



THE COMMUTING AND WELLBEING STUDY

Understanding the Impact of Commuting on People's Lives

An ESRC Secondary Data Analysis Initiative Project

Foreword

Subjective wellbeing is about how well people consider their lives are going and is potentially affected by routines of daily life such as commuting. Clear evidence has not been available on the impacts of commuting on subjective wellbeing. This report contains a summary of findings from a study that rigorously assessed how commuting impacts upon the lives of a large, representative sample of workers in England from the *Understanding Society* longitudinal study. The findings were also presented at an end of project showcase event held in London at the Department of Transport on 11 September 2017.

The Commuting & Wellbeing study was funded by the Economic and Social Research Council (ESRC) (Grant Number ES/N012429/1). The project was led by Dr Kiron Chatterjee at the University of the West of England (UWE Bristol) and ran for eighteen months from February 2016 to July 2017. Further outputs from the study are available at www.travelbehaviour.com.

Project team

Researchers at UWE Bristol – Kiron Chatterjee, Ben Clark, Adrian Davis and Deirdre Toher
Researcher at University of Leeds - Adam Martin

Project partners – Department for Transport, Department of Health, Department of Communities and Local Government, What Works Centre for Wellbeing

How to cite this document

Chatterjee, K., Clark, B., Martin, A. & Davis, A. (2017). The Commuting and Wellbeing Study: Understanding the Impact of Commuting on People's Lives. UWE Bristol, UK.

Corresponding author – Kiron Chatterjee at Kiron.Chatterjee@uwe.ac.uk

Publication date 23 October 2017

Contents

OVERVIEW OF FINDINGS	3
1 INTRODUCTION	7
2 WHAT WE KNOW	9
2.1 A NEED FOR FURTHER RESEARCH	11
3 THE ‘UNDERSTANDING SOCIETY’ DATA SET	12
3.1 DATA ON COMMUTING.....	12
3.2 DATA ON PERSONAL WELLBEING	13
4 IMPACT OF COMMUTING ON ‘DOMAINS OF WELLBEING’	15
4.1 JOB SATISFACTION	17
4.2 LEISURE TIME SATISFACTION	19
4.3 PHYSICAL ACTIVITY AND HEALTH	21
4.4 STRAIN AND MENTAL HEALTH.....	23
5 IMPACT OF COMMUTING ON LIFE SATISFACTION	26
5.1 IMPLICATIONS OF COMMUTING FOR OVERALL WELLBEING	28
6 CHANGING LIVES OVER TIME	30
6.1 SHORT-TERM EFFECTS OF COMMUTING CHANGES	30
6.2 LONGER TERM EFFECTS OF COMMUTING CHANGES	33
6.3 LONG TERM EFFECTS OF DIFFERENT TYPES OF COMMUTING BEHAVIOUR.....	34
6.4 SEEKING LIFE IMPROVEMENTS	35
6.5 CONCLUDING MESSAGE – EVERY MINUTE COUNTS.....	36
ANALYSIS NOTES	37
SOURCES AND REFERENCES	44
POST-PRINT AMENDMENTS	46

Overview of Findings

The Commuting & Wellbeing Study examined the impacts of commuting on the wellbeing of over 26,000 employed people living in England between 2009/10 and 2014/15. The findings are based on data from *Understanding Society* - an innovative world leading study about 21st century life, in which members of 40,000 households are surveyed every year. The data set made it possible to examine how changes in subjective wellbeing from one year to the next are related to changing commuting circumstances.

The key findings from the study are summarised below in relation to four themes. The key findings prompt questions (identified in the grey boxes) on what can be done in response to them. The table on page 6 provides references to where in the report more detailed information can be found on the findings.

Theme 1 – The impacts of longer commute times on employee wellbeing

Every extra minute of commute time reduces job satisfaction, reduces leisure time satisfaction, increases strain and reduces mental health.

What actions can be taken to help employees find attractive housing close to their workplaces?

What can be done to ensure different transport alternatives provide reasonable journey times to employment destinations?

Theme 2 – Commutes that increase job satisfaction and employee retention

Working from home, walking to work and shorter commute times increase job satisfaction and shorter commute times make it more likely that an employee will stay with their job.

What can employers do to encourage and incentivise employees to live near their workplace and to offer flexible working arrangements?

Theme 3 – The benefits of active commuting

Walking and cycling to work increase leisure time satisfaction and walking to work decreases strain. Cycling to work is associated with better self-reported health.

How can networks be developed to support safe and relaxing access to employment destinations on foot and by bicycle?

What can be done to promote the physical and mental health benefits of active commuting and increase the uptake of active commuting?

Theme 4 – Insights for public transport

Bus commuters feel the negative impacts of longer commute journeys more strongly than users of other transport modes. Shorter duration commutes by rail are more strenuous than longer duration commutes by rail.

How can the infrastructure and services necessary for good quality local public transport access to employment destinations be developed?

What can be done to enable rail operators to provide comfortable conditions for commuters?

Differences amongst the population

The study highlighted important differences in how commuting influences the wellbeing of **men and women**. Women are more satisfied with their jobs than men, but this is diminished more for women when they have longer commute times. This is likely to be related to greater household and family responsibilities. Walking or cycling to work are positive options to address this for women, as these options are found to increase their leisure time satisfaction.

The results also show that **younger workers** under 30 years of age and those on **lower incomes** are less sensitive to longer commute durations in terms of job satisfaction. This implies an acceptance amongst these groups that long commute times are unavoidable. The extent to which people feel able to choose where they work appears to influence whether long commute times are considered tolerable.

Conclusions

The findings from the Commuting & Wellbeing study indicate that longer journeys to work have adverse subjective wellbeing effects, particularly through loss of free time. On the other hand, longer commute times were not found to have a large impact on life satisfaction overall. Our analysis showed that this is because longer commute times are taken on for jobs which provide higher salaries and other benefits (which serve to increase life satisfaction). This does not mean that the negative subjective wellbeing impacts of longer commutes can be disregarded. The acceptance that a long commute is a price to pay may only be retained if the commute is considered unavoidable and a social norm.

For some workers the opportunity to work flexibly in time and space (including working from home) reduces the burden of commuting. This might have resulted in us finding a lower impact of longer commute times on subjective wellbeing than would otherwise have been the case. We recommend further research on this topic, including in-depth interviews to investigate how flexibility in working practices influences how the commute affects people's lives.

One finding that we did not fully anticipate at the study outset is the clear link between longer duration commutes, commuting mode and job satisfaction. An important message for employers is that job satisfaction can be improved if workers have opportunities to reduce the time spent commuting, to work from home, and/or to walk or cycle to work – such commuting opportunities are likely to be good news for employee wellbeing and retention and hence reduced costs to businesses.

Study findings by theme

Finding	Page
<i>Theme 1: The impacts of longer commute times on employee wellbeing</i>	
Longer commute times:	
reduce job satisfaction (for women especially)	p.17
reduce leisure time satisfaction (with impact increasing over time)	p.19/p.33
increase strain	p.23
reduce mental health	p.24
are associated with people with lower life satisfaction	p.26
<i>Theme 2: Commutes that increase job satisfaction and employee retention</i>	
Longer commute times:	
reduce job satisfaction (for women especially)	p.17
increase probability of changing job	p.35
Working from home:	
increases job satisfaction	p.17
increases leisure time satisfaction	p.19
Walking to work:	
is associated with people with higher job satisfaction	p.18
<i>Theme 3: The benefits of active commuting</i>	
Walking to work:	
is associated with people with higher job satisfaction	p.18
increases leisure time satisfaction (for women especially)	p.19
reduces strain	p.23
Cycling to work:	
increases leisure time satisfaction (for women especially)	p.19
is associated with people with higher self-reported health	p.22
<i>Theme 4: Insights for public transport</i>	
Bus commuting	
Commuting by bus is associated with people with lower self-reported health	p.22
Compared to other modes, longer commute times by bus more strongly reduce job satisfaction	p.17
Compared to other modes, longer commute times by bus more strongly reduce mental health	p.25
Rail commuting	
Commuting by rail is associated with people with higher leisure time satisfaction	p.20
Longer commute times by rail are associated with lower strain than shorter commute times	p.23

1 Introduction

There is increasing interest in how **transport policies and practices can contribute to better health**¹. Attention has mostly been focused on lessening negative impacts on physical health from traffic injuries, pollution and declining physical activity. But there has been growing recognition that transport and personal mobility can also affect people's mental health and overall wellbeing. This has coincided with governments around the world introducing the goal to improve the wellbeing of their populations².

The journey to and from work is a **routine activity** which is undertaken on about 160 days of the year by those that are full-time employed in England³. The average one-way commute duration is 30 minutes⁴, hence commuting consumes about one hour per day for the average commuter. However, one in seven commuters in England has a commute duration of at least one hour⁵, thus spending at least two hours per day commuting.

Commuting has the **potential to affect wellbeing in various ways**. It may be stressful and adversely affect mood during and after the journey. It may consume time and money that workers would rather spend on other activities. On the positive side, a commute may be relaxing and provide time to switch off and if it involves physical activity it could be appreciated for its health benefits. The impact on wellbeing of commuting is likely to depend upon its duration, the mode of transport used and the conditions experienced. People have good reasons to commute. Commuting allows people to access employment opportunities, to earn (higher) income and to have greater choice in where they live. The question is whether the negative aspects of commuting exceed the benefits of employment.

Commuting trends

Over the last 20 years the average commute duration has increased from 24 minutes to 30 minutes⁶, but this has been counteracted by the trend for workers to travel to their workplace less often⁷. The proportion of people in employment **working from home has increased**⁸. It is apparent that commuting is changing as a result of more flexible working practices. However, not all workers have discretion about how often and when they travel to work, so it remains important to consider the impact of commuting upon people's lives. One aspect of this is that it may generally be those people in higher social groups who have greater choice over how often, when and how they travel to work and it is these who have better health. It is important that the impacts of commuting on wellbeing are considered across the social gradient⁹.

Definitions of subjective wellbeing

Subjective wellbeing (SWB) refers to an individual's evaluation of how well their life is going and is defined formally in the 2013 OECD Guidelines on Measuring Subjective Well-Being as “*Good mental states, including all of the various evaluations, positive and negative, that people make of their lives, and the affective reactions of people to their experiences*”.¹⁰ SWB can be measured¹¹ in terms of: (i) evaluative wellbeing - how satisfied individuals are with their lives overall; (ii) experiential wellbeing - how often individuals experience different emotions; and (iii) eudemonic wellbeing - whether individuals feel they are fulfilling their potential. Measurement of SWB has been introduced into a number of national surveys. Some concerns have been raised about the validity of individuals reporting their own wellbeing but self-reported scores have been found to correspond well with more objective methods of measuring personal wellbeing¹².

The Commuting & Wellbeing study

As is demonstrated in the next chapter, **clear evidence has been lacking** for the impacts of commuting on SWB. The Commuting & Wellbeing study sought to generate novel understanding of the impact of commuting upon people's lives. The new evidence is based on information about the lives of over 26,000 employed people living in England, using data from the *Understanding Society* longitudinal study.

2 What We Know

In this chapter, we summarise what is known about the effect of commuting on subjective wellbeing (SWB). It is useful first to identify what have been found to be the **main determinants of SWB**.

Determinants of subjective wellbeing

When looking across individuals, studies have shown that **good physical health, being in employment and being married or cohabitating** have the largest associations with higher SWB¹³. Those in middle age have lower SWB than younger adults and older adults. Gender differences depend upon the measure of SWB considered. Women tend to report higher life satisfaction than men but lower mental health. The effect of income has been found to be complex with positive but diminishing returns of increased income and relative income (income compared to others) being more important than absolute income. Lower SWB has been found for those working long hours and those seeking a new job¹⁴.

When looking at the same individuals over time it has been found that SWB is quite stable which has been attributed to genetics and personality. The suggestion has been made that people adapt to life events and that SWB 'fluctuates around a biologically determined set point that rarely changes' However, it has been shown that **life events such as unemployment have lasting impacts on SWB**¹⁵.

