Examining the Factors that Impact Public Transport Commuting Satisfaction

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Abstract

The first objective of this research was to examine the level of stress caused by commuting into Dublin city centre. The second objective was to determine the value placed on the comfort and reliability of public transport services. An on-line survey of workers who commute daily into Dublin city centre was conducted, which collected data on the respondents' typical commute, commute-related stress, and socio-economic background. Commute satisfaction levels among public transport users were found to decrease for those who travel on crowded or unreliable services and those who have long wait-times. Stated preference scenarios relating to crowding and reliability were analysed using a multinomial logit model. The model showed that utility derived increases as crowding decreases and as reliability increases.

Introduction

Commuting in Dublin is taking longer than ever before. Statistics released by the Central Statistics Office (CSO) reveal that although there has been little change in the average distance to the workplace since 2002, the time taken to make this journey has increased (CSO 2007).

The public transport system in Dublin comprises an extensive bus network, two light rail lines, and one heavy rail line. The main bus operator, Dublin Bus, manages a fleet of 1,200 buses, operating on 193 routes (Dublin Bus 2007). In 2007, the Dublin Bus fleet travelled over 63 million kilometres, providing 148 million passenger journeys. The bus system consists of 12 Quality Bus Corridors (QBCs), providing passengers with a high quality of service and comparable transit time with that of a private car (Caulfield and O'Mahony 2004). Dublin Bus operates a number of different vehicles in its fleet; typically 77 percent of the onboard capacity is seated.

The Dublin Area Rapid Transit (DART) system is a heavy rail system, which in 2002 provided 22 million passenger journeys (Córas Iompair Éireann 2004). Dublin has two light rail lines that opened in 2004. In 2008, the light rail system provided 27.4 million journeys (RPA 2008). The "green line" has a route length of 10 kilometres and an average travel time of 22 minutes. The second line the "red line" has a route length of 15 kilometres and an average travel time of 46 minutes. Two types of trams are currently in operation in Dublin. The smaller trams have a capacity of 256, and the larger trams have a capacity of 358. The current tram configuration allows for approximately 25 percent of passengers to be seated.

Over 46 percent of Dublin residents report an average commute time of over 30 minutes, with almost a quarter of commutes taking longer than 45 minutes (CSO 2007). Considering that the majority of Dublin residents travel a distance of 14 kilometres or less (CSO 2007), these commute times are disproportionately long. A study of students who travel daily to Trinity College in Dublin's city centre found even longer average commute times, with 60 percent of respondents reporting a commute time of over 60 minutes (Nolan 2007).

Various studies have shown that commuting can cause considerable stress, whether by public transport or private car (Tse et al. 2000; Bhat and Sardesai 2006; Wener et al. 2005). This stress can spill over into commuters' work and home life (Wener et al. 2005), as well as affect the overall quality of life of commuters (Costal et al. 1988). Elevated stress levels can contribute to serious health problems such as cardiovascular disease and suppressed immune functioning (Wener et al. 2005).

The growth of traffic congestion in the city has contributed significantly to a high degree of unreliability in relation to public transport services and uncertainty with regard to journey times in general (Dublin Bus 2006). Unreliable arrival/departure times have been found to be one of the main factors discouraging people from using public transport (Nolan 2007). The Dublin Bus Network Review (Dublin

Bus 2006) found that significant enhancement of Dublin's Quality Bus Corridor (QBC) network is needed immediately to ensure a consistent performance over the entire length of the route. King (2006) found that 60 percent of bus services in Dublin were classified as not "on-time" in accordance with the standards set in the *Transit Capacity and Quality of Service Manual* (TCRP 2003). TCRP classifies on-time services as services running between 0 to 5 minutes in accordance with the schedule of service.

The first section of this paper examines the literature relating to stress levels and commuting. The second section discusses the methodologies used to complete this study. In the third section, the characteristics of the sample are presented. The results of the stated preference analysis are outlined in the fourth section. The paper concludes with a discussion of the main results.

Literature Review

Several studies have demonstrated that riding a bus or commuting by car or train elevates psycho-physiological parameters such as blood pressure and neuroendocrine processes, indicative of stress. These markers of psycho-physiological stress provide objective evidence that the commuting experience is stressful (Wener et al. 2005). Wener et al. (2005) examined the effect of the introduction of a direct train line on commuters in New Jersey, who usually had to transfer trains during their journey to work in Manhattan. The study measured several indicators of stress. Psycho-physiological stress was measured by taking salivary cortisol samples at the end of each morning commute, and baseline cortisol samples were collected at home at the same time on the morning of a non-commuting day. Results collected afterwards showed that those who switched to the new line had slightly reduced levels of salivary cortisol (i.e., reduced stress). These commuters also reported significantly less perceived stress and reduced job strain. It was found that women with children at home particularly benefited from the new line.

