The Longevity of Behaviour Change: A Case Study of the London 2012 Olympic and Paralympic Games

by

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Submitted in accordance with the requirements for the degree of Doctor of Philosophy

University of Leeds

Institute for Transport Studies

December 2014

The candidate confirms that the work submitted is his own and that appropriate credit has been given where reference has been made to the work of others.

Acknowledgments

I would like to take this opportunity to extend my sincerest thanks to my supervisors Professor Greg Marsden and Dr Ann Jopson for the outstanding support, guidance and encouragement they have provided me. This gave me an excellent foundation from which to complete this thesis, and has enabled me to continue to develop my skills as a researcher.

I am extremely grateful to Transport for London for commissioning the Olympic Panel Survey, which provided the extensive data included in this thesis. My particular thanks go to Clare Sheffield, Maeve Clements, and Katherine Blair for their excellent work to ensure the survey was a success. I am also grateful to AECOM for their work and contribution to the panel surveys.

This research was made possible through generous funding from the Economic and Social Research Council. I would also like to extend my appreciation to the members of the Disruption Project, whose feedback and suggestions were a valuable contribution to the research.

My final thanks go to my friends and family, whose continuing support has been so valuable over the past three years. To my office-mates Nick and Dini, your humour and friendship made LG.08 the most enjoyable environment. Daz, your considered advice and support throughout the PhD was indispensable. Lastly thank you to my family for always being there and for being the foundation I need to help me succeed.

Abstract

Travel behaviour change is traditionally regarded as being difficult to achieve, with strategies and initiatives often generating only slow and incremental shifts in behaviour amongst the population. There is an emerging discussion in the literature that more radical approaches to travel behaviour change are needed, to contribute to achieving challenging decarbonisation targets. If a step change is required then one potential source of learning is the study of disruptions to systems of mobility provision, which may provide valuable insights into how more radical travel behaviour change is achieved and, potentially, sustained.

This thesis provides an innovative approach to examining major-event disruption, in this case arising from the London 2012 Olympic and Paralympic Games, to understand the potential for change from such large, disruptive events. A four-wave longitudinal panel survey was applied to establish the extent, and longevity, of change in response to the Games. The research uses the Transtheoretical Model (TTM) to critically examine travel behaviour.

The results show that change was extensive during the Games (54% made at least one change); however change was not often sustained afterwards. Reducing, relocating and re-timing were the most common changes. The key elements of the TTM were not well suited to studying change in such a context, however less commonly used constructs of the model contributed to the identification of four clusters within the sample that provided valuable insight into the behaviour observed.

This research makes a valuable contribution to the growing literature around the potential for learning, and opportunities for change, when there is an imperative to do so. Whilst the longevity of changes to travel were limited, the research provided greater understanding of the adaptability and planning involved in response to major-event disruption, and what this means for future travel planning. The clusters generated helped to show the psychological constructs important for supporting different types of change, which can contribute to approaching and understanding travel behaviour change in broader contexts, when there is an imperative to change.

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Abbreviations

AC	Awareness of consequences
AR	Ascription of responsibility
ATHOC	Athens 2004 Organising Committee for the Olympic Games
BOCOG	Beijing Organising Committee for the Games
CADM	Comprehensive Action Determination Model
CPRC	Cancer Prevention Research Center
DLR	Docklands Light Rail
HAPA	Health Action Process Approach
IOC	International Olympic Committee
IPC	International Paralympic Committee
ITS	Institute for Transport Studies
LAOOC	Los Angeles Olympic Organizing Committee
LOCOG	London Organising Committee of the Olympic and Paralympic Games
MARTA	Metropolitan Atlanta Rapid Transit Authority
NAM	Norm Activation Model
NEP	New Environmental Paradigm
ODA	Olympic Delivery Authority
ONS	Office for National Statistics
ORN	Olympic Route Network
PRN	Paralympic Route Network
SLOOC	Seoul Olympic Organising Committee

SOCOG	Sydney Organising Committee for the Olympic Games
TCC	Transport Coordination Centre
TDM	Travel Demand Management
TfL	Transport for London
TIB	Theory of Interpersonal Behaviour
TPB	Theory of Planned Behaviour
TRA	Theory of Reasoned Action
TTM	Transtheoretical Model
VBN	Value Belief Norm theory

Chapter One

Introduction

1.1 Introducing the research context

The UK is faced with challenging decarbonisation targets that present an ever increasing need to achieve considerable reductions in energy demand across society. The current targets would require an 80% reduction in greenhouse gas emissions on the levels recorded in 1990 by the year 2050. Transport is one of the key contributors to greenhouse gas emissions, recently reported at approximately 23% of all UK emissions (Department of Energy & Climate Change, 2014). Given this prominence, there has been a great deal of focus on challenging the carbon intensity of transport to help achieve these targets although, as Hickman et al. (2010) reports, this has underperformed, which reflects the difficulty in cutting emissions in this sector (Marsden and Rye, 2010). Such difficulty in achieving changes is rooted in the complexities of transport, for example, the views that transport flows are stable, the fixity of infrastructure, and the difficulty in changing attitudes and behaviour (Anable et al., under review).

Policy measures have approached carbon reduction in various ways, for example, promoting lower carbon vehicles, utilising market mechanisms (Marsden and Rye, 2010), workplace travel plans (Roby, 2010), and supporting active travel through infrastructure and programs of support (Gatersleben and Appleton, 2007). Although, it is suggested that a higher intensity application of multiple measures would be necessary to begin to tackle the decarbonisation targets through such approaches (Hickman et al., 2010).

What has emerged more recently, is a developing view in the literature that more radical approaches to travel behaviour change are needed if more substantial contributions are to be made to addressing the carbon intensity of the transport sector. Within this, the study of system disruptions is proposed as a potentially valuable source of learning (Graham, 2010; Marsden and Docherty, 2013). The argument is that such disruptions, owing to their impact, can vastly change the social context and levels of provision around which travel is made, and subsequently create environments where broader shifts in travel behaviour occur (Marsden and Docherty, 2013). Where behaviour is more habitual, and therefore considered more difficult to change, individual change that occurs alongside systemic change is argued

to have greater potential success owing to the wider reconfiguration of the system that is taking place (Schwanen et al., 2012).

Disruptive events, or 'mobility disruptions' in this thesis are defined as "periods of time where systems cease to work as commonly expected and which have a discernible temporary or longer lasting impact on mobility" (Anable et al., under review, p.5). This reiterates the view that such events present a situation where there is a significant shift in the transport provision of the city or location it occurs.

This thesis will present an examination of a large-scale disruptive event where there was an imperative to make changes to travel behaviour. The case study is the London 2012 Olympic and Paralympic Games (the 'Games'), which were held between late July and early September 2012. Critically, the research will examine a range of possible behavioural responses to the Games. This includes:

- reducing or relocating
- re-timing
- re-routing
- re-moding

This case study, which will be discussed in more detail in Section 1.2, created a situation where the majority of the population in the city were faced with a potential need to adapt their travel, at least in the short-term during the event.

The remainder of this chapter will provide a further overview of the thesis, including an introduction to the case study and the data collection process. It will then discuss the contribution to knowledge this research seeks to make, and how this would fit into the existing gaps in the literature. The research questions that were developed to provide a focus for the research are then discussed before an outline of each chapter is given.

1.2 Case study: The London 2012 Olympic and Paralympic Games

The London 2012 Olympic and Paralympic Games presented a vast transport problem for organisers. The influx of large numbers of additional visitors to the city (including athletes, officials, volunteers, and spectators) combined with existing pressures on the system created a high level of demand, particularly at certain hot-spot locations in the city, which needed to be addressed.