Existing evidence of commuting impact on subjective wellbeing

Economic theory would suggest that rational individuals would only take on more burdensome commutes if compensated by a better job or housing and that SWB should therefore not be any lower for those with longer commutes. A study by ONS based on a sample of 62,000 British workers in 2012/13, however, found that longer commute durations are associated with lower SWB¹⁶. With concern that results for the relationship between commuting duration and SWB based on cross-sectional data may not reflect commuting circumstances, but other differences between those with long commutes and short commutes, researchers have analysed data which tracks SWB over time for the same individuals (therefore controlling for unobserved differences between individuals).

A study based on the German Socio-economic Panel Study (GSOEP), which included observations for the same individuals between 1985 and 2003, found longer duration commutes associated with lower life satisfaction¹⁷. This was referred to by the authors as the '**commuting paradox**' with the explanation put forward that this comes about as people incorrectly estimate the effects of commuting and their ability to adapt to it. However, longer duration commutes were not found to be associated with lower life satisfaction in an analysis of data from 1996 to 2008 for participants of the *British Household Panel Survey (BHPS)*¹⁸, although another analysis of the same data set for the

years 1991 to 2004 found that longer duration commutes were associated with worse mental health for women¹⁹.

Differences in SWB associated with **different modes of transport** have not generally been found. An exception is an analysis of *BHPS* data (for 1991 to 2008) which found walking to work and using the bus to be associated with better mental health than commuting by car²⁰.

Potential effects of commuting

In seeking to identify if commuting has an overall effect on SWB, we need to be clear why this might be the case. Research has examined a variety of potential effects of commuting. **Stress during the journey to and from work** has been a prominent explanation. Longer commute durations and more unpredictable journeys have been found to be associated with higher levels of commuting stress²¹. Car commuters have been found to report a higher level of stress and more negative mood than rail commuters (explained by greater effort requirements and lower journey predictability of car commuting)²². Active commuting has been found to be considered more relaxing and exciting than other modes²³. Commuting stress has been found to affect mood, function, illness, job satisfaction and likelihood of changing job²⁴.

It has also been found that the **commute can be seen positively** in terms of (i) time to relax, think and 'shift gears' between one activity and the next²⁵; (ii) enjoyment of the travel itself²⁶ and (iii) use of the time productively²⁷. Nevertheless, commuting has been found to receive the lowest positive affect scores (extent to which an individual subjectively experiences positive moods) among all daily activities and one of the highest negative affect scores²⁸.

Recent research has been seeking to understand better **what influences satisfaction with the journey to work**. Commute satisfaction has been found to be positively associated with walking or cycling to work and negatively associated with using public transport and with longer commute duration²⁹. Perception that the commute has value beyond arriving at the destination increases commute satisfaction³⁰. Talking with other passengers has been found to increase commute satisfaction on public transport³¹. Commuters with greater flexibility over the transport mode they use have greater journey satisfaction³². The value of understanding what influences commute satisfaction is apparent given that research has found satisfaction with the commute contributes to explanation of overall SWB, especially experiential wellbeing (the balance of positive and negative emotions)³³.

Only limited research has been carried out on how **time spent commuting affects engagement with other activities**. It has been found that those with long commute times spend less time on leisure activities and sleep less on weekdays, but compensate with more sleep at weekends³⁴. It has also been found that longer commute times decrease time spent with spouse, children and friends³⁵.

With regard to **physical health**, one study showed that longer duration commutes are associated with poorer health and more GP visits with this particularly evident for car drivers and for women³⁶. Another found that switching from car travel to walking, cycling or public transport is associated with decreases in body-mass index (BMI)³⁷.

2.1 A need for further research

This summary of existing evidence highlights some gaps in knowledge. First, there is an unclear picture for England how different commuting behaviours affect SWB. This could be understood better by investigating how specific aspects of SWB are impacted by commuting and whether these have consequences for overall life satisfaction. Secondly, it has not been considered how *specific changes* to commuting behaviour affect SWB and whether impacts grow or diminish over time. And thirdly, it is unclear the extent to which arduous commutes are tolerated and what commuters do to avoid them.

The Commuting & Wellbeing study sought to generate novel understanding of the impact of commuting upon people's lives by addressing the following three research questions:

Research Questions

1. What specific aspects of wellbeing are affected by commuting and what does this mean for overall life satisfaction?
2. How is wellbeing affected by different commuting behaviour *changes* and do impacts grow or diminish over time?
3. What responses do commuters make to arduous commutes?

The data used in the study is described in the next chapter. Chapter 4 contains our findings on how different aspects of SWB are influenced by commuting and Chapter 5 sets out what this means for overall life satisfaction. Chapter 6 presents findings on how *changes* to commuting behaviour affect SWB and on how commuters respond to arduous commutes.

3 The ‘Understanding Society’ Data Set

This study of Commuting & Wellbeing is based on information about the lives of over 26,000 employed people living in England, using data from the *Understanding Society* surveyⁱ. *Understanding Society* is an innovative world leading study about 21st century life, in which members of 40,000 households in the UK are being surveyed every year. In contrast to cross-sectional population surveys like the Census, this enables us to track how the lives of the *same individuals* are changing over time. In this study we had access to the first six years (or waves) of *Understanding Society* survey data, covering 2009/10 to 2014/15.

3.1 Data on commuting

Every year, the *Understanding Society* survey asks participants two questions about their journey to work:

- 1. About how much time does it usually take for you to get to work each day, door to door (in minutes)?**
- 2. And how do you usually get to your place of work?**

The majority (around 60%) of people included in our sample travelled to work by car in 2009/10. Walking was the next most common means of travelling to work:

Mode	Percentage using mode			Mean one-way commute time (mins)		
	Full sample	Males	Females	Full sample	Males	Females
Drive	54	55	53	24	27	22
Lift from household member	4	2	5	19	21	18
Lift from someone else	2	2	2	25	29	20
Motorcycle	1	1	0	26	27	19
Taxi	0	0	0	20	22	19
Bus/coach	8	6	10	38	39	38
Train	5	6	4	62	63	61
Metro	4	4	3	50	50	51
Cycle	3	5	2	20	21	17
Walk	11	9	14	14	15	14
Work from home	8	9	7	0	0	0
Other	0	0	0	35	36	35
Total	100	100	100	27	30	25

Based on Wave 1 Understanding Society general population sample and ethnic minority boost sample for participants living in England

ⁱ See Analysis Note 1 at the end of the report.

Door to door commute journeys were around 27 minutes on average, but there are large differences in commute durations between modes. For example, rail commuters travelled for over an hour, while car drivers commuted for 24 minutes on average. Walking and cycle commutes were much shorter. Men had slightly longer duration commutes than women (five minutes more on average).

3.2 Data on personal wellbeing

The *Understanding Society* survey captures data about multiple aspects of SWB and this allowed us to explore impacts of commuting on different sub-domains of people’s lives. The items analysed are listed below.

<i>Understanding Society</i> - Indicators of subjective wellbeing	
Life satisfaction	How dissatisfied or satisfied are you with your life overall? (measured on a 7-point scale)
Job satisfaction	How dissatisfied or satisfied are you with your job? (measured on a 7-point scale)
Leisure time satisfaction	How dissatisfied or satisfied are you with the amount of leisure time you have? (measured on a 7-point scale)
Self-reported health	In general, would you say your health is? (excellent to poor on a 5-point scale)
Mental health	Based on the General Health Questionnaire scale (a 36 point scale derived from 12 questions including the question above - the scale is used to identify minor psychiatric disorders)
Strain	Have you recently felt constantly under strain? (measured on a 4-point scale)

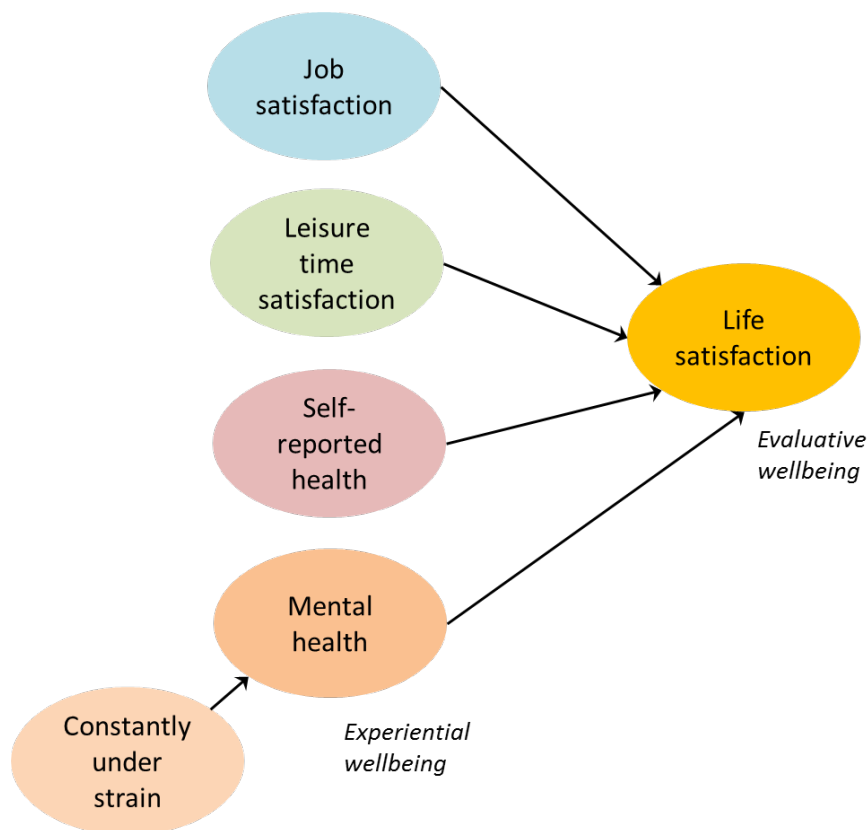


Figure 1: Sub-domains of subjective wellbeing and their relationship to life satisfaction

We explored the relationship between commuting and each of these different aspects, or sub-domains, of SWB. **Life satisfaction** represents an evaluative assessment of how well a person’s life is going overall. We were interested to see if any effect of commuting could be found, but understood that this might not be easy to detect given that negative impacts of commuting will be compensated by positive impacts such as high earnings. We therefore analysed the effect of commuting on four sub-domains where it was plausible that commuting could have an effect not compensated for by other factors.

Evaluative assessments were available for **job**, **leisure time** and **health**. It is assumed that survey respondents respond to the health question mainly with respect to their physical health. **Mental health** is measured in *Understanding Society* using a combined score based on 12 questions designed to detect the presence of symptoms of psychiatric disorders – a number of the questions relate to negative emotions and hence this indicator can also be seen as an indicator of experiential wellbeing. We conceived that an onerous commute could induce negative feelings and hence a low mental health score. One of the 12 questions, the question about **strain**, was felt to be particularly pertinent with regards to commuting and was examined in its own right.

4 Impact of Commuting on ‘Domains of Wellbeing’

In this chapter we summarise our findings on how commuting affects the following sub-domains of SWB:

- i. Job satisfaction;
- ii. Leisure time satisfaction;
- iii. Physical activity and health; and
- iv. Strain and mental health

In chapter 5 we will move on to discuss how the impacts across these sub-domains combine to influence overall life satisfaction.

For each aspect of SWB, we first of all summarise how people responded to the survey question used in the analysis, and how responses differed by commute duration and mode – illustrated using bar charts.

Any relationships apparent from the bar charts could relate to factors other than the commuting situation. For example, rail users have higher incomes on average than bus users and the higher income will contribute to higher wellbeing. Hence our **key insights** into the specific effects of commuting on SWB are based on statistical (regression) models that enabled us to account for other factors.

Our **key insights** are summarised in bold headlines after the bar charts. Alongside each insight we indicate the **level of confidence** (from the statistical models) using the following ratings:

✓✓✓	✓✓	✓
Very Confident	Confident	Tentative

The following note explains how our analysis of the *Understanding Society* data enabled us to obtain results and how we interpreted the results and judged confidence in them.

A note about the analysis and confidence in results

The longitudinal data consisted of up to six observations (at one year intervals) from about 26,000 individuals. This allowed us to analyse how variation in SWB relates to variation in commuting behaviour over two different dimensions.

- 1) How variation in SWB relates to variation in commuting behaviour *within individuals* based on up to six observations (also accounting for variation in personal circumstances over the observations).
- 2) How variation in SWB relates to variation in commuting behaviour *between individuals* based on about 26,000 individuals (also accounting for variation in personal circumstances between individuals).

Our findings reported in chapters 4 and 5 are based on statistical models which separately identified relationships for these two dimensionsⁱⁱ.