Insufficient capacity and crowding is a major cause of stress among commuters who use public transport. O'Regan and Buckley (2003) found that commuters who travel by DART had higher levels of commuting stress compared to other commuters in Dublin. The higher levels of stress reported by DART users were found to be a result of the crowded conditions on DART services.

Reliability of commuting times is important, as unpredictability in journey length has been demonstrated to correlate positively with subjective and objective

stress-related measures in commuters (Tse et al. 2000). Bhat and Sardesai (2006) indicate that there are two possible reasons why travel time reliability influences commuter travel decisions: there are likely to be negative consequences for commuters arriving late at work, and commuters inherently place a value on the certainty presented by a reliable transportation system, regardless of any consequences associated with late/early arrival. It is for these reasons that unreliable transport systems result in commuter stress.

Lucas and Heady (2002) discuss the concept of time urgency and examine the differences between commuters with a flexitime schedule and those without (flexitime schemes allow workers to choose, within limits, the times at which they start and finish work). The objective of this research was to examine the stress levels of flexitime commuters compared with workers on a fixed work schedule. According to the study, time urgency is a personality concept relating to one's perception of time, and people who are time-urgent will experience higher levels of stress resulting from commuting deadlines and pressure. Since flexitime schedules greatly reduce commuting pressures, it was proposed that flexitime commuters would experience less driver stress, less time urgency, and higher levels of commute satisfaction.

Evans and Stecker (2007) examined numerous studies on the impact of environmental stress. They concluded that exposure to stressors such as traffic congestion can have serious implications, such as causing motivational deficiency. The negative effects of an environmental stressor are more pronounced when there is no control or perceived control over the situation, as is the case with traffic congestion. Stress induced by traffic congestion has also been linked to increased absenteeism (Bhat and Sardesai 2006). Unreliability and delays on commuter trains in London have been associated with low productivity and low efficiency in tired workers. This loss in productivity has been estimated to cost London city at least £230 million per annum (Cox et al. 2006).

Methodology

Survey Design and Distribution

To evaluate the impact of commuting on quality of life, data were collected from workers in Dublin city centre via an on-line survey. To meet the objectives of the study, it was essential that the survey collected data relating to the respondents'

typical commute, commute related stress, willingness to pay to improve their commute, and their socio-economic details.

Once the survey had been designed, a number of businesses and organisations were contacted to request the participation of employees in this study. Contact details of the largest businesses and organisations in Dublin city centre were sourced using KOMPASS (an online directory of Irish businesses). Twenty companies were contacted, and five of these agreed to circulate an email to employees requesting them to complete the survey via a web-link contained in the email. This email also contained information regarding the background and purpose of the survey. The initial emails were sent on the December 4, 2007, and responses were collected between the December 4, 2007, and January 14, 2008. At this point, a total of 324 responses had been collected.

The use of web-based surveys has increased substantially in recent times. This is mainly due to their ability to collect large amounts of data without interviews, to process results without data entry, and the elimination of stationery and postage costs (Witt 1998). One must take into account the biases that a web-based survey introduces, that is, that not all individuals have access to the internet. In 2006, 56 percent of households in Dublin had access to the internet (CSO 2009). Web-based surveys have been increasingly adapted for transport studies, for example, in stated preference, travel diaries, and travel behavioural studies (Fayish and Jovanis 2004; Stinson and Bhat 2004; DeSalle and Tarko 2003; Marca 2003).

Stated Preference Design

Stated preference questions are designed to reveal the alternative that individuals say they would choose in a given hypothetical situation. Each alternative is assigned a certain combination of attributes, and the individual chooses the alternative they find has the most appealing combination of attributes. In the case of this survey, the aim of the stated preference scenarios is to reveal the participants' preference for commuting by either bus or rail, when each option has been assigned a particular level of crowding, reliability, and fare.