Extensive engagement and awareness raising sought to encourage changes to the usual behaviour of individuals across London to avoid delays and congestion on the network, and allow London to operate as effectively as possible in the face of unique demand. The value of, and justification for, using the London 2012 Games as the case study in this thesis will be presented in Chapters 2 and 3. However, briefly summarised, this case study offers a valuable opportunity to study the behavioural response to a large scale disruption, where there was an imperative to change. This provides an opportunity to examine potential approaches and tools to learn more about the factors that underpin the behaviour that is observed to contribute to the emerging discussion in the literature. This will help to contribute to the theoretical debate (as introduced in Section 1.1) about whether mobility disruptions can provide points of learning about travel behaviour change, and can demonstrate more extensive, and sustained shifts in behaviour to contribute to reducing the carbon impact of the transport sector.

To study the impact of the London 2012 Games, and particularly to understand the longer-term situation, a four-wave longitudinal panel study was conducted. This formed part of a collaboration with Transport for London (TfL). The researcher contributed a number of survey items to the initial three-waves of the surveys, which were carried out by AECOM, an international consultancy firm, who were commissioned by TfL. The researcher was also able to provide comments on the overall questionnaire design. The initial three surveys took place immediately before, during, and shortly after the Games. The fourth wave was conducted directly by the researcher, in collaboration with TfL and was conducted 15 months after the end of the third survey wave.

1.3 Research aims and questions

The context of this research, as described in Section 1.1, has demonstrated that there is a need for a greater understanding of the behavioural impacts of large-scale, disruptive events. Broad research aims were identified that help to guide the research questions that are addressed in this thesis. The broad aims of this research are:

- to contribute to the emerging area of literature around mobility disruptions to establish the potential behavioural impact of such events
- to examine a possible tool to study the psychological factors underpinning any travel behaviour observed in response to the disruption
- to examine what can be learnt to contribute to the understanding of the implications for longer-term behaviour change

Previous Olympic and Paralympic Games have been examined to establish the degree of changes observed in the transport system during the event, which have shown that large amounts of change can be anticipated. These are discussed in more detail in Chapter 2. There is however limited understanding of the travel behaviour changes observed amongst a specific sample of travellers. Giuliano and Prashker (1986) studied the behaviour of commuters during the Los Angeles Olympics in 1984, although this included only one survey wave and was limited to employees of four businesses in Los Angeles. Brewer and Hensher (2001) examined the Sydney 2000 Games. This focused on studying the intentions to change, and therefore included three 'pre' waves (the earliest being approximately seven months prior to the Olympics) and one 'post' Olympics wave. There remains a need for more in depth study of the response of individuals to the disruptions caused by the Olympic and Paralympic Games, and particularly to take into consideration to the importance of different types of change.

As part of this opportunity to study in greater detail the travel behaviour change resulting from the Games, there was the potential to examine a possible tool that may provide greater insight into the factors underpinning the changes observed. Socio-psychological models have been applied widely to the study of transport, although often the focus of these has been on the understanding of willingness to make changes (e.g. Bamberg, 2007; Crawford et al., 2001; Ahern, 2002; De Groot et al., 2008) or to study the impact of voluntary behaviour change initiatives (e.g. Fu et al., 2012; Jones and Sloman, 2003; Mutrie et al., 2002). There is evidence of studying change through such means when there is an imperative to change. For example, Beatty et al. (2002) examined the impact of the UK 2000 fuel shortage on willingness to reduce car use. What is missing in the literature is a greater understanding of the impacts when the wider system is affected (e.g. through a major-event) and there is an imperative for broader types of change to be made. This research therefore seeks to apply such a model, the Transtheoretical Model (TTM)[1], to this case study in an effort to elicit greater understanding of the factors involved in the behaviour. Crucially, the model is applied in an exploratory role, to examine its efficacy in such a context.

The panel study utilised in this research was designed to capture an extensive amount of data relating to the travel behaviour of individuals in London. As this was a panel study, the same individuals were surveyed at each wave, helping to build a picture of travel behaviour over the course of an extended period of time. Importantly, this intends to contribute to the understanding of the longevity of travel behaviour change. Examining longer-term

[1] The TTM was developed by Prochaska and DiClemente (1983; 1982).

behaviour change is often difficult owing to constraints of time and resources, and therefore this thesis presents a valuable opportunity to conduct such work, and demonstrate the longer-term impacts of an event such as the Games. This may also have wider implications for contributing to the understanding of the longevity of behaviour change more broadly within transport.

1.3.1 Research Questions

To address the aims and deliver the potential impacts of this work, as detailed in the previous section, this research focuses upon a number of research questions, which will be addressed throughout this thesis and help guide the study. The questions encompass a broad range of factors that form the basis of this research and will ultimately help this thesis to contribute to the discussions around travel behaviour change.

The research questions are listed below.

1. **How did travel behaviour change as a result of the London 2012 Games?**
    a. Commute journeys
    b. Non-work journeys
    c. Business travel

2. **If travel behaviour changed as a result of the London 2012 Games, what were the reasons for these changes?**
    a. Commute journeys
    b. Non-work journeys
    c. Business travel

3. **What role did employers have in influencing the behaviour change of their employees during the London 2012 Games?**

4. **If changes in travel behaviour occurred during the London 2012 Games, how and why were these sustained?**

5. **What did the London 2012 Games teach us about the longevity of travel behaviour change?**

6. **How applicable is the Transtheoretical Model, and other relevant behaviour change models, for studying travel behaviour change in the context of a large-scale disruptive event?**

Questions 1 and 2 are focused upon establishing the impact of the London 2012 Games on the travel behaviour of travellers (including the commute, non-work, and business journeys). These questions demonstrate the importance of establishing the degree of change that

occurred during the Games, allowing for an understanding of the impact of the event and how this compares to previous Games. The focus of this research upon commuters means that an understanding of the role of employers is a useful addition to the discussion. Employers were heavily engaged with by the organisers to assist with encouraging change, which means that this question can help to show how employer support translated to actual behaviour change by their employees.

The longitudinal element is a further important aspect of this research, and is addressed through two questions in this thesis. Firstly, the research considers how and why changes made during the Games were sustained afterwards, both in the short and long-term. The further question relates to what is learnt about the longevity of travel behaviour change, which is not well understood. The final aspect of these questions relates to the application of a theoretical framework, namely the TTM. Through this, the research will examine the value of such frameworks for understanding change in the context of a large, disruptive event. It will also help to provide a greater assessment of the potential for disruptive events to generate more pronounced, longer-term changes in travel behaviour.

1.4 Thesis Outline

Chapter One presents an introduction to the context within which this research is placed. It highlights the need for this research to advance the existing knowledge relating to travel behaviour change. The research questions are then presented along with an introduction to the case study and methodology that is adopted in this thesis.

Chapter Two presents an examination of the literature relating to major-events to provide an overview of the motivations for studying change through an event such as the London 2012 Games. The chapter presents a description of previous Games to demonstrate the transport measures that have been introduced for such events, helping to provide an overview of the context within which London 2012 is studied. Given the focus of this thesis on the travel behaviour impacts of such events, the evidence from previous studies is examined to show the extent of change that has been observed in the past. This review also begins to introduce the approaches utilised in previous research to study the behavioural impacts of such major-events. Finally, the chapter will critique the value of studying change through major-events and why this may help to provide greater insights into the opportunities available for more substantial change through disruptive events.

Chapter Three examines the London 2012 case study in greater depth to provide an overview of the transport measures that were introduced for the Games to help address the

potential impacts on travel. The chapter first introduces the background to the London Games including the existing situation on the system and a more detailed assessment of the anticipated demand during the Games. The chapter then describes the different elements of the London 2012 transport strategy that formed part of the wider transport plan to manage the transport for the Games. The transport strategy described includes three different elements: infrastructure and service improvements, traffic management, and travel behaviour change measures. Finally, an assessment of the value and appropriateness of studying this particular major-event is presented to help justify its inclusion as part of this study.