The results for within-individual variation have the advantage of controlling for unmeasured differences between individuals (that may be correlated with commuting, e.g. personality traits), but the disadvantage of requiring sufficient variation in commuting behaviour within individuals to generate useful results.

The results for between-individual variation utilise the variation in commuting behaviour between individuals available in the data but have the disadvantage that they do not control for unmeasured differences between individuals (e.g. personality traits).

In judging confidence, we have placed greater weight on the results for within-individual variation. These give evidence for whether an individual's SWB changes according to their commuting behaviour (e.g. the transport mode they use). We refer to statistically significant relationships based on results for within-individual variation in language as follows:

"Longer commute times *reduce* job satisfaction"

Where statistically significant relationships were obtained for between-individual variation, but not for within-individual variation, we consider this still provides plausible evidence that commuting behaviour affects SWB and refer to this in language as follows:

"Walking to work is *associated* with higher job satisfaction"

Against each of our key insights in chapters 4 and 5, we have adopted the following scale to indicate the level of confidence in the supporting evidence:

Confidence level	Rating	Based on	Significance level
Very confident	✓✓✓	Within-individual variation	>=99%
Confident	✓✓	Within-individual variation	>=95%
Tentative	✓	Between-individual variation	>=95%

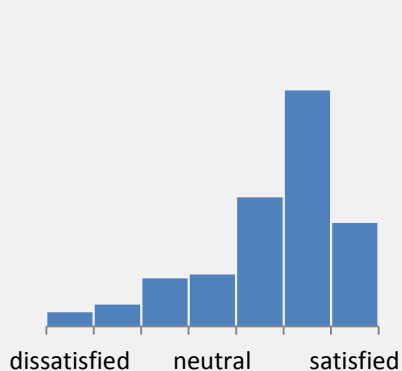
ⁱⁱ See Analysis Note at the end of the report.

4.1 Job satisfaction

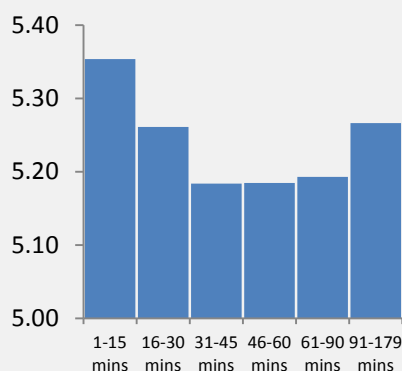
Survey participants were asked:

How dissatisfied or satisfied are you with your job?

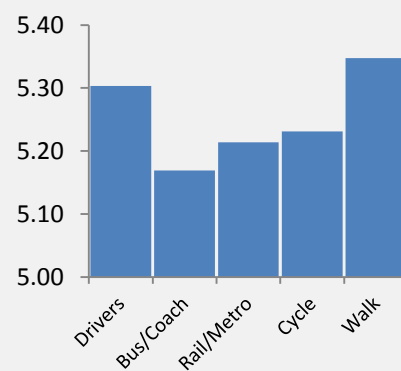
The majority of people (78%) reported being mostly to completely satisfied with their job.



Job satisfaction is highest amongst those with the shortest and longest commutes.ⁱⁱⁱ



Job satisfaction is highest amongst drivers and walkers.



After accounting for other factors, our **key insights** are as follows:

Confidence

JS1: Longer commute times reduce job satisfaction



We found that job satisfaction decreases with the amount of time spent travelling to work (every extra 10 minutes (each way) reduces job satisfaction by 0.008 points on the 7-point scale). It increases with salary and with certain job roles (self-employed and manager) and decreases when working long hours (over 40 hours per week).

An additional 10 minutes (each way) of commuting time is associated with the equivalent effect on job satisfaction as a 19% reduction in gross personal income, i.e. a loss of £4,080 per annum for someone earning the sample median income of £21,600 per annum^{iv}.

JS2: Working from home increases job satisfaction



Job satisfaction is 0.10 points higher (on the 7-point scale) when individuals work from home (compared to commuting by any mode). This implies that flexible working conditions can improve employee satisfaction.

JS3: Job satisfaction is more sensitive to longer journey times by bus than longer journeys by other modes



Job satisfaction is higher for short bus journeys (compared to short journeys by other modes) but decreases by more for every additional minute of commute time for bus users.

ⁱⁱⁱ Very few people reported commutes of over 90mins - around 1% of the sample.

^{iv} See Analysis Note 3 at the end of the report.

JS4: Walking to work is associated with higher job satisfaction ✓

Those individuals that walk to work have higher job satisfaction on average by 0.10 points (on the 7-point scale) compared to other commuters (after accounting for journey time differences and other personal differences such as income and occupation type), but for the same individuals we do not see higher job satisfaction on occasions when they walk to work compared to using other modes. This gives tentative evidence that walking to work improves job satisfaction.

Differences amongst the population

We examined whether the general relationships identified varied for different groups in the population:

Gender

Job satisfaction is 0.14 points higher for women than men (on the 7-point scale). The negative impact on job satisfaction with longer journeys to work applies more strongly to women than men (reducing job satisfaction for women by 0.019 points with every extra 10 minutes each way). The larger effect for women is likely to be related to greater household and family responsibilities which place more time pressure on them.

Age

Younger workers aged 16-29 have lower job satisfaction than older workers but are found not to be sensitive to longer commute journeys. A plausible explanation is that younger workers accept they will need to make longer commute journeys early in their career.

Income

Job satisfaction increases with personal income and the job satisfaction of those with higher incomes is found to be more sensitive to the duration of the commute. This suggests again that expectations play a role. Those with lower income jobs accept the need for longer journeys to work.

Area type

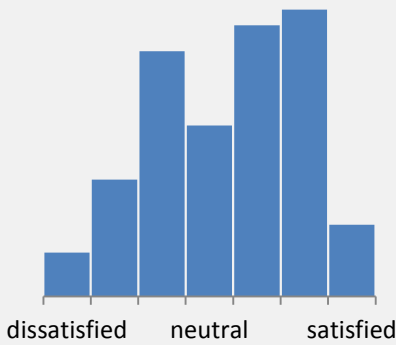
Longer duration commutes have a stronger negative effect on job satisfaction for those living in a metropolitan area outside London. This implies travel conditions may be particularly difficult in English metropolitan areas outside of London.

4.2 Leisure time satisfaction

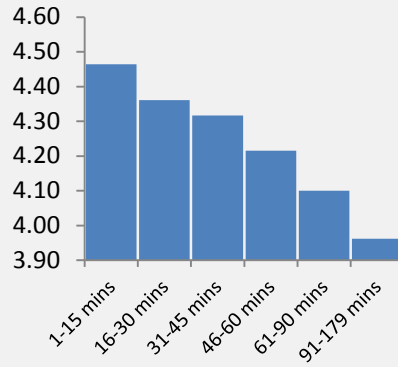
Survey participants were asked:

How dissatisfied or satisfied are you with the amount of leisure time you have?

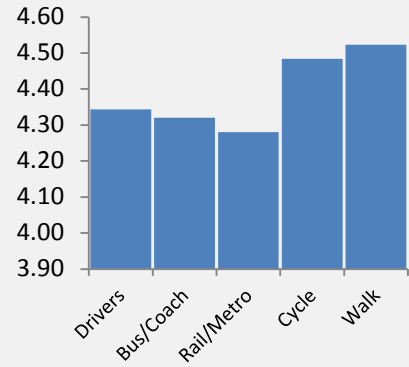
The responses to this question are evenly spread. 52% reported being satisfied with leisure time availability.



There is a clear downward trend in leisure time satisfaction as commute duration increases.



Leisure time satisfaction is highest amongst cyclists and walkers, reflecting their shorter commute durations.



After accounting for other factors, our **key insights** are as follows:

Confidence

LT1: Longer commute times reduce leisure time satisfaction



Lifestyle factors that intensify personal time constraints decrease leisure time satisfaction. This includes longer commute times, as well as working long hours and having children. Every extra 10 minutes of commute time (each way) reduces satisfaction with leisure time availability by 0.030 points (on the 7-point scale). We also found that earning more decreases leisure time satisfaction, implying it compromises available leisure time. By contrast, higher *household* income is found to increase leisure time satisfaction suggesting that people benefit in terms of leisure time from the income generated by other household members.

LT2: Working from home increases leisure time satisfaction



Not having to take time out of the day to travel to work increases leisure time satisfaction by 0.17 points (on the 7-point scale). Flexible working would appear to be an important means of improving employee wellbeing.

LT3: Walking and cycling to work increase leisure time satisfaction



Workers have higher levels of satisfaction with leisure time availability when they walk or cycle to work compared to using other modes of transport (after accounting for journey time differences). Walking and cycling increase leisure time satisfaction by 0.07 points and 0.08 points respectively (on the 7-point scale). This outcome is larger for women suggesting that active commuting is seen particularly by women as relaxing and beneficial exercise.

LT4: Rail commuting is associated with higher leisure time satisfaction

Those individuals that commute by rail have higher leisure time satisfaction on average by 0.13 points (on the 7-point scale) compared to other commuters (after accounting for journey time differences and other personal differences such as income and occupation type), but for the same individuals we do not see higher leisure time satisfaction on occasions when they commute by rail compared to using other modes. This gives tentative evidence that rail commuting improves leisure time satisfaction.

Differences amongst the population

We examined whether the general relationships identified varied for different groups in the population:

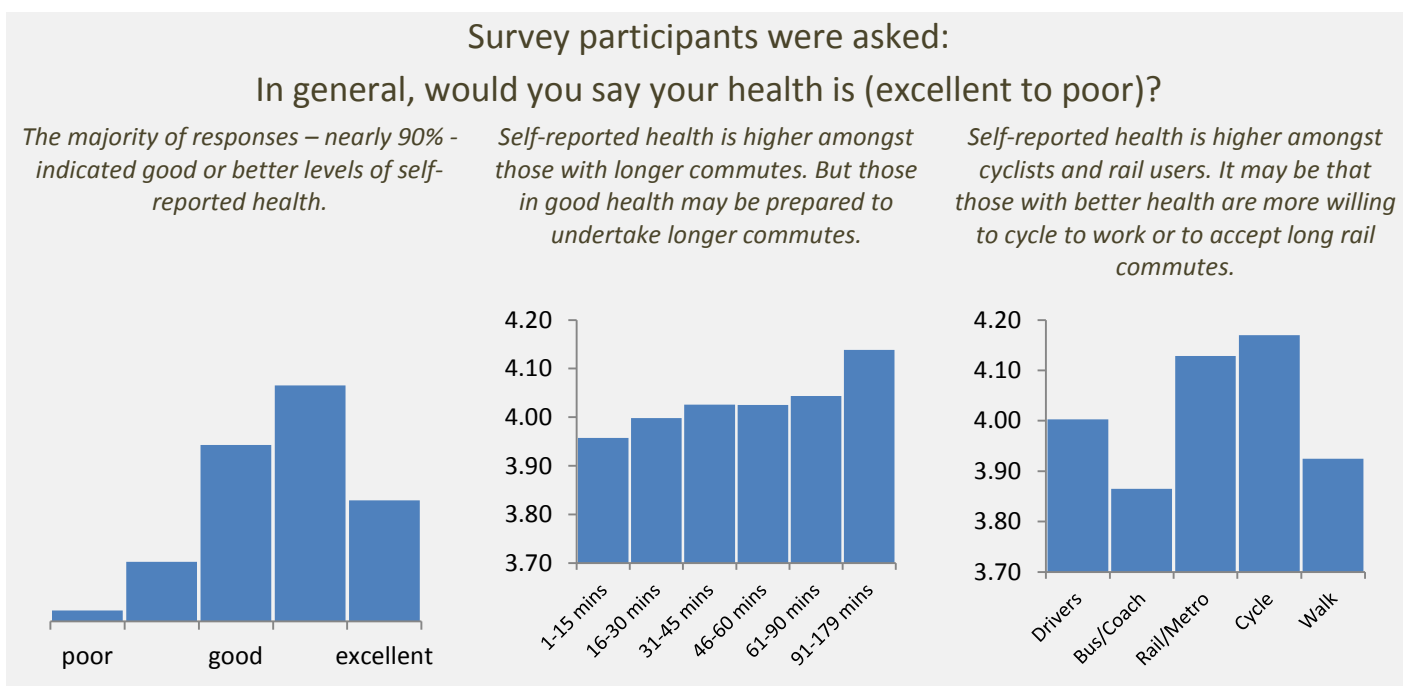
Gender

Women have substantially lower leisure time satisfaction compared to men (by 0.20 points on the 7-point scale). This is likely to relate to greater household and family responsibilities – their satisfaction is decreased by having a partner while men's satisfaction is unaffected. The effect of longer commute durations on leisure time satisfaction is nevertheless the same for men and women.