The stated preference scenarios for this survey were constructed using a fractional factorial design. To produce a fractional factorial, a statistical package, *SPSS Conjoint*, was used. The method of producing a factorial using this software is described in Hensher et al. (2005). The factorial produced 18 treatment combinations to be evaluated. Three versions of the survey were distributed to respondents, and they were asked to evaluate six treatment combinations.

For the purpose of this study, participants were asked to choose between two alternatives for commuting to work—bus or rail. Each of these alternatives has three attributes: crowding, reliability and cost. Figure 1 details an example of one of the stated preference scenarios used in the survey. Table 1 contains the factorial design used in the study.

Scenario Three: Based upon the information below please select the mode of transport you would use to complete your journey to work.

	BUS	**RAIL**
Crowding on-board the bus or train	Standing room only	Not getting at least one service due to overcrowding, and the vehicle is at crush capacity when boarding
Variability in your travel time	Your travel time can vary by up to 15 minutes per trip	Your travel time can be by up to 15 minutes
The cost of your trip	€1.00	€1.50
Please choose one	☐	☐

Figure 1. Sample Stated Preference Scenario

Crowding has three levels:

- Seats available
- Standing room only
- Not getting at least one service due to overcrowding, and the vehicle is at crush capacity when boarding

Reliability has three levels:

- Your travel time is standard for all trips
- Your travel time can vary by up to 15 minutes
- Your travel time can vary by up to 30 minutes

Cost has three levels:

- €1.00
- €1.50
- €2.00

Table 1. Factorial Design

Treatment Combination	**Bus Option**			**Rail Option**		
	Crowding on-board the bus	*Variability in travel time*	*The cost of your trip*	*Crowding on-board the train*	*Variability in travel time*	*The cost of your trip*
1	SO	15 mins	€1.00	SO	15 mins	€2.00
2	SA	30 mins	€2.00	SO	15 mins	€1.50
3	NB	ST	€1.00	SO	30 mins	€2.00
4	NB	ST	€2.00	SO	ST	€1.50
5	SO	ST	€1.50	NB	30 mins	€1.50
6	SA	15 mins	€1.00	NB	30 mins	€1.50
7	SA	ST	€1.50	SA	15 mins	€2.00
8	SO	ST	€2.00	NB	15 mins	€1.00
9	SA	15 mins	€2.00	NB	ST	€2.00
10	NB	30 mins	€1.50	NB	ST	€2.00
11	SO	30mins	€1.00	SA	ST	€1.50
12	SO	15 mins	€1.50	SO	ST	€1.00
13	NB	15 mins	€2.00	SA	30 mins	€1.00
14	NB	30 mins	€1.00	NB	15 mins	€1.00
15	SA	ST	€1.00	SA	ST	€1.00
16	NB	15 mins	€1.50	SA	15 mins	€1.50
17	SA	30 mins	€1.50	SO	30 mins	€1.00
18	SO	30 mins	€2.00	SA	30 mins	€2.00

SO: Standing room only

SA: Seats available

NB: Not getting at least one service due to overcrowding, and the vehicle is at crush capacity when boarding

ST: Your travel time is standard for all trips

15 mins: Your travel time can vary by up to 15 minutes

30 mins: Your travel time can vary by up to 30 minutes

Survey Results

Personal Characteristics

Table 2 demonstrates that the age of the survey participants is well distributed, with each age bracket sufficiently represented. The highest proportion of participants is between 25 and 35 years of age (35%). The gender of the participants is split reasonably evenly, with 58 percent female and 42 percent male (see Table 2). The income band corresponding to the highest proportion of respondents (19%) is €60,000 - €80,000 per annum. The next highest income categories are €30,000 - €40,000 per annum (12%) and €40,000 - €50,000 per annum (11%). A total of 29 percent of participants earn over €80,000 per annum (see Table 2).

Mode of Transport Used

Table 3 details the modes of transport used by respondents to travel to work. The results in Table 3 are compared against 2006 Census data to demonstrate that the survey sample is representative of the population. These results show that the survey sample is a good representation of the population in the area surveyed, as the modal split of the sample is in line with the modal split of the population. The majority of respondents (56%) travel by public transport (see Table 3); 18 percent of respondents indicated that they walked or cycled to work. These results may be due to the fact that all participants work in Dublin city centre and so have some form of public transport service near to their workplace.

The results in Table 4 show that over half of the people surveyed (51%) leave home before 8:00 am. The survey reveals that reliability problems are not a major issue for participants, as the vast majority (83%) state that their bus/DART/Luas service is either “very reliable” or “somewhat reliable” (see Table 4). A total of 85 percent of respondents state that the public transport service they use is usually “very crowded” or “somewhat crowded.” The results indicate an extreme lack of capacity on public transport services in Dublin.

