

Journal Pre-proofs

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PII: S2213-624X(19)30106-3
DOI: <https://doi.org/10.1016/j.cstp.2019.09.001>
Reference: CSTP 385

To appear in: *Case Studies on Transport Policy*

Received Date: 8 April 2019
Revised Date: 9 September 2019
Accepted Date: 16 September 2019

Please cite this article as: S. Dale, M. Frost, S. Ison, L. Budd, The Impact of the Nottingham Workplace Parking Levy on Travel to Work Mode Share, *Case Studies on Transport Policy* (2019), doi: <https://doi.org/10.1016/j.cstp.2019.09.001>

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THE IMPACT OF THE NOTTINGHAM WORKPLACE PARKING LEVY ON TRAVEL TO WORK MODE SHARE

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6700 words

5 figures

3 Tables

Resubmission Date: 09/09/2019

Abstract

A Workplace Parking Levy (WPL) scheme raises a levy on private non-domestic off-street parking provided by employers. In April 2012 Nottingham became the first UK City to implement such a scheme with the revenue generated hypothecated for funding two additional tram lines into the city, the refurbishment of the main railway station and enhancements to a number of bus services.

Evaluations of similar Parking Space Levies schemes in Australia show that their introduction, along with any transport improvements they part fund, have been followed by mode switch to non-car based modes, a pre-requisite for congestion constraint. The aim of this paper is to investigate the impact the introduction of the Nottingham Workplace Parking Levy and its associated transport improvements has had on transport mode choice for commuters. This research however, does not directly demonstrate cause and effect leaving open the possibility that the observed mode shift could be caused by exogenous factors. The paper is based on data collected from a survey of 2,500 commuters in Nottingham, relating to their mode choice.

The results indicate that 8.6% of commuters currently travelling by sustainable modes switched from the car between 2010 and 2016 at least in part due to the implementation of the WPL and/or the associated transport improvements. In the region of 50 per cent of those individuals gave the WPL as a stand-alone scheme as an important factor in their decision to shift away from the car via an increase in the cost of parking at work or because their employer had removed workplace parking spaces. However, this research has also revealed evidence of commuters switching to the car away from other modes demonstrating a significant suppressed demand for travel by car which in part offsets some of the beneficial impacts of the WPL package.

1. Introduction

Urban traffic congestion and poor local air quality result from the widespread and sustained use of private petrol and diesel powered vehicles. This significantly affects the social, environmental and economic health and wellbeing of cities worldwide as well as contributing to global climate change (Ison and Rye, 2008). Delays arising from traffic congestion impose a range of externalities and costs on individuals, businesses and societies. Various transport demand management (TDM) measures, including parking pricing and road user charging, have been advocated as a means of managing demand and reducing car dependency while promoting the use of more sustainable public transport and active travel (walking and cycling) alternatives (Ison and Rye, 2008).

In 2007, the City Council in charge of transport planning and provision in Nottingham, a medium sized city in the East Midlands region of the UK, stated its intention to introduce a Workplace Parking Levy (WPL) on car parking spaces used by major employers within the city boundary who had over 10 liable workplace parking spaces (Dale et al 2015, Bishop, 2018). The scheme's objectives were to reduce congestion (which was estimated to cost the city economy £160 million every year in the AM peak period alone (EMDA 2007) and fund public

transport improvements to incentivise mode shift, particularly during peak times to travel to/from the work place.

The WPL was introduced in 2012 and, from an initial outlay of £4m for development and implementation, generated over £44m revenue in the first five years of its operation (Bishop 2018). The City Council has subsequently reinvested this money in local transport initiatives, including expanding the city's tram network, redeveloping Nottingham's mainline railway station and investing in local bus services (Dale 2017, Bishop, 2018). Following Nottingham's lead, other major UK cities, including Hounslow (a London Borough), Reading, Bristol, Oxford and Cambridge, are reportedly considering introducing their own Workplace Parking Levies (WPLs) as part of a package of local TDM measures that aim to reduce urban traffic congestion and fund local transport improvements.

The aim of this paper is to investigate the impact the introduction of the Nottingham Workplace Parking Levy and its associated transport improvements has had on transport mode choice for commuters in the city and make recommendations for other cities who are considering introducing a similar scheme. To achieve this an extensive survey of commuters has been carried out to ascertain if they changed mode between 2010 and 2016 and if so why. The paper presents a background and brief literature review of the scheme followed by detail of the survey method employed to collect City wide transport data from which analysis of attributable modal shift has been evaluated. The survey data is presented and the principal findings on modal shift are discussed followed by discussion and conclusions.

2. Background to Nottingham and the Workplace Parking levy

The Nottingham City administrative area has a population of 329,000 and is the central area of a larger conurbation, Greater Nottingham which has a population of 690,000. In common with many major urban areas in the UK and worldwide, the city of Nottingham, faces complex challenges arising from the need to deliver high quality transport infrastructure and provision across a spatially heterogeneous urban area in an age of austerity and growing demand while simultaneously reducing congestion, improving local air quality, reducing carbon emissions to alleviate climate change and making the city an attractive place to live and do business (NCC, 2015).

In order to meet this challenge, in 2007, Nottingham City Council proposed the UK's first Workplace Parking Levy (WPL) which would levy a charge on employers who had over 11 liable workplace parking spaces within the city. The objective was to reduce congestion in the city by increasing the effective cost of commuting by car while also funding transport improvements that would incentivise mode shift. The WPL was introduced from 2012 and generated £44m revenue for the City Council in the first 5 years of its operation (Bishop 2018). The Policy justification for the Nottingham WPL was based on the perceived success of similar schemes elsewhere in the world, in particular Perth, Australia combined with the relative speed and low cost of introduction. (Dodd, 2007).

Public acceptance was identified as a major barrier to implementing a WPL (Frost and Ison 2009). In order to address this Nottingham City Council engaged in an extensive public consultation process liaising with the business community and other stakeholders regarding initial proposals and options for the WPL or other charging methods. By July 2007 the WPL

proposals had been sufficiently developed to enable the Council to hold a one week non-statutory “public examination” of the proposals as part of the consultation exercise (Dodd 2007). 109 employers, residents and other stakeholders were invited to take part and of these 28 took up that offer (Dodd 2007). It was led by an independent chairman, the “Examiner” who published a report ‘The Proposed Nottingham Workplace Parking Levy, Report of the Public Examination’ on the public examination in which various recommendations were made with respect to the proposed scheme. The key recommendations related to the need for ongoing business support to offset the cost of the WPL to employers, which included the provision of a Workplace Travel Planning Service and parking management advice which enjoys ongoing funding from the WPL.

The WPL is just one element of a package of measures part funded by revenue from the WPL. These are as follows and together with the WPL are referred to as the WPL Package:

1. Net Phase 2 - the provision of two additional tram lines linking the suburbs of Clifton and Beeston/Chilwell to the City Centre including additional Park and Ride facilities;
2. The refurbishment of Nottingham railway station’s passenger facilities (concourse and platform areas);
3. Quality enhancements to the LinkBus services which are supported by the City Council to link major employment sites, hospitals and the Universities to the wider transport network;
4. Additional support for businesses in the form of workplace travel planning services, parking management advice and cycle infrastructure grants.

These measures are designed to complement each other so that the overall impact is greater than the sum of the individual parts. Figure 1 shows the transport geography of the City including the current tram network, major radial and orbital roads and the park and ride sites.

The Nottingham WPL package is the only European example of this type of intervention and therefore provides a good opportunity to assess the impact of these measures on mode shift, a crucial component of congestion constraint across a constrained CBD with a background of economic growth.

In order to understand the role such a scheme could be expected to play in impacting mode shift away from the car and understanding how a WPL relates to other congestion charging tools the following section provides a literature review. Much of the following literature underpinned the business case for the Nottingham WPL and the expectations regarding its success.

