was carried out to estimate to what extent each attribute affected the odds of someone choosing to take a given route. For example, whether participants were more likely to choose a route with private car compared to one with bus. The results were also used to predict the proportion of people who would prefer to travel by each mode within two scenarios defined by DfT: reducing fares for public transport or making shared transport modes more convenient. The study included a benchmarking stage to compare mode preferences predicted by the results of the DCE to estimates of actual travel behaviour from the National Travel Survey.

Findings

The analysis found that private car was the most preferred mode of travel, and the least preferred were private cycle, rental cycle, and car club. Participants also preferred routes that were cheaper, quicker, and with a low chance of delays, all else held equal. Simulated preference shares showed that reducing the cost of bus and rail by 50% increased the share of bus by 0.92 percentage points from 14%, and the share of rail by 1.49 percentage points from 18%. Reducing the additional time for the two shared transport modes was predicted to increase the share of car club by 0.46 percentage points from the baseline share of 5%, and the share of rental cycle by 0.39 percentage points from the baseline of 6%.

Further analyses compared participants' choices across the contextual factors. Participants undertaking their trip in the rain preferred walking and cycling less than those travelling in dry weather, shifting their choices to routes by private car and public transport. In the dark, participants similarly preferred walking and cycling less than those travelling in the light, shifting instead to private cars and taxis but not public transport. Those travelling with a flexible arrival time preferred car the most, but that switched to rail for participants who needed to arrive at a specific time.

Analysis by gender found women expressing stronger positive preferences for travelling by private car, taxi, and public transport than men, as well as stronger negative preferences for private and rental cycle. These differences appeared to be partially context dependent, for example women shifted from walking/wheeling to travelling by car when travelling in the dark while men did not appear to do so.

The benchmarking exercise found the ordering of mode shares broadly consistent between the simulated results from the study and the NTS estimates, with private car being the most popular mode, followed by walking/wheeling and bus. However, there were notable differences in scale, with the simulations underestimating the share of private car and overestimating the shares of other modes. We discuss a number of potential explanations for these differences. The study focused on preferences, which may not take into account barriers to access, while the NTS estimates are intended to measure actual behaviour. There are also several ways in which the types of trips covered by the two sets of estimates may not be similar enough to allow for a clean comparison.

Overall, the study found a consistent popularity of private car across contexts and demographic subgroups. There was a relative lack of appetite for the newer shared modes (car club and rental cycle), potentially due to the low awareness and understanding of them at the moment. Modal choices were affected by weather, light conditions, and whether a trip was time-sensitive, and there were substantial differences in how males and females responded to these contextual factors.

This research provided a case study of using the method of online choice experiment to explore travel preferences for a short leisure trip. Further study can extend the method to explore travel preferences for additional modes, under different trip purposes and lengths, and examine the influences of other micro-level factors.

Introduction

Background

The Department for Transport (DfT) wants to achieve a sustainable transport network in which people can choose to travel in in a way that meets their needs and preferences. To do this, it is working with local authorities and transport operators to improve all modes of transport and provide more people with access to all travel options.

To inform further action to improve transport for the user and enable people to choose sustainable travel options, DfT needs to understand people's travel preferences and what factors influence these. DfT knows that different groups might have different modal preferences, but further work is required to know more about the needs of these groups. Previous research found that in particular, there were differences in travel behaviours and the use of newer transport modes between different gender groups and ethnic minorities (Department for Transport, 2021).

To help develop evidence on this, DfT commissioned this research in September 2023 to understand people's travel preferences in the limited context of a short leisure trip made under different conditions to establish the viability of this approach to studying preferences and to develop evidence on modes for which the evidence is particularly weak.

Research questions

The study's research questions were:

RQ1. Which transport modes do people prefer, and by how much?

RQ2. To what extent are modal preferences affected by variation in key attributes – mode of transport, cost, travel time, additional time and chance of delays?

RQ3. How do modal preferences differ depending on the context in which the trip is undertaken, specifically:

- whether it is light or dark outside
- whether it is dry or raining
- whether or not it is important to arrive at the destination at a specific time

RQ4. How do modal preferences differ between demographic subgroups within the study sample?

To address these research questions, Verian ran an online discrete choice experiment (DCE). DCEs are a technique for finding out how influential different attributes of a decision are on the choices people make through the elicitation of stated preferences. They are an established method that have been used to explore transport preferences (König & Grippenkoven, 2019; Ulahannan & Birrell, 2022) and have been used to successfully predict real-world behaviour (McPhedran et al., 2022).

The core DCE design answers RQs 1-2. To answer RQ3, the context for the trip was varied at random. Finally, a post-DCE questionnaire collected demographic information for subsample comparisons, to answer RQ4.

Methods

Discrete choice experiment

Design

To answer RQs 1 and 2, the DCE tested how five attributes affected the likelihood of someone choosing a given travel route: mode of transport, cost, travel time (i.e., time spent actually in transit), additional time (e.g., waiting for a train, looking for a parking spot), and chance of delays. The full list of attributes and levels agreed with DfT are summarised in Table 1.

Table 1: DCE attributes and levels

Attribute	Levels
Mode of transport	1 Walk/Wheel
	2 Private car
	3 Taxi
	4 Car club
	5 Private cycle
	6 Rental cycle
	7 Bus
	8 Train/Tram/Tube/Light rail/Metro[1]
Cost Costs or fees for the journey (e.g., fares, rental fees, parking fees) but not periodic costs for maintaining access to a mode (e.g., MOT)	1 Low
	2 Medium-low
	3 Medium-High
	4 High
Travel time Time spent in transit, including walking to and from the station(s) and/or bus stop(s)	1 Low
	2 Medium-low
	3 Medium-High
	4 High
Additional time Any extra time needed to complete the journey (e.g., waiting for a train, looking for a parking spot)	1 Low
	2 Medium-low
	3 Medium-High
	4 High
Chance of delays	1 High chance of delays
	2 Low chance of delays

The medium-low and medium-high level values for cost, travel time, and additional time were designed to reflect realistic estimates for each mode, while the values of the low and high level represented more extreme, but still plausible cases. These estimates were derived from a combination of previous research and existing transport statistics identified by DfT. The full list of costs, travel times and additional times tested for each mode, including the sources from which they were derived is in Technical Annexe 2 – DCE attribute levels.

[1] Hereafter referred to as 'Rail'

The DCE consisted of 32 choice sets, each containing pairs of travel routes. The 32 choice sets were divided into two blocks of 16, and each participant was randomly shown one of the two blocks (16 choice sets). The two routes in each choice set always differed by mode and could also differ by any or all of the other attributes. Participants were asked to select which route, if any, they would choose. If, given the two routes, the participant would prefer not to travel they could select: "Neither route and won't travel". Figure 1 below shows an example of the choices in the DCE. For a full list of choices posed to participants, see Technical Annexe 4 – Questionnaire. For a technical description of how the choice sets were constructed from the matrix of possible combinations of attribute-levels, see Technical Annexe 1 – Data collection and analysis methods.

Framing and presentation

Before beginning the DCE, participants were asked to imagine they were planning a journey to visit a friend at their home.

To encourage realistic decision-making, participants were shown the choice sets within a mocked-up journey planner app, styled on Google Maps. Irrelevant features of the real-life app were removed in the mocked-up version to help participants make choices focusing on the key attributes of interest in the experiment. For an example of how a choice was presented to the participants in the experiment, see Figure 1. For the explanation of each element of the mocked-up journey planner app as shown in the participant instructions, see Figure 2.

Figure 1: Example choice from the DCE.

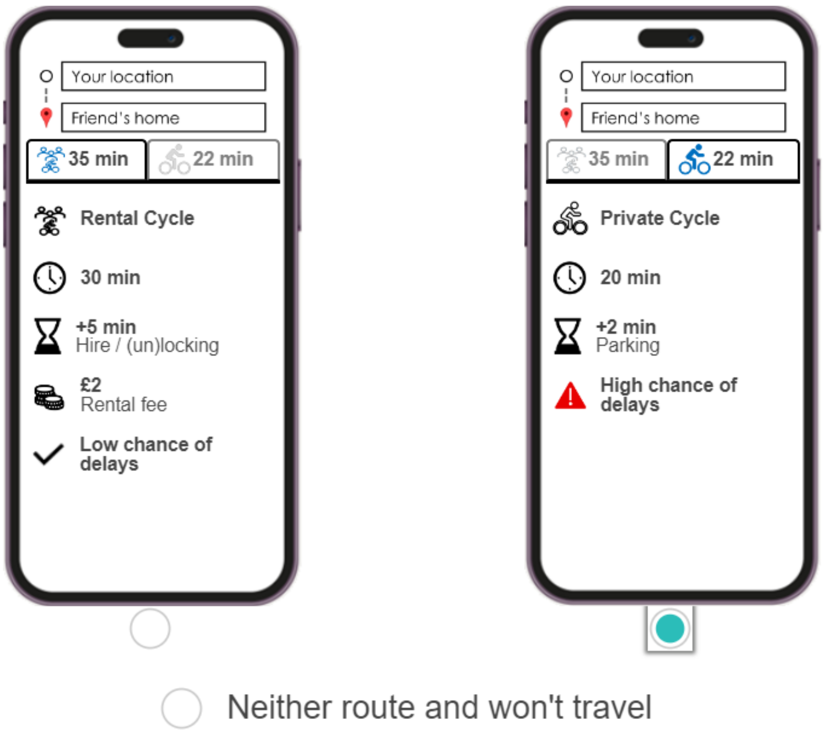


Figure 2: Explanation of each element of the choice interface, as shown in the participant instructions.

Trip context

To answer RQ3, Verian systematically varied the context in which the trip took place. The contextual factors selected for exploration by DfT were:

- whether it is light or dark outside
- whether it is dry or raining
- whether it is important to arrive at the destination at a specific time or it does not matter when they get there

These three binary contextual factors created a total of eight possible combinations, each corresponding to an arm, to which participants were assigned at random. The trip's context was explained to participants in the pre-task instructions. An attention check immediately followed, and those who did not pay attention were screened out (see 'Data quality and exclusions' for more).

Post-DCE questionnaire

After completing the DCE, participants answered questions about their use of and access to different modes in real life, awareness of car clubs, e-bikes and rental cycles, and demographic characteristics. The purpose of this questionnaire was to inform recruitment quotas and provide answers to RQ4. For the full post-DCE questionnaire, see Technical Annexe 4 – Questionnaire.

Analysis methods

Exploratory analysis

Descriptive statistics for all data collected are reported either in the body of this report or in Appendix C – Responses to post-DCE survey questions. The report includes some exploratory independent-samples t-tests for equality of means of the frequency of choices associated with different modes, with Bonferroni Correction for multiple testing applied. These tests are included to highlight key pairwise differences between different contexts (e.g., light versus dark) and between demographic subgroups (female versus male). The results of these exploratory tests should be treated as illustrative and complementing the study's main results, not as robust standalone findings.

Statistical models

To analyse the results of the DCE, Verian applied a mixed (or random parameters) main effects logit model with correlated random parameters. A logit model predicts the probability an event occurring based on a given set of independent factors; in the case of this study, the model predicts the probability of choosing a specific route based on its attribute levels. A mixed model allows for parameters to vary across participants, providing more flexibility for the model to have a better fit of the data. Mixed logit models are one of the accepted analytic techniques for DCEs (Hauber et al., 2016), and one of their key advantages is that they allow for heterogeneity in preference between individuals. For a more detailed description of statistical methods, additional robustness checks and rationale, please see Technical Annexe 1 – Data collection and analysis methods.

The model includes a separate parameter for each mode of transport, except walking/wheeling which serves as the reference mode to which others are compared. The model also includes a parameter for high chance of delays (relative to low chance of delays), and three continuous predictors representing the effects of cost, travel time, and additional time on travel preferences.

The model produces two outputs of interest for each parameter:

- a p-value, which can be used to determine whether a given parameter has a statistically significant effect on choice, and

- odds ratios, which give the direction and strength of the effect. An odds ratio for transport mode is the ratio of the odds of choosing to undertake a route using a given mode (e.g., bus) to an otherwise identical route where the mode is set to the reference level (i.e., walking/wheeling). An odds ratio above one means the corresponding level is preferred to the reference level, and a number below one means the opposite.

These two model outputs tell us whether the effect is statistically significant and the size of the effect (odds ratio). For example, a statistically significant odds ratio of 1.5 for private car, suggests that private cars are preferred over the reference level (walk/wheel). Specifically, the odds of choosing a route with private car is 1.5 times the odds of choosing a route with walking/wheeling, when travel time, additional time, cost, and chance of delays are all held equal.

Where statistically significant results are reported, these have a p-value of under 0.05, where the p-value is the probability of getting the observed or more extreme data, assuming the null hypothesis is true.

Simulating mode shares

The main analysis model can be used to simulate the proportion of people who would choose a given mode from a set of specified routes. This report contains the results of several such simulations to illustrate the study's results in an intuitive fashion. It should be noted that these simulations rest on several assumptions, which are discussed at length under 'Strengths and Limitations'. For details of how these simulations were carried out, see Technical Annexe 1 – Data collection and analysis methods.

Benchmarking against estimates from the National Travel Survey

To understand how well the stated preferences elicited by the DCE match actual behaviour under real world constraints, Verian conducted a benchmarking exercise to compare the predicted mode shares from the DCE to the estimates from the National Travel Survey (NTS). For more details about the methods of the benchmarking exercise, see Technical Annexe 3 – Notes on benchmarking exercise.

Sampling and fieldwork

Sample

Participants, who were adults aged 18 to 65 and resident in England, were recruited from Kantar's online access panel, Lifepoints. For recruiting purposes, the study was described to participants as "a study about travel preferences". We recruited 3,542 participants to achieve the target sample size of 2,400 after exclusions for screening and quality checks (see Section 4 – Sample description for more details).

Panellists are rewarded with payments for completing online surveys using 'Lifepoints', which they can exchange into vouchers/e-gift certificates or money via PayPal. Participants were paid approximately £1 for the completion of this study (Median completion time: 8 minutes and 23.7 seconds).

Quotas on age groups within gender, ethnicity, socio-economic group and region of residence were applied to make sure the sample was demographically representative of the general population in England.

Fieldwork dates

Fieldwork was conducted between 2 February and 13 March 2024.

Exclusions / data quality

The experiment included an attention check question asking participants to recall a critical part of the study's instructions – the context in which the trip was taken. This question was included immediately after the trip context was introduced to the participants. Those who failed the attention check question once were shown the instructions again and given a second chance to answer the question. Any participants who failed for a second time were excluded from the study.

Additionally, any 'speeders' – participants who completed the study more quickly than a careful reading of the instructions would allow for – were also excluded. The definition of speeders was a standard one used across many surveys: dropping any participants who completed in under 40% of the median completion time (3 minutes and 13 seconds).