Table 2. Personal Characteristics of the Sample

	N	%
Age		
18-24	31	11
25-34	98	35
35-44	59	22
45-55	62	22
>55	28	10
Total	278	100
Skipped question	46	
Gender		
Male	117	42
Female	162	58
Total	279	100
Skipped question	45	
Income		
Less than €9,999 per annum	1	0
€10,000 - €19,999 per annum	15	5
€20,000 - €29,999 per annum	24	9
€30,000 - €39,999 per annum	34	12
€40,000 - €49,999 per annum	31	11
€50,000 - €59,999 per annum	27	10
€60,000 - €79,999 per annum	52	19
€80,000 - €99,999 per annum	32	12
€100,000 - €119,999 per annum	19	7
€120,000 - €139,999 per annum	10	4
€140,000 or more per annum	18	6
I do not wish to give this information	15	5
Total	278	100
Skipped question	46	

Table 3. Mode of Transport Used

	Survey Sample		*2006 Census Data*	
Mode of transport used to commute to work	*N*	*%*	*N*	*%*
On foot	35	11	3,461	9
Bicycle	21	7	2,434	6
Bus	85	27	10,300	26
Train, DART or Luas	89	29	10,788	27
Motor cycle or scooter	5	2	605	2
Drive a car	73	23	9,972	25
Passenger in a car	3	1	1,032	3
Lorry or van	0	0	229	1
Other means	0	0	32	0
Work mainly from home	0	0	120	0
Not applicable	0	0	394	1
Total	311	100	39,367	100
Skipped question	13			

Table 4. Details of Mode of Transport

Morning departure time	*N*	*%*
Before 6:30 am	15	5
6:31-7:00 am	36	11
7:01-7:30 am	46	15
7:31-8:00 am	62	20
8:01-8:30 am	64	20
8:31-9:00 am	61	19
9:01-9:30 am	24	8
19:31-10:00 am	6	2
After 10:01 am	0	0
Total	314	100
Skipped question	10	
Reliability of your public transport service		
Very reliable (almost always runs according to the schedule)	69	42
Somewhat reliable	67	41
Neither reliable nor unreliable	6	4
Somewhat unreliable	16	9
Very unreliable (almost never runs according to the schedule)	6	4
Total	164	100
Skipped question	160	
Crowding on-board public transport		
Very crowded (standing room packed)	69	42
Somewhat crowded	70	43
Neither crowded nor uncrowded	19	12
Somewhat uncrowded	3	2
Very uncrowded (many available seats)	2	1
Total	163	100
Skipped question	161	

Analysis of Commuter Satisfaction

To establish the level of stress caused by commuting, respondents were asked to indicate their level of disagreement/agreement with six statements, measured on a five point scale. These results were combined to create a single variable known as "commute satisfaction." Table 5 details the results.

A total of 42 percent of participants were found to either "agree" or "strongly agree" to feeling crowded during their commute to work (see Table 5). However, 40 percent of respondents either "strongly disagreed" or "disagreed" to feeling crowded (see Table 5). The number of commuters who "agree" or "strongly agree" that "overall, commuting is stressful" (44%) is only slightly higher than those who "disagree" or "strongly disagree" (39%) with this statement. The results indicated that a higher number of respondents "disagree" or "strongly disagree" (44%) that their commute takes a lot of effort than "agree" or "strongly agree" (40%) (see Table 5). A high majority of participants (71%) "agree" or "strongly agree" that their commute is consistent on a day-to-day basis.

A total of 40 percent of participants do not believe that commuting affects their productivity at work, and only 5 percent strongly agreeing with this statement. This is surprising, as previous studies have observed that long or stressful commutes can significantly affect the motivation of workers. A total of 54 percent of respondents "agreed" or "strongly agreed" that commuting affected the time and energy they have for recreation/socialising.