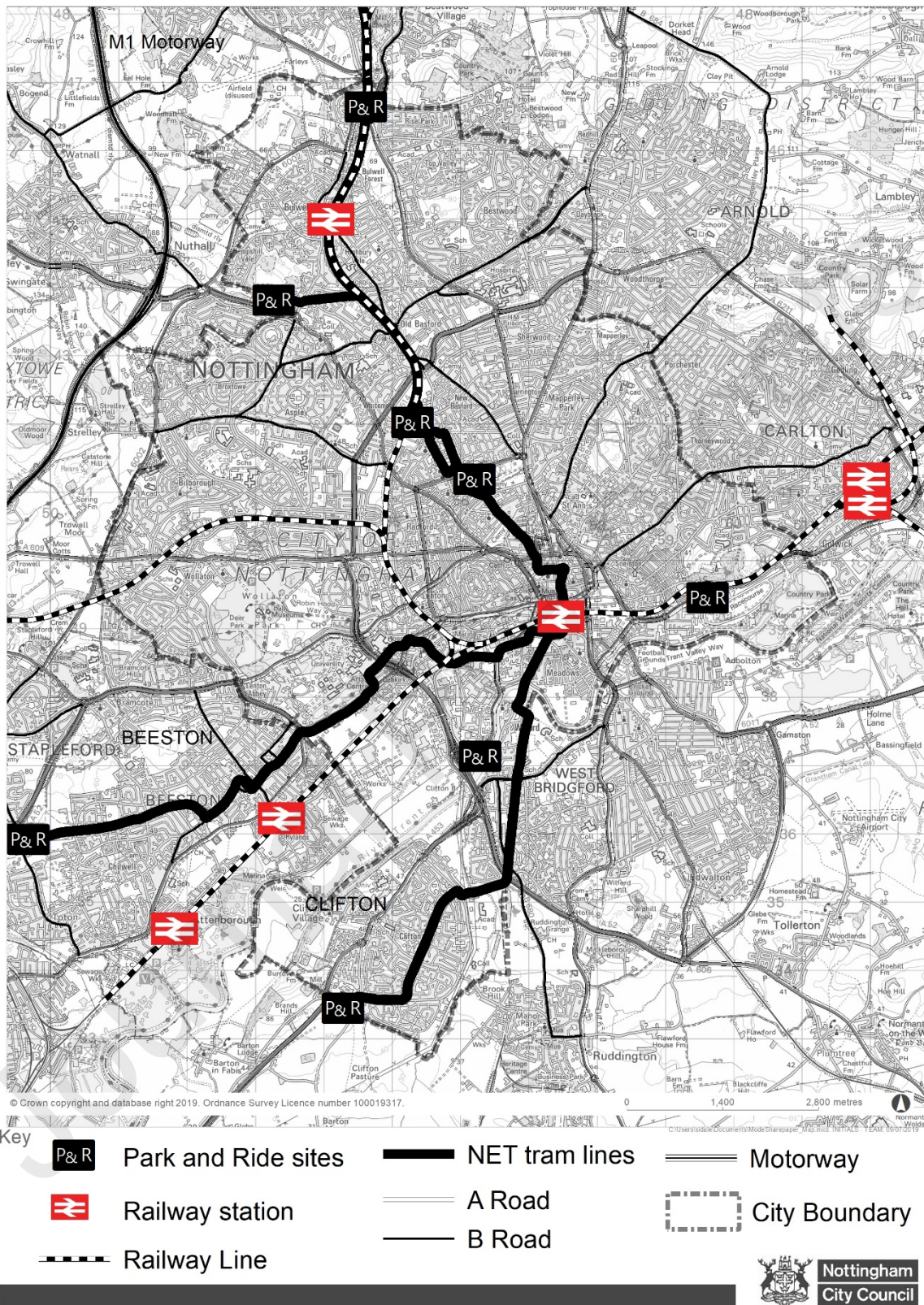


Figure 1 Nottingham Transport Geography

3. Congestion Charging, Parking Space Levies and Mode Shift – A brief Literature Review

Based on his work on the Congestion Relief Index Aftabuzzaman (2011) concluded that the most effective Transport Demand Management Measures (TDM) were “car deterrence” measures with the most important measures being those that apply an additional cost to private car trips. These congestion charging measures can be split into parking space levies (PSL) and road user charging schemes (RUC).

RUC schemes are the more common typically comprising a toll charged when vehicles cross into a defined zone or region usually a city or city centre by crossing a cordon (Button and Vega 2008) Button and Vega go on to identify 8 now longstanding examples, of these London is the most relevant to Nottingham being a UK city and thus framed in British culture and UK legislation. Congestion in the charging zone has been monitored using excess travel time per km, essentially delay (Transport for London 2008). Figures show that in 2002 (pre charging) this was 2.3 minutes, post implementation this figure fell to 1.6 minutes in 2004 but since then, despite a sustained and continued decrease in traffic volumes it has returned to its previous levels. This is attributed to deterioration in network conditions (Transport for London, 2008). Results from monitoring of the other similar RUC schemes show similar reductions in congestion (Button & Vega 2008).

In contrast to RUC schemes, PSLs impact specifically on commuting by car. Legorreta and Newmark (2015) conducted a review of parking space levies (PSL) worldwide summarising their key characteristics. While they defined PSL’s as a “special property tax charged on non-residential off-street parking” a closer examination of the 11 schemes that they identify reveals that only Nottingham, Perth, Sydney, Melbourne and Singapore actually impose a regional levy on each parking place. Additionally it should be noted that only the Nottingham WPL is a true workplace parking levy as the Australian schemes include other types of off street parking spaces such as those for customers Legorreta and Newmark (2015). Richardson (2010) studied the outcome in Perth; and states that following introduction, parking supply contracted by 10% before slowly rebounding, but not recovering to pre-1999 levels. This is contrary to the pre 1999 trend of steadily increasing parking supply.

Clearly a reduction in workplace parking supply is not a guarantee that congestion will decrease. However, Richardson (2010) presents figures from the Australian Bureau of Statistics for Perth which shows that there has been a significant shift in mode share. Prior to implementation only 35% of journeys to work were by public transport; however by 2010 this had risen to over 50%, while private car mode share had fallen by a similar amount demonstrating a mode shift to public transport. Indeed public transport use grew by 67% in the decade from 1999 to 2009. While these figures are positive, Richardson (2010) does not present any data to benchmark these against other similar cities. It can be concluded that, while the results of this investigation are encouraging, further benchmarking and corroborative research is required to show causal attribution of the encouraging trends in mode share to the Perth PSL. It is important to note that, over a decade after the introduction of the PSL, Perth is still struggling to overcome traffic congestion on account of the booming economy and a large population increase (Martin 2012). Thus the literature suggests that while the Perth Parking Levy has affected both mode shift and resulted in an initial drop in

traffic levels, these benefits are being obscured by continued economic growth. Young et al (2013) in analysing the impact of the Melbourne scheme reached a similar conclusion with a decline in the supply of parking spaces resulting in a positive impact on mode shift. However, they also acknowledge that changing economic and policy factors obscure the extent of the impact of the PSL scheme.

Monitoring data for Sydney appears to be sparse (Enoch and Ison 2006). Enoch and Ison argue that, as 85% of all traffic entering Sydney is through traffic and that as 460,000 vehicles travel in the city with only 36,000 chargeable spaces, the impact of the PSL on congestion is likely to be minimal. More recently Ison et al (2014) conclude that the Sydney PSL has not resulted in a reduction in the supply of parking spaces and that it is not clear whether it has had an impact on congestion.

The above discussion reveals that Perth has seen the most impactful results with respect to congestion and mode shift. However, all three Australian schemes appear to lack a comprehensive evaluation of that directly links the observed changes in these important indicators to the PSL schemes. It is therefore important that the Nottingham WPL's ability to illicit the desired mode shift is understood especially given that it is the first and only such scheme to be introduced in the UK to date.

4. Research Method

In order to assess the impact on mode share following the introduction of the WPL Package a survey of 2000 commuters was conducted in late 2016. The results from this survey are supplemented with data showing the changes to mode share for mechanised modes (Car, Bus, Tram and Motorbike) public transport patronage and the number of cycle trips over time.