Chapter Four provides a critical review of a number of theoretical models that were considered for inclusion in this research. Each theory is described and critiqued to show how they have been applied previously and their merits for their potential application in this research. The chapter will summarise the frameworks before providing the assessment and justification for the subsequent application of the TTM.

Chapter Five presents the methodology that was applied in this research. The development of the four-wave panel survey is described, including its design and the justification for approaching the research in such as way. The chapter then examines each survey wave in detail, providing a demonstration of when, and how, the surveys were deployed and a description of the different elements of each survey. The final aspect of the chapter is an overview of the approach taken for analysing the data that was collected through the surveys.

Chapter Six is the first of three analysis chapters, providing an in-depth examination of the data that was collected through the panel survey. This chapter focuses on examining the first three waves, which encompasses the before, during and after situation around the Games. The chapter firstly introduces the sample that is examined. It examines travel behaviour change for the whole sample, before then describing the four types of change that were examined: Reduce/Relocate, Re-time, Re-route, and Re-mode. This detailed examination helps to show the differences that exist between types of change. The final aspects of this chapter include an assessment of the value of the Transtheoretical Model when applied in this study and further analysis that was conducted to further develop the understanding about the application of the model.

Chapter Seven again examines the data from the first three waves of the panel survey but with a focus on the business travel and the non-work journeys made by the sample. This is to provide an assessment of how the individuals responded to the Games for different

journey purposes. The main objective of this being to enable an understanding of what similarities or differences may exist between journey purposes in the context of the Games. The chapter follows the same approach as Chapter Six to examine each of the different types of behaviour available.

Chapter Eight provides the analysis of the fourth survey wave, which studies the longer-term behaviour displayed by the sample. This is specifically focused upon the commute journey and examines how individuals were travelling 15 months after the end of the Games, and what this informs us about sustained changes from the Games. The chapter also provides further examination of the TTM when applied in this context. Finally, the chapter will introduce and assess the behavioural response of the sample to a further disruption to travel. This was a two-day London Underground strike in February 2014 and provides insight into how individuals in the sample coped with a different type of disruption.

Chapter Nine presents the discussion of the findings that have emerged from the analysis. This chapter refers back to the original research questions posed and provides a critical assessment of how the research contributes to what is already known. The chapter discusses the different types of change to show the distinctions between these changes. It also examines the role of employers, the longevity of change, and a discussion of the application of the TTM in this study.

Chapter Ten draws together the conclusions from this research. This first provides a summary of the key findings that are identified from this research. The implications of the findings for both practice and theory are then discussed to demonstrate the contribution the research has made to the field. The final two sections of this chapter will examine the limitations of the research and detail the recommendations for future work that would help add further contributions to the field.

Chapter Two

Studying Change Through 'Major-Events'

2.1 Introduction

The previous chapter has introduced the research questions that will be addressed in this thesis. A key element of these questions is the objective of advancing the understanding of the impacts of a major-event such as the Olympics and Paralympics on travel behaviour change, both in the short and long-term. An initial step in achieving this is to review the existing known impacts of such events to begin to understand their potential as contexts to support behaviour change. A crucial question in this being, do major-events such as the Games provide opportunities for learning and intervention that has not been fully realised?

A major-event is a one-time or recurring event that draws substantial visitors to a particular location (often a host city), placing exceptional pressures on the infrastructure and services, whilst occurring for only a short, fixed period of time (Malfas et al., 2004; Ritchie, 1984). 'Mega-events' and 'Hallmark events' are also terms used to describe such events, examples of which include: the Olympic and Paralympic Games, the Football World Cup, Presidential inaugurations, Papal visits, and Oktoberfest in Munich (Ritchie, 1984). Major-events fall into the wider category of 'mobility disruptions', which are defined by Anable et al. (under review, p.5) as "periods of time where systems cease to work as commonly expected and which have a discernible temporary or longer lasting impact on mobility". This suggests that such a disruption will present a situation where there is a significant change in the conditions, volume, and level of service of the transport provision of the city, which may present greater opportunities for advancing understanding of travel behaviour change.

This chapter will first review the literature around previous Olympic and Paralympic Games to understand what has already been studied. It will then introduce further examples of mobility disruptions and the impacts on the transport network these have been observed to have. Finally, it will discuss the potential value in studying change through major-events and the opportunities they may provide to elicit greater learning about travel behaviour change.

2.2 Learning from previous Olympic and Paralympic Games

This section will first provide an overview of a number of previous Olympic and Paralympic Games to present the context around which such events take place, and how they might differ between locations. It will then review the existing studies of travel behaviour change relating to the Games, which will help to demonstrate the very different context that exists during an event such as this, and what the anticipated behavioural responses to the disruption might be.

2.2.1 The background to previous Games

The scale of an Olympic and Paralympic Games means that the transport planning for the event is assured to be extensive and wide-ranging. It also means that the Games are not a typical travel behaviour change problem. Faced with a vast influx of visitors for a relatively short period of time, each host city must address a variety of challenges that can push its infrastructure and resources to the limits. The pressures faced are influenced by the city context (e.g. the existing state of the transport system and the geography of the city), but also by the requirements of key stakeholders, including the IOC (International Olympic Committee). Additionally, the post-Games legacy (often a prominent subject, Kassens-Noor, 2012) that is envisioned for the city's transport system can place added influence on the measures and infrastructural improvements ultimately initiated. For example, in Athens there was a focus on improving the road network, which therefore formed a key part of the planning (Kassens-Noor, 2010).

Many of the policies and tools used to manage Games-time transport reappear at each occurrence of Games, along with the introduction of more recent or innovative options. This section will provide an overview of the approaches to managing transport in previous Games, beginning with the 1984 Los Angeles Games and chronicling to Beijing in 2008 (Chapter 3 is dedicated to the London 2012 Games, which will be examined in greater detail). This provides an understanding of the context within which travellers were making their journeys in each Games and the degree of change in the provision and organisation of the network that occurred. This is an important consideration when exploring the impact of the Games on travel behaviour, and its efficacy as a tool for understanding and initiating more substantial shifts in behaviour.

Los Angeles 1984

Owing to the dispersed nature of the venues across the Los Angeles region, a key challenge was the effective movement of people across the region. The official post-Games report

stated that the spread out nature of the competition sites was beneficial to the running of the wider system during the Games as it reduced conflicts between the existing users (e.g. commuters) and the temporary users (e.g. incoming athletes and spectators) (LAOOC, 1985). This is not to underestimate the level of impact of the Games but does introduce the effect of venue and facility location on transport decisions. Furthermore, despite this spread of venues, significant pressures were anticipated on the network, particularly in central Los Angeles. Figure 2.1 provides an overview of the venues to demonstrate their location. Although there is no scale on the map, the distance between San Fernando and Newport Beach (circled on the map) is measured ('as the crow flies') at 54 miles, which helps to provide some insight into the dispersion of venues across the region.