Income

People in the middle income quintile are less sensitive to longer commutes with respect to their leisure time satisfaction than people with lower and higher incomes. This indicates they are more willing to sacrifice leisure time for their job.

4.3 Physical activity and health



First, we checked whether people who commute to work on foot, by bike or by public transport are more physically active than car drivers. In wave 2 of *Understanding Society* respondents were asked ‘On how many days in the last four weeks did you spend 30 minutes or more walking?’. Our analysis confirmed that those who commute to work on foot walked the most frequently, but those who commuted by bike or by public transport also walked significantly more frequently than people who commute to work by car. In the case of public transport, this could be because people walk to or from the railway station or bus stop. We then examined the relationship between commuting and self-reported health. After accounting for other factors, there were few clear associations between commuting and self-reported health.

Our **key insights** are as follows:

Confidence

PH1: Longer commute times *may* reduce self-reported health

-

Our results indicated that *Understanding Society* participants had slightly worse self-reported health when they had longer duration commutes (by 0.004 points on the 5-point scale for every extra ten minutes each way), but there is not quite a 90% level of confidence of this result. We know from the bar chart above that those with better health are more likely to have longer commutes. Hence it appears that good health is a prerequisite to undertaking a longer commute, but if an individual increases their commute duration their self-reported health will tend to worsen.

PH2: Cycling to work is associated with higher self-reported health ✓

We found that those individuals that cycle to work have higher self-reported health compared to other commuters (after accounting for differences between individuals, including commute duration), but for the same individuals we do not see statistically significant higher self-reported health on occasions when they cycle compared to using other modes. This indicates that healthy individuals take up cycling to work, rather than cycling resulting in better health, and raises the concern that those from higher social groups are the ones who take up health-enhancing lifestyle options. We will return to this insight in chapter 6 where we present evidence that the specific switch from driving to cycling is associated with an improvement in self-reported health in the year that the switch occurred.

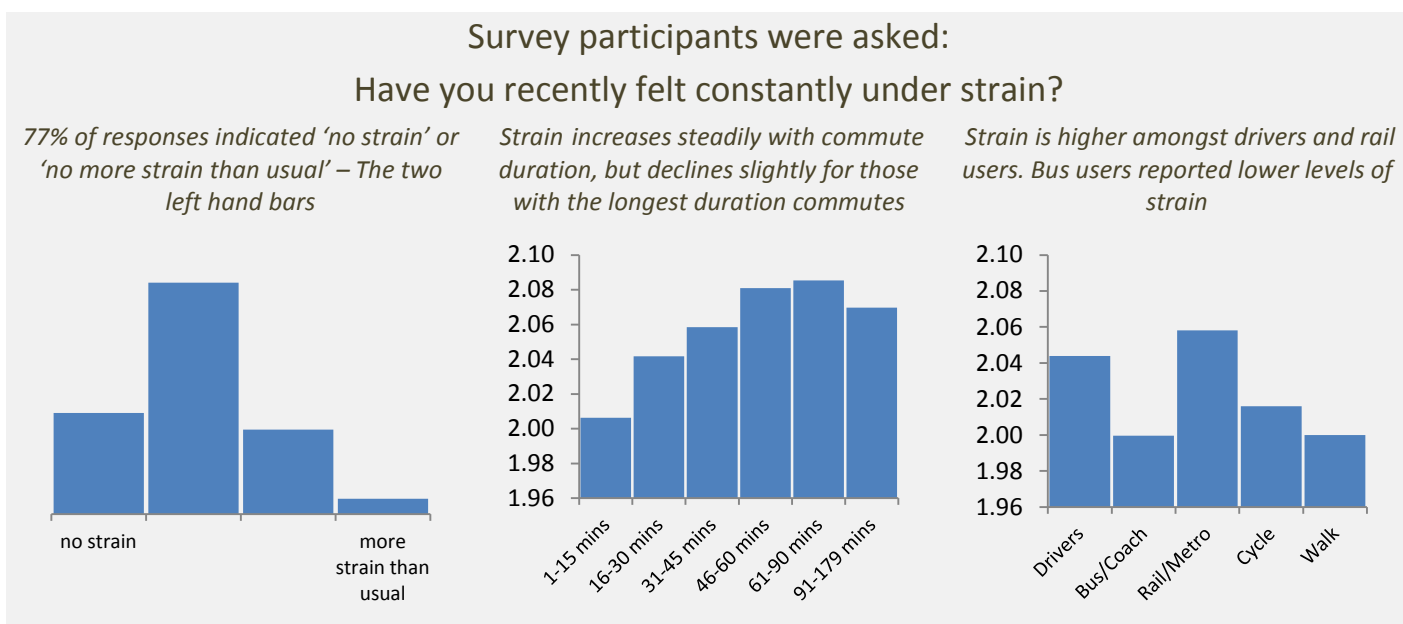
PH3: Commuting by bus is associated with lower self-reported health ✓

We found that those individuals that commute by bus have lower self-reported health compared to other commuters (after accounting for differences between individuals, including commute duration), but for the same individuals we do not see lower self-reported health on occasions when they commute by bus compared to using other modes. This gives evidence that less healthy individuals take the bus to work but it cannot be concluded that their health worsens as a result of using the bus to get to work.

Differences amongst the population

The relationships between commuting and self-reported health are not strongly influenced by gender, age, income and where people live.

4.4 Strain and mental health



After accounting for other factors, our **key insights** are as follows:

Confidence

ST1: Longer commute times increase strain ✓✓

Longer commute times increase strain (by 0.004 points on the 4-point scale for every extra ten minutes each way) with strain also increased by working long hours (over 40 hours per week), a management job, a higher personal income, having children and having a longstanding health condition.

ST2: Walking to work reduces strain ✓✓✓

Strain decreased when people walk to work compared to using other modes of transport to get to work. The decrease in strain linked to walking (of 0.047 points on the 4-point scale) is equivalent to the increased strain (of 0.041 points) when having a management role.

ST3: Longer commute times by rail are associated with lower strain than shorter commute times by rail ✓

We found that rail commuters with longer commute times have lower strain than rail commuters with shorter commute times. One possible explanation is that people with shorter rail commutes find them more stressful as they are more likely to involve the use of crowded, urban commuter lines or metro systems. Commuters with longer journeys may be better able to use their journey time productively.

Differences amongst the population: Strain

We examined whether the general relationships identified varied for different subgroups in the population:

Gender

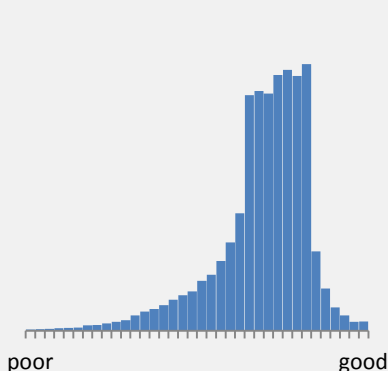


Women have higher levels of strain than men (by 0.12 points on the 4-point scale), but the negative impact on strain with longer journeys to work is found to apply more strongly to men than women (increasing strain for men by 0.006 points for every extra 10 minutes (each way)). This may be because women's strain is already at a higher level.

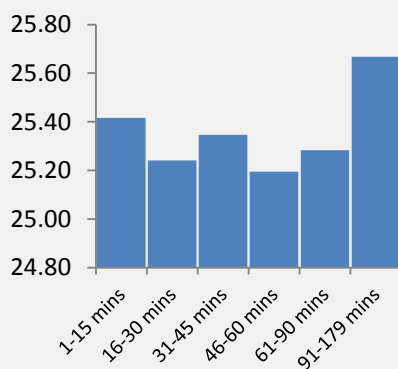
Mental health

In addition to the question on strain, survey participants were asked 11 other questions reflecting potential symptoms of poor psychological state including for example, "have you recently lost much sleep over worry?" These are combined into a single indicator of mental health known as the General Health Questionnaire-12 (GHQ12) score where high scores are indicative of a lower likelihood of poor mental health.

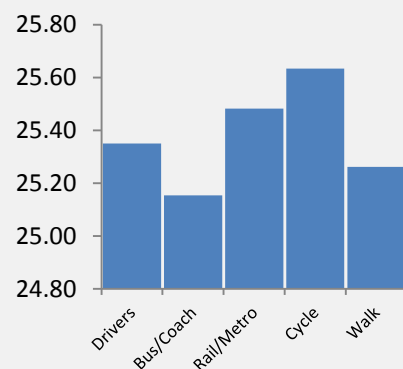
The majority of the GHQ12 responses indicate good mental health. The long tail to the left indicates a small group with poor mental health



GHQ12 scores decrease slightly as commute duration increases. But scores are also higher for those with the longest duration commutes



GHQ12 scores are lowest amongst bus users. Cyclists have the highest scores – slightly higher than drivers, rail commuters and walkers



After accounting for other factors, our **key insights** are as follows:

Confidence

MH1: Longer commute times reduce mental health



Not many personal factors were found to be associated with the GHQ12 measure of mental health, but longer commute times were found to decrease mental health (by 0.025 points on the 36-point scale for every extra ten minutes each way). Women have substantially lower mental health than men (by 0.96 points) but are no different in sensitivity to longer commute durations.

MW2: Commuters are more sensitive to longer commute times by bus for mental health



Mental health decreases to a greater extent with every additional minute of commute time when people use the bus compared to using other modes. A similar result was obtained for job satisfaction and suggests that long commutes involving bus travel create difficulties in coping with everyday life.

Differences amongst the population: Mental health

The relationships between commuting and mental health are not strongly influenced by gender, age, income and where people live.

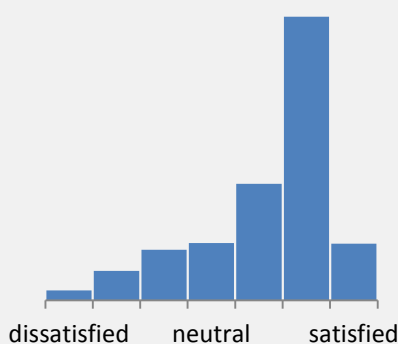
5 Impact of Commuting on Life Satisfaction

Having reported how commuting affects different aspects of SWB, in this chapter we report findings on how commuting was found to be related to overall wellbeing as represented by *Understanding Society* participants' assessment of their *life satisfaction*.

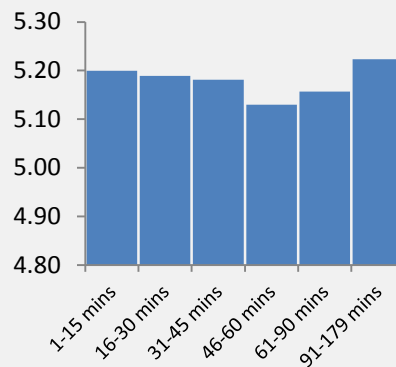
Survey participants were asked:

How dissatisfied or satisfied are you with your life overall?

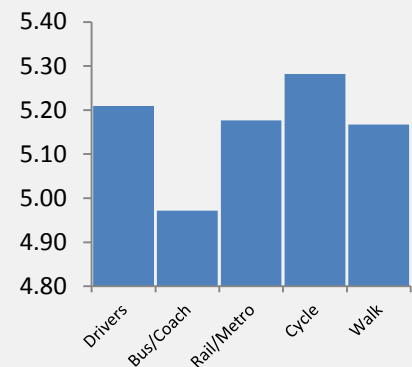
Most people are positive about their lives: three quarters reported being somewhat to completely satisfied with their life overall.



Life satisfaction scores decrease slightly as commute duration increases. But scores are also higher for those with the longest duration commutes^v



Life satisfaction scores are lowest amongst bus users. Cyclists have the highest scores – slightly higher than drivers, rail commuters and walkers.