The 2016 Nottingham commuter survey involved structured interviews and self-completion questionnaires (either completed online or returned by post). The questions were adjusted slightly to reflect the mode surveyed and method. While it is recognised that some form of random (probability) sampling of commuters was desirable (Iacobucci and Churchill 2010), this was not possible due to the following constraints; firstly no sampling frame was available there being a lack of any dataset of the whole commuting population that identified individuals that could be selected for inclusion in the survey, secondly, not all businesses co-operated with a workplace based survey of car users. Finally, it was considered that an expert 'judgment approach' (Chisnall 1997) was a more reasoned way of selecting a representative sample of bus service users in particular, but also participatory businesses (further discussed below). Given the above constraints the sample was a non-probability sample based on a population defined as commuters travelling in the AM and/or PM peak periods and surveyed in the City area (Figure 1). This is stratified by mode of travel with a sample being taken from commuters using the following modes: Car, Bus, Tram: NET Line 1, Tram: NET Lines 2 and 3, Rail and Cycle.

A mix of structured interview and self-completion survey methods of data collection was unavoidable given the nature of modes assessed and the physical constraints of the survey, hence it was recognised that there was some response bias where self-completion is adopted and that there may be other forms of bias which could occur because people might answer

questions differently in a structured interview compared with a self-completed questionnaire. The approach for each mode was as follows:

Car – As a roadside interview survey could not be justified due to the cost and the traffic disruption generated, it was decided that surveying car users at the workplace was the most appropriate approach to collect the required data for this mode. Thirteen businesses within two of the main Nottingham business parks were surveyed along with six employers situated elsewhere in the City. The geographic locations of the two business parks were seen to be typical of different areas of the city and with a differing access to public transport (from good links via the NET to relatively poorly connected with limited access to buses). The NG2 Business Park is located close to the City Centre while the Nottingham Business Park is on the north-west edge of the City. The Nottingham Business Park is relatively poorly served by public transport while the NG2 Park is located on the new tram line and within walking distance of the City Centre transport hubs. In addition to these two business parks, all businesses for which Nottingham City Council [NCC] Workplace Travel Planning team has contact details were asked to participate in the survey (giving around 30 firms in total). However, only six agreed including NCC itself which has multiple sites located across the City. The locations of the employers who participated in this survey are shown in Figure 2. Overall this produced a sample which has reasonable geographical spread, but bias is possible, firstly, as these Businesses were known to Nottingham City Council they are more likely to have received workplace travel planning advice. This would have been a major concern if the modes being surveyed were non car based modes which the travel planning advice is aimed to promote however a view was taken that car users were relatively immune to this bias. If anything one would assume that the results would underplay the tendency to switch to the car from other modes compared to a random sample and the results should be viewed with this in mind. Secondly, the businesses who took part tended to be larger ones with predominantly a white collar workforce. Over all the resources available combined with the refusal of many businesses to participate has driven this pragmatic methodology however overall we are of the view that bias is unlikely to impact the core conclusions from the survey of car users.

Bus/Tram/Rail – Commuters on these modes were surveyed at random by direct interview at selected bus and tram stops and at Nottingham Railway Station. The bus stops and services were chosen to gather data primarily from passengers using the Linkbus Services (see above). However, some non-Linkbus regular commercial bus route services were included so that all major areas/corridors of travel within the City bus network were represented.

Cycle – Cyclists were stopped at a census point by the survey team and asked to engage in face to face interviews, if they declined, because they did not have time, they were given a self-completion questionnaire to fill in later. The survey locations were chosen based on practical considerations such as safety, at natural stopping points and so that all major cycle corridors into the City Centre were covered. Although respondents were selected at random some response bias could not be ruled out due to the self-completion element of the methodology.

The sample sizes for each mode were as follows:

Car = 584
Bus = 496
Tram = 999
Train = 311
Cycle = 168

Questionnaire Design

The questionnaire design was screened to try to minimise bias due to the wording of individual questions and question sequence effects, both problems commonly associated with questionnaire design (Chisnall 1997). A key design consideration was how to formulate the question which asked why respondents had changed mode.

There were two principle elements that were considered in the design of this question:

The Dimension: – set or ‘battery’ of attitudes chosen to represent issues requiring research (Brace 2010). A battery of 16 statements giving potential reasons as to why individuals chose to switch mode were devised by cross referencing established dimensions from other NCC travel surveys (GNTP 2016) together with consulting with internal stakeholders.

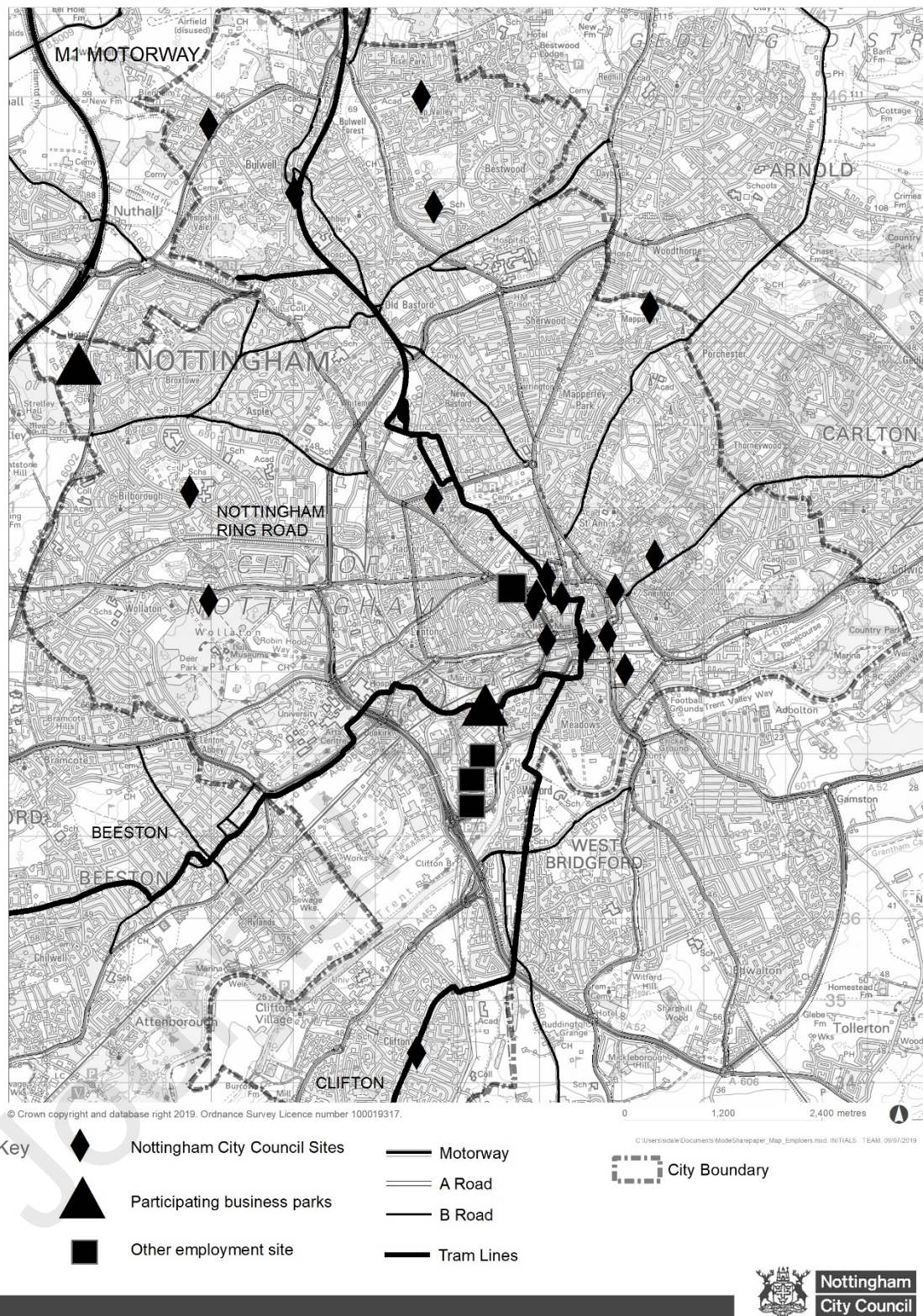


Figure 2 Location of Businesses Participating in Survey

The line of questioning employed was as follows:

Have you changed your usual main mode of travel to your work or place of study since the 1st Jan 2010? If you have changed more than once tell us about the most recent.

What was your previous usual main mode of travel to your work or place of study?

Thinking about why you made the decision to change your usual mode of travel to the bus, please indicate how important each of the following reasons were in making that decision by giving it a score of 1 to 5 with 5 being very important and 1 being of no importance. Please indicate if the reason is not applicable (NA) to you.