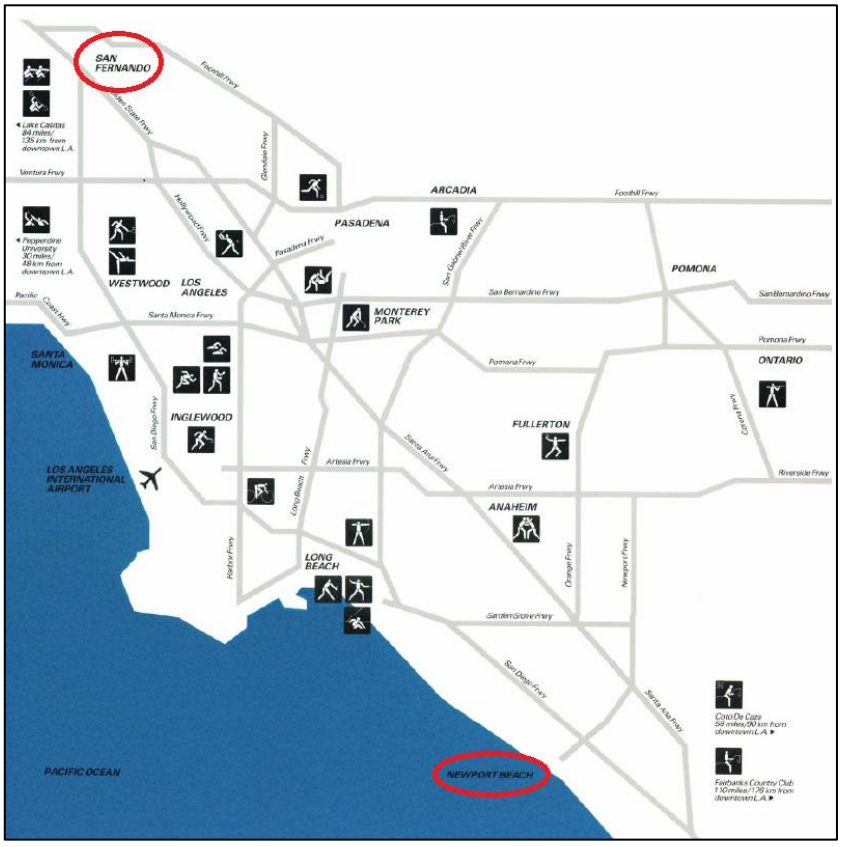

Figure 2.1: Location of Olympic venues in Los Angeles (La Angelena, 2009)

To address the wider transport needs of the Games, and to counter potential disruptions to travel, a range of measures were put in place by organisers. These included: public information campaigns, engagement with businesses and employees (e.g. encouraging reduced working weeks, annual leave, re-timing journeys), a freight programme, shuttle buses, and park and ride services (Giuliano and Prashker, 1986; Giuliano, 1985; LAOOC, 1985).

Seoul 1988

The Olympic Park, the main hub for the 1988 Seoul Games, was located approximately eight miles from the centre of the city. There is a lack of literature around the Seoul Games, although the official post-Games report provided an overview of the transport measures that were introduced during the Games (SLOOC, 1988). This included: shuttle buses and VIP vehicles of the Games Family[2], the extension of bus routes to connect competition sites, an extension of bus operating hours, and increased frequency and capacity on the subway system. The organisers also engaged with a small number of regular travellers to encourage a reduction in the traffic volume. This included: compulsory holiday over a three day period during the Games and regulated hours for some government workers, and flexible start and finish times for schools.

Barcelona 1992

The 1992 Games were transformative for the host city of Barcelona and were a catalyst for significant urban regeneration (Brunet, 2009). The venues and facilities for the Games were spread over four key areas, which are shown in Figure 2.2. Of these areas the 'Montjuïc Area' (No.1 in Figure 2.2) was the main Olympic Park housing the Olympic Stadium.

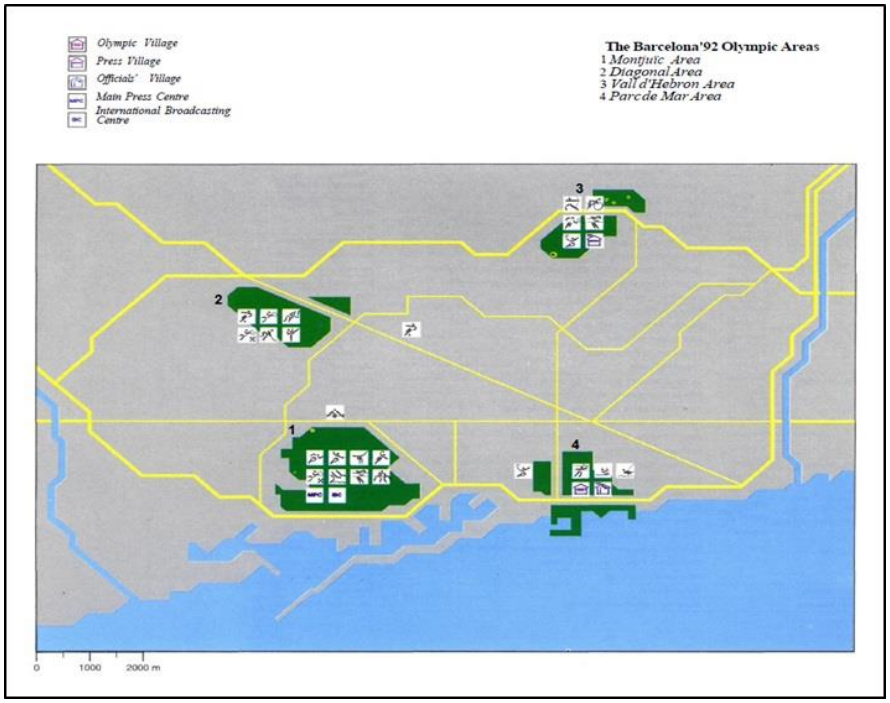

Figure 2.2: Locations of Olympic Areas in Barcelona (COOB'92, 1992)

[2] The Games Family would typically include athletes, press and media, officials, and sponsors.

In the lead up to the Games there was substantial investment in infrastructure that included road projects (specifically the completion of a new ring road), metro upgrades, airport upgrades and the refurbishment of a former train station (Kassens-Noor, 2012). Further temporary measures included shuttle buses, dedicated spectator and athlete's buses, freight delivery re-timing, traffic bans, and park and ride services (Kassens-Noor, 2012; Currie and Delbosc, 2011; COOB'92, 1992).

Atlanta 1996

The Atlanta Games were driven by the private sector and were designed to raise the profile of the city on the world stage (Kassens-Noor, 2012; Kassens-Noor, 2010). A key element of this was the redevelopment of the Central Business District (CBD), which reflected the decision to concentrate the location of many of the Games venues in the centre of the city (Kassens-Noor, 2012). Traditionally, the transport system in Atlanta was orientated around road transport, with public transport playing a relatively minor role (Kassens-Noor, 2012).

A broad range of transport measures was introduced for the Games. This included: significant road building and expansions, spectator bus services, expansion of the MARTA (Metropolitan Atlanta Rapid Transit Authority) bus and rail services, high-occupancy vehicle lanes, public transport expansions, temporary buses, park and ride, changes to freight deliveries, and behaviour change initiatives (e.g. employee holiday incentives, engagement with businesses) (Kassens-Noor, 2012; Currie and Delbosc, 2011; Kassens-Noor, 2010; Amodei et al., 1996). Kassens-Noor (2012) asserted that many elements of the Games plan reflected the long-term transport aims of the city rather than meeting the needs of the Games. For example, the extensive road building and introduction of an advanced traffic management system.

During the Games, Atlanta's transport system did not perform as effectively as planned. Key failures were linked to an underestimation of passenger numbers on public transport which led to significant queues (Kassens-Noor, 2012). The roads experienced heavy congestion and some athletes were late for their events (The Telegraph, 2012).