Consistent with earlier research, our analysis showed that living with a partner, being in good health, financial security, and not being in middle age are the most important contributors to life satisfaction. We found there is *not* a strong *direct relationship* between commute duration and life satisfaction, but life satisfaction is affected indirectly via leisure time satisfaction, job satisfaction and strain.

Our **key insights** are as follows:

Confidence

LS1: Longer commute times are associated with lower life satisfaction

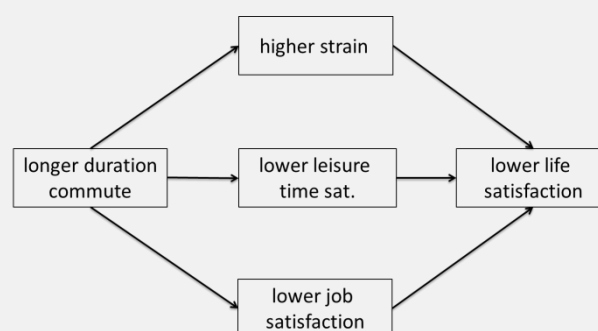


When comparing individuals, we found that longer duration commutes are associated with lower life satisfaction after accounting for other differences between individuals (by 0.015 points on the 7-point scale for every extra ten minutes each way). This applies to both men and women but it represents a relatively small effect (working part-time is associated with a higher life satisfaction score of 0.12 points). For the same individuals we did not find lower life satisfaction on occasions when they have longer duration commutes.

^v Very few people reported commutes of over 90mins - around 1% of the sample.

LS2: Lower life satisfaction of those with longer commute times is mainly due to reduced leisure time satisfaction ✓

A path analysis which explored the mechanisms by which commute duration influences life satisfaction across individuals^{vi} revealed that longer commute journeys reduce leisure time satisfaction, reduce job satisfaction and increase strain (consistent with findings of chapter 4). These factors in turn act to reduce life satisfaction. By far the biggest influence is leisure time satisfaction. In the statistical analysis, this accounted for 80% of the negative impact of longer commute durations on life satisfaction.



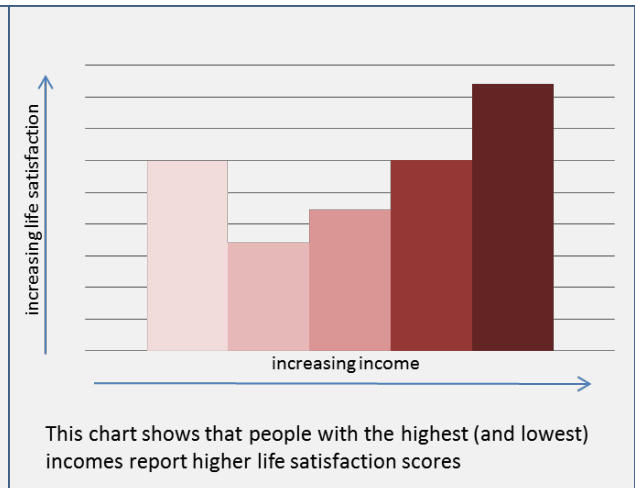
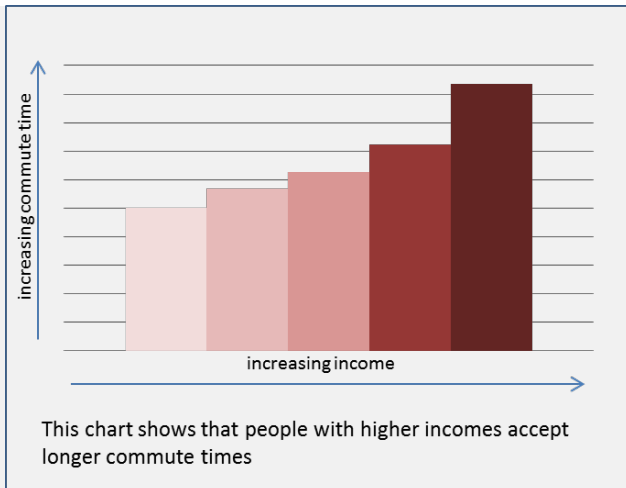
From this path analysis (based on between-individual variation which has the disadvantage that it does not control for unmeasured differences between individuals) we calculated that:

An additional 10 minutes (each way) of commuting time is associated with the equivalent effect on life satisfaction as a reduction of £490 per month in gross personal income (or £5,880 per annum)³⁸.

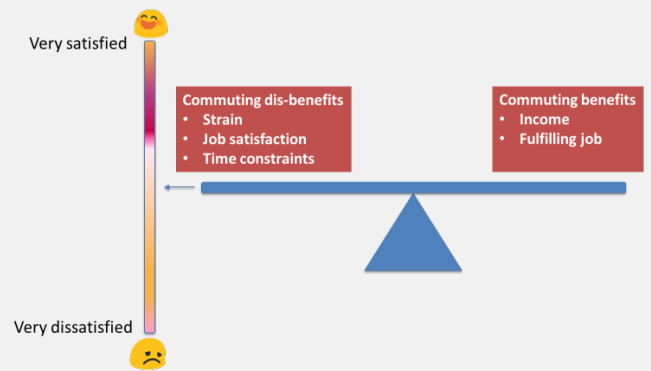
LS3: Commuting involves a life satisfaction trade-off ✓

While longer commute times are shown to have a negative impact on life satisfaction as indicated above, our analysis showed that they are at the same time associated with other factors that *increase* life satisfaction: for example a higher income, and a management job role. This shows that people may accept a longer commute journey in order to achieve other benefits.

^{vi} See Analysis Note 4 at the end of the report.



Our overall interpretation for commuters in England is that they are generally successful in trading-off the drawbacks of a longer commute journey against the benefits that they bring. We reach this conclusion given that only a modest association was found between commute times and life satisfaction (indicating that the benefits of longer commutes generally cancel out the drawbacks).



LS4: Commute mode does not have a direct influence on life satisfaction

The bar chart presented at the beginning of the chapter on page 26 indicates clear differences between the average life satisfaction scores of the different commuting groups (drive, bus, rail, cycle, walk). However, nearly all of this variation was found to be explained by other factors such as higher income amongst rail commuters and higher self-reported health amongst cyclists. That is not to say that the commute mode does not play an important role for SWB, as we explore in the next section.

5.1 Implications of commuting for overall wellbeing

Our overall view of how commuting influences different aspects of SWB is summarised in Figure 2 on the next page, based on a synthesis of the findings explained in this and the preceding chapter.

Taken together, the **key insights** from our study imply that a **shorter commute time** has benefits in terms of:

- Increased job satisfaction;
- Increased leisure time satisfaction; and
- Reduced strain / improved mental health

In doing so, shorter commute times can indirectly contribute to a more satisfying life – particularly through the release of time. This is only the case if the benefits of undertaking the commute can also be maintained (like earnings for example).



Figure 2: How commuting influences life satisfaction

We also found that longer commute times by public transport have some specific effects compared to commuting by other modes. Longer commute times by bus more strongly reduce job satisfaction and mental health, while longer commute times by rail are linked to lower strain than shorter rail journeys.

The mode of transport used also plays a role *beyond the time taken to get to work*. Active commuting is found to have some specific benefits. Walking and cycling to work contribute to improved wellbeing via increased leisure time satisfaction and walking to work contributes via reduced strain as well. Cycling is associated with higher self-reported health, although it is found that healthier people choose to cycle. We return to this finding in the next chapter where we examine the specific effects of changing commute situation on SWB.

Working from home is shown to increase job satisfaction and leisure time satisfaction.

6 Changing Lives over Time

The two previous chapters presented evidence on how SWB is influenced by different commute behaviours. The findings are based on statistical associations between commuting behaviours and SWB for over 26,000 individuals participating in the *Understanding Society* longitudinal study and observed annually on up to six occasions.

This chapter explicitly considers how SWB changes over time in association with changes in commuting behaviour. The time dependent nature of the relationship between commuting and SWB has received little attention to date. This is an important area to investigate for three reasons.

1. Establishing whether a relationship is *causal* requires it to be demonstrated that the *cause* – in our case commuting behaviour or a change to this, happens before the *effect* - in our case a change in SWB.
2. Identifying whether a long-term outcome is the same as a short-term outcome is relevant for evaluating interventions. For example, it is important to know if a change in SWB endures or is short-lived – it has been argued that individual's happiness returns to a baseline level following a change in life circumstances³⁹.
3. Examining the process of change over time provides informative insights into how commuters adjust to changing circumstances as they move through their lives.

This chapter summarises our evidence of:

- i. How changes to commute behaviour (in terms of duration and mode) affect different aspects of SWB;
- ii. How the effects of changes to commute behaviour on SWB, grow or diminish in the years following the change;
- iii. How maintaining the same commuting behaviour over the long term (e.g. undertaking a long duration commute for 6 years) affects the development of SWB over time; and
- iv. How people seek to improve their SWB by adjusting their life situation and commuting behaviour from one year to the next.

6.1 Short-term effects of commuting changes

First of all, we note there is a substantial amount of change in individual commuting behaviour from year to year:

- Commute mode - in 18% of cases the participants of *Understanding Society* reported a different method of transport for getting to work since the previous year. Mode changes were much less likely for car drivers than users of other modes^{vii}.
- Commute duration - in 22% of cases the participants of *Understanding Society* reported a change in commute duration category since the previous year between a short (up to 15 minutes), medium (16 to 45 minutes) or long duration commute (46 to 179 minutes). Duration category changes were more likely for long duration commuters.
- Workplace or residence change – changes in commuting behaviour are much more likely for those workers who change their workplace or residence⁴⁰. In 20% of cases the participants of *Understanding Society* reported a change in either or both of these since the previous year (14% changed workplace destination and 8% changed residential location).

Figure 3 overleaf summarises results for the effects of selected commuting behaviour changes on SWB^{viii}. The changes in SWB occurred between the same survey waves as the commuting behaviour changes – it is possible that changes in SWB preceded changes in commuting behaviour, but we believe it is more theoretically plausible that changes in commuting behaviour preceded changes in SWB. The behaviour changes presented are those where statistically significant results were obtained.

Overall our analysis of the effects of commuting behaviour changes on wellbeing indicated:

- (i) There are short-term SWB benefits of switching from driving to active commuting (to those for whom this is possible);
- (ii) There are short-term SWB benefits of starting working from home (to those for whom this is possible and specifically when stopping driving and rail use); and
- (iii) There are short-term SWB dis-benefits of changing from a shorter to a long duration commute (we also found equivalent benefits for changing from a long to a short duration commute).

These results are consistent with the results reported in chapters 4 and 5. For instance, the observation that switching from driving to cycling is associated with an increase in self-reported health adds confidence that cycling is linked to improved health. This was tentatively implied by the findings presented in chapter 4. It provides added evidence by showing that changes in SWB occur for the same time period during which commuting behaviour changes.

^{vii} See Analysis Note 5 at the end of the report.

^{viii} See Analysis Note 6 at the end of the report.