The battery of statements used is linked to the above question is shown below:

1. Change of workplace;
2. Change of home address;
3. Employer removed access to parking at work;
4. Increase in the cost of parking at work;
5. Improved bus service;
6. Deterioration in bus service;
7. New tram line opened;
8. Improvement in the quality of cycle lanes/storage/facilities;
9. Deterioration in the quality of cycle lanes/storage/facilities;
10. Improvement in the rail service;
11. Deterioration in the rail service;
12. Wanted to do more exercise;
13. Change in family circumstances/health issues;
14. Shorter journey time;
15. More reliable option;
16. Other – please specify.

Some of these statements were mode specific and as such not all were included in each questionnaire. The statements provided the opportunity for respondents to select each element of the WPL Package. Statements 3 and 4 related to the WPL impact while statement 5 related to the enhanced Linkbus services. Statement 7 related to the NET Phase 2, 8 accounted for the effects of the WPL funded workplace travel planning and related cycle infrastructure grants and finally, 10 related to the improvements to Nottingham Railway Station. To avoid question bias negative options in statements 6, 9 and 11 were also provided. 14 and 15 were also attributed to the WPL transport improvements since they were the key changes to these modes since 2010.

The 16 statements were grouped into categories to indicate causality for the following:

- The WPL scheme (2 and 4)
- The WPL Package transport improvements (5,7,8,10 and in cases where 1 and 2 were not applicable 14 and 15)
- The WPL Package as a whole(3,4, 5,7,8,10 and in cases where 1 and 2 were not applicable 14 and 15)

The Scale – A semantic differential scale of 1 to 5 based on the adjective pairing of unimportant and important (with 5 being very important and 1 being of no importance), was adopted for this survey. This form of scale was preferred over the Likert Scale (Chisnall 1997) which is more restrictive as it is centred on a position of neutrality as a central point on the scale which would not be appropriate in this instance, for example while something may be unimportant, it can't be very unimportant.

5. Data Analysis and Findings

In this section the existing data for mode share collected over recent years is presented along with other supporting indicators followed by a presentation and analysis of the results from the survey of Nottingham Commuters. To set the scene Figure 3 presents the current modal split for travel into Nottingham in the AM Peak Period. This shows that the mode share for non-car based nodes is over 40% which is, at over 40% an historical high level. This paper explores the role the WPL package has played in achieving this.

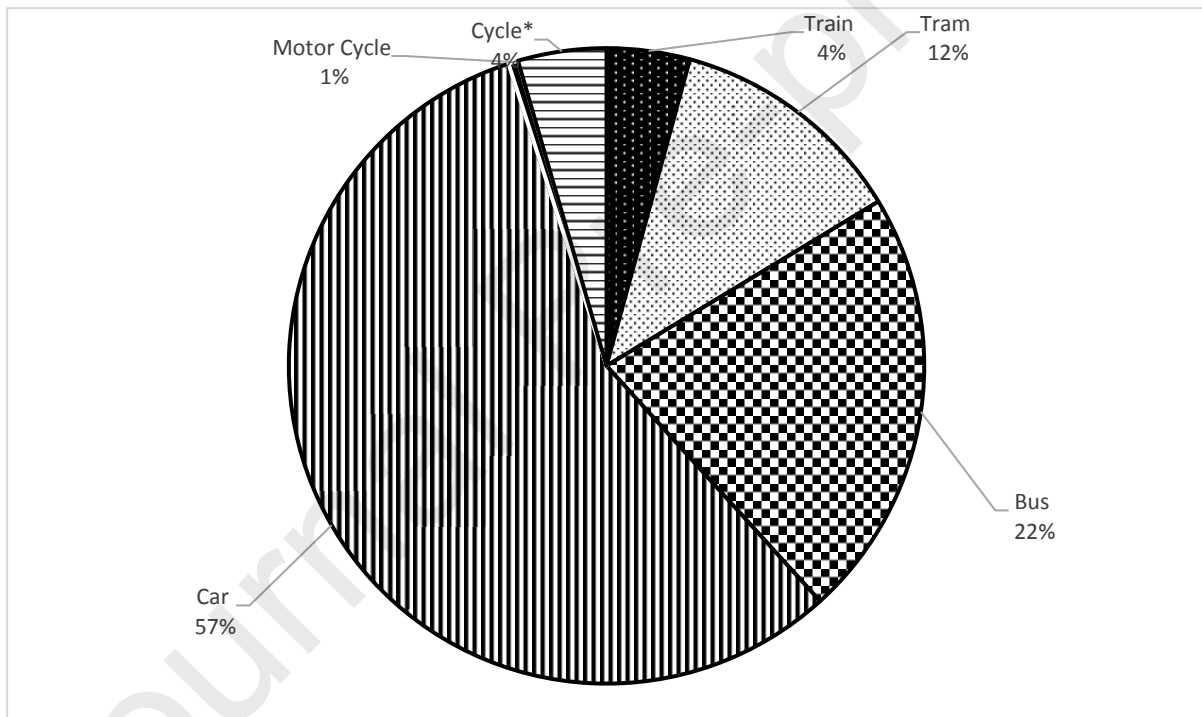


Figure 3: 2018 Modal Share For Inbound Travel 7am-10am Across the Nottingham Inner Traffic Area Cordon. *Cycle mode share calculated from cycle counts across the City and 2011 census data

Source: Nottingham City Council

Mode Share 2007 - 2017

Figure 4 shows public transport (PT) mode share as proportion of motorised modes (Car, Bus, Tram, Train, Motorcycle) for inbound people movements via motorised modes travel into Nottingham in the AM peak period (07:00-10:00) over the period 2007-2017. The key milestones for the implementation of the WPL package are also illustrated. As discussed in the

previous section this data was collected on the Inner Traffic Area Cordon (ITA) which approximates to the Nottingham Ring Road and for passengers alighting at Nottingham railway station. As the data is collected at each survey point on the cordon on just one day each year there is some inherent volatility in the data in order to compensate for this a 3-year rolling average has also been provided in Figure 4.