Results

Sample description

2,400 adult residents aged 18 to 65 (M_{age} = 42.5) in England were included in the final sample, after excluding participants who failed the attention check twice (n = 998) and the 'speeders' (n = 144).[2] The median completion time of the study was 8 minutes and 23.7 seconds (Mean: 12 minutes, 29.3 seconds, IQR: 5 minutes 58.8 seconds to 12 minutes 4.1 seconds). Please see Appendix A for details on the demographic composition of the sample.

Travel preferences when aggregating across contexts

Descriptive statistics for participants' choices

Across the full sample, participants selected one of the two travel routes an average of 12.41 (*SD = 4.25*) of the 16 choice sets presented to them. A small minority chose the opt-out "Neither route and won't travel" on every choice (n = 57).[3]

The most frequently chosen mode of transport was private car, which respondents selected an average of 2.02 times. This was followed by rail, bus, taxi, private cycle, walking/wheeling, car club, and finally rental cycle. See Table 2 for the mean and standard deviation of the frequency per participant with which each mode was chosen.

Table 2: Mean and Standard Deviation of the frequency per participant with which each mode was selected

Mode	Mean	Standard Deviation (SD)
Private car	2.02	1.13
Rail	1.87	1.47
Bus	1.74	1.22
Taxi	1.63	1.06
Private cycle	1.59	1.43
Walk / Wheel	1.46	1.42
Car club	1.10	1.43
Rental cycle	0.99	1.08

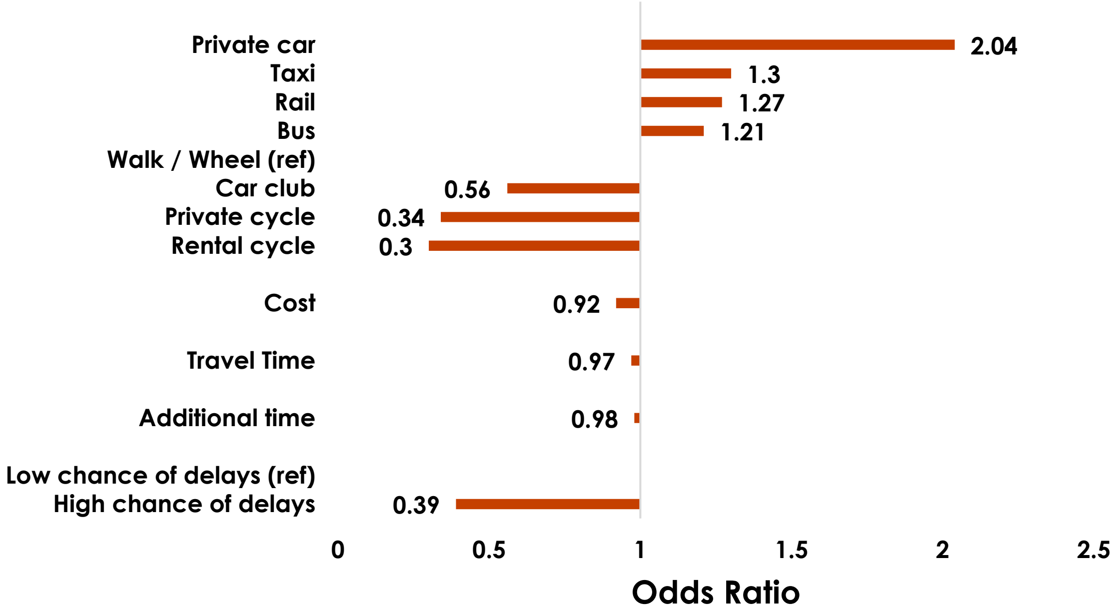
[2] "n" refers to number of participants.
[3] These participants might have had a low preference for travelling in general and were included in the analysis to allow the estimates to reflect the overall travel preferences across the full study sample. Please see Technical Annexe 6 – Sensitivity analysis for results of the sensitivity analysis excluding these participants.

Estimated preference weights for choice attributes

The main mixed logit analysis model found statistically significant effects for all modes, cost, travel time, additional time, and chance of delays on the odds of someone choosing a given route.

The model's parameters can be shown as 'odds ratios' for each level of each attribute, as in Figure 3. These odds ratios can be interpreted as preference weights showing the direction and strength of preferences for that level, with values greater than one indicating a positive preference for that attribute and a value less than one meaning the opposite. Odds ratios for categorical predictors (mode and chance of delays) show preferences relative to a reference level (walking/wheeling and low chance of delays, respectively), which take an implicit value of one. Continuous predictors for cost, travel time, and additional time do not have a reference level, and they show the effect of each additional pound or minute respectively on the odds of someone choosing any given route. For example, as shown in Figure 3, the odds ratio for cost is 0.92 indicating that increasing the cost of a route by £1 decreases the odds of choosing a route by 8%. See Appendix B Table 1 for a full model summary table.

Figure 3: Odds ratios produced from the main mixed logit analysis model coefficients. For each non-reference mode and high chance of delays, odds ratios > 1 indicate a preference for that level over the reference level (walk/wheel and low chance of delays). For cost, travel time, and additional time, odds ratios > 1 indicate a preference for higher value. All odds ratios differed from 1 with statistical significance.



As in the descriptive statistics for participants' choices, private car was the most strongly preferred mode and rental cycle the least preferred mode. The other modes sit in between, although their ordering differs slightly from those seen in the descriptive statistics. This is because the frequency of choosing a mode in the descriptive statistics was influenced not only by the mode, but also by the other attributes associated with the mode in a route; whereas the odds ratios for the modes estimated by the analysis model represent 'pure' modal preferences controlling for the other attributes specified. For example, private cycle's odds ratio is less than one, indicating that it is less preferred to walking/wheeling once the differences in the trip lengths one would expect of the modes have been covered by the travel time and additional time attributes.

Beyond 'pure' modal preferences, participants preferred routes that were less costly, took less time in transit, required less time spent waiting, and with a lower chance of delay. The odds of participants choosing a route with a high chance of delays were 0.39 times the odds of choosing one with a low chance of delays, everything else held equal. Given the odds ratio of 0.92 for cost (per pound), the influence of a high chance of delays on the odds of a route being chosen is equivalent to a £11.30 increase in cost. The similarity between the odds ratio for travel time and additional time suggests that participants did not seem to care much about whether time was spent in transit or on other things like waiting for the bus or looking for parking lots. The influence of a £1 increase in cost on the odds of a route being chosen is equivalent to increasing the travel time by approximately 2.7 minutes, and to increasing the additional time by approximately 4.1 minutes.

Simulated preferred mode shares

Where the odds ratios produced by the main analysis model show the effect of each attribute-level in isolation, simulations can be used to predict how many people would prefer to travel by any given route, among a range of possible routes using different modes with pre-specified attribute levels. Verian carried out preference share predictions for a set of eight routes – one for each mode of transport – each with a set cost, travel time, additional time, and low chance of delays.

The simulations produced preference shares for mode under three scenarios: one baseline scenario where the values of cost, travel time, and additional time are designed to approximate real-world values for each mode,[4] and two scenarios with modified attribute levels. Scenario 1 reduces the cost of bus and rail routes by 50% and scenario 2 reduces the additional time for shared transport modes (car club and rental cycle) by approximately 50%. For details of the exact values used for the simulations, see Technical Annexe 1 – Data collection and analysis methods.

Under the baseline scenario, private car was predicted to be the preferred mode with a share of 20%. This means that around 20% of a population resembling the study sample would prefer to travel by private car if given the choice between the eight routes offered in the baseline scenario. After private car, the next most popular modes were rail, bus, private cycle, taxi, walking/wheeling, rental cycle, and car club (Figure 4).

[4] Cost, travel time, and additional time were set at the mid-point of the two middle values for that mode, and chance of delays was set to low for all modes.

Figure 4: Simulated preferred mode shares under the baseline scenario, based on the main mixed logit analysis model.

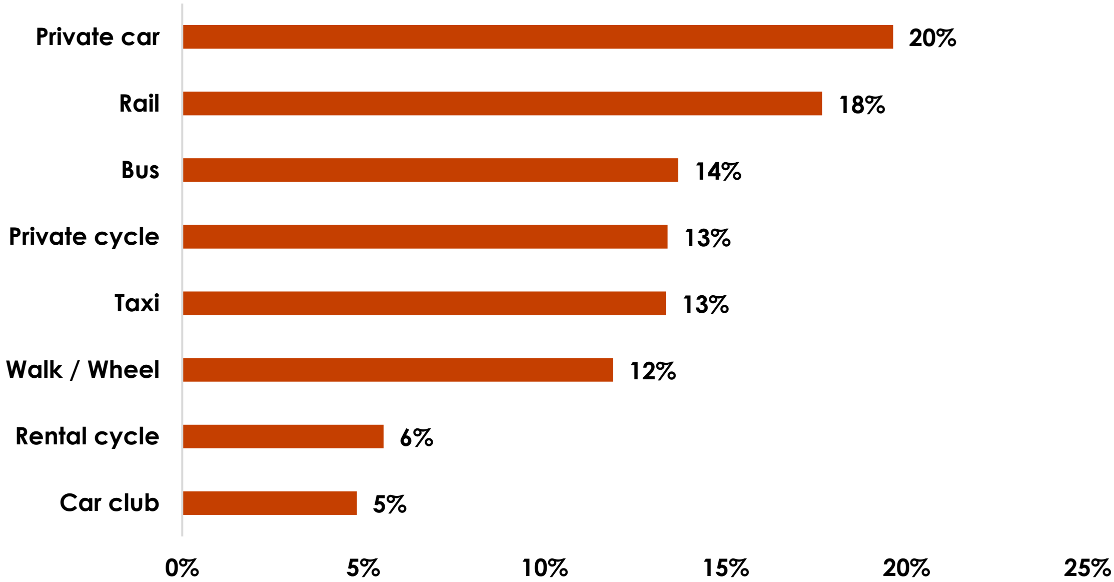


Table 3 shows the absolute and relative changes in simulated preferred mode shares under each of the two scenarios with modified attribute levels from the baseline scenario. Reducing the cost of bus and rail in scenario 1 was predicted to increase the share of bus by 0.92 percentage points from 14%, and the share of rail by 1.49 percentage points from 18%. Reducing the additional time for the two shared transport modes in scenario 2 was predicted to increase the share of car club by 0.46 percentage points from the baseline share of 5%, and the share of rental cycle by 0.39 percentage points from the baseline of 6%.

Table 3: Simulated preferred mode shares under the baseline scenario, scenario 1, and scenario 2, based on the main mixed logit analysis model.

Mode	**Baseline Scenario**	**Scenario 1** – Reducing cost of bus and rail by 50%		**Scenario 2** – Reducing additional time for car club and rental cycle by ~50%	
	Simulated preferred mode share (%)	Absolute change (percentage point)	Relative change (%)	Absolute change (percentage point)	Relative change (%)
Private Car	20	-0.65	-3	-0.22	-1
Rail	18	1.49	8	-0.10	-1
Bus	14	0.92	7	-0.15	-1
Private Cycle	13	-0.40	-3	-0.12	-1
Taxi	13	-0.63	-5	-0.16	-1
Walk / Wheel	12	-0.42	-3	-0.10	-1
Rental Cycle	6	-0.16	-3	0.39	7
Car Club	5	-0.15	-3	0.46	10

How contextual factors influence travel preferences

Descriptive statistics for participants' choices and exploratory pairwise comparisons

Table 4 shows differences in the mean frequency with which each mode was selected[5] when the sample is split by the three contextual factors affecting the trip: whether it is light or dark outside, whether it is dry or raining outside, and whether or not the participant needs to arrive at the destination at a specific time.

Table 4: Mean frequency per participant with which each mode was selected by the three contextual factors. Frequencies for any given mode that differed with statistical significance[6] across a context are shown in bold with an asterisk.

	Subsample by contextual factor					
	Weather conditions		**Light conditions**		**Arrival time**	
Mode	Raining	Dry	Light	Dark	Specific arrival time	Flexible arrival time
Private car	**2.16***	**1.98***	2.01	2.13	**1.99***	**2.15***
Rail	2.00	1.84	1.89	1.94	1.95	1.89
Bus	1.79	1.78	1.82	1.75	1.75	1.83
Taxi	1.62	1.71	1.66	1.67	1.70	1.63
Private cycle	**1.41***	**1.84***	**1.72***	**1.53***	1.62	1.64
Walk / Wheel	**1.28***	**1.71***	**1.61***	**1.38***	1.52	1.48
Car club	1.15	1.11	1.14	1.12	1.15	1.11
Rental cycle	**0.88***	**1.16***	1.06	0.97	1.03	1.00

Exploratory independent-samples t-tests for equality of means found statistically significant increases in private car selection when it is raining ($t(2,341) = -4.096$, $p < .001$) and when the arrival time is flexible ($t(2,341) = 3.483$, $p < .001$). Conversely, participants opted to walk/wheel or cycle less often when it was raining outside than when it was dry (walk/wheel: $t(2,341) = 7.427$, $p < .001$; private cycle: $t(2,341) = 7.429$, $p < .001$; rental cycle: $t(2,341) = 6.305$, $p < .001$), or when it was dark outside than when it was light (walk/wheel: $t(2,341) = 3.868$, $p < .001$; private cycle: $t(2,341) = 3.129$, $p = .002$). No other pairwise differences by context were statistically significant.

Estimated preference weights and simulated preferred mode shares

Verian repeated the main mixed logit analysis with subsamples split along each of these contextual factors and used the resulting models to generate simulated preference shares. Full summary tables for each of these subsample models are

[5] Excluding n = 57 participants who chose to opt out and select neither route on every choice.
[6] Independent-samples t-tests for equality of means. Statistically significant if $p < .002$ following Bonferroni correction for 24 tests.

shown in Appendix B, and simulated mode shares for the baseline scenario are shown in Figure 5 - 1, 2 and 3.[7]

Figure 5 (1): Simulated preferred mode shares for the baseline scenario based on subsample mixed logit analysis models by contextual factor – Raining vs Dry.