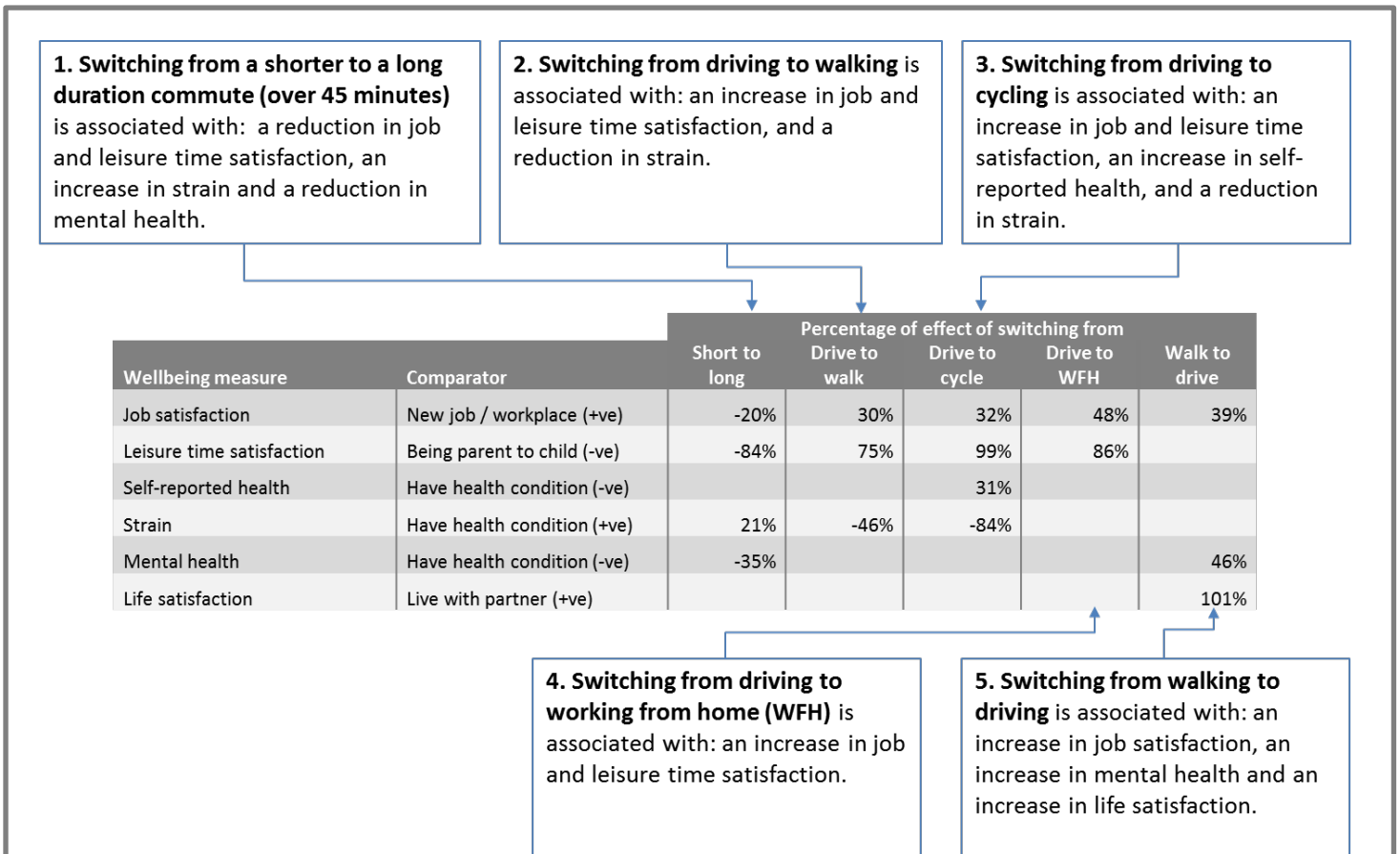


Figure 3: The short term effects of commuting changes

A note on how to interpret the figure:

In the ‘Comparator’ column we have identified one of the most important factors that influences each aspect of wellbeing. For example, starting a new job⁴¹ is the most important determinant of improved job satisfaction.

Taking the findings on switching from driving to walking as an example –the fourth column along - the table shows that switching from driving to walking is associated with:

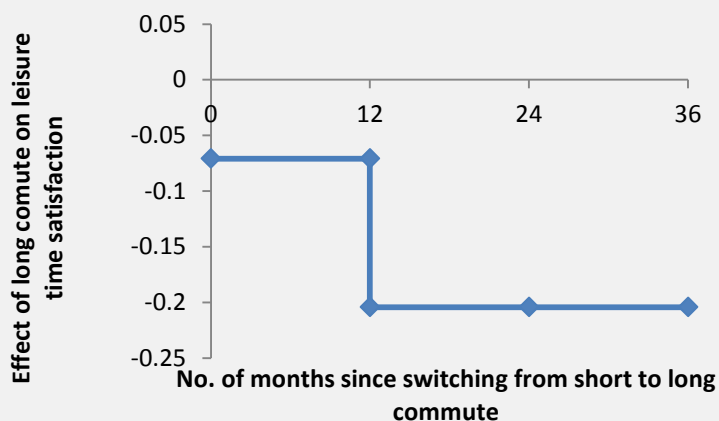
- An increase in job satisfaction: and the improvement is equivalent to 30% of starting a new job – a major determinant of improved job satisfaction.
- An increase in satisfaction with leisure time availability: and the improvement is equivalent to 75% (three quarters) of being a parent to a child - a major determinant of reduced leisure time satisfaction.
- And a reduction in strain: and the reduction is equivalent to 46% of having a long standing health condition – a major determinant of increased strain.

The effects of the other commuting changes can be interpreted in the same way.

6.2 Longer term effects of commuting changes

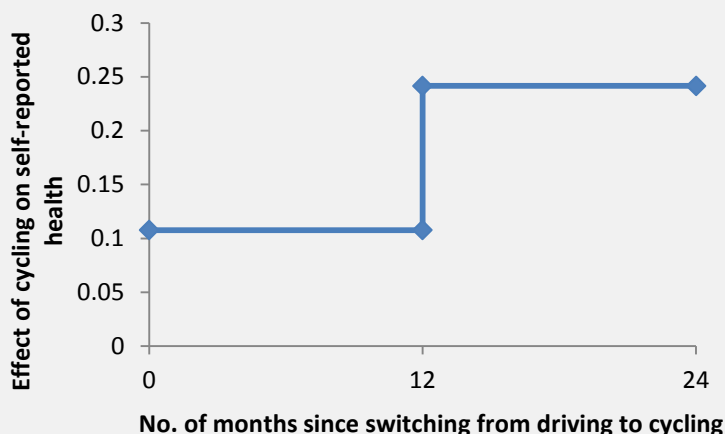
We found examples where the effects on SWB of a commuting behaviour change grew or diminished in the period following the change^{ix}. Two notable examples where there were statistically significant differences in short and long-term effects are summarised below. Note that we were able to examine what happens to SWB up to three years following the change.

We noted earlier in the report that longer commute times are linked to lower leisure time satisfaction. Our models also indicated that if someone switches from a short commute (15 minutes or less) to a long commute (greater than 45 minutes) the full negative effect of this switch is not felt in the first 12 months.



This suggests that people initially take on a longer duration commute without realising its full impact or appreciating other benefits (e.g. better job) that over time become less salient.

We also noted earlier in this chapter that switching from driving to cycling is associated with an increase in self-reported health. In fact, a larger uplift in self-reported health occurs between 12 and 24 months after the switch occurred⁴².

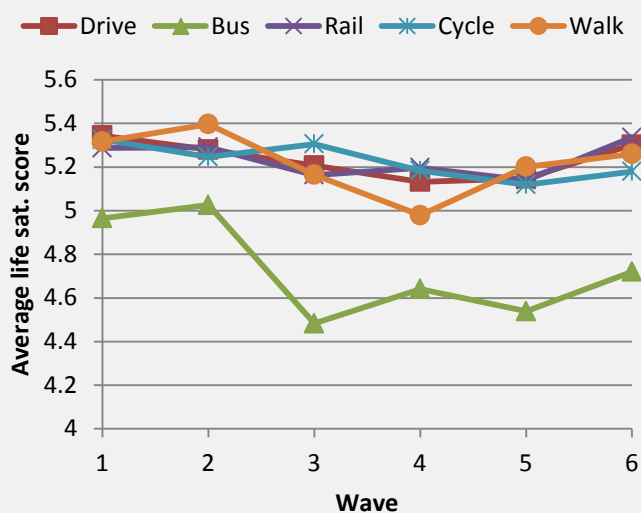


With driving to cycling and driving to walking switches we found that strain reduced initially and job satisfaction increased initially but these changes were not sustained subsequently (at 12 and 24 months). Generally for commute mode switches the changes to different aspects of SWB, where they were found to occur, appear to usually be short-lived. Meanwhile, for commute duration changes the changes to SWB appear to grow and be sustained. This is evidence that long commute times have long-term effects on SWB.

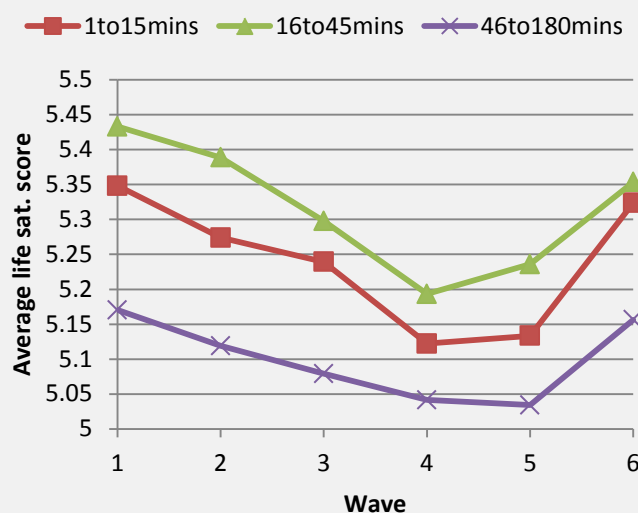
^{ix} See Analysis Note 7 at the end of the report.

6.3 Long term effects of different types of commuting behaviour

It is not only changes to the commute that could have an impact on SWB. We also explored whether maintaining the same commuting situation could be beneficial or detrimental to SWB over the longer term^x. Two examples are illustrated below, showing the association between the change in life satisfaction over six waves and: (i) maintaining the same commute mode; and (ii) maintaining the same commute duration. Note that staying with the same commute situation over six consecutive years is unusual – for example we found that just 30% of the sample that had responded to all six waves maintained the same mode for all six waves.



1. This chart shows that long term bus use is associated with lower life satisfaction on average over the six waves (compared to use of other modes) and this association remains after controlling for other factors.



2. This chart indicates that prolonged periods of long duration commuting are associated with consistently lower life satisfaction on average over the six waves and this association was found to remain after controlling for other factors. There was no difference in the trend over time for different commute duration categories.

So those who sustain long commute times appear to accept the situation with stable life satisfaction over time. But we note in the next section that long duration commuters are more likely to *change* their working or residential situation.

^x See Analysis Note 8 at the end of the report.

6.4 Seeking life improvements

People would be expected to seek to adjust their circumstances over time to improve their SWB and to meet their life goals. This may be achieved through searching for a new job, a different home or indeed a more comfortable commute - particularly for those undertaking arduous journeys to work. Hence lower levels of SWB may influence, as well as be influenced by commuting changes.

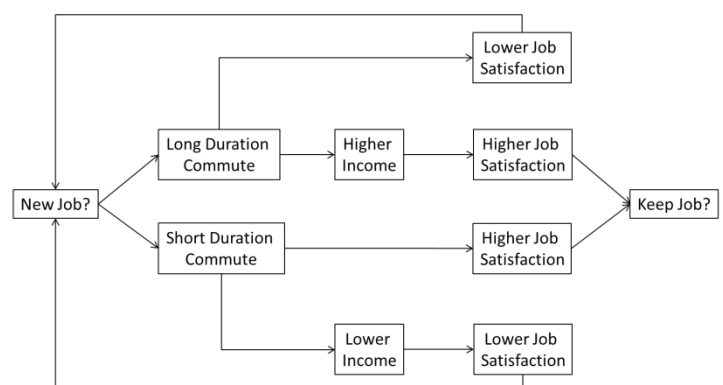
We sought evidence of ‘dynamic feedback loops’ between SWB, commuting and changes in life situation, by examining the case of the uptake / curtailment of long duration commuting^{xi}. Long duration commuting was defined as commuting one way for over 45 minutes.

- In 13% of cases the participants of our *Understanding Society* analysis sample reported undertaking a long duration commute.
- 31% of these involved a switch to a short duration commute by the following year.

Our analysis indicated that long duration commutes are taken on, in part, to receive higher income. For example, those in the sample that changed from a short to a long duration commute from one year to the next increased their income by £165 per month in gross personal income on average. This compares to an additional £79 per month for maintaining a short duration commute. We also found that people are more likely to *maintain* a long duration commute from one year to the next if they are satisfied with their jobs and are receiving higher incomes.

On the other hand, we showed in chapter 4 that the experience of a longer commute duration is itself linked to lower job satisfaction. We found further evidence that being a long duration commuter in the base year increases the likelihood of changing jobs by the following year, by around 25%. This implies that people seek to avoid arduous commutes by changing jobs.

Overall, this implies that longer duration commutes are maintained as long as the benefits of higher income and a satisfying job outweigh the drawbacks of the commute journey. If not, people are more likely to alter their situation by changing jobs. In other words, there is dynamic feedback between long duration commuting, job satisfaction and earnings and the propensity to change jobs.



^{xi} See Analysis Note 9 at the end of the report.