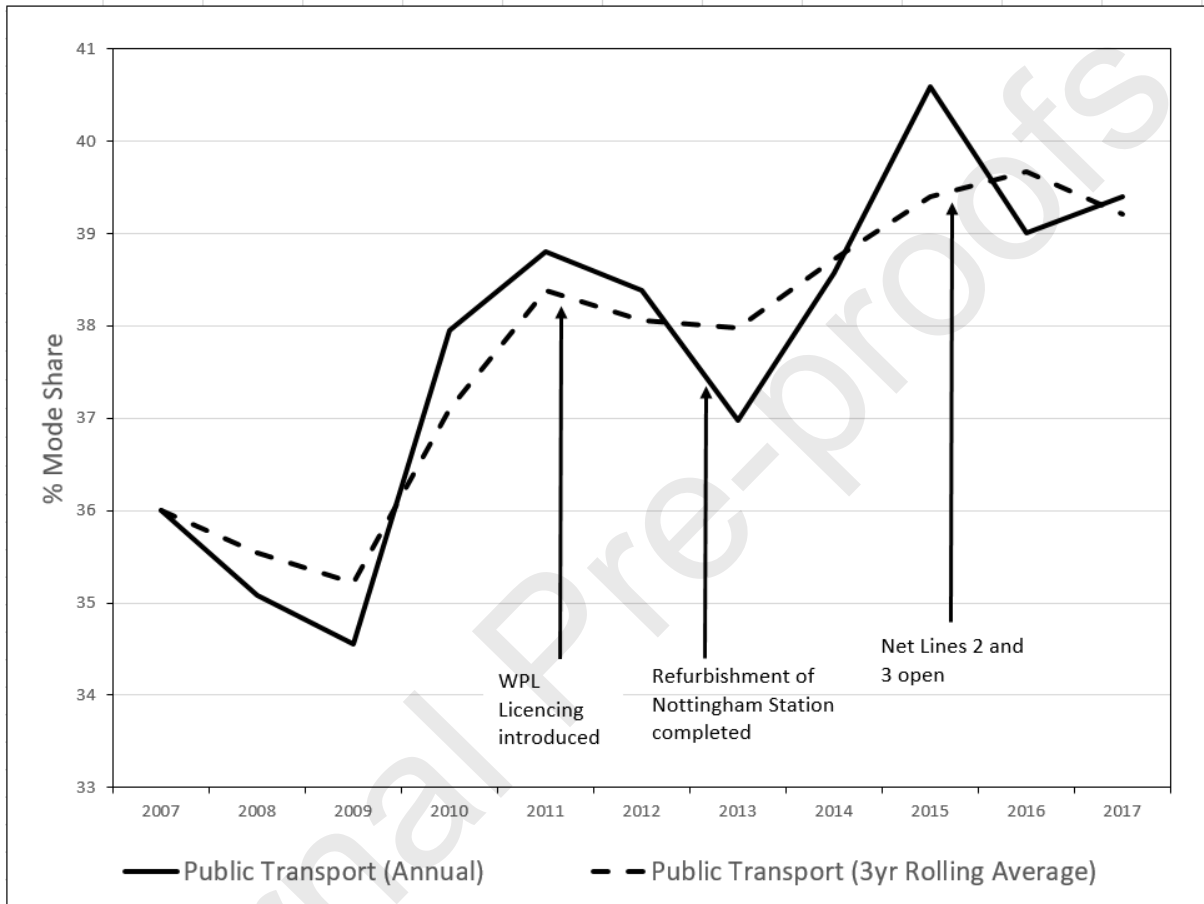


Figure 4 AM inbound peak period public transport share for Nottingham (motorised modes only Car, Bus, Tram, Train, Motorcycle)

Figure 4 can be summarised as follows

1. A rise from 2010 to 2011. This coincides with a period running up to the commencement of the WPL on the 1st October 2011. Dale et al (2017) show that in this period employers took pre-emptive action to reduce the number of workplaces they provided in order to reduce their liability.
2. A fall between 2011 and 2014 coincided with the period following changes made to Nottingham City Transport's Easy Rider City Card travel card and integrated day ticketing arrangements in December 2011, neither of which included tram travel beyond the start of 2012. This effectively increased the cost of travel by the tram.

3. A rise from 2013 to 2014. This coincides with the completion of the refurbishment to Nottingham Station in 2013. The survey of passengers alighting at Nottingham station revealed that the numbers rose by 9% on completion of the refurbishments in the first year and then by 53% by 2015 before falling back to slightly above pre-recession levels. Looking at the average over the four years prior to the completion of the refurbishment and comparing it to the four years after, it can be seen that the numbers of passengers rose by just over a quarter.
4. In Autumn, 2015, the proportion of people travelling by PT crossing the Inner Traffic Area (ITA) cordon, increased by 2% coinciding with the opening of NET Phase 2. Although this dropped back to just below 40% in the following two years it remained at a historically high level. These observations need to be caveated as a 1.5-2% increase is fairly small given data collection methodology, despite this it is encouraging that the trend seems consistent with what would be expected given the WPL Package interventions.

As noted above the mode share data for the ITA Cordon does not include cyclists. The level of cycling in Nottingham is monitored quarterly by Nottingham City Council across a network of count sites across the City and is expressed as an index with 2010 being 100. There has been a 46% increase in cycle trips in Nottingham between 2010 and 2017. When this index is applied to the 3.5% cycling mode share suggested by the UK 2011 Census, an increase from 3.0% to 4.5% in mode share is indicated between 2010 and 2017. This calculation can only be used as a guide since the NCC cycling monitoring data applies to general cycle use on the network whereas the 2011 census data refers to commuters only. Although this increase may reflect the increase in cycling as a leisure activity the trend also corresponds with the introduction of the WPL.

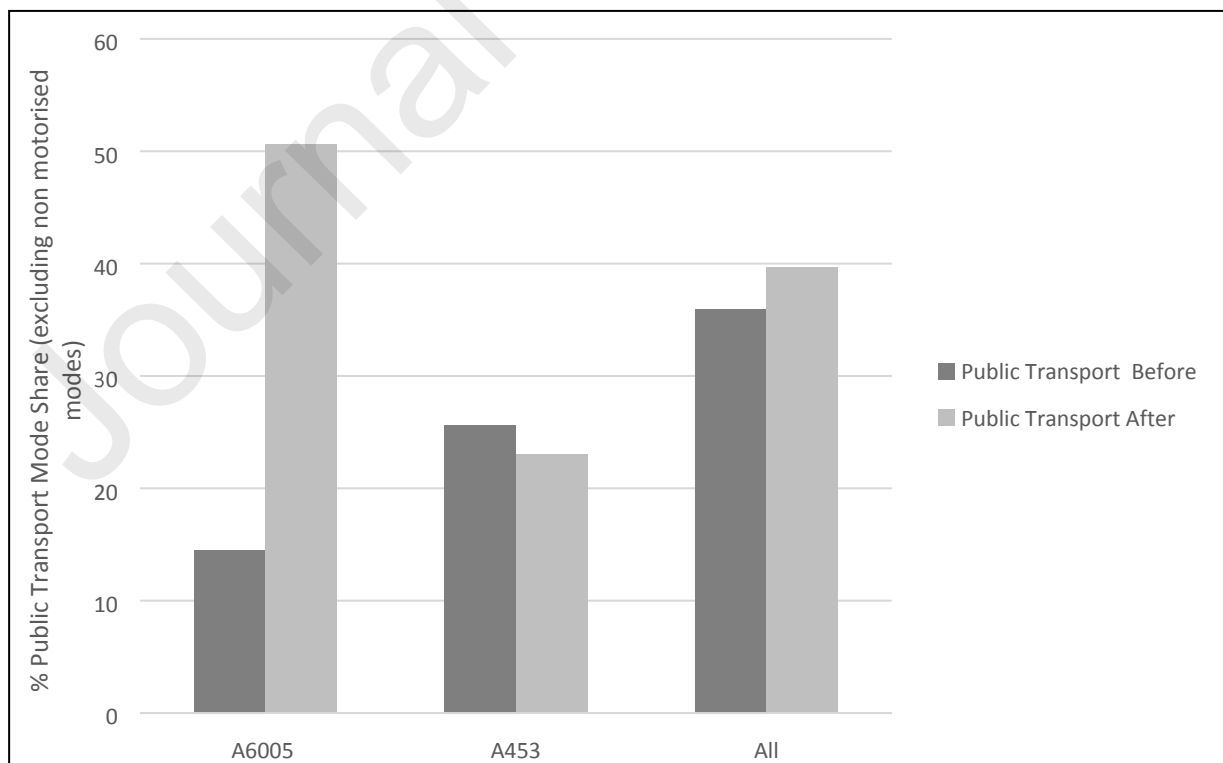


Figure 5 Public Transport Mode Share Before and After Introduction of the WPL Package

Source: Nottingham City Council

Figure 5 reveals the Public Transport Mode Share before and after the introduction of the WPL Package. The data is averaged from 2008-2010 for the before period and from 2015 to 2017 for the after period. This shows that the Public Transport Mode share has increased over all and especially on the A6005 corridor which includes the new tram line from the City Centre to Beeston. However on the A453 corridor, the Public Transport Mode Share has decreased almost certainly as result of the investment in the A453 link road from junction 24 of the M1 motorway to Nottingham to a dual carriageway which has resulted in a 26% increase in the traffic flow from the before period.

It can be argued that tracking mode share on its own can be misleading and it is worth noting that public transport patronage and the total numbers of people crossing the ITA Cordon inbound in the morning peak period have both increased over the study period. Figure 6 illustrates annual public transport patronage in Greater Nottingham.