Regression Analysis

The results presented in Table 5 were summed to create a single variable known as "commute satisfaction." Each level of disagreement/agreement was assigned a value as follows:

- Strongly Disagree = -2
- Disagree = -1
- Neither Agree nor Disagree = 0
- Agree = 1
- Strongly Agree = 2

The variables were scored on the basis that agreement with a statement indicates a higher level of commute satisfaction, whereas disagreement indicates a lower level of commuter stress. However, the values assigned to the statement "Commuting is consistent for me on a day-to-day basis" were reversed (i.e., "Strongly Disagree"

Table 5. Measuring Commute Satisfaction

	N	%
When I am travelling to work I feel crowded		
Strongly disagree	46	16
Disagree	73	24
Neither agree nor disagree	55	18
Agree	83	28
Strongly agree	42	14
Total	299	100
Skipped question	25	
Commuting is stressful for me		
Strongly disagree	34	12
Disagree	80	27
Neither agree nor disagree	51	17
Agree	88	29
Strongly agree	46	15
Total	299	100
Skipped question	25	
My commute to work each day takes a lot of effort		
Strongly disagree	38	13
Disagree	92	31
Neither agree nor disagree	48	16
Agree	78	27
Strongly agree	38	13
Total	294	100
Skipped question	30	

Table 5. Measuring Commute Satisfaction (cont'd.)

	N	%
Commuting to work is consistent on a day to day basis		
Strongly disagree	15	5
Disagree	50	17
Neither agree nor disagree	20	7
Agree	153	52
Strongly agree	57	19
Total	295	100
Skipped question	29	
My commute affects my productivity on the job		
Strongly disagree	49	16
Disagree	117	40
Neither agree nor disagree	72	24
Agree	46	15
Strongly agree	15	5
Total	299	100
Skipped question	25	
Commuting decreases the time and energy I have for recreation/socialising		
Strongly disagree	34	11
Disagree	78	26
Neither agree nor disagree	27	9
Agree	95	32
Strongly agree	65	22
Total	299	100
Skipped question	25	

= 2, "Strongly Agree = -2, etc.), as agreement with this statement would indicate lower commute satisfaction and disagreement would indicate higher commute satisfaction. The values of each response to the six statements were summed to reach the value for "commute satisfaction" for each respondent. This variable ranged from a value of -12 for the least satisfied respondents to +12 for most satisfied respondents.

To quantify the strength of the relationship between the two variables, the coefficient of determination (R^2) was evaluated. An R^2 value between 0.5 and 0.8 indicates a strong relationship between the two variables examined. A chi-square test was carried out to determine if the data reject the null hypothesis (the null hypothesis being that there is no difference between the set of observed frequencies and the set of predicted frequencies and that any difference between the two can be attributed to sampling). In this case, the lower the asymptotic significance value, the more likely it is that the two traits are related and the null hypothesis is rejected.

Relationship Between Travel Time and Commute Satisfaction

A linear regression analysis was conducted to ascertain if a relationship existed between travel time and commute satisfaction. The relationship between the time taken to travel to work and the individual's commute satisfaction level was found to be positive (see Table 6). The percentage of respondents with a "low level of commute satisfaction" increases as "Time taken to travel to work" increases. This implies that the longer a respondent spends travelling to work, the lower the satisfaction level with their commute. Furthermore, the null hypothesis is rejected at the 99% confidence level by an asymptotic significance value of 0.00 (see Table 7).

Relationship Between Public Transport Reliability and Commute Satisfaction

As expected, the analysis shows that commuters travelling on an unreliable public transport service experience lower levels of commute satisfaction than those who commute on a reliable service. These variables have a strong relationship, implied by the R2 value of 0.9 estimated in the linear regression analysis (see Table 6). The null hypothesis is rejected at the 99% confidence level by the asymptotic significance value of 0.00 (see Table 7).

Relationship Between Public Transport Crowding and Commute Satisfaction

The relationship between public transport crowding and commute satisfaction was tested using a liner regression analysis. It was found that as the level of crowd-

ing on public transport services increases, so too, does the percentage of commuters with a low level of commute satisfaction. This result is not unexpected and concurs with the findings of previous studies, which indicated that personal space invasion and crowding is one of the main causes of lack of commuter satisfaction (Lucas and Heady 2002; King 2005). The asymptotic significance value of 0.00 rejects the null hypothesis at the 99% confidence level (Table 7).

Relationship Between At-Stop Wait Time and Commute Satisfaction

In the survey, respondents were asked how long, on average, they had to wait at their bus stop or train station each morning. Respondents were found to have an average wait time of 10 minutes. The time spent waiting at a bus stop/rail station was found to be related to the variable "low level of commuter satisfaction". This relationship was shown to be positive, indicating that as the waiting time increases, so, too, does the proportion of respondents with a low level of commuting satisfaction. The analysis produced an asymptotic significance value of 0.00, rejecting the null hypothesis at the 99% confidence level (Table 7).