The presence of dynamic feedback between commuting and wellbeing - through which people adjust their lives to improve their situation and to meet their aspirations - is part of our explanation for the absence of a strong association between commute duration and life satisfaction discussed in chapter 5. We must acknowledge however that quantitative research such as this cannot fully reflect: (i) the complexity of people's lives and the processes through which long-term lifestyle decisions are made; and (ii) the variation in the extent to which people across society are able to be socially mobile. We know that poorer social groups have less agency to improve their situations, for multiple and complex reasons.

This points towards a need for complementary qualitative research of different groups in society through the use of in-depth interviews, to gain more detailed insights into the opportunities and constraints people face when considering where to live and work, and hence determining the nature of their commute and its impacts on SWB.

6.5 Concluding message – every minute counts

Overall, this analysis of *Understanding Society* data has generated new evidence of how the commute journey has an impact on multiple aspects of SWB - longer duration commutes reduce job satisfaction, reduce leisure time satisfaction, increase strain and reduce mental health. These drawbacks are counteracted by benefits of employment and housing, although we have not been able to provide a full picture of the complexity involved in people's decisions on where to live and work.

One finding that we did not fully anticipate at the study outset is the clear link between longer duration commutes, commuting mode and job satisfaction. An important message for employers is that job satisfaction can be improved if workers have opportunities to reduce the time spent commuting, to work from home, and/or to walk or cycle to work – such commuting opportunities are likely to be good news for employee wellbeing and retention and hence reduced costs to businesses.

Analysis Notes

Analysis Note 1: Analysis Sample

The analysis sample was constrained to include *Understanding Society* participants (responding in at least one wave from waves one to six) that were members of the *Understanding Society* general population or ethnic minority boost samples; that were resident in England; that were employed and that had reported valid commute mode (including working from home) and commute time information. Analyses of commute time were further restricted to respondents reporting times of less than 180 minutes, as commute times of over 180 minutes were outliers (180 observations or 0.18% of the pooled waves one to six sample).

Analysis Note 2: Core Regression Models

Unless otherwise stated, the findings reported in chapters 4 and 5 are based on a series of regression models, estimated on the pooled wave one to six sample of commuters. This means that the sample included one or more observations per individual. The models were estimated in Stata using the 'Mundlak' command. This procedure provides two sets of regression coefficients: One based on within individual variation (effectively fixed effects coefficients) and one based on between individual variation (coefficients are estimated using the means for individuals with repeated observations). This enabled an interpretation of how wellbeing scores correlate with commuting (after controlling for other factors) based on an assessment of both within and between individual variation in a single modelling framework.

The models took the SWB scores as the dependent variable. These measures are ordinal in nature and the Mundlak command estimates a linear fixed effects model, hence treating the dependent variable as a cardinal measure. Although ordinal models are more appropriate in such circumstances, the results of linear models have been found to be consistent with ordinal models and are also easier to interpret, since the coefficients represent the marginal effects of the covariates¹⁸.

The SWB scores were estimated as a function of commute mode and time and a number of controls for confounding factors. In general, the controls listed below were included. These were selected based on previous analyses of SWB^{13,17,18,19,20}, an assessment of bivariate correlations in the data set and an incremental process of regression model development:

age, live with a partner, parent of a resident child, belong to a religion, education level, long standing health condition, settlement type of the home location, tenure type, employment hours, temporary employment, employment type, monthly gross personal income (£100 per month) (logged), equivalised net monthly household income (£100 per month) (logged), gender, ethnicity, and a binary variable to indicate ethnic minority boost sample membership.

The model specification therefore assumes a linear relationship between commute time and SWB and a log form relationship between income and SWB, which reflects diminishing SWB returns on income. These functional forms have been adopted in previous studies¹⁸ and were found to offer reasonable approximations based on our own assessment of the pattern of association between the different measures of SWB and commute time / income.

Note also that the results presented in chapters 4 and 5 are drawn from several model variants estimated for each measure of SWB. This enabled examination of interactions between commute time and mode, gender, area type, and income, and an assessment of the effect of working from home compared against commuting to work (which necessarily required commute time to be excluded from the model).

Analysis Note 3: Job Satisfaction - Income Equivalence Estimation

Income equivalence estimations were performed to provide an indication of the relative size of the effect of commute time compared to the size of the effect of personal income on job satisfaction. This is helpful since it is difficult to interpret the magnitude of effect of commute time on job satisfaction through consideration of the absolute value of the commute time regression coefficient alone.

The calculation was performed following the method outlined by Fujiwara and Campbell⁴³ and using the base model specification outlined in Analysis Note 2, but with household income removed.

This indicated that a 10 minute increase in one way commute time has the same effect on job satisfaction as a 19% reduction in gross personal income.

The absolute value of this income equivalence varies according to the position in the income distribution and this is illustrated through the following examples:

- For a sample member earning the median gross income of £1,800 per month (or £21,600 per annum), a 10 minute increase in commute time is equivalent to a £340 reduction in gross monthly income (or £4,080 per annum).
- For a sample member earning the 25th percentile income of £1,150 per month (or £13,800 per annum), a 10 minute increase in commute time is equivalent to a £210 reduction in gross monthly income (or £2,520 per annum).

- For a sample member earning the 75th percentile income of £2,710 per month (or £32,520 per annum), a 10 minute increase in commute time is equivalent to a £500 reduction in gross monthly income (or £6,000 per annum).

These can be considered to be conservative estimates, since our analysis also showed that (i) changes in commute time are more likely if the origin (home location) or destination (employment location) changes from one year to the next and (ii) moving into a new job is associated with a significant increase in job satisfaction.

We repeated the income equivalence estimation using a variant of the model which accounted for moving home and changing job (as binary variables to indicate whether these had occurred since the previous wave). This had the effect of increasing the negative effect of commute time on job satisfaction. Using this model variant indicated that a 10 minute increase in one way commute time has the same effect on job satisfaction as a 27% reduction in gross personal income.

Analysis Note 4: Path Model

The analysis reported in chapter 5 indicated a negative association between commute time and life satisfaction for variation in commute time between individuals but not within individuals. If individuals are rational then they would be expected to take on longer duration commutes only if they gain other benefits which leave them no worse off overall. The lower life satisfaction for individuals with longer duration commutes could be related to personal characteristics of those individuals not considered in our analysis or it could represent a genuine effect of longer duration commutes that is not identified when considering year-to-year changes in individuals' commuting circumstances, perhaps due to insufficient variability in individual commuting circumstances over the six waves of data available.

A cross-sectional 'path model' was estimated to examine whether the negative association between commute time and life satisfaction (between individuals) was mediated through the direct effect of commute time on job satisfaction, satisfaction with leisure time availability and strain.

A path model is a form of Structural Equation Model which involves a structural (i.e. path) component, but no measurement model. Measurement models are required when it is necessary to operationalize concepts through latent constructs based on multiple related measures. All of the concepts in our hypothesized model (indicated in the diagram in the main report) were operationalized by a single indicator variable from the *Understanding Society* data set and hence a measurement model was not required.

The path model was estimated on an *Understanding Society* wave 2 sample (n~16,500). This included employed individuals, resident in England, that were members of the

Understanding Society general population sample, the British Household Panel Survey sample and the ethnic minority boost sample.

Analysis Note 5: Frequency of Commuting Changes

Commute mode

18% of the observations involved a change in commute mode since the previous time point. The table below shows the percentage of mode users that were using the same or a different mode by the following year.

This shows that driving is the most stable commuting mode - 91% of car drive commutes were still being driven by the following observation. This compares to only around two thirds of cycle (68%) or bus (66%) commutes.

Driving was also found to be the mode to which people switched the most - 14% of cycled commutes and 12% of walked commutes had switched to driving by the following observation.

		Frequency of changes to commute mode								
Base year		%age of base year group using mode in following year								%age changing from base year mode
Mode	Frequency	%age	drive	bus	rail	cycle	walk	other	wfh	
drive	39,499	58.2%	91.0%	0.6%	1.2%	0.7%	1.8%	2.1%	2.5%	9.0%
bus	4,352	6.4%	10.5%	66.4%	6.9%	1.6%	7.3%	6.2%	1.1%	33.6%
rail	5,232	7.7%	8.0%	5.9%	77.5%	1.1%	2.4%	2.2%	2.8%	22.5%
cycle	2,224	3.3%	13.7%	2.6%	3.1%	67.6%	7.6%	3.9%	1.5%	32.4%
walk	7,429	10.9%	12.1%	4.7%	2.0%	2.5%	72.7%	4.1%	1.9%	27.3%
other	4,286	6.3%	26.2%	6.3%	3.2%	1.9%	7.5%	52.7%	2.3%	47.3%
wfh	4,863	7.2%	21.3%	0.7%	3.1%	0.5%	2.9%	1.9%	69.5%	30.5%
Total	67,885	100.0%								

Note: wfh = work from home

Commute duration

To examine the effects of changing commute duration, we considered switches between short (up to 15 minutes), medium (16 to 45 minutes) and long duration (over 45 minutes) commutes (for observations with a matched pair in the previous wave). Around 85% of observations had a one-way commute duration of 45 minutes or less, i.e. long duration commutes are comparatively rare, as shown in the table below. This also shows the percentage of each commute duration group that maintained the same or changed commute duration by the following year:

Frequency of changes to commute duration						
Base Year			%age of base year group in following year			%age changing from base year group
Group	Frequency	%age	1 to 15 mins	16 to 45 mins	46 to 179 mins	
1 to 15 mins	23,811	41.7%	80.9%	16.9%	2.1%	19%
16 to 45 mins	25,598	44.8%	15.1%	77.0%	7.9%	23%
46 to 179 mins	7,702	13.5%	7.0%	24.0%	69.0%	31%
Total	57,111	100.0%				

Origin and destination

Around 20% of the observations involved a change in either the origin (home location) or destination (work location) of the commute since the previous time point:

Commuting change	No. of observations	%
Changed destination (employer / workplace)	9,803	14
Changed origin (moved to a new local area)	5,571	8
Changed origin or destination	14,231	20
Total observations	70,249	100

Analysis Note 6: Conditional Change Score Models

The findings reported in section 6.1 are based on a series of 'conditional change score models'.

These models took the *change* in wellbeing score (for each individual) from one wave to the next as the dependent variable. This was estimated as a function of the base year wellbeing score (since the change in wellbeing score from one wave to the next is *conditional* on the base score), the commute duration in the base wave, the change in commute duration by the following wave, the change in commute mode by the following wave and standard variables to control for possible socio-demographic confounding factors.

The conditional change score models provided insight into factors correlated with between individual variation in the change in wellbeing score from one wave to the next.

Analysis Note 7: Lagged Effects of Behaviour Change

The findings reported in section 6.2 are based on a series of regression models with random effects.

These models took the wellbeing score as the dependent variable. This was estimated as a function of commute duration, commute mode, standard controls for socio-demographic characteristics and binary variables to indicate whether a given commuting change (e.g. a mode switch or a change in commute time category) had occurred in the current wave (within 0-12 months), in the previous waves (12-24 months ago), or two waves ago (24-36 months ago). This enabled an examination of whether the size of the effect of a behaviour change alters up to three years since the change occurred. The models were necessarily estimated on the sample of commuters that were present in waves three and beyond (so that it was possible to examine behaviour changes occurring up to two waves ago).

The regression models with lagged effects were estimated with random effects. This means that they account for correlation in the residual errors between repeated observations for the same individuals. The coefficients for random effects models take account of both within and between individual variation.

Analysis Note 8: Long Term Effects of Different Commuting Behaviours

The findings reported in section 6.3 are based on a series of regression models with random effects. These were estimated on a particular sub-sample of commuters that maintained the same commute mode (n~3700) or the same commute duration category (n~2,500) over six waves. The commute mode / duration trajectories were coded as categorical variables.

The models took the wellbeing score as the dependent variable. This was estimated as a function of (i) the commuting trajectory - to identify whether there was an association between the trajectory and the wellbeing score; and (ii) the interaction between the commuting trajectory and time - to identify whether the wellbeing score increased or declined at a faster / slower rate over time according to the commuting trajectory type. The standard controls were included to account for possible socio-demographic confounding factors.

Analysis Note 9: Probability of Curtailing Long Duration Commutes or Changing Jobs

The findings reported in section 6.4 draw on an analysis of factors that influence the probability of (i) curtailing long duration commutes and (ii) changing job from one wave to the next.