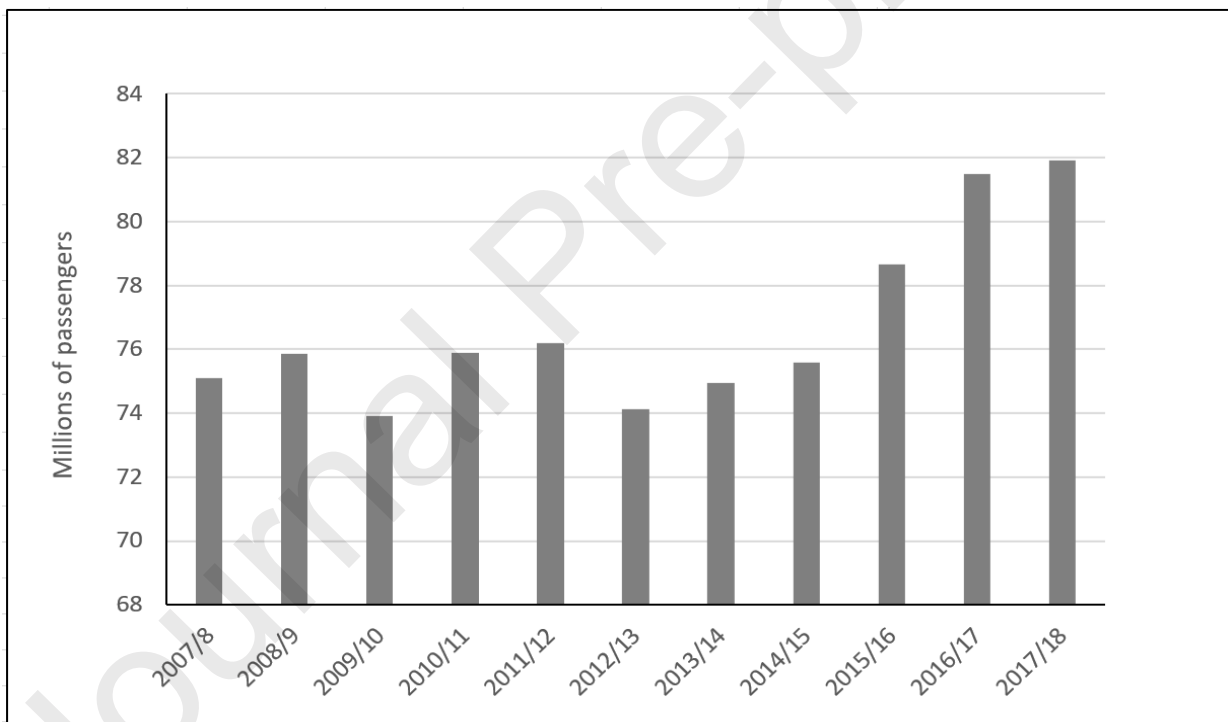


Figure 6: Public transport patronage in Greater Nottingham

Source: Nottingham City Council

The annual total PT patronage for Greater Nottingham demonstrates a trend generally consistent with that of the mode share illustrated in Figure 4. The key observation is that it has seen a steep rise since the completion of Net Phase 2.

The number of people crossing the cordon by mode shows that, taken on a 3-year rolling average the number of people travelling by car fell by 6.6% between 2010 and 2017 while public transport numbers rose by 9.6%. Closer examination of the data suggests that most of

this change coincides with the introduction of the WPL with respect to car use and the completion of NET Phase 2 for public transport use.

While the above pattern of change in the metrics described so far in this section is what one would expect to see given the WPL Package Theory of Change (Dale et al 2015) it does not provide clear evidence to confirm cause and effect. In other words, based solely on the data above the case that the WPL has increased mode share of public transport and cycling is circumstantial (hence the need for the more detailed research reported below).

A further consideration is that it is possible that demographic change over time may drive differing propensity to choose a particular mode. The assumption made in this research is that, over the 6 year study period, the demographics of the working age population remain sufficiently similar so as not to change the overall propensity to choose any given mode of travel. Changes to the age structure and gender balance shown annually as part of the Annual Population estimates (ONS 2016) were very small and it was concluded that this was only likely to impact mode choice in the longer term.

The Commuter Survey

The survey of commuters is focused on attributing evidence for the observed changes to the WPL Package.

Commuter Survey Analysis methodology

The 16 statements presented in Section 4 can be grouped into broader categories to indicate causality for the following:

- The WPL scheme;
- The WPL Package transport improvements;
- The WPL Package as a whole.

For example, if a respondent scored 'Employer removed access to parking at work' as 4 or 5 thus indicating this reason as an important factor in their decision to switch mode from the car then the WPL Scheme can be attributed as an important cause of this mode switch. Additionally, other non WPL Package related categories can also be identified. Table 1 below summarises how the statements are grouped into these categories. For non-car modes the reasons to switch mode were generally likely to be similar thus the same groupings have been used for these. However for those swapping to the car they were likely to be very different, for example improvement to bus or train services or additional cycle facilities are unlikely to be a motivation to switch away from those modes to the car nor would the implementation of the WPL. Thus we considered it appropriate to use different groupings for car to non-car modes so as to highlight the most important reasons for mode shift. Hence, for commuters who are on public transport, walk or cycle, the category 'other' refers to reasons for changing mode that are unrelated to the WPL package. For those that are travelling by car, the category 'other' relates to positive reasons which are related to the implementation of the WPL Package or wanting to do more exercise.

Table 1 Groupings of statements into categories attributing reasons for mode switch

	Possible responses to question: Reason for mode switch	Grouping of reasons into categories which attribute mode switch	
		Non Car Modes	Car
1	Change of workplace	Other	O&D change
2	Change home address	Other	O&D change
3	Employer removed access to parking at work	WPL	Other
4	Increase in cost of parking at work	WPL	Other
5	Improved bus service	WPL funded schemes	Other
6	Deterioration in bus service	Other	Deterioration in PT or cycle facilities
7	New Tram Line opened	WPL funded schemes	Other
8	Improvement in quality of cycle lanes/storage/facilities	WPL funded schemes	Other
9	Deterioration in quality of cycle lanes/storage/facilities	Other	Deterioration in PT or cycle facilities
10	Improvement in rail service	WPL funded schemes	Other
11	Deterioration in rail service	Other	Deterioration in PT or cycle facilities
12	Wanted to do more exercise	Other	Other
13	Change in family circumstances/Health Issues	Other	Changes in life situation
14	Shorter journey time	Shorter journey time/more convenient	Shorter journey time/more convenient
15	More reliable option	Shorter journey time/more convenient	Shorter journey time/more convenient
16	Other	Other/allocated to one of the above	Other/allocated to one of the above

The analysis of the commuter survey produced two metrics primarily based on this key question.

1. The number and percentage of respondents scoring 4 or 5 for at least one statement indicating the WPL and/or WPL Package schemes as a reason for mode shift. This analysis utilises the categories presented in Table 1, although for this metric the 'shorter journey time/more reliable' category has been included within the WPL funded scheme category, provided a change in origin and/or destination (O&D) hadn't been indicated as an important cause for the change of mode.
This metric is presented for the WPL as a standalone scheme, WPL funded schemes, and the WPL Package as a whole. In order to allow for the differing sample sizes, a weighted average across all five modes was then calculated to give an estimate of the percentage of commuters travelling on sustainable modes who had switched from the car, at least in part, due to the WPL Package, i.e. they have scored at least one reason for switching which relates to the WPL Package as 4 or 5. This analysis for non-car modes is presented in Table 2, while Table 3 presents the data for commuters using the car.
2. The percentage of the total score for the categories presented in Table 2 attributing causality for mode change to car and non-car modes. For example, if the sum of all scores for all the statements indicated of relevance by bus commuters came to 100 and there were 4 bus commuters scoring 'increase in cost of parking at work' 5 and 3 scoring 'increase in cost of parking at work' 4, then the category referring to the WPL would have a total score of 32 ($5+5+5+5+4+4+4=32$) out of 100 or 32

It is important to understand the bias that could exist within the survey sample. Table 2 compares the demographics from the 2011 census travel to work data to that of the survey sample.

Table 2 Basic Demographic Characteristics of the Commuter Survey Sample and the 2011 Census Travel to Work Data

METRIC	% Commuter Survey Respondents	% 2011 Census Population	
Gender			
Female	58.31%	47.35%	
Male	40.71%	52.65%	
Prefer not to say	0.98%	0.00%	
Age: Commuter Survey			Age: 2011 Census
Under 18	3.29%	0.00%	NA
18-25	18.43%	13.83%	Age 16 to 24
25-34	23.53%	21.98%	Age 25 to 34
35-44	20.43%	36.90%	Age 35 to 49
45-59	27.80%	24.54%	Age 50 to 64
60 or over	5.73%	2.75%	Age 65 and over
Prefer not to say	0.78%	0.00%	NA
Ethnicity			
Asian	4.67%	5.69%	
Black	4.67%	3.17%	
Chinese	0.75%	0.50%	
Mixed	3.14%	2.23%	
Prefer not to say	2.00%	0.00%	
White	84.78%	88.41%	

Table 2 shows that the two data sets are similar with respect to ethnicity and age distribution. However it also shows that men are underrepresented compared to women. The reason for this is unknown and appears to be present in all modes except cycling suggesting that this is not generated by the sampling technique.