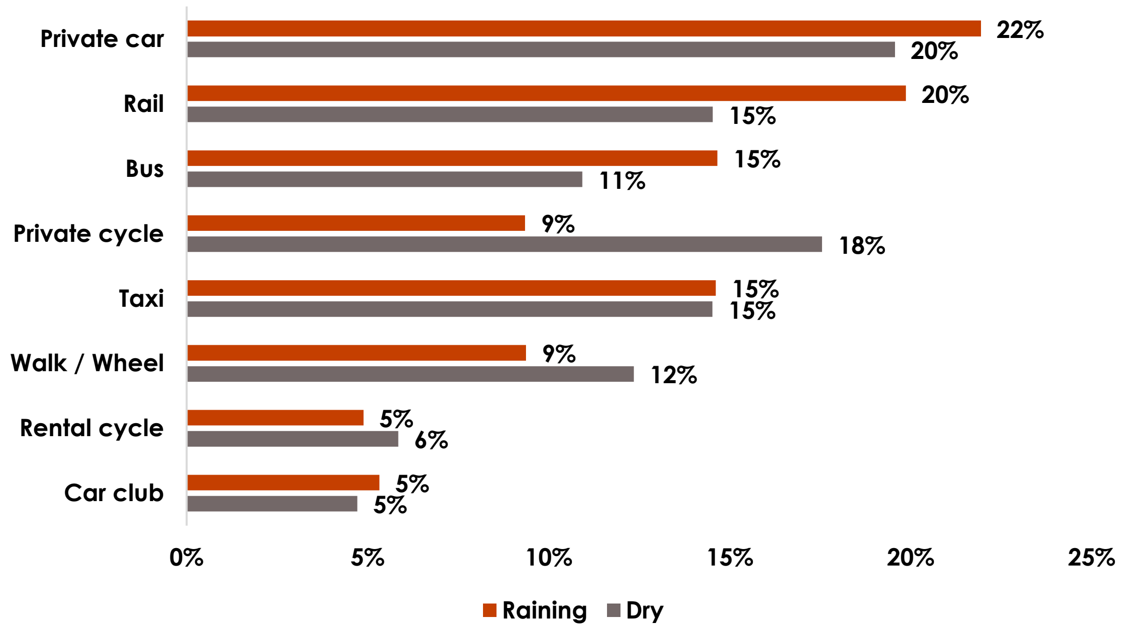
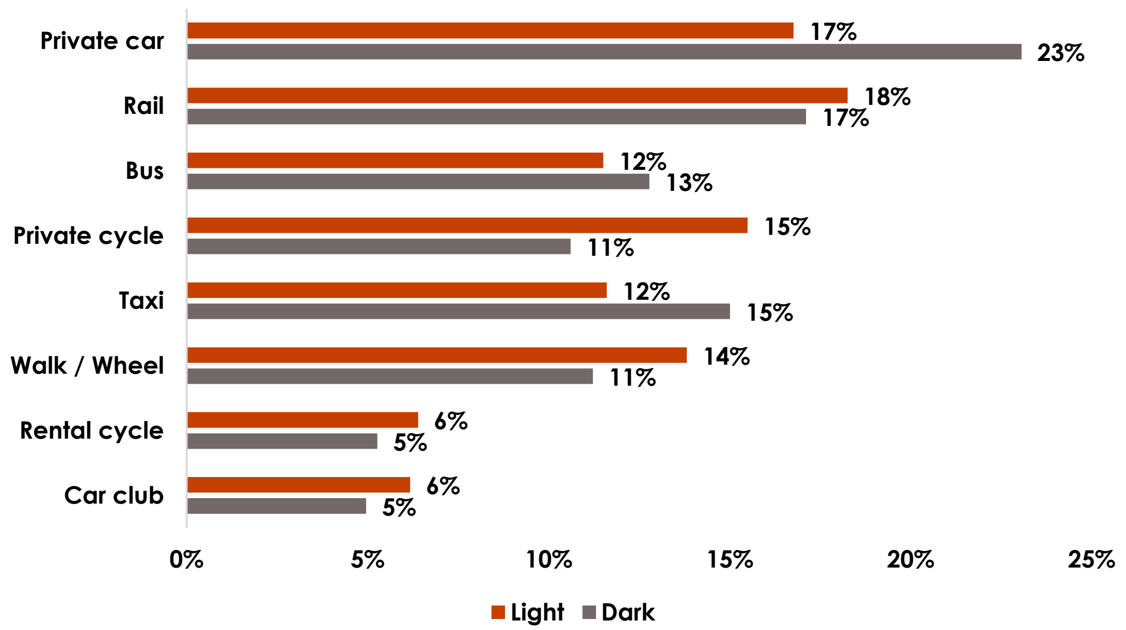
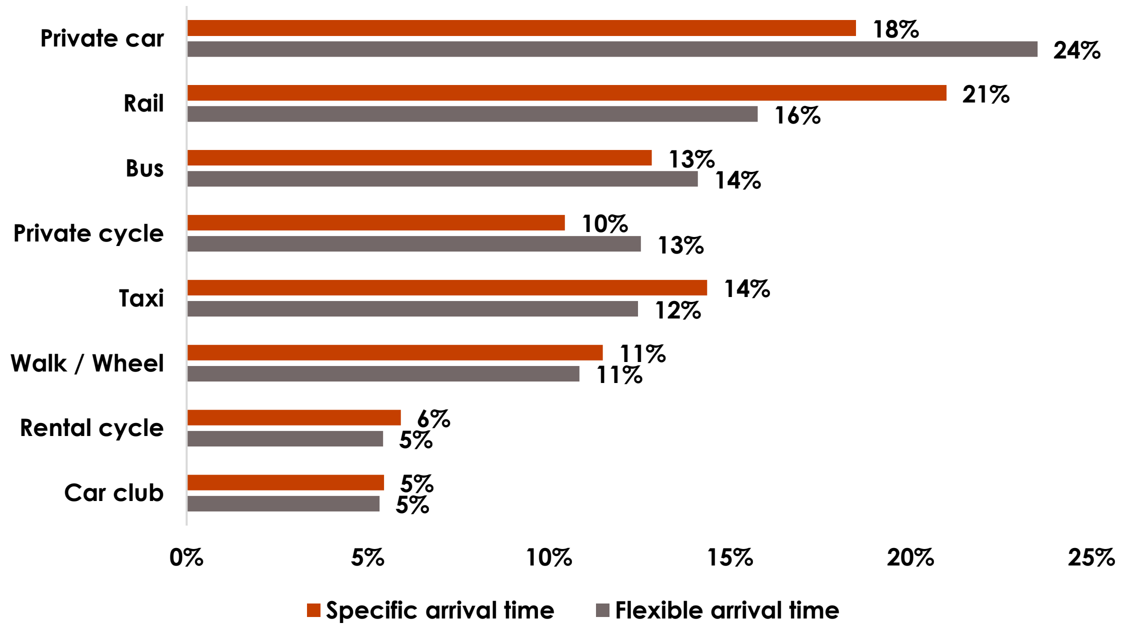


Figure 5 (2): Simulated preferred mode shares for the baseline scenario based on subsample mixed logit analysis models by contextual factor – Light vs Dark.



[7] A hierarchical Bayes analysis was also conducted to test the effects of contextual factors on modal preferences. See Technical Annexe 1 for details on the analysis method and Technical Annexe 5 for the results.

Figure 5 (3): Simulated preferred mode shares for the baseline scenario based on subsample mixed logit analysis models by contextual factor – Specific vs Flexible arrival time.



Verian also generated simulated preference shares under scenario 1 and scenario 2 using the subsample mixed logit analysis models to explore how the changes might differ depending on the three contextual factors.

Reducing the cost of bus and rail in scenario 1 is predicted to increase the share of bus by between 0.77 and 1.21 percentage points depending on the trip context. The increase is higher when it is raining compared to when it is dry, in the light compared to dark, and when arrival time is flexible rather than specific. At the same time, the share of rail is predicted to go up by between 1.24 and 2.03 percentage points in scenario 1 depending on the trip context. Similar to bus, the increase is higher when it is raining and when the arrival time is flexible. Whereas, for rail, the increases are similar in the light and dark. See Appendix D – Table 1 for the details of the predicted impact of scenario 1 on bus and rail, broken down by the three contextual factors.

Reducing the additional time for car club and rental cycle in scenario 2 is predicted to increase the share of car club by 0.38 to 1.37 percentage points depending on the trip context. The increase is higher when it is raining compared to when it is dry, when it is light compared to dark, while the increases are similar when the arrival time is specific and flexible. The predicted increase in the share of rental cycle in scenario 2 is between 0.04 and 1.10 percentage points depending on the trip context. Different from car club, the increase is higher when it is dry compared to when it is raining, when it is dark compared to light, and when the arrival time is specific rather than flexible. See Appendix D – Table 2 for the details of the predicted impact of scenario 2 on car club and rental cycle, broken down by the three contextual factors.

The full results of the simulations for all modes in the scenarios can be found in Appendix B.

Exploring the influence of demographic factors on travel preferences

Gender differences in modal preferences

Table 5 shows differences in the mean frequency with which each mode was selected[8] when the sample is split by gender. Exploratory independent-samples t-tests for equality of means found that women were statistically significantly less likely to choose each of the following modes than men: private cycle, rental cycle and car club.

Table 55: Mean frequency and standard deviation per participant with which each mode was selected by gender. Frequencies for any given mode that differed with statistical significance[9] across gender are shown in bold with an asterisk.

	Male		**Female**	
Mode	Mean	Standard Deviation (SD)	Mean	Standard Deviation (SD)
Private car	2.06	1.09	2.08	1.10
Rail	1.91	1.43	1.92	1.49
Bus	1.77	1.16	1.80	1.24
Taxi	1.66	1.02	1.67	1.06
Private cycle	**1.84***	1.41	**1.43***	1.42
Walk / Wheel	1.56	1.37	1.43	1.46
Car club	**1.23***	1.47	**1.04***	1.39
Rental cycle	**1.19***	1.10	**0.85***	1.04

Verian repeated the main mixed logit analysis with subsamples split by gender. In the main analysis model, cost is treated as a separate attribute so mode preferences can be quantified independently of price. This is important as it allows the results to be generalised beyond the specific price points tested. The odds ratios reveal that the observed pattern of mode choice may be partly attributed to gender differences with respect to cost, with women showing a stronger preference for cheaper routes than men. Independently of cost, women show stronger positive odds ratios for private car, taxi, and public transport modes (bus and train) than men, and more negative odds ratios for shared and private cycling (Figure 6).

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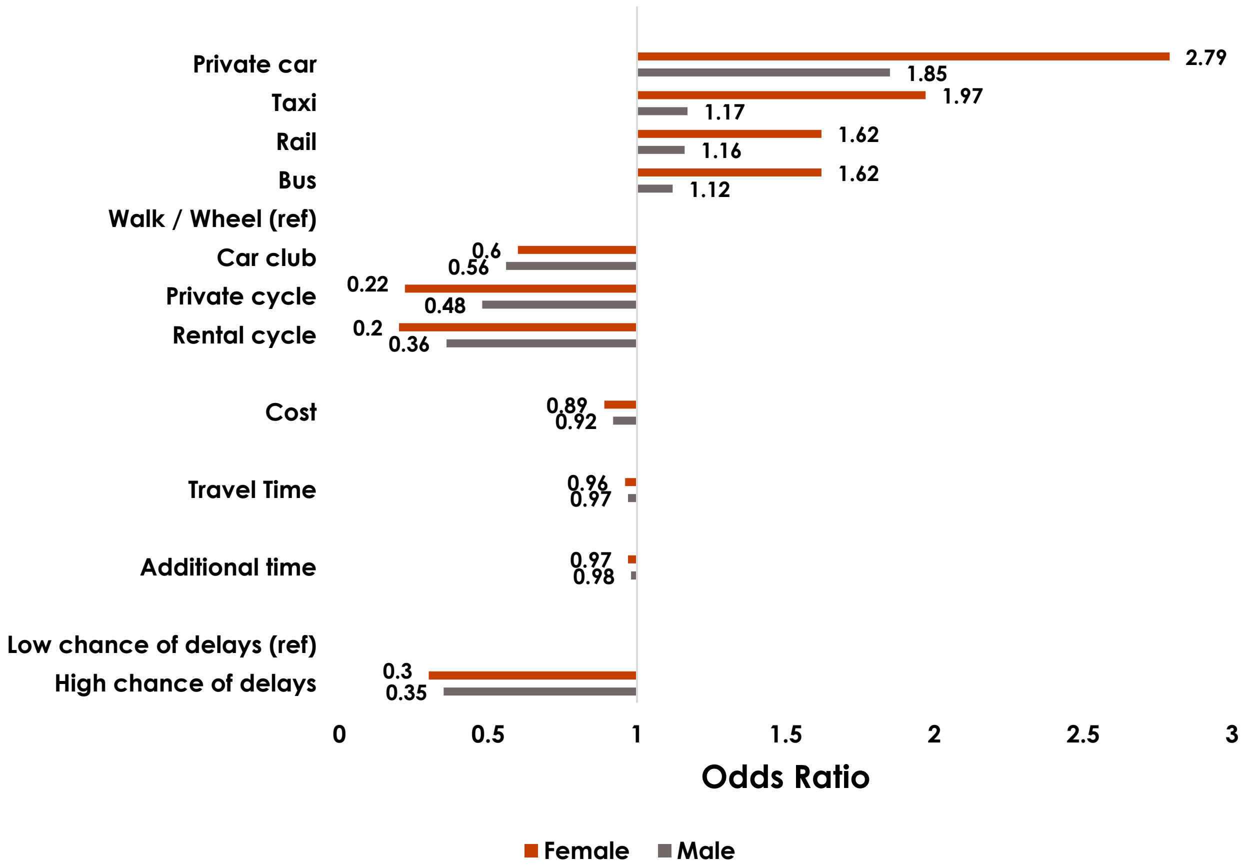
8 Excluding any participants who chose to opt out and select neither route on every choice.

9 Independent-samples t-tests for equality of means. Statistically significant if $p < .006$ following Bonferroni correction for 8 tests.

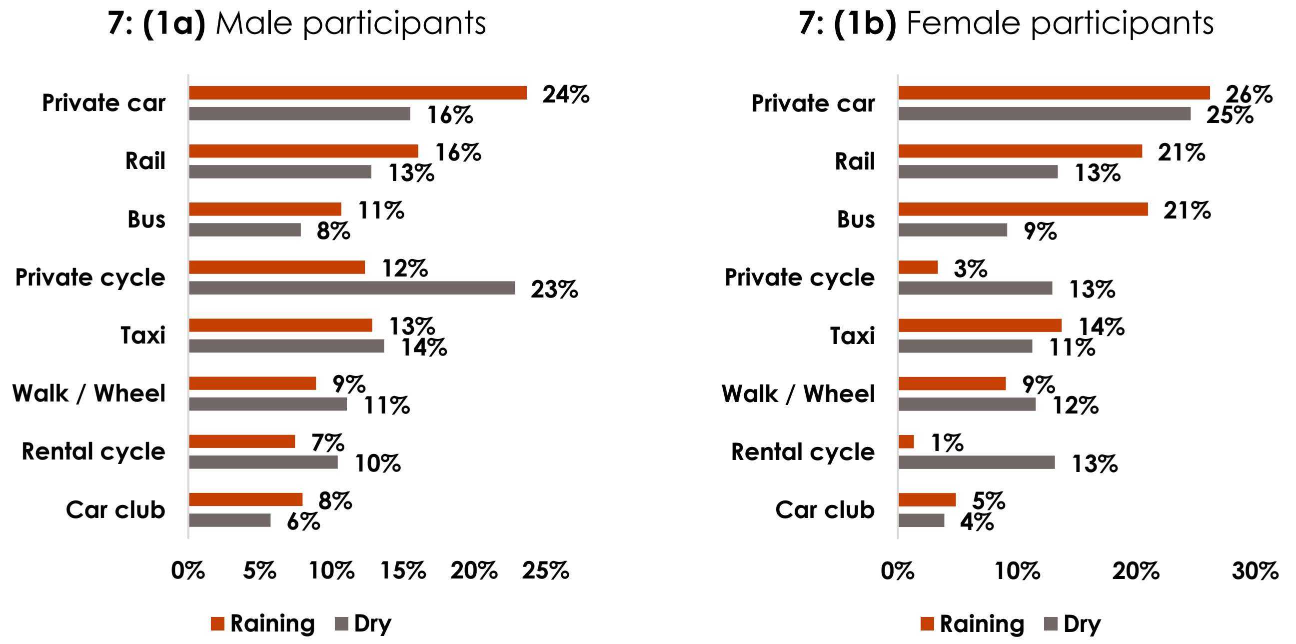
Figure 6: Odds ratios produced from the male and female subsample mixed logit analysis model coefficients. For each non-reference mode and high chance of delays, odds ratios > 1 indicate a preference for that level over the reference level (walk/wheel and low chance of delays). For cost, travel time, and additional time, odds ratios > 1 indicate a preference for higher value.