Table 6. Chi-Squared Tests

Test	Result
Relationship Between Travel Time and Commute Satisfaction	
Slope	0.10
R^2	0.5
Relationship Between Public Transport Reliability and Commute Satisfaction	
Slope	0.11
R^2	0.9
Relationship Between Public Transport Crowding and Commute Satisfaction	
Slope	0.24
R^2	0.8
Relationship Between At-Stop Wait Time and Commute Satisfaction	
Slope	0.01
R^2	0.5

Multinomial Logit Model Results

The results of the multinomial logit model are displayed in Table 7. It can be seen that, with the exception of the cost coefficient for rail, all coefficients were found to be significantly different from zero at the 99% confidence level (see Table 7). The model also produced a $\rho^2(0)$ value of 0.28 and a $\rho^2(c)$ value of 0.25, indicating a good model fit.

As expected, as the level of crowding increases on a bus or rail service, the utility derived from the service decreases. It was found that crowding on rail services produced a larger negative coefficient (-1.11) than crowding on bus services (-0.81). This may be due to the fact that rail carriages tend to have fewer seats and more standing space than buses, resulting in passengers having much less personal space when the carriage is full to capacity. Utility was found to decrease as reliability decreased, although this variable is far less significant than the level of crowding on-board for both bus and rail. Rail has a slightly greater negative coefficient (-0.31) than bus (-0.21) for the reliability variable. Intuitively, as the cost of a service increases, the utility derived from it should decrease, as is the case for the bus option, which had a negative coefficient of -0.63; the rail option had a negative coefficient of -0.31 (see Table 7).

Table 7. Multinomial Logit Modelling

Variables	Coefficient	t-value
Constant	0.84	4.1
Bus—Crowding	-0.81	-7.2**
Bus—Reliability	-0.21	-8.3**
Bus—Cost	-0.69	-3.9**
Train—Crowding	-1.11	-9.2**
Train—Reliability	-0.32	-9.5**
Train—Cost	-0.31	-2.6
N	1,648	
ρ^2 (0)	0.28	
ρ^2 (c)	0.25	
Final Likelihood	-851.23	

* Significant at the 95% confidence level

** Significant at the 99% confidence level

To examine the relative importance of the coefficients in Table 7, a number of ratios were estimated. The ratio that compares bus crowding to bus reliability was estimated to be 3.9 (see Table 8). This result indicates that bus users would derive almost four times a greater benefit from a reduction in crowding compared to an improvement in reliability. A similar result was found when comparing train crowding to train reliability, with a slightly lower ratio of 3.5 (see Table 8).

The ratio that compares the train crowding coefficient with the bus crowding coefficient indicates that rail users would derive a greater benefit from a reduction in crowding. A comparison between the train reliability coefficient and the bus reliability coefficient demonstrates that rail users would derive a greater benefit from an improvement in schedule reliability.

Table 8. Comparison Between Crowding and Reliability

	Ratio
Bus crowding / bus reliability	3.9
Train crowding / train reliability	3.5
Train crowding / bus crowding	1.4
Train reliability / bus reliability	1.5

Conclusions

The results from this study revealed that there was not an overwhelming level of agreement with the statements pertaining to commuting stress. The data relating to the respondents who were found to have a "high level of stress" due to commuting were examined using linear regression analysis. It was found that commuting stress correlated significantly with features of the respondent's commute.

Respondents who travel on a crowded public transport experience higher levels of commuting stress, probably due to increased invasion of personal space and cramped, uncomfortable conditions. High stress levels are also more prolific among respondents who commute using unreliable public transport services, most likely induced by a lack of control over the situation. Commuters who spend longer times waiting for a public transport service also tend to be more stressed. Long wait times are most likely caused by services not running according to schedule, which, in turn, induces stress due to lack of reliability and a diminished

sense of control. The longer this wait-time, the more intense these feelings of stress become, as would be expected intuitively.

The results of the multinomial logit modelling reveal that respondents would derive a benefit from an improvement in service reliability and a reduction in crowding. The results demonstrate that for both the bus and rail coefficients, a reduction in crowding was shown to be more beneficial than an improvement in reliability. The findings also suggest that rail users would derive a greater benefit from a reduction in crowding and an improvement in reliability compared to bus passengers.

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