Commuter Survey Findings

Table 3 reveals that, of those commuters surveyed, 22.8% switched to the bus, tram, train or bike from the car since 2010. Across these modes 13.4% of respondents said they had switched mode away from the car and that at least one reason facilitated by the WPL package is important in making that decision, a weighted average¹ of 8.6% of all respondents. 4.4% have stated that at least one reason related to the WPL as a standalone scheme was important in making that decision. Of the WPL package elements the two new tramlines are, not surprisingly, the most successful in attracting commuters away from the car with 29.5% of users surveyed saying they previously used the car. These findings demonstrate that, while not the dominant reason for commuters switching from the car, the WPL and its associated transport improvements are playing an important role in such decisions.

Looking at this data more closely, the % of commuters surveyed by mode that had switched mode

¹ The results for each mode were weighted by the overall mode split so that the differing sample sizes on each mode did not skew the results

from the car and rated at least one reason resulting from the introduction of the WPL package as important reveals that 13.1% of cyclists said they switched away from the car, at least in part due to the introduction of WPL package. Of these 4.2 % gave reasons relating to the WPL as a standalone scheme. This split was 7.3% and 5.4% for bus users and 7.1% and 3.5% for Train Users. For Tram users interviewed on the two new tram lines part funded by the WPL 29.2% said they had swapped in part due to the introduction of WPL funded schemes, not surprising given that these two lines are new. Only 0.3% gave reasons relating to the WPL itself. On the existing Tram Line (NET Line 1) 7.2% stated they had switched mode away from the car and gave at least one reason facilitated by the introduction of the WPL package as important. Of these 2.8% gave at least one reason related to the WPL as a standalone scheme.

Table 3 Number and percentage of respondents scoring 4 or 5 for at least one reason applicable to the WPL package

Mode	Total Sample	Sample swapping away from car	WPL (Statements 3 & 4)		WPL Funded Schemes (Statements 5,7,8,10,14 and 15)		WPL Package (WPL+WPL Funded Schemes)		% Respondents swapped away from the car	Mode Split based on annual monitoring divided by 100*	Weighted average scoring 4 or 5 due to WPL scheme across all modes*	Weighted average scoring 4 or 5 due to WPL Package across all modes*
			No. scoring 5 or 4	% No. 5 or 4	No. scoring 5 or 4	% No. 5 or 4	No. scoring 5 or 4	% scoring 4 or 5				
Cycle	168	45	7	4.2%	15	8.9%	22	13.1%	26.8%	0.04	NA	
Bus	496	80	27	5.4%	12	2.4%	36	7.3%	16.1%	0.63		
Tram 1	290	51	8	2.8%	14	4.8%	21	7.2%	17.6%	0.13		
Tram 2&3	719	212	2	0.3%	164	22.8%	165	22.9%	29.5%	0.07		
Train	311	65	11	3.5%	12	3.9%	22	7.1%	20.9%	0.13		
All	1984	453	55	2.8%	217	10.9%	266	13.4%	22.8%		4.4	8.6

* The weighted averages are based on mode split in 2015 for people crossing the Inner Traffic Area Cordon inbound in the AM Peak period, cycle count data and people alighting at Nottingham Station

The above descriptive statistics show that the WPL scheme is more important than the WPL funded schemes in promoting a mode switch amongst bus users while for others switching away from the car it is the WPL funded transport improvements that play the largest role in prompting mode switch.

Table 4 Number and percentage of respondents switching to the car since 01/01/2010

Mode	Total Sample	Sample swapping to car	% Respondents swapping to the car
Car NCC	379	98	25.9
Car Non NCC	205	48	23.4
Car All	584	146	25.0

Table 4 reveals that a quarter of those car users surveyed have switched to the car since 2010. The sample of car users contained a disproportionate number of responses from Nottingham City Council (NCC) employees, thus Table 4 shows the results for NCC and Non NCC respondents separately. It is noted that the results are similar for both sub samples.

This data supports the conclusions reached by Dale et al (2017) that there is strong suppressed demand for commuting by car which is released, either as the disposable income of individuals increases, or as and when road space becomes available due to the WPL package prompting capacity increase.

Figures 7 & 8 present the percentage of the total score for the categories detailed in Table 1 for Non-car based modes and the car respectively. This is calculated on the basis previously described. The results of this analysis generally support the above conclusion that the WPL Package overall is making an important contribution to mode shift away from the car. However, it is not the only dominant reason for changing mode in the majority of decisions.