The subsample analysis was extended to cross contextual factors with gender, again using the same model specification as in the full sample. Full summary tables for these models are shown in Appendix B, and simulated mode shares for the baseline scenario are shown below in Figure 7 – 1 to 3.

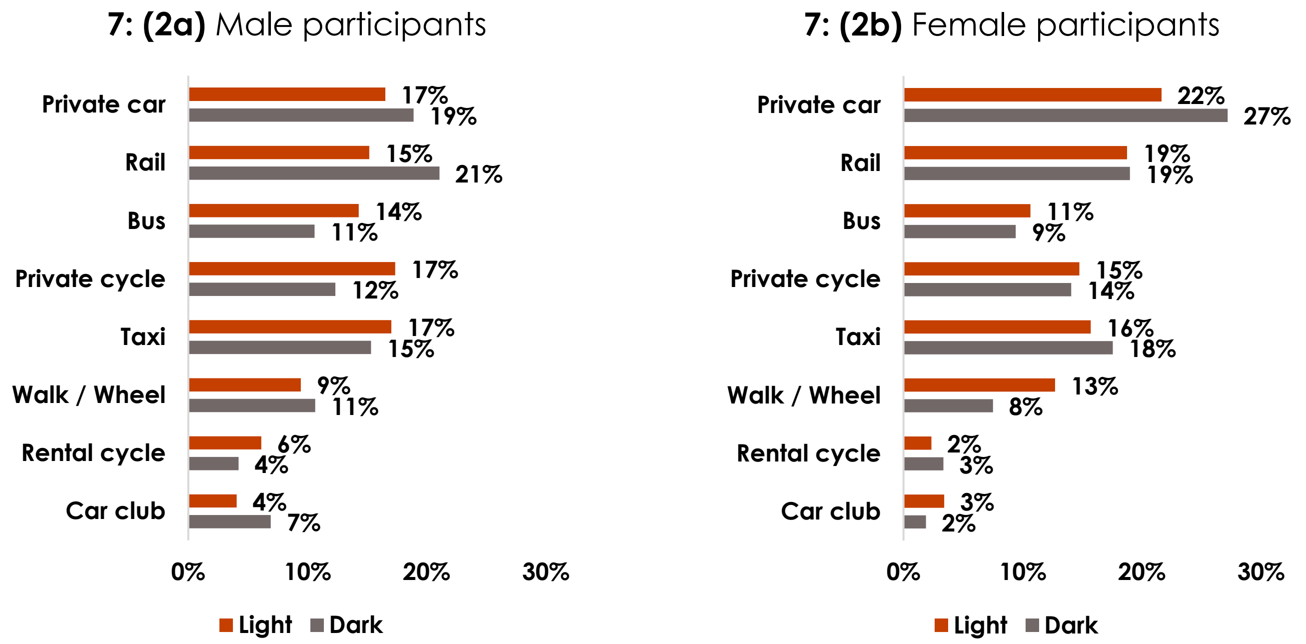
The simulations suggest both men and women would switch from walking/wheeling and cycling when it is raining outside, but that they may switch to different modes. For men, the largest increase is in private car usage, while for women there are more marked increases in use of public transport modes (rail and buses).

Figure 7: (1) Simulated preferred mode shares for the baseline scenario based on subsample mixed logit analysis models for Male (Figure 7: (1a)) and Female (Figure 7: (1b)) participants by contextual factor – Raining vs Dry.



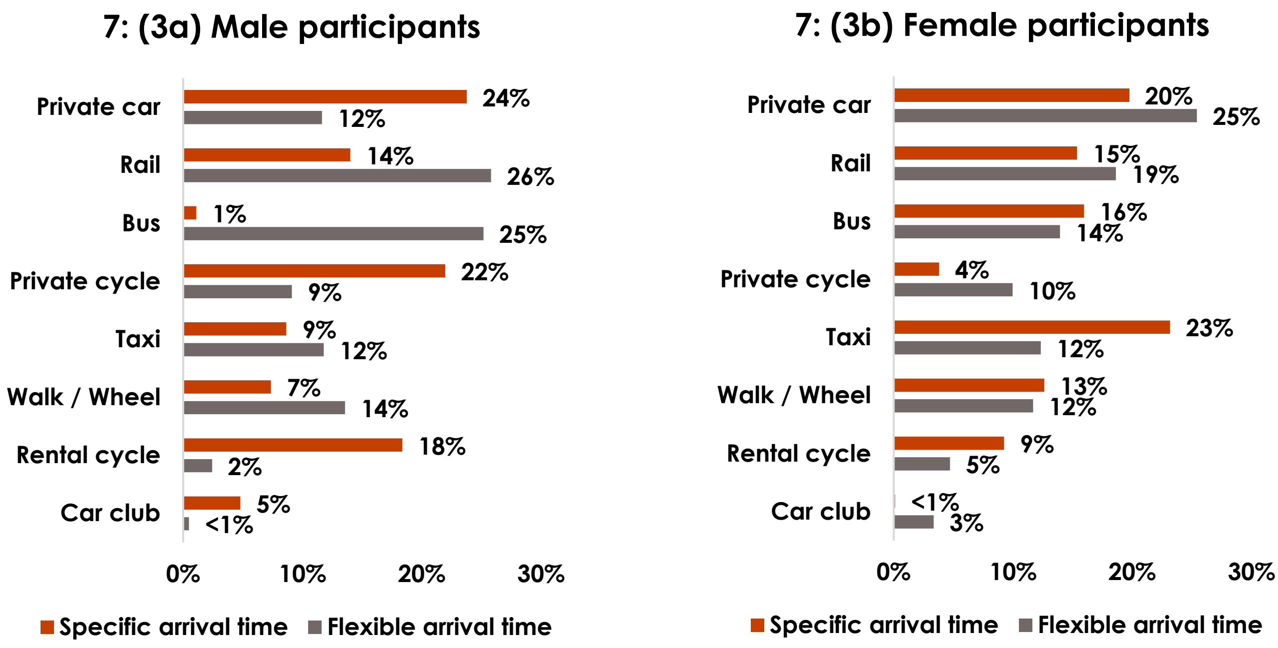
Simulated mode preference shares in the light and dark show a marked decrease in predicted walking/wheeling in the dark for women but not in men. For women, the mode whose use most noticeably correspondingly increases is private car.

Figure 7: (2) Simulated preferred mode shares for the baseline scenario based on subsample mixed logit analysis models for Male (Figure 7: (2a)) and Female (Figure 7: (2b)) participants by contextual factor – Light vs Dark.



When simulated mode shares were contrasted by whether it was important for a participant to arrive at the destination at a specific time yielded strikingly different simulated mode shares by gender. Men appeared more likely to prefer car or cycling modes (both private and shared) when there was a specific arrival time, and conversely were less likely to opt for public transport by bus or rail. By contrast, the largest observable shift for women was an increase in taxi's share when they needed to arrive at a specific time, and the opposite pattern for private car to that observed in men.

Figure 7: (3) Simulated preferred mode shares for the baseline scenario based on subsample mixed logit analysis models for Male (Figure 7: (3a)) and Female (Figure 7: (3b)) participants by contextual factor – Specific vs Flexible arrival time.



Descriptive analysis of modal preferences by other demographic factors

Verian also conducted a descriptive analysis of modal preferences by ethnicity, urban/rural, access to private car, and awareness of the two shared modes – car club and rental cycle. Please see Appendix D – Table 3 for details.

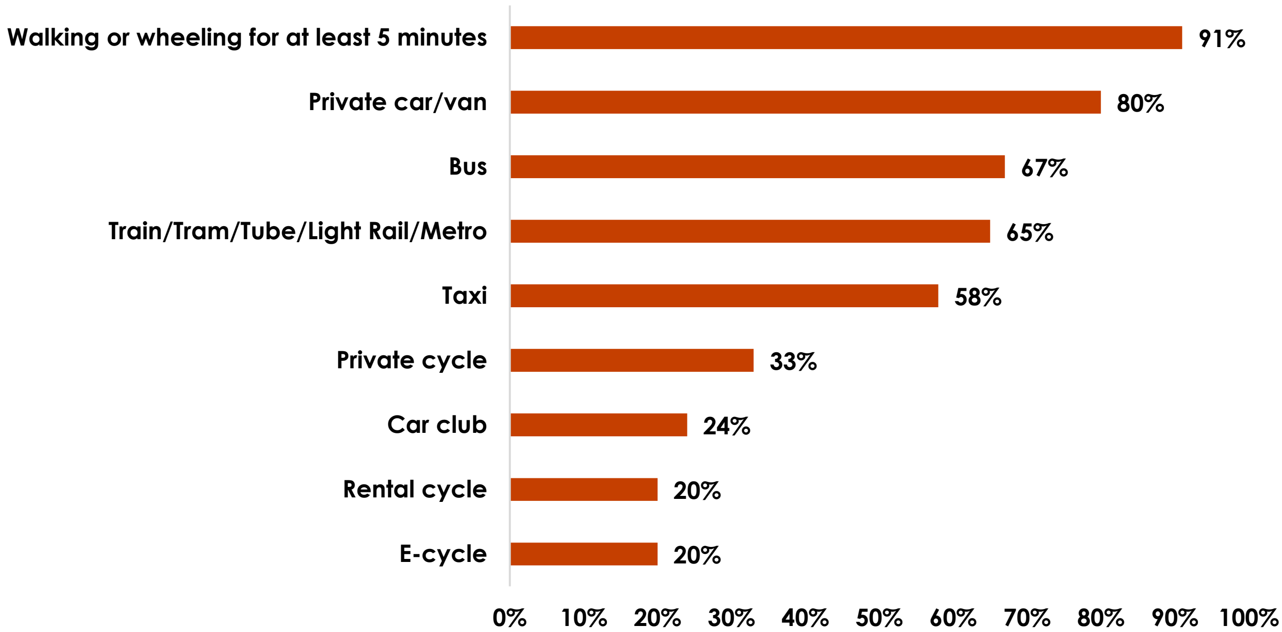
Descriptive findings from the post-DCE questionnaire

This section reports the results of the post-DCE questionnaire. These survey questions provide more demographic and background information about the participants in the study. For a full summary of responses to all questionnaire measures, please see Appendix C.

Recent use of different modes of transport

When asked about the proportion of trips they have personally travelled by the different modes of transport in the last 6 months, 91% of participants reported having walked (or wheeled) for at least 5 minutes[10] and 80% having travelled by private car/van, followed by bus (67%), rail (65%) and taxi (58%). A minority reported travelling in via by private cycle (33%), car club (24%), rental cycle (20%), or e-cycle (20%) in the last 6 months (see Figure 8).

Figure 8: Percentage of participants who reported having travelled by each mode in at least 'A few' trips over the last 6 months



Base: all participants (n = 2,400). Question: *"Thinking about the last 6 months, in what proportion of trips have you personally travelled by the following modes of transport?"* Participants responded by choosing one response option from "All", "Most", "Some", "A few" or "None". Figure 8 shows the percentage of participants

[10] It could seem implausible that 9% of the participants did not 'Walk/Wheel for at least 5 minutes' in any of their trips in the last 6 months. However, this could be to do with what counted as trips/travelling for these participants; for example, they could have walked to a nearby park but they did not consider that as a trip so chose 'None' in this question. A sensitivity analysis was conducted to check if the main DCE analysis results were robust to the exclusion of participants with unlikely survey response – please see Technical Annexe 6 – Sensitivity analysis for more details.

who chose any response other than "None". Please refer to Appendix C Table 1 for a detailed breakdown of responses.

Access to different modes of transport

A majority of participants reported having access to private car (Overall: 69%, Male: 67%, Female: 70%), bus (Overall: 63%, Male: 61%, Female: 64%), and taxi (Overall: 53%, Male: 53%, Female: 53%). Just under half of the sample reported having access to rail (Overall: 49%, Male: 49%, Female: 49%). Approximately one quarter of participants reported having access to private cycle (Overall: 25%), however slightly more males reported access (29%) than females (21%).

Relatively few participants reported having access to car club (Overall: 8%, Male: 12%, Female: 4%), rental cycles (Overall: 7%, Male: 8%, Female: 5%), or e-cycles (Overall: 6%, Male: 8%, Female: 4%).

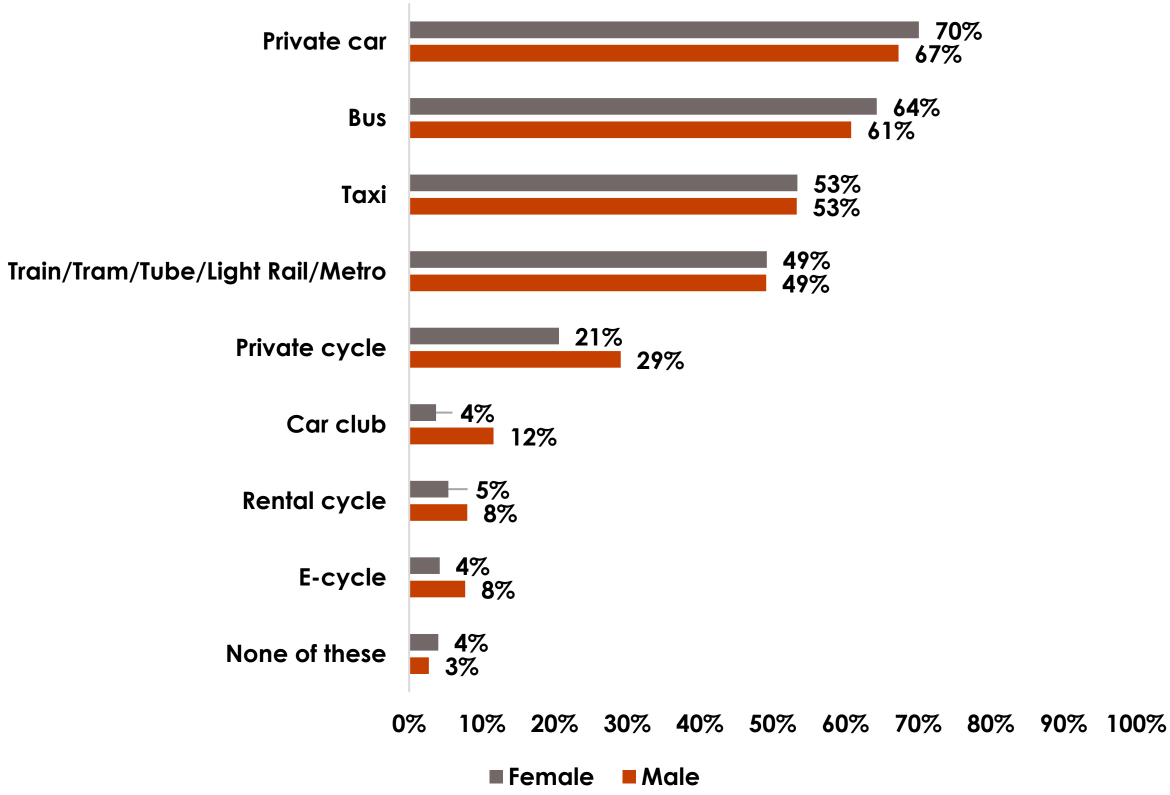
Finally, a small proportion of the sample reported having no access to any modes of transport listed (Overall: 3%, Male: 3%, Female: 4%). See Figure 9 for reported access to different modes broken down by gender.