Sydney 2000

The Sydney Games were considered a highly successful all-round Olympics (The Independent, 2008). In terms of transport, the organisers sought to create a 'green Games' that focused on public transport usage (Kassens-Noor, 2010; Bovy, 2006). A key feature of the Sydney transport strategy included significant emphasis on rail to move people to and from the event sites and the centre of Sydney (Kassens-Noor, 2012). Further elements

included two temporary Olympic bus networks (one for spectators and one for athletes), parking restrictions, road closures, park and ride sites, free spectator travel, freight delivery restrictions, business engagement and TDM measures (e.g. consultations and travel plans for businesses and communities affected) (Kassens-Noor, 2012; Currie and Delbosc, 2011; SOCOG, 2001).

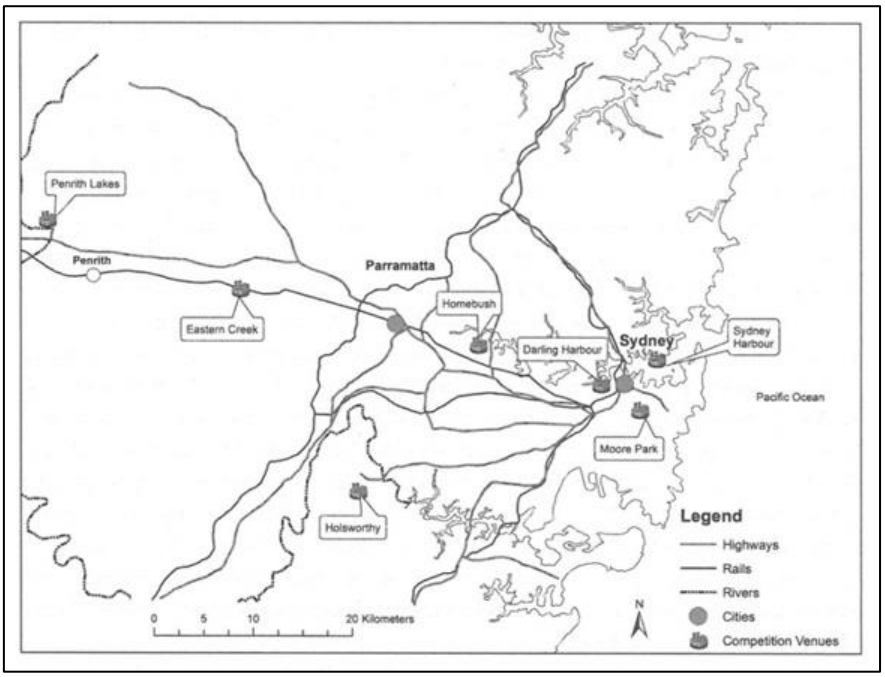

Figure 2.3: Locations of Olympic areas in Sydney (Kassens-Noor, 2012)

Venues were concentrated around two main Olympic areas within Sydney: Homebush and Sydney Harbour (see Figure 2.3), which hosted 21 out of 25 events between them (De Franz et al., as cited in Kassens-Noor, 2012). A notable feature of the Sydney Games was the more widespread adoption of the 'big scare' approach that had been used to varying effect in some previous Games (Currie and Delbosc, 2011). Through this approach, significant effort is put into highlighting the delays people may face unless they alter their travel during the Games. If successful, this can reduce and displace the demand on the transport system to allow it to run more efficiently.

Athens 2004

The Athens Games has similarities with the 1992 Barcelona Games as they both specifically sought to use the Games as a way of transforming the landscape of the city. Congestion of the inner city and access to the airport were two significant problems facing Athens before the Games, with the redevelopment for the Games being an opportunity to address these.

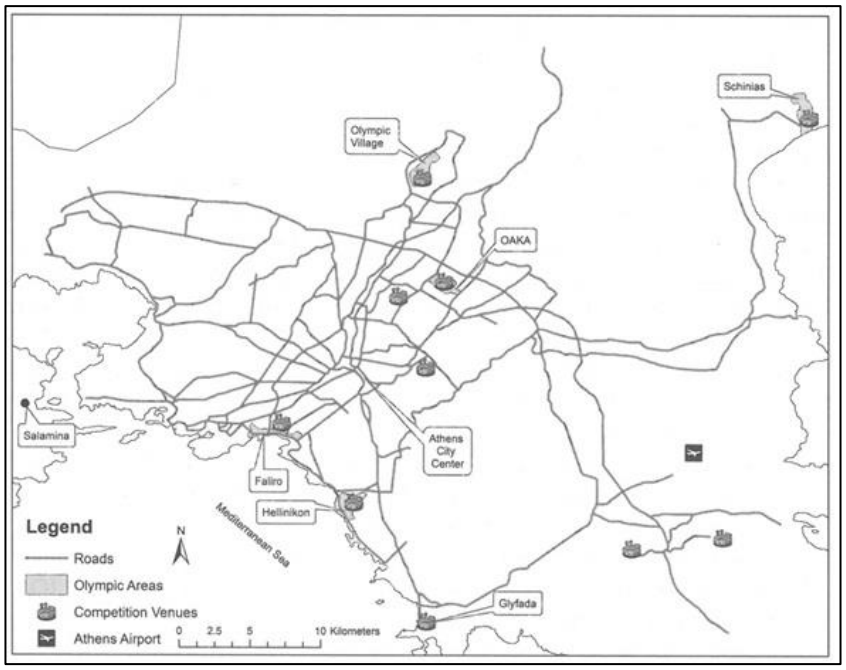

Figure 2.4: Locations of Olympic areas in Athens (Kassens-Noor, 2012)

Figure 2.4 illustrates the distribution of venues in the city between three main areas, OAKA (Athens Olympic Sports Complex), Faliro, and Hellinikon. The transport measures that were adopted by the organisers for the Games included: extensive expansion of new and upgraded roads, alterations to the city's metro lines, a rail link from the city to the airport, a new tram line, spectator and Games Family bus networks, a communications programme, and for the first time dedicated Games Lanes (Currie and Delbosc, 2011; Kassens-Noor, 2012; ATHOC, 2004).

Beijing 2008

Reflecting the approaches of previous Games, Beijing utilised the Olympics and Paralympics in 2008 as a catalyst for new construction and developments in their city. Brunet and Xinwen (2009) highlight some of these developments. These included 116.6km of new rail lines within the city and 82.1km in the suburbs, new motorways and urban roads, new transportation hubs, public transport expansions and an intelligent transport system. The locations of the Olympic venues in Beijing are shown in Figure 2.5. A number of venues were clustered to the north of the centre of the city (circled), which included the Olympic Stadium.

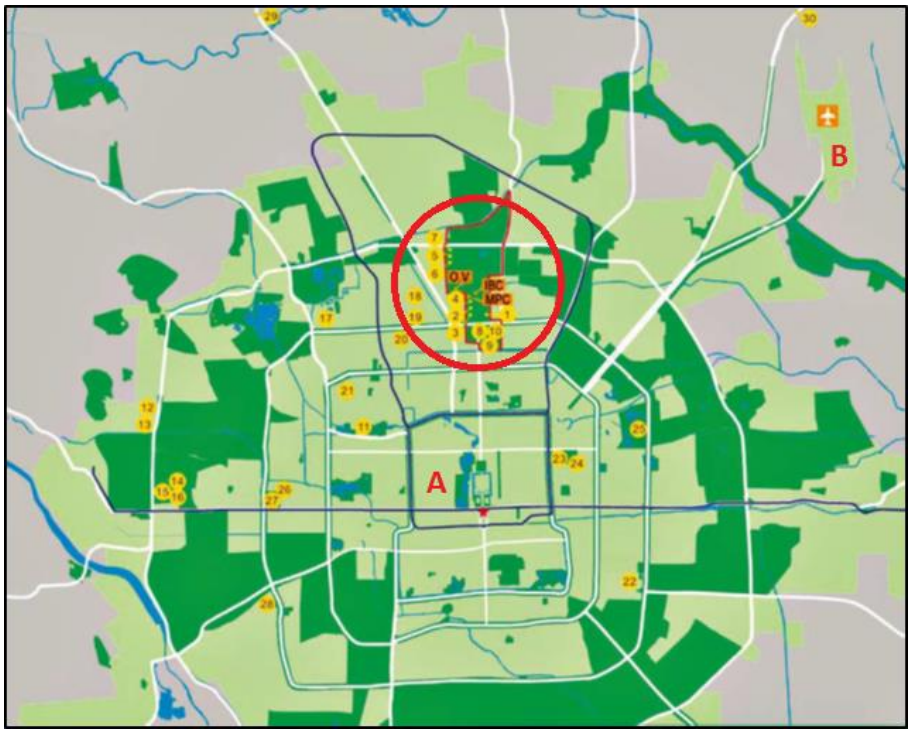

Figure 2.5: Locations of Olympic areas in Beijing (BOCOG, 2011)