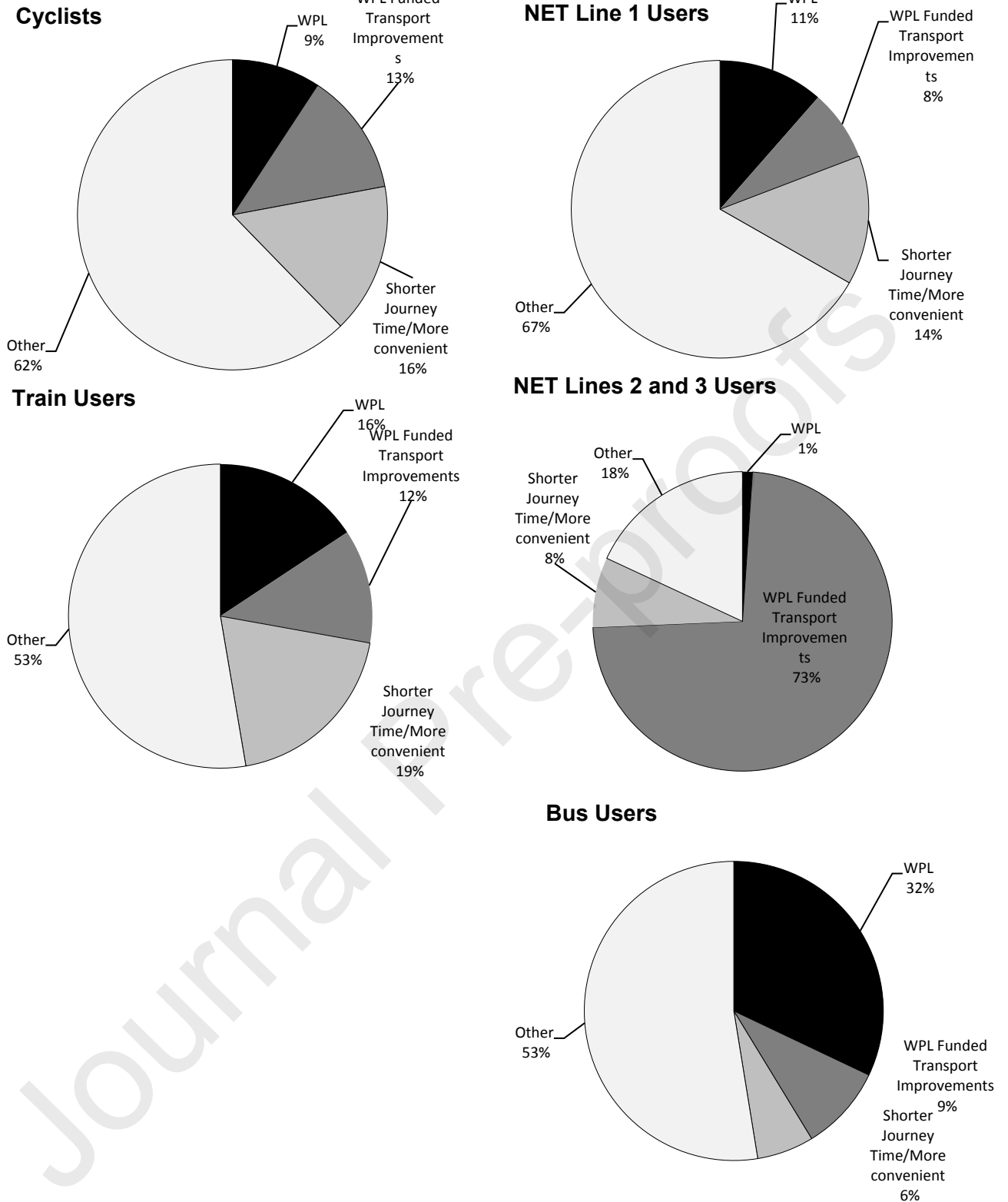


Figure 7 Reasons for mode switch non-car based modes

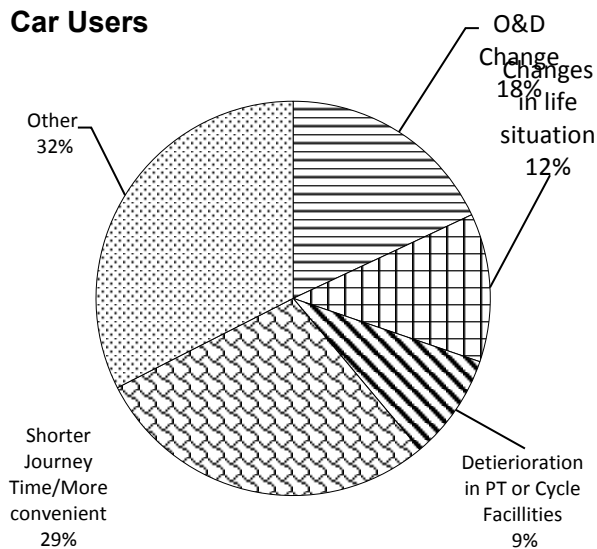


Figure 8 Reasons for mode switch to the car

The figures for cycling, train and bus users all follow a similar pattern with the grouping 'Other' scoring at over 50%, while the WPL Package related groupings occupy between one third and one half of the total score. The role played by the WPL as a standalone scheme is substantially more important amongst bus users than for train or cycle users.

The figure for NET Line 1 is similar to that of train users, however, for NET Lines 2 and 3 which only opened in 2015, WPL funded transport improvements account for 73% of the score. This is not surprising given that, by definition, users must have previously used another mode.

It is interesting to note that scores for the car are dominated by 'Other' and 'Shorter journey time/more convenient', this seems to reflect the broad attraction of that mode compared to other options. Indeed, the reasons that car users state for their switch away from sustainable modes are revealing in that they are in part indicative as to the possible reasons that commuters haven't switched to these modes despite the introduction of the WPL. Generally they relate to convenience, whether it be a shorter journey or a change in life circumstances or even a change in journey origin and destination, grouped together this would account for 58% of the score. It is also worth noting that a further 9% is attributed to a deterioration in cycle facilities and public transport services despite the WPL funded 'improvements'.

The key findings from this research can be summarised as follows:

1. 8.6% of those currently using sustainable modes have indicated that the WPL Package has played an important part in their decision to switch away from the car.
2. The data suggests that this causality is split roughly 50/50 between the PT/cycle improvements and the WPL itself with an average of 4.4% of commuters on sustainable modes switching from the car in part due to, either an increase in the cost of parking at work, or the removal of parking at work.
3. There is evidence of significant suppressed demand for travel by car and this may be obscuring the beneficial impact on individual mode shift of the WPL package.
4. The WPL Package has caused individuals to switch from commuting by car to more sustainable modes of travel. This is due to the 'carrot' improved public transport capacity and quality combined with the 'stick' of having to pay more for parking at or near work.

6. Discussion and Conclusion

The analysis has demonstrated that mode shift away from the car is occurring as a result, at least in part, of the introduction of a Workplace Parking Levy. This builds on research in Australia Richardson (2010) and Hamer et al (2009) which presents evidence of mode switch due to Parking Space Levies in Perth and Melbourne but fall short of showing direct attribution of cause and effect.

The data presented in this paper reveals that the mode share of public transport has risen over the study period from 2010 to 2017 and a more detailed examination of this data reveals an increase in PT mode share prior to the introduction of the WPL and then a further rise in 2015/16 associated with the opening of NET Phase 2, the two additional tramlines. The initial rise can only partly be attributable to the WPL as the bulk of the increase occurred between 2009 and 2010, prior to any pre-emptive actions taken by major employers in response to the WPL, however the further increase in PT mode share after the opening of NET Phase 2, the most significant of the public transport improvements part funded by the WPL in 2015, appears to be directly linked to that intervention. This impact is supported by public transport patronage data which shows that, following the opening of these two new tram lines, there was a rise in public transport patronage due to more people arriving by rail and patronage on the two new tramlines. Cycling has also shown a steady growth in the number of trips throughout the evaluation period although no specific causality is evident.

The survey of 2000 commuters suggests that mode switch due to the WPL and its associated transport improvements has been ongoing throughout the study period. This survey revealed that all sustainable modes have attracted individuals to switch away from commuting by car and that around 8.5% of all commuters on these modes have switched away from the car, at least in part because of the WPL Package. About half of these commuters cited the increase in the cost of parking at work or the removal of workplace parking as an important reason for their switch indicative of an impact of the WPL as a standalone scheme.

However, the survey also demonstrates that a quarter of all current car users surveyed have switched to this mode in the study period, with convenience and a quicker journey time being important reasons for this switch. This demonstrates that there is significant suppressed demand for commuting by car. It is concluded that this limits the ability of the WPL to actually reduce congestion as when road space is consequently released by the WPL itself, or the measures it part funds, further car trips are generated.

Further research is needed into the cause and release of this suppressed demand but it is most probably driven by both economic factors (as individuals have more disposable income they are able to firstly purchase a car and then to use it and pay for parking) and road space availability, as individuals switch away from the car for the reasons outlined in this research it creates road space for other car users to take their place.

The WPL package has led to a significant increase in overall transport capacity which will cater for the anticipated future economic and population growth. Evaluation of the impacts of the PSL schemes in Australia, Perth (Richardson 2010) and Melbourne (Hamer et al 2009), suggest a greater mode switch away from the car than that demonstrated in Nottingham. This perhaps reflects the higher level of charge per space. However, Hamer suggests that this change in Melbourne may not be due to the PSL itself, but rather a result of other factors.

Given this inherent demand for commuting by car it seems unlikely that a WPL in its current form or the availability of high-quality public transport can actually reduce congestion

although at present research suggests that it would be worse than it is without the WPL (Dale et al 2017). However, if a City such as Nottingham wishes to sustain economic growth it must cater for the extra demand for travel. The WPL Package does this, and one would expect to see the road network reach a point of stability with respect to congestion and flow with additional demand accommodated by PT and active travel. It is too early to say whether this is now occurring for certain as delay is still increasing and further research is required to confirm exactly why. However, PT and active travel mode share has increased as have the demand for travel and the 2018 data release from the ONS regarding GVA shows a significantly higher growth in Nottingham since 2013 than other comparable Cities (ONS 2018).

The findings from this research have important implications for other Cities in the UK and further afield considering implementing a similar intervention to the Nottingham WPL package as it provides evidence that this will positively impact the mode share of sustainable travel modes by encouraging some commuters to switch away from the car. This will inform future Business Cases for the implementation of a WPL. However authorities should also consider if the areas for which they are responsible are also likely to be subject to suppressed demand for travel by car, in which case it could be recommended that the expectation regarding an actual reduction in congestion is carefully managed.

A number of methodological limitations concerning this survey need to be kept in mind. Firstly, males were under represented within the sample, this was the case across all modes, except cycling and the reason for this is unclear. Secondly, memory bias is always an issue in retrospective travel surveys and finally the sample of car users was taken from larger businesses who had already engaged at some point with Nottingham City Council with regards to workplace travel planning. While the latter would have been a concern if it was non-car based modes that were being sampled this is less of a concern with regards to car users. Despite these limitations, which were driven by practical and resource issues, they provide no basis to reject the core conclusions from this research.

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Highlights

- Existing Parking Space Levies schemes in Australia associated with beneficial mode shift
- 2500 commuters in Nottingham surveyed to ask if they had switched mode and why
- 4.4 % of commuters switched mode away from the car, in part, due to the WPL
- 8.6 % switched mode away from the car, in part due to the WPL and the schemes it funds.
- Suppressed demand for travel by car partly offsetting benefits of the WPL