Reported access to some modes may seem low. The National Travel Survey Factsheet (Department for Transport, 2022) found that 78% of English households own a car, whilst pedal cycle access ranges from 32-50% for various age groups between 17 and 60. Access to rail is harder to measure, so we do not have a direct comparison point calculated. There are a number of possible explanations for this, and they may differ by mode. For example, it is possible that some participants interpreted 'having access to' a mode in a more restrictive way than intended by the question. For example, they could have had friends or family driving them around but considered themselves not 'owning or having access to' a private car. Similarly, participants might have interpreted access to public transport modes in terms of whether they are easy to access, rather than possible. For example, a bus stop may be too far away to be of practical use, even if it is technically accessible. The same may apply to the cost of travel by taxi. Participants could have also interpreted access to car clubs and rental cycles based on installation of apps/holding of accounts rather than availability in their neighbourhoods, which might perhaps explain the gender differences in the responses to these modes.

Note that the explanations set out above are speculative and cannot be confirmed from the responses to this study.

One possibility when questionnaire responses appear implausible is that some participants were not paying careful attention when giving their answers. Given that risk, it is important to ascertain whether the study's main results are distorted by a subset of participants making atypical choices. To answer this question, sensitivity analyses were carried out to replicate the study's main analysis excluding different subsamples of participants who gave answers that could be considered implausible. The overall pattern of results was always similar, lending credence to the inference that the reported results reflect participants' genuine preferences. Technical Annexe 6 - Sensitivity analysis for more details.

Figure 9: Reported access to different modes of transport by gender.



Base: all participants (n = 2,400). Question: *"Which of the following transport modes, if any, do you own or have access to?"*. Participants responded to each question with 'Yes' or 'No'. 'None of these' was mutually exclusive from other response options.

Ability to drive and cycle

76% of participants reported holding a full valid driving licence in the UK, whilst 79% of participants reported being able to ride a pedal cycle, such as a bicycle, tricycle, recumbent cycle.

Awareness of 'new' modes of transport

Most participants reported that they had either never heard of car clubs (32%) or that they had "heard of them but [knew] nothing about them" (24%). Less than half were unfamiliar with e-bikes ("Never heard of them": 7%, "Heard of them but [knew] nothing about them": 25%) and rental cycles ("Never heard of them": 12%, "Heard of them but [knew] nothing about them": 27%). See Appendix C Table 3 for a full breakdown of responses related to awareness of these modes of transport.

Importance of motivational and contextual factors during decision making

Participants were asked about the importance of three motivational factors: the environment, personal finances and getting to places quickly. These factors were selected due to their potential influence on decision making in the context of route planning. Most participants indicated they were concerned about the environment (73%), and personal finances (71%). Similarly, more than half of participants reported that getting to places quickly was important (56%). See Appendix C Table 5 for a full breakdown of participants' responses to these questions.

Participants were also asked about the importance of a variety of contextual factors when making travel decisions. Most participants reported that both the weather (76%) and light conditions (63%) were important contextual factors during decision making. Similarly, many participants reported that they were concerned about protecting their health (61%) and personal safety (61%) when travelling, while about half of the sample (51%) considered what else they could do (e.g. reading, working, socializing) in transit. See Appendix C Table 6 for a full breakdown of participants' responses to these questions.

Benchmarking against estimates from the National Travel Survey

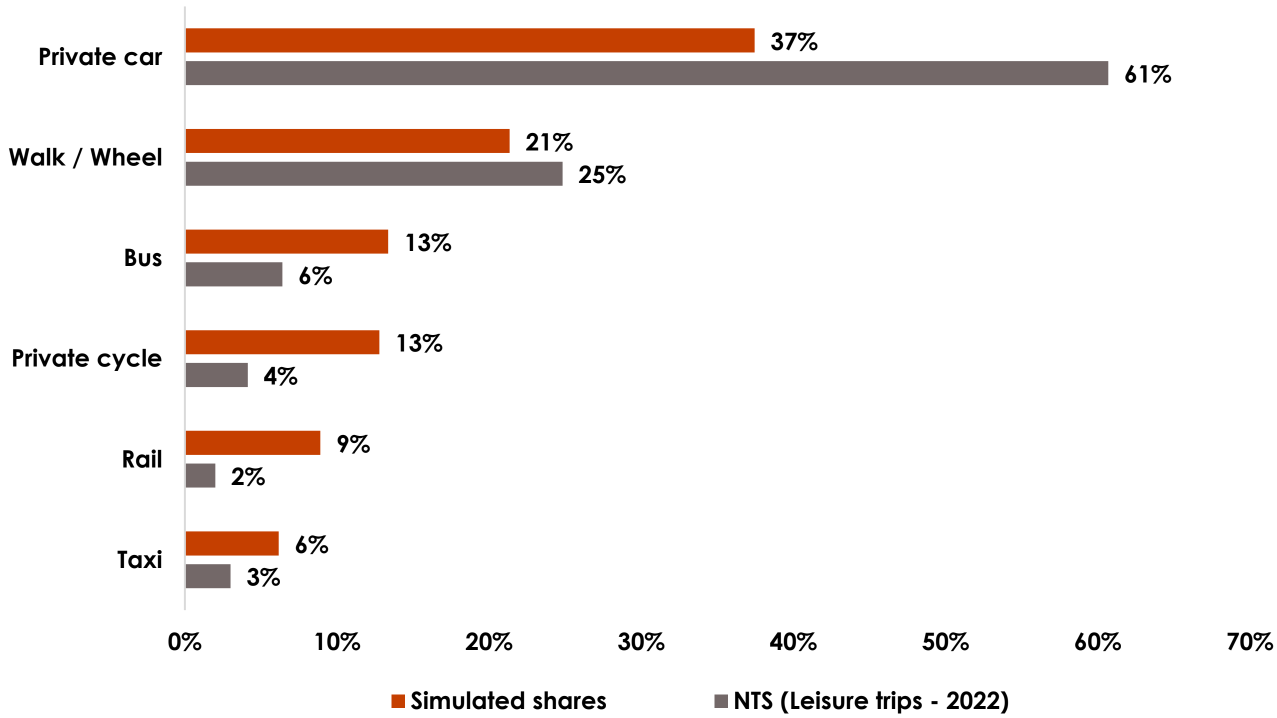
This section reports the findings from the benchmarking exercise, where the simulated preferred mode shares based on the stated preferences elicited in the study were compared against the real-world behaviour measured by the National Travel Survey (NTS). The preferred mode shares were simulated using the estimated full-sample mixed-logit model with mode-specific attribute values based on average trip characteristics for each mode as recorded within the NTS. The real-life shares were calculated using the average number of leisure trips by main mode from the 2022 National Travel Survey. For more details about the methods of the benchmarking exercise, see Technical Annexe 3 – Notes on benchmarking exercise.

Main benchmarking exercise

The main benchmarking exercise compared the shares of six out of the eight modes included in the experiment, except the two shared modes – car club and rental cycle – since they were not explicitly included under any of the categories provided in the NTS.

The ordering of the shares of the six modes was broadly consistent between the simulated results from the study and the NTS estimates, with private car being the most popular mode, followed by walking/wheeling, bus and private cycle. Rail and taxi were the least popular modes (Figure 10).

Figure 10: Results of the main benchmarking exercise comparing simulated preferred mode shares based on average NTS trip characteristics to the NTS estimates of shares of leisure trips by mode



However, there were also notable differences in the scales of predicted mode shares and the ‘real-life’ shares from the NTS estimates. For example, the simulated results underestimated the shares of private car by 24 percentage points, while overestimating the shares of bus, private cycle, rail and taxi.

There are several reasons that can potentially explain the differences. Firstly, the DCE assessed preferences over short journeys (< 5km) while the NTS benchmark estimates covered any trip length for a leisure purpose. It is plausible that many longer leisure trips were undertaken by car, leading to the higher shares of car in the NTS estimates.

Secondly, the DCE measured stated preferences, which are not constrained by practicality (e.g., access to public transport modes), habits or other constrains like finances, as real-world behaviour is. Participants might have also given socially desirable answers or chosen modes they would ideally want to take but would not in reality given the hypothetical nature of the choices in the study (i.e, the ‘intention-action gap’ as documented by previous literature (Sheeran & Webb, 2016)). Both of these factors could potentially explain the higher shares of bus, rail, and private cycle in the simulated results.

Thirdly, the simulated shares were sensitive to the attribute values used, regarding how long travelling by each mode should take and how much it would cost. In reality, these values are hugely variable depending on the location of the traveler and the trip length. Boiling such variation down to a single value for each attribute per mode means that some route choices available in real life were not represented in the simulations, where they would be in the NTS estimates.

In addition, the modes in the NTS estimates did not align perfectly with the modes used in the experiment, therefore the comparisons depend in part on how the modes were categorised in the benchmarking exercise. In the main benchmarking exercise, the two shared modes – car club and rental cycle – were excluded from the simulations. An additional benchmarking exercise was carried out to include these two modes in the simulations. The simulated share of car club was combined with the simulated share of private car to be compared with the share of ‘Car or van driver’ in the NTS estimates, while the simulated share of rental cycle was combined with that of private cycle to be compared with the share of ‘Pedal cycle’ in the NTS estimates. The simulated shares increased by 2 percentage points for car and pedal cycle respectively, but the overall pattern did not change much from the main benchmarking exercise. See Appendix D Figure 1 for the results of the additional benchmarking exercise including the two shared modes.

Additional benchmarking exercises for rural and urban areas

Two more additional benchmarking exercises were conducted using the NTS estimates for rural and urban areas respectively. These additional exercises used mode-specific attribute values based on average trip characteristics for each mode as recorded within the NTS for urban and rural areas respectively, and the rail mode was excluded as it was not possible to determine representative attribute values for the mode for these different areas. The NTS estimates for these benchmarking exercises were calculated using number of trips for all purposes, as data for leisure trips broken down by urban and rural areas was not available. The potential impact of the imperfect match of the trip purpose between the study and the NTS estimates should be taken into account when interpreting the results of these additional benchmarking exercises.

The results of the benchmarking exercise for rural areas were similar to the main exercise, with an underestimation of the share of private car and an overestimation of the share of bus, private cycle and taxi. See Appendix D Figure 2 for the results of the additional benchmarking exercise for rural areas.

Conversely, the results of the benchmarking exercise showed some differences from the main benchmarking exercise. The predicted share of private car was not very far from the NTS estimates for urban areas, instead a gap for walking/wheeling appeared as the study underestimated its share. This was caused mainly by the different real-life mode shares, as the NTS data showed a larger share of walking and a lower share of car in the urban areas. The underestimation for walking/wheeling could potentially be due to the differences in the coverage of trip lengths between the experiment and the NTS. The large share of walking trips in urban areas was likely to include many trips that were even shorter than the one used in the experiment, e.g., to nearby supermarkets to pick up some groceries. People would have a stronger preference for walking for such short trips compared to visiting a friend’s home as in the experiment. See Appendix D Figure 3 for the results of the additional benchmarking exercise for urban areas.

Finally, the same benchmarking exercises were repeated using data from the 2019 NTS as the data collection in 2022 was affected by the coronavirus (COVID-19) pandemic. The shares calculated using the 2019 NTS data were similar so as the findings of the benchmarking exercises. See Technical Annexe 5 – Additional results Figures 1-4 for the results of the benchmarking exercises using the 2019 NTS estimates.

Discussion

Summary of findings

RQ1. Which transport modes do people prefer, and by how much?

In the experiment, participants were asked to imagine they were planning for a short trip to visit a friend. The DCE found an overall preference for private car over other modes, with an odds ratio exceeding two (2.04) meaning that the odds of participants choosing a route by car are more than twice the odds of a walking/wheeling route that is identical with respect to time, cost, and chance of delays. In reality, a trip by car and on foot are unlikely to be of equal cost and duration, so when plausible values for these parameters are supplied for mode share simulations, the difference is less pronounced: the results predicted 20% of trips would be made by private car, and 12% by walking/wheeling. Self-reported measures from the post-DCE questionnaire reinforced this finding, with private car/van being the most used mode of transport (excluding walking) in the last six months (80%) and the mode accessible to the highest proportion of participants (69%).

The least preferred modes were the two shared transport options: car club and rental cycle, with a 5% and 6% simulated preferred mode share respectively. These two mirrored self-report measures, with more than three quarters (Car club: 76%, Rental cycle: 80%) of participants saying they had not used either mode in the last six months.

RQ2. To what extent are choices of travel mode affected by variation in key attributes – cost, travel time, additional time, and chance of delays?

The results of the DCE suggested significant negative preferences for each of these attributes. An odds ratio of 0.92 for cost indicates an increase of £1 in cost reduces the odds of someone taking that route by 8% relative to an otherwise identical route without the cost increase. While this appears small compared to the odds ratios seen for modal preferences, it is worth noting that this change in odds applies cumulatively with each incremental change in price (i.e. a £2 increase in cost leads to the odds being 0.85 (0.92*0.92) times the original odds of an otherwise identical route).

Likewise, negative preferences (odds ratios < 1) were found for each additional minute of travel time and additional time (0.97 and 0.98, respectively). The similarity of these two values suggests that participants have treated travel and additional time as interchangeable, perhaps because the mocked-up journey planner gave the overall route duration in sum as well as showing the two 'time' attributes separately. If so, it may be the case that the choice architectures of real journey planner apps – which nearly all summarise routes in terms of total time taken – shape how travellers evaluate alternative routes.

Lastly, the DCE found a strong negative preference for routes in which there was a high chance of additional delays or disruption, with an odds ratio of 0.39.