Further measures included to manage the transport in Beijing included the use of Olympic Games lanes, TDM measures (re-timing of employee holidays, temporary changes to commuter behaviour etc.), restrictions on car use (i.e. alternating the days certain cars could travel[3]), and airport capacity increases (Currie and Delbosc, 2011; Bovy, 2009; Liu et al., 2008). To demonstrate the scale of the distribution of the venues, the reader should note that the distance between the centre of Beijing ('A' on Figure 2.5) and the airport ('B') is approximately 15 miles.

Summary

This review of the recent hosts of the Olympic and Paralympic Games has indicated that there is a great deal of continuity between events in terms of the measures implemented to deal with the significant transport problems faced. There is of course opportunity for innovation, for example, the introduction of Games Lanes in Athens that have now become an established measure. Interestingly, as far back as Los Angeles in 1984, there was extensive engagement with employers and employees to address the background demand on the network during the Games. Moving into the next section of this chapter, this is an

[3] This is an existing policy in Beijing, which demonstrates how existing policies were utilised for the Olympics and Paralympics.

important point to note as the chapter continues to examine the value of studying change amongst commuters (but also the wider population) in the context of major-event.

2.2.2 The travel behaviour impacts of previous Games

The previous section has provided an overview of the measures used to manage the unprecedented demands placed upon a host city and its transport network during the Games. Although longer-term improvements in infrastructure are clearly a key part of the transport preparations for the Games, the need to manage the short-term influx of visitors means that an extensive range of temporary measures are vital. A central element of this is the attempt to temporarily influence travel behaviour (of both visitors and residents) during the Games. The evidence from the literature shows that the hosting of the Games and the extensive efforts made to manage transport during this time creates a unique and often unprecedented environment within which journeys are made. To examine whether these new environments are shown to support greater shifts in travel behaviour, the next section will examine the studies around previous Olympic and Paralympic Games to understand the extent of change that has been observed.

There are a number of studies that have examined the travel behaviour impacts of the Games, although the number of those studying a sample of individuals (as in this thesis) is very limited. Evidence from earlier Games is particularly restricted, a problem that is recognised by Currie and Delbosc (2011). The combination of past studies means that it is possible to examine a broad range of behaviours in relation to the Games. This includes; relocating the destination, reducing the number of journeys made (e.g. taking annual leave from work or postponing the journey), changing the time when the journey is made, travelling by a different mode, and travelling by a different route.

2.2.2.1 Sample-based studies of previous Games

The earliest Games discussed in the previous section were the 1984 Los Angeles Games. Giuliano reports on behaviour changes during these Games through a number of publications (Giuliano, 1988; Giuliano and Prashker, 1986; Giuliano, 1985). One of these publications included a study of a sample (n = 1,992) of commuters from four businesses in Los Angeles during the Olympics (Giuliano and Prashker, 1986), which is a very relevant comparison study to the research in this thesis. The findings showed that there was clear evidence of travel behaviour change amongst commuters. In terms of when journeys were made, 34.9% re-timed their journey to work (23.3% left earlier and 11.6% departed later) and 26.1% changed the time of their return journey (17.9% departed earlier and 8.2% departed later). 10% changed their route of travel, although only a very small proportion

made changes to mode. Giuliano and Prashker reflect that the small amount of mode change is a result of the short-term nature of the event. Finally, an average of 15.5% of the sample (n = 476) reduced or relocated their commute journeys.

A further sample-based study of note is that conducted by Brewer and Hensher (2001). This was focused upon the impact of the Sydney 2000 Games on commuter travel patterns. This was a longitudinal study, but rather than examining the before, during and after situation, the authors conducted three survey waves pre-Games and one post-Games. The purpose of three pre-Games surveys was to understand whether the intentions to make specific changes during the Games remained stable in the lead up to the event. The post-Games wave was conducted with the aim of enabling an understanding of the degree that intention predicted action during the Games. In terms of actual change from the commuter perspective, this study found that the sample employed different 'coping strategies' for their travel during the Games. This included taking leave (26.7% of the sample), departing for work earlier (18.3%), departing later from work (11.7%), changing mode (5.0%), and telecommuting for the first time (3.0%).

Both these studies indicated that reducing or re-timing were more popular changes amongst these samples. There is also evidence of re-moding and re-routing although these were less common.

2.2.2.2 Further studies of previous Games

A range of further studies have also provided assessments of the travel behaviour changes that occurred during previous Games. Reducing the number of journeys made was found to be a common change in the two studies discussed in the previous section. Further literature has also demonstrated the use of this particular change. Kassens-Noor (2010), in a summary of the Barcelona, Atlanta, Sydney, and Athens Games stated that telecommuting, relocation of employees, and enabling more annual leave were all factors that helped to reduce the demand on the network in these cities. Currie (2008) also emphasises this, highlighting that 15.1% of residents stated that they would definitely leave Athens during the Games.

A reduction in traffic volumes and an increase in speeds also appear to be a very common feature of previous Games. This reflects both efforts to reduce the base-load demand and the wider transport infrastructure improvements and provision. For example, Liu et al. (2008) reported that there was an up to 30% reduction in peak traffic flows during the Beijing Games, which resulted in an increase in speeds on the roads. A similar reduction in peak time traffic was also reported for the Athens Games (Currie, 2008). In Sydney, a report by Booz Allen (Currie and Delbosc, 2011) found that road traffic volumes reduced by 10-20%

compared to normal weekday levels, contributing to a situation where traffic was free-flowing. Similarly, a 15-20% decrease in city traffic during the Games was reported in Barcelona (COOB'92, 1992). Interestingly, Kassens-Noor (2010) and Currie and Delbosc (2011) both reported that the low traffic levels at the beginning of the Games prompted residents to return to their cars in the latter stages of the Games, which undoubtedly contributed to traffic problems in the city.

Such figures highlight the degree of change on the roads that has been observed in the past, although this is only one aspect of the system. To reduce the number of vehicles on the road, and also to accommodate the increases in demand across the wider system, shifts in other forms of travel are likely to have been observed. As the studies by Brewer and Hensher (2001) and Giuliano and Prashker (1986) have demonstrated, from the commuter perspective there have been recorded reductions in the number of journeys made (through taking annual leave or working from home) and also changes of when people travel, by what means, and to what locations.

The clearest indication of the re-timing of journeys for commuters is the ‘flattening’ of the peak periods during the day. Mao (2008) reported that in Beijing the morning peak extended by one hour. The lengthening of peak travel times was also evident in further host cities, including Los Angeles (Giuliano and Prashker, 1986), Atlanta (Amodei et al., 1996) and (Brewer and Hensher, 2001).