This was examined using binary logit models which took the behaviour change of interest as the dependent variable, i.e. a binary variable to indicate curtailment of long duration commuting or change of job. This was modelled as a function of 'stressor' factors that may be expected to alter the probability of the behaviour change occurring, including: base year income, base year measures of wellbeing (such as job satisfaction which might be expected to increase or decrease the probability of changing jobs), base year commute mode, base year commute duration and the standard controls. The models also included controls for a range of life event / change variables that may be associated with behaviour changes including gaining / losing a partner, having a child, acquiring a long standing health condition, and change in income.

Sources and References

-
- ¹ CIHT (2016). *A Transport Journey to a Healthier Life. A discussion paper on how transport policy and procedure can contribute to the health and wellbeing agenda*. London: The Chartered Institution of Highways & Transportation. Available from <http://www.ciht.org.uk/en/document-summary/index.cfm/docid/1DFB69FB-64B0-4221-8675F55F64DCA1E2>.
- ² Stiglitz, J. E., Sen, A. and Fitoussi, J.-P. (2009). Report by the Commission on the Measurement of Economic Performance and Social Progress. Available at: <http://www.stiglitz-sen-fitoussi.fr/en/index.htm>.
- ³ 333 commute trips per year on average for those full-time employed in England. Source is National Travel Survey data for 2015 reported in Table NTS0411 accessible from <https://www.gov.uk/government/statistical-data-sets/nts04-purpose-of-trips>.
- ⁴ Source is National Travel Survey data for 2016 for England reported in Table NTS0406 accessible from <https://www.gov.uk/government/statistical-data-sets/nts04-purpose-of-trips>.
- ⁵ Source is Labour Force Survey data for Oct-Dec 2015 for England reported in Table TSGB0111 accessible from <https://www.gov.uk/government/statistics/transport-statistics-great-britain-2016>.
- ⁶ Source is National Travel Survey data for 1995/97 and 2016 for England reported in Table NTS0406 accessible from <https://www.gov.uk/government/statistical-data-sets/nts04-purpose-of-trips>.
- ⁷ 363 commute trips per year on average for those full-time employed in England in 2006 and 333 in 2016. Source is National Travel Survey data for 2006 and 2015 reported in Table NTS0411 accessible from <https://www.gov.uk/government/statistical-data-sets/nts04-purpose-of-trips>.
- ⁸ Source is National Travel Survey data for 2002 to 2015 for England reported in Table NTS0804 accessible from <https://www.gov.uk/government/statistical-data-sets/nts08-availability-and-distance-from-key-local-services>.
- ⁹ Marmot, M., Allen, J., Goldblatt, P., Boyce, T., McNeish, D., Grady, M., and Geddes, I. (2010). *Fair Society, Healthy Lives: the Marmot Review. Strategic Review of Health Inequalities in England Post-2010*. London: Institute of Health Equity. Available from: <http://www.instituteofhealthequity.org/resources-reports>
- ¹⁰ OECD (2013). *OECD Guidelines on Measuring Subjective Well-being*, Paris: OECD Publishing. Available from: <http://dx.doi.org/10.1787/9789264191655-en>
- ¹¹ Tinkler, L. and Hicks, S. (2011). *Measuring Subjective Well-being*. Newport: Office for National Statistics. Available from: <http://webarchive.nationalarchives.gov.uk/20160105231554/http://www.ons.gov.uk/ons/guide-method/user-guidance/well-being/publications/previous-publications/index.html>.
- ¹² Layard, R. (2005). *Happiness: Lessons from a New Science*. London: Penguin.
- ¹³ Dolan, P., Peasgood, T. and White, M. (2008). Do we really know what makes us happy? A review of the economic literature on the factors associated with subjective well-being. *Journal of Economic Psychology*, 29(1), 94-122.
- ¹⁴ Oguz, S., Merad, S. and Snape, D. (2013). Measuring National Well-being – What matters most to personal well-being. Office for National Statistics. Available from: <http://webarchive.nationalarchives.gov.uk/20160105231902/http://www.ons.gov.uk/ons/rel/wellbeing/measuring-national-well-being/what-matters-most-to-personal-well-being-in-the-uk/art-what-matters-most-to-personal-well-being-in-the-uk.html>.
- ¹⁵ Lucas, R.E. (2007). Adaptation and the set-point model of subjective well-being: Does happiness change after major life events?. *Current Directions in Psychological Science*, 16(2),75-79.
- ¹⁶ ONS (2014) Commuting and Personal Wellbeing. Office for National Statistics. Available from: http://www.ons.gov.uk/ons/dcp171766_351954.pdf.
- ¹⁷ Stutzer, A., and Frey, B. (2008). Stress that doesn't pay: The commuting paradox. *The Scandinavian Journal of Economics*, 110(2), 339-366.
- ¹⁸ Dickerson, A., Hole, A., and Munford, L. (2014). The relationship between well-being and commuting revisited: Does the choice of methodology matter? *Regional Science and Urban Economics*, 49, 321-329.
- ¹⁹ Roberts, J., Hodgson, R. and Dolan, P. (2011) "It's driving her mad": Gender differences in the effects of commuting on psychological health. *Journal of Health Economics*, 30, 1064-1076.

-
- ²⁰ Martin, A., Goryakin, Y. and Suhrcke, M. (2014). Does active commuting improve psychological wellbeing? Longitudinal evidence from eighteen waves of the British Household Panel Survey. *Preventative Medicine*, 69.
- ²¹ Novaco, R., and Gonzalez, O. (2009). Commuting and well-being. In Y. Amichai-Hamburger (Ed). *Technology and well-being*, pp. 174-205. Cambridge: Cambridge University Press.
- ²² Wener, R.E. and Evans, G.W. (2011). Comparing stress of car and train commuters. *Transportation Research Part F*, 14, 111-116.
- ²³ Gatersleben, B. and Uzzell, D. (2007). The journey to work: exploring commuter mood among driver, cyclists, walkers and users of public transport. *Environment and Behavior*, 39, 416-431.
- ²⁴ Kluger, A.V. (1998). Commute variability and strain. *Journal of Organizational Behaviour*, 19, 147-165.
- ²⁵ Blumen, O. (2000). Dissonance in Women's Commuting? The Experience of Exurban Employed Mothers in Israel. *Urban Studies*, 37(4), 731-748.
- ²⁶ Mokhtarian, P.L. and Salomon, I. (2001). How derived is the demand for travel? Some conceptual and measurement considerations. *Transportation Research Part A*, 35, 695-719.
- ²⁷ Lyons, G., Jain, J. and Holley, D. (2007). The use of travel time by rail passengers in Great Britain. *Transportation Research Part A*, 41, 107-120.
- ²⁸ Kahneman, D., Krueger, A., Schkade, D., Schwarz, N. and Stone, A. (2004). A survey method for characterizing daily life experience: The day reconstruction method. *Science*, 306 (1776).
- ²⁹ Olsson, L., Garling, T., Ettema, D., Friman, M. and Fujii, S. (2013). Happiness and satisfaction with work commute. *Social Indicators Research*, 2013 (111), 255-263.
- ³⁰ St-Louis, E., Manaugh, K., van Lierop, D. and El-Geneidy, A., (2014). The happy commuter: A comparison of commuter satisfaction across modes. *Transportation Research Part F*, 26, 160-170.
- ³¹ Ettema, D., Friman, M., Gärling, T., Olsson, L.E. and Fujii, S. (2012). How in-vehicle activities affect work commuters' satisfaction with public transport. *Journal of Transport Geography*, 24, 215-222.
- ³² Mao, Z., Ettema, D. and Dijst, M. (2016). Commuting trip satisfaction in Beijing: Exploring the influence of multimodal behavior and modal flexibility. *Transportation Research Part A*, 94, 592-603.
- ³³ Olsson, L., Garling, T., Ettema, D., Friman, M. and Fujii, S. (2013). Happiness and satisfaction with work commute. *Social Indicators Research*, 2013 (111), 255-263.
- ³⁴ Jones, P. and Thoreau, R. (2008) The impact of commuting duration on family lifestyles: A comparison of the London and Paris regions. Proceedings of the European Transport Conference, 6-Oct-2008, Noordwijkerhout, Netherlands.
- ³⁵ Christian, T. (2012). Automobile commuting duration and the quantity of time spent with spouse, children, and friends. *Preventive Medicine*, 55, 215-218.
- ³⁶ Künn-Nelen, A. (2016). Does commuting affect health? *Health Economics*, 25(8), 984-1004.
- ³⁷ Martin, A., Panter, J., Suhrcke, M., Ogilvie, D. (2015). Impact of changes in mode of travel to work on changes in body mass index: evidence from the British Household Panel Survey. *Journal of Epidemiology and Community Health*. doi:10.1136/jech-2014-205211.
- ³⁸ Clark, B. and Chatterjee, K. (2017). How and why commuting influences life satisfaction: Bulletin 2 - Technical appendix. Available from <https://travelbehaviour.files.wordpress.com/2016/12/b2-commutinglifefat-techappendix.pdf>.
- ³⁹ Lucas, R.E. (2007). Adaptation and the set-point model of subjective well-being: Does happiness change after major life events?. *Current Directions in Psychological Science*, 16(2),75-79.
- ⁴⁰ Clark, B., Chatterjee, K. and Melia, S. (2016). Changes to commute mode: The role of life events, spatial context and environmental attitude. *Transportation Research Part A: Policy and Practice*, 89, 89-105.
- ⁴¹ The change job / workplace dummy variable was coded to capture changes to the destination of the commute from one wave to the next. It indicates: Changes between self-employed and employed, changing to a new employer, staying with the same employer but changing workplace location.
- ⁴² Due to data limitations, we do not know whether this uplift is maintained beyond the 24 month period or is a temporary effect.
- ⁴³ Fujiwara, D. and Campbell, R. (2011). *Valuation Techniques for Social Cost-Benefit Analysis*. London: HM Treasury. Available from <https://www.gov.uk/government/publications/valuation-techniques-for-social-cost-benefit-analysis>.

Post-Print Amendments

The first addition of this report was issued in print form at the ‘end of project showcase’ on 11th September 2017. The following amendments have been made to the online version:

1. Section 4.1: The explanation of the commute time - income equivalence calculation (for job satisfaction) included in the print version originally read:

“An additional 10 minutes (each way) of commuting time is associated with the equivalent effect on job satisfaction as a reduction of £480 per month in gross personal income”.

This estimate was based on a regression model which included linear terms for commute time and personal income. Following further sensitivity tests and the adoption of a log form relationship between income and job satisfaction, the statement has been revised in the online version to:

“An additional 10 minutes (each way) of commuting time is associated with the equivalent effect on job satisfaction as a 19% reduction in gross personal income, i.e. a loss of £4,080 per annum for someone earning the sample median income of £21,600 per annum”

Refer to Analysis Note 3 for further information regarding the method used in the calculation.

2. Section 5: The explanation of the income equivalence calculation for life satisfaction included in the print version originally read:

“An additional 10 minutes (each way) of commuting time is associated with the equivalent effect on life satisfaction as a reduction of £480 per month in gross personal income”.

This statement included a typographical error and has been revised in the online version to:

“An additional 10 minutes (each way) of commuting time is associated with the equivalent effect on life satisfaction as a reduction of £490 per month in gross personal income (or £5,880 per annum)”.

An end note has also been included to provide a reference to a technical bulletin which explains how this income equivalence estimation was calculated:

Clark, B. and Chatterjee, K. (2017). How and why commuting influences life satisfaction: Bulletin 2 - Technical appendix. Available from <https://travelbehaviour.files.wordpress.com/2016/12/b2-commutinglifesat-techappendix.pdf>

3. Analysis Note 2: This has been revised to provide a more detailed explanation of the regression models used in the analysis reported in chapters 4 and 5.
4. Analysis Note 3: This has been revised to provide a more detailed explanation of the method used to calculate the commute time - income equivalence estimate (for job satisfaction) reported in chapter 4.

University of the West of England, Bristol
Frenchay Campus
Coldharbour Lane
Bristol BS16 1QY

www.uwe.ac.uk



**FOREST
CARBON**

CARBON WOODLAND PAPER
Creating UK forests, compensating CO2

UWE Bristol, SK39220 09.17
Printing and Stationery Services