Simulated mode shares depend on the values for cost, travel time, and additional time supplied, so varying those values can provide an indicative view of the impact of policy-relevant scenarios with modified attribute values on modal choice. Reducing fares for rail and buses from the baseline value of £3 to £1.50 resulted in a 0.92-1.49 percentage point increase in preference shares for those modes, with small corresponding decreases spread across other modes. The impact of making shared transport modes more convenient (reducing additional time from 7.5 minutes to 3 minutes) was more modest, resulting in increases of 0.39-0.46 percentage points.

It should be noted that these estimated shares are subject to a number of caveats in their interpretation. Varying the values of individual parameters is an abstract way to test the impact of a policy-relevant scenario with modified attribute values which does not account for how a policy is implemented and communicated to the public. The results should therefore be seen as providing an indicative view of a policy's impact in principle. The results are also subject to several critical caveats arising from the study's design, which are discussed at length under 'Strengths and limitations'.

RQ3. How do modal preferences differ depending on the context in which the trip is undertaken?

When the context for the trip included rain, participants appeared to shift away from walking and cycling and towards private car and public transport. Simulated mode shares for walking/wheeling dropped from 12% to 9% when comparing dry vs. rainy weather, with an even larger drop for private cycle (18% to 9%). Conversely, the mode shares for private car, rail, and bus increased from 20%, 15%, and 11% respectively when dry to 22%, 20%, and 15% when it was raining.

When the context for the trip was dark, there was a similar shift away from walking and cycling, but the modes that increased in simulated shares were private car and taxi, but not public transport. Mode shares for walking/wheeling and private cycle dropped from 14% and 15% respectively in the light to 11% and 11% in the dark. Conversely, private car and taxi shares increased from 17% and 12% in the light to 23% and 15% in the dark.

When varying whether the participant needed to arrive at their destination at a specific time, the most noticeable shifts in mode shares were for private car and rail. The mode shares for private car decreased from 24% when the arrival time was flexible to 18% when it was not, with an opposing shift for rail routes, from 16% to 21%.

Simulating mode shares across different scenarios revealed small differences in the predicted impact of the changes in attribute values by context. Scenario 1 (reducing public transport costs) appeared to increase rail usage by more when participants needed to arrive at the destination by a specific time (+2.0 percentage points) than when the arrival time was flexible (+1.2 percentage points). The impact of scenario 2 (reducing additional time for shared transport modes) may be moderated by weather, with the increase of car clubs being larger in the rain than when it is dry (+1.4 percentage points compared to +0.4 percentage points) and the opposite pattern being observed for rental cycles (+0.6 percentage points compared with 1.1 percentage points). While potentially of interest in future work, these differences are small and are derived from subgroup analyses and are thus subject to larger margins-of-error than full-sample estimates. They should therefore be treated with caution.

RQ4. How do modal preferences differ between key demographic subgroups within the study sample?

The main demographic comparison focused on differences between men and women. Women chose walking/wheeling, private cycle, rental cycle, and car club less often than men. Examination of odds ratios suggests this pattern of choice is partially underpinned by differences in how people treat cost[11], with women showing a stronger preference for cheaper routes than men. If mode preferences are considered independently of cost, women more strongly preferred private car/taxi, and public transport modes than men, but were also more averse to shared and private cycling.

Simulated mode preference shares across the contextual factors revealed differences in how men and women may be expected to respond to context. Both men and women appeared to switch from walking/wheeling and cycling when it was raining, with men moving to private car and women to public transport. Women, but not men, appeared less likely to walk/wheel in the dark than in the light, with uptake of other modes correspondingly increasing. Lastly, men and women favoured different modes when they needed to arrive at a specific time, with men shifting to private car and cycling (private and rental) and women shifting to taxis.

Strengths and limitations

This study provides indicative evidence for how contextual and demographic factors shape modal preferences, and how policies targeting key attributes of public and shared transport modes might drive changes in modal choice. Online experiments allow researchers to simulate choice environments quickly in response to policy demands, but there are reasons to be cautious in interpreting the results. The simulated mode shares presented here are expressions of relative preferences for the specific travel options offered and are caveated by the context in which the DCE choices were presented, and the pool of participants recruited. Below, six specific considerations to note when interpreting the study's results are highlighted.

Firstly, **the DCE focused on a short (< 5km) trip to see a friend**, and the cost and travel/additional times were anchored around a value intended to be plausible for such a trip. Preferences for some modes, unsurprisingly, look rather different for different lengths of trip. For example, in the 2022 National Travel Survey, 83% of trips under 1 mile were made on foot, compared to 0% (rounded) between 5 and 10 miles. Modal preferences may similarly vary by trip purpose. Indeed, estimates from

[11] Note that participant income was not controlled for in the model.

the 2022 National Travel Survey suggest trips where walking was the main mode made up around 15% of all trips reported, but that figure drops to only 8% when thinking about 'leisure' trips.[12]

The results of the present study are best seen as providing a case study in which to answer its research questions. A short trip was chosen to allow for meaningful choices between a wide range of modes including active modes such as walking/wheeling and novel modes like rental cycle. And a leisure trip was chosen to create a realistic situation where people made a one-off choice between available routes when planning an imminent trip, which would allow us to best elicit 'pure' modal preferences and explore the effects of trip context.

Some findings of the study may be expected to apply to other contexts in broad terms (e.g., it is unsurprising that people prefer not to walk in the rain), but the results should not be taken as robust quantitative estimates to be generalised to any given trip purpose or distance. The study can be repeated to explore travel preferences for longer trips where modes like private car and rail have more advantages, and for other trip purposes like shopping and personal business where people also make one-off route choices. However, larger modifications of the study design would be required to explore travel preferences for repeated trips like commuting, which involves a different decision process and a distinct set of considerations.

Secondly, and related to the above, **simulated mode shares reflect preferences between the specific routes offered**. The results might therefore look different if the cost or route durations of one or more of the modes were changed. Indeed, this is the basis for the simulations of the two scenarios with modified attribute values. Verian have provided DfT with the data for this study to allow for future work to simulate mode shares based on a different set of parameter-values, if desired.

Thirdly, the DCE measures **expressed modal preferences, not actual behaviour**. Participants could thus choose modes that they would not be able to use in real life. This might apply particularly to the high share of rail in the simulated preferred mode shares relative to real-life outcomes, as access to rail is often limited. The advantage of this is that it allows the experiment to explore how attractive modes of public and shared transport that are not universally accessible might be. However, it also means participants may have mis-judged how attractive they find a given mode due to a limited understanding of it. Even for modes that are well understood, it is entirely possible that some participants would plan to undertake a route and then subsequently do something different – an example of the well-documented 'Intention-Action' gap (Sheeran & Webb, 2016)

Fourthly, the DCE **treated all routes as using one mode**. This simplification was necessary to limit the complexity of the design and analysis but is unlikely to be

[12] Note that the number differed from that in the main benchmarking exercise because some of the modes in the NTS estimates were not included in the benchmarking exercise, thus increasing the relative share of walking trips.

completely true in real life for some modes. For example, most bus routes would involve at least some walking to and/or from a bus stop at either end. Future work might focus more closely on multi-modal routes by limiting the scope for variation in other aspects of the design, such as the number/types of modes explored and the contexts in which trips are to be taken.

Fifthly, **the experiment was carried out using a non-probability sample drawn from an online access panel** so the results are not robust population estimates (Brown et al., 2017). This also applies to comparisons between demographic subgroups, since coverage and sampling biases between groups may not be consistent. Future work might seek to improve generalisability by drawing on a more robust, random probability sample (albeit at higher cost), or by evaluating real travel behaviour in a field trial or using quasi-experimental analysis methods.

And finally, in any online experiment there is the question of **whether participants adequately understood and engaged with the task**. The study included an attention check, which 998 participants failed twice and so were excluded. This is a high failure rate, so it is important to ascertain whether responses that could be of low quality did not distort the study's main findings. To answer this point, several sensitivity analyses were carried out to determine whether excluding subsets of participants from the main analysis yielded different results. The subsets dropped for these analyses included those who failed the attention check once (n = 345), selected neither route on every choice set within the DCE (n = 57), or gave answers to the post-DCE questionnaire that might be unlikely (e.g., having made no trips in the last 6 months; n = 7). Note that none of these definitively demonstrate that a response is low quality, so they are still represented within the main results of the study. Reassuringly, the sensitivity analyses produced very similar findings to those reported here (see Technical Annexe 6 – Sensitivity analysis for the full results of all sensitivity analyses), meaning there is no evidence that the results are being distorted by data from inattentive participants.

Despite the limitations, DCEs are an established method for predicting behaviour (Breidert et al., 2006), with strong external validity (McPhedran et al., 2022). The mocked-up journey planner app provided an effective at-a-glance summary of route options with incidental features that might arbitrarily cue participants to choose in a certain way removed. The look and feel of the task was designed by Verian and DfT to mimic the features of the most popular journey planner apps, and in particular styling on Google Maps, which is likely to be familiar to most participants. The hypothetical design allowed the experiment to address contextual factors, for which there is a relative paucity of contemporary quantitative evidence. And finally, the simulation of mode shares allowed the study's results to provide indicative evidence for the impact of policy changes on modal preferences, including preferences for those modes that are not the direct targets of the interventions.

Conclusions

This study provided further evidence on travel preferences among adults in England using an online choice experiment, filling the evidence gap regarding the preferences of emerging shared access modes, and the influences of contextual and demographic factors.

The results showed a consistent popularity of private car across context and demographic subgroups, as reflected in real world estimates of uptake like the NTS. Meanwhile, the relatively high levels of predicted preference shares for rail and bus in the study suggests that use of public transport may be gated heavily by limited access. In addition, there was a lack of interest in the newer, shared modes (car club and rental cycle, although awareness and understanding of both modes was low and preferences may shift as the public becomes more familiar with them.

Contextual factors played an important role in modal choices, but their impact was not the same across the whole population. Instead, the results of this study highlighted several ways in which men and women respond differently to varying trip contexts. These insights can help to inform pathways to achieving DfT's policy objectives. For example, the study found that women, but not men, shifted away from walking / wheeling in the dark relative to the light. This is consistent with what one might expect from differing perspectives on safety, and improving outdoor lighting might lead more women to walk, helping to achieve the Government's vision on active travelling. Similarly, increasing the reliability of public transport might encourage people, especially men, to use them more for time-sensitive trips.

Viability of using DCEs to explore travel preferences

This study showcased the possibility of exploring travel preferences using an online DCE. This method offered the flexibility to examine preferences for modes that are not yet widely available in real life, and to test the effects of factors that are difficult to capture in real-world data. The results can then be used to predict choices in hypothetical scenarios, providing indications for the possible impact of potential policy interventions. The study produced a coherent set of results, consistent across different analytical methods and robust against sensitivity checks. The results also demonstrated external validity against real-life data to some extent, but substantial differences also existed.

The design of online DCEs inevitably requires simplification of the decision environment. Using a simulated user interface like in this study would help improve ecological validity. Nevertheless, results should be interpreted within the specific context of the study, and adjustments should be made for potential social desirability bias and practical constraint when using the results to predict real-life behaviour. It is also important to select the attribute values carefully to accurately reflect the choices available in the scenario of interest to allow more meaningful simulations.

Further study can extend the methodology to include additional modes as well as multi-modal routes, explore the effects of other contextual and demographic factors, and examine travel preferences for different trip purposes and trip lengths. Where budget allows, one could also consider carrying out similar studies with a random probability sample, to help overcome the limitations in terms of data quality and sample selection bias.

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Appendix A – Summary of sample demographics

Appendix A Table 1: Demographic breakdown of participants

Demographic	Demographic subgroup	Target %	Achieved %
Gender x Age	Female – 18-34	18%	18%
	Female – 35-44	11%	11%
	Female – 45-65	22%	23%
	Male – 18-34	17%	18%
	Male – 35-44	10%	11%
	Male – 45-65	21%	20%
	Other / Prefer not to say	-	<1%
SEG	ABC1	54%	57%
	C2DE	46%	43%
Ethnicity	White	80%	81%
	Other ethnic group	20%	19%
	Prefer not to say	-	1%
Region of	North East	5%	5%
	North West	13%	14%
	Yorkshire and the Humber	10%	9%
	East Midlands	9%	9%
	West Midlands	10%	9%
	East of England	11%	11%
	London	17%	18%
	South East	16%	17%
	South West	10%	10%
Rural	Urban	-	86%
	Rural	-	14%
	Prefer not to say	-	<1%

Appendix B – DCE model tables

Full sample mixed logit model

Appendix B Table 1: Full sample mixed logit model

Predictor	Estimate	Odds ratio	Confidence interval	*p*
ASC	2.27	9.65	2.15 - 2.39	< .001
Mode - Bus	0.19	1.21	0.10 - 0.29	< .001
Mode – Car club	-0.58	0.56	-0.72 - -0.45	< .001
Mode – Private car	0.71	2.04	0.60 - 0.83	< .001
Mode – Private cycle	-1.08	0.34	-1.20 - -0.96	< .001
Mode – Rental cycle	-1.21	0.30	-1.34 - -1.08	< .001
Mode - Taxi	0.26	1.30	0.14 - 0.38	< .001
Mode – Train / Tram / Tube / Light rail / Metro	0.24	1.27	0.16 - 0.33	< .001
Cost	-0.08	0.92	-0.09 - -0.08	< .001
Travel time	-0.03	0.97	-0.03 - -0.03	< .001
Additional time	-0.02	0.98	-0.02 - -0.02	< .001
High chance of delays	-0.95	0.39	-1.00 - -0.91	< .001

Note: Mode – Walk / Wheel is used as the baseline attribute level for Mode, and Low chance of delays is used as the baseline attribute level for 'Chance of delays'. Estimates of the parameter correlations and random effects are not included in the table. Observations = 115,200. Participants = 2,400.