The reduction in traffic flows observed points to a movement away from private vehicles. For example, in Beijing the traffic composition increased from 7% to 14% for non-motorised modes and from 5% to 6% for buses (Liu et al., 2008). In Sydney, the reported reductions in traffic on the road network was associated with the efforts made to encourage bus and rail use, and also the removal of journeys through residents taking annual leave or temporarily leaving Sydney completely. Changes to route are more difficult to ascertain through the existing literature. The studies by Giuliano and Prashker (1986) and Brewer and Hensher (2001) have shown that changes to route do occur. Given the similarities in approaches of many other host cities to Atlanta (Giuliano and Prashker) and Sydney (Brewer and Hensher) it is reasonable to anticipate at least some degree of changes to route in the other cities.

There is a lack of insight in the studies that have been examined of the degree of change that is sustained after the Games. Kassens-Noor (2010) asserts that sustained changes post-Games are uncommon, influenced in part by two factors. Firstly, there is a change in attitudes during the Games (e.g. people are more willing to wait longer for services), which

then fades post-Games leading to a return to pre-Games routines. Secondly, the incentives and resources to help people travel differently during the Games diminish (i.e. the service provision on the network returns to normal). Whilst the continuation of the service level and support available during the Games may not be sustainable owing to the available resources, these points do suggest that success at sustaining changes may need more consideration of the wider system. However, there is a lack of understanding of the factors that may underpin the greater sustainment of travel behaviour change, which this research will therefore seek to contribute to.

2.2.2.3 Summary of the reported changes

Section 2.2.2 has provided an overview of the changes in travel behaviour that have been observed in previous Games, as far back as Los Angeles in 1984. For some previous Games there is a lack of evidence available to indicate the degree of change that occurred. However, this section ultimately helps to provide an insight into the amount of change that has been observed in previous Games, which helps to inform us of the impact that the London 2012 may be expected to experience. It also demonstrates how such a disruptive event does have the potential to elicit large amounts of change from users of the transport system. Table 2.1 provides an overview of the amounts of change recorded in previous Games, which helps to show where there are consistencies within different changes.

Table 2.1: Summary of key findings from previous Games

Games	Paper	Summary of key findings
Los Angeles 1984	Giuliano and Prashker (1986)	23.3% departed from home earlier 11.6% departed for work later 17.9% departed from work earlier 8.2% departed from work later 10% changed route to and from work Only a very small proportion changed mode to/from work An average of 15.5% reduced or relocated commute journeys
Barcelona 1992	COOB'92 (1992)	15-20% decrease in city traffic
Atlanta 1996	Currie (2008)	Approximately 30% reduction in peak congestion Flattening of peak periods
Sydney 2000	Brewer and Hensher (2001) Currie and Delbosc (2011)	26.7% took leave from work 18.3% departed from home earlier 11.7% departed from work later 5% changed mode for their commute journey 3% telecommuted for the first time 10-20% reduction in road traffic volumes
Athens 2004	Currie (2008)	Up to 66% reduction in travel times
Beijing 2008	Liu et al. (2008) Mao (2008)	30% reduction in peak traffic flows 7% increase in use of non-motorised modes 1% increase in bus Morning peak extended by one hour

2.3 Studying change through major-events

The evidence on previous Games presented in this chapter clearly demonstrates that during such an event, there is a consistently extensive shift in how travellers engage with the transport system. Such examples are in contrast to traditional transport policies and initiatives, where the changes achieved are often only incremental (Anable et al., under review). What this helps to demonstrate is that in such situations where there is an imperative to change, more substantial shifts in travel behaviour are possible, and may be less problematic for the individual than initially perceived (Marsden and Docherty, 2013).

Approaches to travel behaviour change are traditionally centred on the habits considered to be ingrained in travel. The repetitive nature of the journeys individuals make, for example the commute journey, leads to the formation of habits. Such habits are formed when the behaviour is frequently and successfully repeated in stable contexts, and with positive outcomes (Thøgersen, 2009; Eriksson et al., 2008; Verplanken and Aarts, 1999). In these instances the element of deliberation is all but removed with the behaviour being performed with great automaticity (Gärling and Axhausen, 2003; Aarts et al., 1998).

In such circumstances it is traditionally held that these habits must be 'broken' to achieve a change in behaviour (Gärling and Axhausen, 2003). Recent work by Schwanen et al. (2012) has sought to expand upon the traditional 'breaking of habits' position by arguing that, in the context of carbon intensive habits, such efforts can go further when applied within a setting of wider systemic change. This is, the authors argue, not a case of top-down controlled management but rather the provision of greater amounts of instruments to allow the reconfiguration of habits to preferred, low carbon options.

Considering major-events, the systemic change Schwanen et al. discuss as important for supporting more substantial displacement of habits is comparable to what has been observed in Olympic and Paralympic Games. These present, over several weeks, situations where a substantial increase in demand, changes to working culture, awareness raising campaigns, and numerous other factors contribute to a shift in the social context very different from what usually exists. This makes such major-events, and other disruptions, interesting points of learning as they may provide new lessons about the adaptations possible when such changes to the transport supply occur, even if for only a short-term period (Marsden and Docherty, 2013).

Whilst a large degree of shift in behaviour can be anticipated during an event, there is more uncertainty about the behaviour such events can influence in the longer-term. Within the

traditional conceptual framing of transport there is a focus upon stability in the system (Marsden and Docherty, 2013), and therefore post-disruption the efforts are often focused upon the need to return to the status-quo. However, the large degree of change possible through an event such as the Olympic and Paralympic Games highlights that there may be greater potential for harnessing such changes in the longer-term. This is also within a context where there is a recognition that there is an existing 'churn' within the network (Marsden and Docherty, 2013), which relates to how the natural life cycle that individuals experience can lead to a rethinking of options and changes in travel (Goodwin, 2008). This churn is important to note as it emphasises the potential adaptability individuals have in their travel, outside of the traditional 'habit breaking' approaches.

Major-events clearly offer an environment where significant shifts in the social context occur. The opportunities for change are increased and, as the evidence from previous Games show, they can generate a large degree of change amongst those affected. What is noticeable about these events is that they appear to create an environment where change becomes more accepted and understood both within society and from employers. This research will study change through the Olympic and Paralympic Games to examine whether such major-events do offer useful point of learning and provide opportunities to achieve more substantial shifts in longer-term behaviour change. Importantly, given this is an emerging area of research, it also helps to examine the value of a potential tool (the TTM) in helping to provide an explanation for the changes observed at the individual level.

2.4 Conclusion

The studies of previous Games that have been examined in this chapter all indicate that these events clearly have the potential to elicit significant shifts in travel behaviour, at least in the short-term. This is true even when the management of the event has been less effective (e.g. Atlanta). Many of the approaches and measures used in past Games generally reappear (in some form) at each occurrence of the Games suggesting they have a track record of success. Some measures have appeared more recently (e.g. the Games lanes), signifying the evolving nature of planning for the Games. The approaches are very much driven by the context of each host city but ultimately they have generally achieved successful shifts in travel behaviour of residents. The short, fixed nature of the Games means that reducing journeys is a common change, although there is also evidence of changes to mode, route and time of travel.

Whilst the Olympic and Paralympic Games do offer a situation where the broader social system and transport provision is altered drastically, creating environments within which

change is much more common, it is not understood fully what can be learnt from this. Reflecting on the research questions presented in Section 1.3.1, this chapter helps to demonstrate the importance and relevance of these questions within the wider context of this research. As Anable et al. (under review) assert, there is a need for greater theoretical insights to help explain the changes observed, and to understand more about differences between the degree of change at the individual level. This thesis aims to address this through a case study of the London 2012 Olympic and Paralympic Games. Given the emerging nature of this area of research, there is also a lack of insight about the tools that may be effective in studying such situations. This will be discussed more in the next two chapters, with the objective of applying it to study the London 2012 Olympic and Paralympic Games.