Subsample mixed logit models

Appendix B Table 2: Subsample mixed logit model by contextual factor – Light

Predictor	Estimate	Odds ratio	Confidence interval	*p*
ASC	2.63	13.92	2.42 - 2.85	< .001
Mode - Bus	0.16	1.18	0.02 - 0.30	.021
Mode – Car club	-0.66	0.52	-0.88 - -0.44	< .001
Mode – Private car	0.56	1.75	0.38 - 0.74	< .001
Mode – Private cycle	-1.09	0.34	-1.28 - -0.90	< .001
Mode – Rental cycle	-1.25	0.29	-1.46 - -1.03	< .001
Mode - Taxi	0.10	1.10	-0.09 - 0.28	.317
Mode – Train / Tram / Tube / Light rail / Metro	0.14	1.15	0.01 - 0.27	.032
Cost	-0.10	0.91	-0.11 - -0.08	< .001
Travel time	-0.03	0.97	-0.03 - -0.03	< .001
Additional time	-0.02	0.98	-0.03 - -0.01	< .001
High chance of delays	-1.04	0.35	-1.12 - -0.96	< .001

Note: Mode – Walk / Wheel is used as the baseline attribute level for Mode, and Low chance of delays is used as the baseline attribute level for 'Chance of delays'. Estimates of the parameter correlations and random effects are not included in the table. Observations = 57,600. Participants = 1,200

Appendix B Table 3: Subsample mixed logit model by contextual factor – Dark

Predictor	Estimate	Odds ratio	Confidence interval	*p*
ASC	2.15	8.60	1.96 - 2.34	< .001
Mode - Bus	0.33	1.39	0.18 - 0.47	< .001
Mode – Car club	-0.47	0.63	-0.66 - -0.28	< .001
Mode – Private car	0.95	2.58	0.78 - 1.12	< .001
Mode – Private cycle	-1.10	0.33	-1.28 - -0.93	< .001
Mode – Rental cycle	-1.22	0.29	-1.43 - -1.02	< .001
Mode - Taxi	0.48	1.62	0.29 - 0.66	< .001
Mode – Train / Tram / Tube / Light rail / Metro	0.42	1.52	0.28 - 0.56	< .001
Cost	-0.08	0.92	-0.09 - -0.07	< .001
Travel time	-0.03	0.97	-0.03 - -0.02	< .001
Additional time	-0.02	0.98	-0.03 - -0.02	< .001
High chance of delays	-1.02	0.36	-1.11 - -0.93	< .001

Note: Mode – Walk / Wheel is used as the baseline attribute level for Mode, and Low chance of delays is used as the baseline attribute level for 'Chance of delays'. Estimates of the parameter correlations and random effects are not included in the table. Observations = 57,600. Participants = 1,200

Appendix B Table 4: Subsample mixed logit model by contextual factor – Dry

Predictor	Estimate	Odds ratio	Confidence interval	*p*
ASC	2.65	14.09	2.46 - 2.84	< .001
Mode - Bus	0.10	1.11	-0.03 - 0.24	.143
Mode – Car club	-0.71	0.49	-0.93 - -0.48	< .001
Mode – Private car	0.46	1.59	0.28 - 0.65	< .001
Mode – Private cycle	-0.90	0.41	-1.07 - -0.73	< .001
Mode – Rental cycle	-0.99	0.37	-1.16 - -0.82	< .001
Mode - Taxi	0.23	1.26	0.02 - 0.44	.028
Mode – Train / Tram / Tube / Light rail / Metro	0.05	1.05	-0.08 - 0.18	.431
Cost	-0.09	0.91	-0.11 - -0.08	< .001
Travel time	-0.03	0.97	-0.03 - -0.03	< .001
Additional time	-0.02	0.98	-0.03 - -0.02	< .001
High chance of delays	-1.07	0.34	-1.16 - -0.98	< .001

Note: Mode – Walk / Wheel is used as the baseline attribute level for Mode, and Low chance of delays is used as the baseline attribute level for 'Chance of delays'. Estimates of the parameter correlations and random effects are not included in the table. Observations = 57,600. Participants = 1,200.

Appendix B Table 5: Subsample mixed logit model by contextual factor – Raining

Predictor	Estimate	Odds ratio	Confidence interval	p
ASC	2.21	9.14	2.01 - 2.41	< .001
Mode - Bus	0.47	1.59	0.31 - 0.62	< .001
Mode – Car club	-0.30	0.74	-0.52 - -0.09	.006
Mode – Private car	1.11	3.04	0.93 - 1.29	< .001
Mode – Private cycle	-1.25	0.29	-1.44 - -1.06	< .001
Mode – Rental cycle	-1.50	0.22	-1.77 - -1.23	< .001
Mode - Taxi	0.65	1.91	0.44 - 0.86	< .001
Mode – Train / Tram / Tube / Light rail / Metro	0.60	1.83	0.45 - 0.75	< .001
Cost	-0.10	0.90	-0.11 - -0.09	< .001
Travel time	-0.03	0.97	-0.04 - -0.03	< .001
Additional time	-0.03	0.97	-0.03 - -0.02	< .001
High chance of delays	-1.07	0.34	-1.16 - -0.98	< .001

Note: Mode – Walk / Wheel is used as the baseline attribute level for Mode, and Low chance of delays is used as the baseline attribute level for 'Chance of delays'. Estimates of the parameter correlations and random effects are not included in the table. Observations = 57,600. Participants = 1,200

Appendix B Table 6: Subsample mixed logit model by contextual factor – Specific arrival time

Predictor	Estimate	Odds ratio	Confidence interval	p
ASC	2.33	10.23	2.15 - 2.50	< .001
Mode - Bus	0.21	1.23	0.07 - 0.34	.003
Mode – Car club	-0.55	0.58	-0.74 - -0.36	< .001
Mode – Private car	0.65	1.91	0.48 - 0.81	< .001
Mode – Private cycle	-1.06	0.35	-1.22 - -0.89	< .001
Mode – Rental cycle	-1.27	0.28	-1.49 - -1.06	< .001
Mode - Taxi	0.31	1.37	0.13 - 0.49	.001
Mode – Train / Tram / Tube / Light rail / Metro	0.32	1.38	0.19 - 0.46	< .001
Cost	-0.08	0.93	-0.09 - -0.07	< .001
Travel time	-0.03	0.97	-0.03 - -0.02	< .001
Additional time	-0.02	0.98	-0.03 - -0.02	< .001
High chance of delays	-1.17	0.31	-1.27 - -1.08	< .001

Note: Mode – Walk / Wheel is used as the baseline attribute level for Mode, and Low chance of delays is used as the baseline attribute level for 'Chance of delays'. Estimates of the parameter correlations and random effects are not included in the table. Observations = 57,600. Participants = 1,200

Appendix B Table 7: Subsample mixed logit model by contextual factor – Flexible arrival time

Predictor	Estimate	Odds ratio	Confidence interval	*p*
ASC	2.46	11.73	2.25 - 2.67	< .001
Mode - Bus	0.20	1.23	0.06 - 0.35	.005
Mode – Car club	-0.72	0.49	-0.92 - -0.52	< .001
Mode – Private car	0.81	2.25	0.63 - 0.99	< .001
Mode – Private cycle	-1.26	0.28	-1.45 - -1.07	< .001
Mode – Rental cycle	-1.31	0.27	-1.52 - -1.10	< .001
Mode - Taxi	0.27	1.31	0.08 - 0.46	.006
Mode – Train / Tram / Tube / Light rail / Metro	0.19	1.21	0.06 - 0.33	.004
Cost	-0.10	0.90	-0.11 - -0.09	< .001
Travel time	-0.03	0.97	-0.04 - -0.03	< .001
Additional time	-0.02	0.98	-0.03 - -0.01	< .001
High chance of delays	-0.91	0.40	2.25 - 2.67	< .001

Note: Mode – Walk / Wheel is used as the baseline attribute level for Mode, and Low chance of delays is used as the baseline attribute level for 'Chance of delays'. Estimates of the parameter correlations and random effects are not included in the table. Observations = 57,600. Participants = 1,200

Appendix B Table 8: Subsample mixed logit model by gender – Male participants

Predictor	Estimate	Odds ratio	Confidence interval	*p*
ASC	2.48	11.92	2.26 -2.69	< .001
Mode - Bus	0.11	1.12	-0.04 - 0.27	0.144
Mode – Car club	-0.57	0.56	-0.80 - -0.35	< .001
Mode – Private car	0.62	1.85	0.43 - 0.81	< .001
Mode – Private cycle	-0.74	0.48	-0.93 - -0.55	< .001
Mode – Rental cycle	-1.02	0.36	-1.23 - -0.80	< .001
Mode - Taxi	0.16	1.17	-0.06 - 0.37	0.147
Mode – Train / Tram / Tube / Light rail / Metro	0.15	1.16	0.00 - 0.29	< .001
Cost	-0.08	0.92	-0.10 - -0.07	< .001
Travel time	-0.03	0.97	-0.03 - -0.02	< .001
Additional time	-0.02	0.98	-0.02 --0.01	< .001
High chance of delays	-1.05	0.35	-1.15 - -0.95	< .001

Note: Mode – Walk / Wheel is used as the baseline attribute level for Mode, and Low chance of delays is used as the baseline attribute level for 'Chance of delays'. Estimates of the parameter correlations and random effects are not included in the table. Observations = 55,872. Participants = 1,164

Appendix B Table 9: Subsample mixed logit model by gender – Female participants

Predictor	Estimate	Odds ratio	Confidence interval	*p*
ASC	2.56	12.89	2.32 - 2.79	< .001
Mode - Bus	0.48	1.62	0.33 - 0.64	< .001
Mode – Car club	-0.51	0.60	-0.74 - -0.28	< .001
Mode – Private car	1.03	2.79	0.82 - 1.23	< .001
Mode – Private cycle	-1.53	0.22	-1.75 - -1.31	< .001
Mode – Rental cycle	-1.59	0.20	-1.84 - -1.34	< .001
Mode - Taxi	0.68	1.97	0.45 - 0.91	< .001
Mode – Train / Tram / Tube / Light rail / Metro	0.48	1.62	0.33 - 0.63	< .001
Cost	-0.12	0.89	-0.13 - -0.10	< .001
Travel time	-0.04	0.96	-0.04 - -0.03	< .001
Additional time	-0.03	0.97	-0.04 - -0.03	< .001
High chance of delays	-1.19	0.30	-1.30 - -1.09	< .001

Note: Mode – Walk / Wheel is used as the baseline attribute level for Mode, and Low chance of delays is used as the baseline attribute level for 'Chance of delays'. Estimates of the parameter correlations and random effects are not included in the table. Observations = 59,088. Participants = 1,231

Appendix C – Responses to post-DCE survey questions

Appendix C Table 1: Reported frequency of use of mode of transport.

Base: all participants (n = 2,400)

Question: "Thinking about the last 6 months, in what proportion of trips have you personally travelled by the following modes of transport?"

Mode	'All'	'Most'	'Some'	'A few'	'None'
Private car	14%	40%	15%	11%	20%
Car club	2%	4%	8%	9%	76%
Taxi	2%	7%	17%	32%	42%
Bus	5%	16%	21%	25%	33%
Rail	3%	10%	20%	31%	42%
Private cycle	2%	7%	11%	13%	67%
Rental cycle	2%	3%	6%	9%	80%
E-cycle	2%	4%	6%	8%	80%
Walk / Wheel	8%	30%	34%	20%	9%

Appendix C Table 2: Reported proportion of trips made with children and/or adults requiring care.

Base: all participants (n = 2,400)

Question: "Thinking about the last 6 months, in what proportion of trips have you personally travelled with children, or with adults requiring care?"

	'All'	'Most'	'Some'	'A few'	'None'
Trips with children and/or adults requiring care	7%	19%	19%	13%	43%

Appendix C Table 3: Reported awareness of different modes of transport.

Base: all participants (n = 2,400)

Question 1: "A car club allows you to hire a vehicle for a specific journey through an app (e.g. ZipCar) or using a membership card. Before today, how much, if anything, would you say you knew about car clubs?"

Question 2: "An electric cycle or e-cycle, commonly referred to as an e-bike, is a pedal cycle which reduces the effort of cycling by providing assistance with a motor and battery. Before today, how much, if anything, would you say you knew about e-cycles?"

Question 3: "A rental cycle allows you to hire a pedal cycle (including e-cycles) for a specific journey (e.g., through services like Lime Bike). Before today, how much, if anything, would you say you knew about rental cycles?"

Mode	'Don't know'	'Never heard of them'	'Heard of them but know nothing about them'	'Just a little'	A fair amount	A great deal
Car club	3%	32%	24%	19%	14%	9%
E-Bike	2%	7%	25%	33%	22%	10%
Rental cycle	2%	12%	27%	32%	19%	9%

Appendix C Table 4: Reported ability to use different modes of transport

Base: all participants (n = 2,400)

Question 1: "Can you ride a pedal cycle, such as a bicycle, tricycle, recumbent cycle?". Question 2: "Do you hold a full driving licence valid in Great Britain?"

Mode	'Yes'	'No'
Ability to ride a bike	79%	21%
Hold a full driving license valid in Great Britain	76%	24%

Appendix C Table 5: Reported attitude towards statements about motivational factors which may influence mode choice

Base: all participants (n = 2,400)

Question: "To what extent do you agree or disagree with the following statements:"

Statement	'Strongly agree'	'Tend to agree;	'Neither agree nor disagree'	'Tend to disagree'	'Strongly disagree'	'Don't know'
'I am concerned about the environment '	32%	41%	19%	5%	3%	<1%
'I am concerned about my personal finances'	38%	33%	16%	8%	5%	1%
'I am concerned with getting places as fast as I can'	20%	34%	28%	13%	4%	1%

Appendix C Table 6: Reported attitude towards statements about factors which may influence mode choice

Base: all participants (n = 2,400)

Question: "To what extent do you agree or disagree with the following statements:"

Statement	'Strongly agree'	'Tend to agree;	'Neither agree nor disagree'	'Tend to disagree'	'Strongly disagree'	'Don't know'
'I think about the weather when making travel decisions'	31%	45%	15%	6%	2%	1%
'I think about whether it is light or dark outside	26%	37%	20%	11%	5%	1%
'I think about what else I can do while travelling (e.g. reading, working, socialising)'	19%	32%	25%	15%	8%	1%
'I think about protecting my health'	26%	35%	24%	9%	4%	1%
'I am concerned about my personal safety'	28%	33%	21%	13%	5%	1%

Appendix C Table 7: Reported employment status

Base: all participants (n = 2,400)

Question: "Did you do any paid work in the 7 days ending Sunday the [date of last Sunday], either as an employee or as self-employed?"

	'Yes'	'No'
In employment	61%	39%

Appendix C Table 8: Reported educational qualifications

Base: all participants (n = 2,400)

Question 1: "Do you have any educational qualifications for which you received a certificate?".

	'Yes'	'No'
Educational qualifications with certificate	88%	12%

Base: participants who answered 'No' to Question 1 (n = 283)

Question 2: "Do you have any professional, vocational or other work-related qualifications for which you received a certificate?"

	'Yes'	'No'
Professional, vocational, or other work-related qualifications with certificate	17%	83%

Base: participants who answered 'Yes' to Question 1 or Question 2 (n = 2,165)

Question 3: "Do you have any of the educational or school qualifications listed?"

Qualification	'Yes'	'No'
"Higher degree or postgraduate qualifications (e.g. M.A., MSc., M.Ed, Ph.D. etc)"	18%	82%
"First degree level qualification Degree, or degree level equivalent (e.g. BA; BSc) including foundation degrees; such as PGCE"	32%	68%
"Diploma in higher education; HNC; HND; Nursing or Teaching qualification (excluding PGCE)"	12%	88%
"A level; AS level; NVQ level 3; GNVQ Advanced; or equivalent"	31%	69%
"GCSE grade A* to C or 4 to 9; O level; CSE grade 1; NVQ level 2; GNVQ intermediate; or equivalent"	36%	64%
"GCSE grade D to G or 1 to 3; CSE below grade 1; NVQ level 1; GNVQ Foundation level; or equivalent"	12%	88%
"None of these"	1%	99%

Appendix C Table 9: Reported home-ownership status

Base: all participants (n = 2,400)
Question: "Do you (or your household) own or rent your current accommodation?"

Home ownership status	
"Own outright"	33%
"Buying it with the help of a mortgage/loan"	22%
"Part own and part rent (shared ownership)"	3%
"Renting it (includes being on Housing Benefit or Local Housing Allowance)"	34%
"Living rent-free (includes living rent-free in a relative's/friend's property but excluding squatting)"	5%
"Squatting"	<1%
"Other"	3%

Appendix C Table 10: Reported disability status

Base: all participants (n = 2,400)
Question 1: "Do you have any physical or mental health conditions or illnesses lasting or expected to last 12 months or more?"

	'Yes'	'No'	'Don't know'	'Prefer not to say'
Physical or mental health conditions or illnesses lasting or expected to last 12 months or more	28%	69%	1	2%

Base: participants who answered 'Yes' to Question 1 (n = 674)
Question 2: "Does your condition or illness/do any of your conditions or illnesses reduce your ability to carry out day-to-day activities?"

	'Yes, a lot'	'Yes, a little'	'Not at all'	'Don't know'	'Prefer not to say'
Disability which impacts daily life	34%	50%	14%	1%	1%

Appendix D – Additional results

Appendix D Table 1: Simulated preferred mode shares for Bus and Rail under the baseline scenario and scenario 1, based on subsample mixed logit analysis models by contextual factor.

Context		Bus			Rail		
		Simulated preferred mode share (%) under Baseline Scenario	Absolute change (percentage point) under scenario 1	Relative change (%) under scenario 1	Simulated preferred mode share (%) under Baseline Scenario	Absolute change (percentage point) under scenario 1	Relative change (%) under scenario 1
Weather conditions	Dry	11	0.80	7	15	1.43	10
	Raining	15	1.11	8	20	1.68	8
Light conditions	Light	12	1.21	11	18	1.45	8
	Dark	13	0.92	7	17	1.54	9
Arrival time	Flexible arrival time	14	1.16	8	16	2.03	13
	Specific arrival time	13	0.77	6	21	1.24	6

Appendix D Table 2: Simulated preferred mode shares for Car club and Rental cycle under the baseline scenario and scenario 2, based on subsample mixed logit analysis models by contextual factor.

Context		**Car club**			**Rental cycle**		
		Simulated preferred mode share (%) under Baseline Scenario	Absolute change (percentage point) under scenario 2	Relative change (%) under scenario 2	Simulated preferred mode share (%) under Baseline Scenario	Absolute change (percentage point) under scenario 2	Relative change (%) under scenario 2
Weather conditions	Dry	5	0.38	8	6	1.10	19
	Raining	5	1.37	26	5	0.56	11
Light conditions	Light	6	0.87	14	6	0.41	6
	Dark	5	0.56	11	5	0.59	11
Arrival time	Flexible arrival time	5	0.62	12	5	0.04	1
	Specific arrival time	5	0.72	13	6	0.69	12

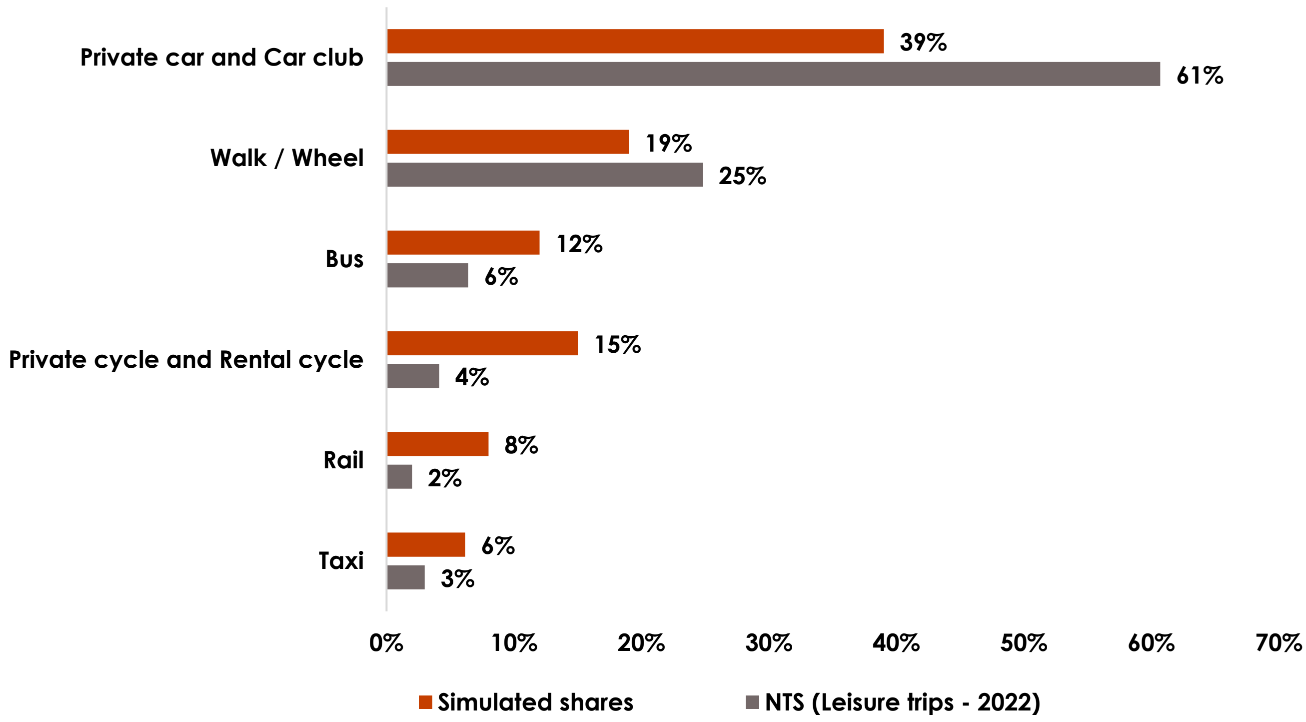
Appendix D Table 3: Mean frequency per participant with which each mode was selected by demographic subgroup.[13]

		Mode							
Demographic factor	**Subgroup**	Walk / Wheel	Private car	Car club	Taxi	Rail	Bus	Rental cycle	Private cycle
Ethnicity	White ethnicity (n= 1897)	1.51	2.1	1.08	1.64	1.89	1.83	0.95	1.61
	Other ethnicity (n = 434)	1.45	1.96	1.35	1.75	2.04	1.63	1.29	1.70
Urban / rural	Urban (n = 2004)	1.51	2.04	1.16	1.69	1.92	1.81	1.06	1.62
	Rural (n = 326)	1.45	2.23	0.94	1.53	1.89	1.67	0.75	1.66
Access to private car	Yes (n = 1616)	1.43	2.27	1.08	1.61	1.95	1.71	0.95	1.59
	No (n = 727)	1.65	1.62	1.24	1.80	1.85	1.97	1.16	1.72
Awareness of car club	Knew at least a little about (n = 963)	1.51	2.15	1.51	1.77	2.04	1.81	1.40	1.84
	No awareness or knowledge (n = 1313)	1.49	2.02	0.86	1.59	1.84	1.77	0.73	1.47
Awareness of rental cycle	Knew at least a little about (n = 1398)	1.53	2.09	1.28	1.75	2.04	1.81	1.21	1.82
	No awareness or knowledge (n = 898)	1.45	2.06	0.90	1.53	1.74	1.77	0.71	1.34

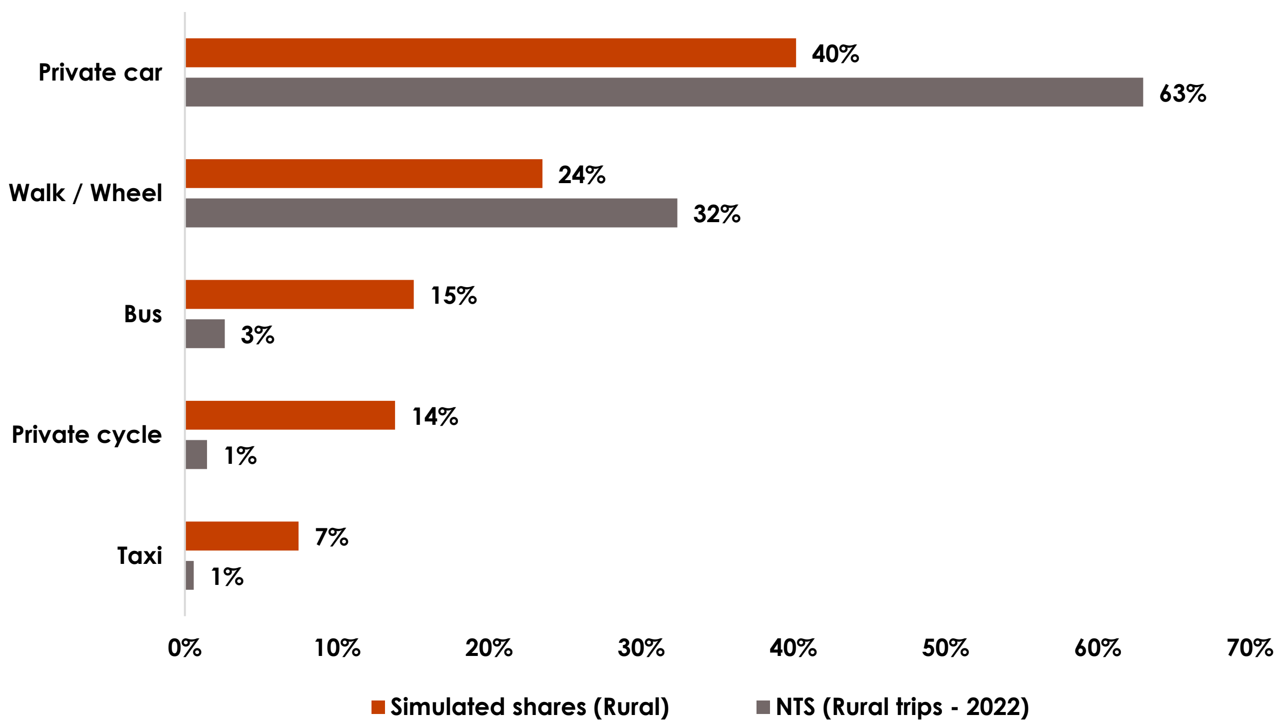
Note: Ethnicity is re-coded as 'white' or 'any other ethnicity' (Question: "What is your ethnic group"). Urban/ rural is recoded as 'lived in an urban area' (a big city, the suburbs or outskirts of a big city, or a small city or town) or 'rural area' (a country village, or a farm or home in the country) (Question: "Would you describe the place where you live as..."). Access to a private car is coded according to reported access (Question: Which of the following transport modes, if any, do you own or have access to?"). Awareness of car clubs and rental cycles was re-coded as 'knew at least a little bit about [car clubs/ rental cycles]', versus only having heard about them but knowing nothing, or not having heard of them at all (Questions: "A car club allows you to hire a vehicle for a specific journey through an app (e.g. ZipCar) or using a membership card. Before today, how much, if anything, would you say you knew about car clubs?", A rental cycle allows you to hire a pedal cycle (including e-cycles) for a specific journey (e.g., through services like Lime Bike). Before today, how much, if anything, would you say you knew about rental cycles?").

[13] Excluding participants who chose to opt out and select neither route on every choice or who chose not to answer demographic questions.

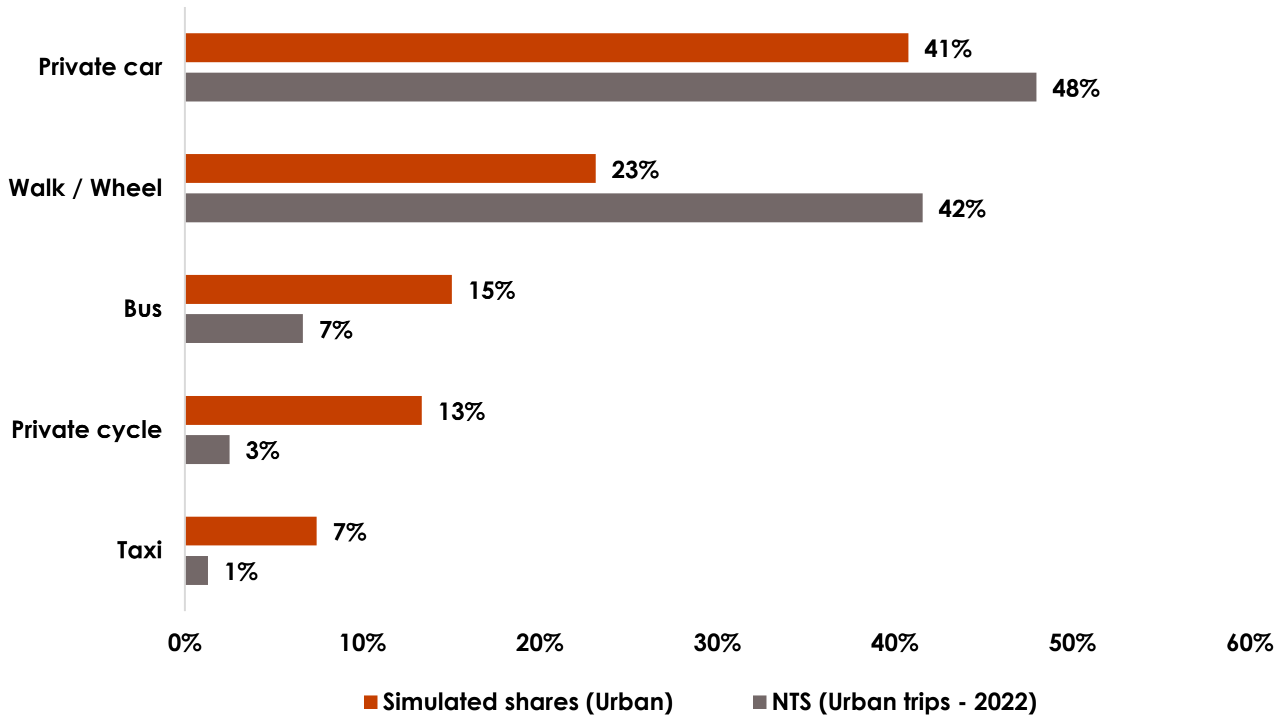
Appendix D Figure 1: Results of the additional benchmarking exercise comparing simulated preferred mode shares (including Car club and Rental cycle) based on average NTS trip characteristics to the NTS estimates of shares of leisure trips by mode



Appendix D Figure 2: Results of the additional benchmarking exercise comparing simulated preferred mode shares based on average NTS trip characteristics for rural areas to the NTS estimates of shares of trips in rural areas by mode



Appendix D Figure 3: Results of the additional benchmarking exercise comparing simulated preferred mode shares based on average NTS trip characteristics for urban areas to the NTS estimates of shares of trips in urban areas by mode



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