Chapter Three

Case Study: The London 2012 Olympic and Paralympic Games

3.1 Introduction

The summer Olympic and Paralympic Games have evolved to become one of the largest recurring events, drawing substantial numbers of people to the host city for a short period of time. Given the short-term nature of the Games, the main focus from the transport perspective is to ensure the system keeps moving throughout this period. Increasingly however, the 'transport legacy' has become a further consideration for organisers, which may help to justify the large financial demands of hosting the Games. A transport legacy may exist in the form of high profile projects such as major infrastructure improvements but also in less visible legacies such as advances in how transport is managed in the host city (Kassens-Noor, 2010).

This chapter will examine the background to the London 2012 Games case study. It will first examine the transport situation in London before the Games, which will help to highlight the most pertinent problems facing organisers. The requirements placed on the organisers by the IOC (International Olympic Committee) will then be described before the measures introduced to address these requirements – through the Games' transport strategy – are discussed in detail. This will provide a greater understanding of how the organisers sought to influence the behaviour of travellers in London. An important final element of this chapter will be the discussion of the justification for studying London 2012 as the case study for this research.

3.1.1 London's transport network prior to the Games

This section will present an overview of London transport network prior to the Games to provide a description of the context within which the transport strategy for the London 2012 Games was being developed. This is derived from the 'Travel in London' report published by TfL, which presents a valuable overview of the data relating to all aspects of the London transport network. London is characterised by a broad range of transport for options for people travelling within the city. Prior to 2012, there was an increasing growth in the

demand for travel, which reflected the expanding population and employment in London (TfL, 2012c). In 2011, there were a total of 25.5 million trips made on an average day in London (TfL, 2012c) (an increase of 2.6 million trips compared to 2001). Table 3.1 presents the mode share for these journeys. Note that more than one mode may have been used as part of the whole trip but this table displays the main mode for that trip. The ten-year period prior to 2011 observed an increasing shift towards public transport at the expense of private car use. This was mainly through an increase in the use of rail, bus, and walking.

Table 3.1: Number of trips per main mode on an average day in London in 2011. Source: TfL (2012c)

	Number of trips made (millions)										
Mode	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**
Rail	1.7	1.7	1.8	1.8	1.8	1.9	2.1	2.2	2.1	2.3	2.4
London Underground/DLR	1.9	1.9	1.9	2.0	1.9	2.0	2.1	2.1	2.2	2.1	2.2
Bus (including tram)	2.6	2.8	3.2	3.3	3.2	3.1	3.3	3.8	3.9	4.0	4.1
Taxi/Private hire vehicle	0.3	0.3	0.3	0.3	0.3	0.3	0.4	0.3	0.3	0.3	0.3
Car – as driver	6.8	6.8	6.7	6.6	6.5	6.5	6.5	6.1	6.2	6.1	5.9
Car – as passenger	3.6	3.5	3.5	3.4	3.4	3.6	3.8	3.4	3.5	3.7	3.7
Motorcycle	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
Bicycle	0.3	0.3	0.3	0.3	0.4	0.4	0.4	0.4	0.5	0.5	0.5
Walk	5.5	5.5	5.6	5.7	5.7	5.8	5.8	5.9	6.0	6.1	6.2
All modes	**22.9**	**23.1**	**23.4**	**23.6**	**23.4**	**23.7**	**24.5**	**24.6**	**24.8**	**25.3**	**25.5**

In 2011, London residents made on average 2.55 trips per day over the 7-day week. Figure 3.1 shows the breakdown of these trips by journey purpose for 2011 along with those for previous years. This shows how commute journeys accounted for 0.38 trips per person per day. Business travel was only a small proportion of the trips meaning that non-work travel accounted for a large proportion of the trips made per person per day.

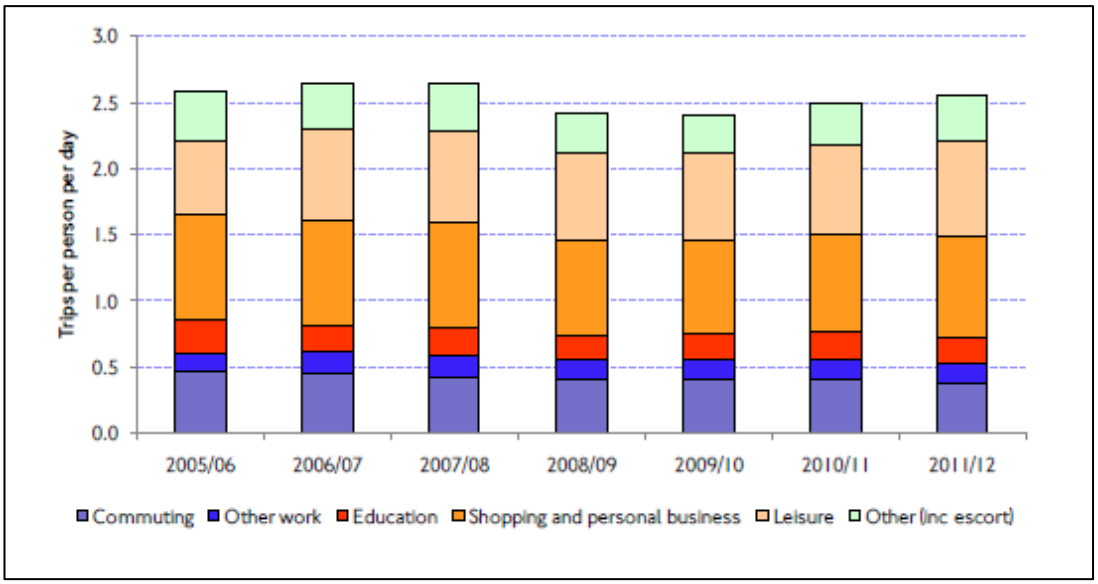

Figure 3.1: Trip rates by journey purpose - London residents (TfL, 2012c)

The performance of the London transport network is generally reported as improving in the years up to and including 2011. For example, on the London Underground there was a decrease in excess journey time from 6.4 minutes in 2009 to 5.8 minutes in 2011. On the road network vehicle speeds have been relatively stable in recent years and the journey time reliability stands at approximately 90%. The growth in trips on the London transport network clearly shows the increased pressures faced, and whilst there is an increasing growth in public transport demand this has been occurring gradually over the past few years.

3.1.2 Visitors to London during the Games

The scale and prominence of the Olympic and Paralympic Games as a major-event means that any host city can expect to experience an influx of visitors, placing greater demands on the city's infrastructure, including transport, as was the case with London 2012. The London 2012 Games Transport Plan (ODA, 2011) predicted that the Games Family would bring the following numbers of people to the city: 18,000 Olympians, 6,000 Paralympians, 5,000 technical officials, 8,000 press, 20,000 broadcasters, 6,000 IOC/IPC (International Paralympic Committee) officials and dignitaries, and 25,000 marketing partners and guests.

The remaining visitors to the city comprised spectators. During the London 2012 Olympics, there were 6.25 million spectators (including 2.8 million for the main Olympic Park) and for the Paralympics there were 2.7 million (TfL, 2012a). This also combined with over one million spectators for road-based cycling events, 350,000 for the marathons and nearly 250,000 for other events such as the triathlon (TfL, 2012a). It was predicted that 33% of

tickets would be purchased by those living in the Greater London area, 42% by people living in the UK and 25% from outside the UK (ODA, 2011).

Despite these vast figures, the influx of visitors - when compared to the existing daily demand on the network – does not appear to add significant volumes to the overall network. For example, an average day in London sees 25.5 million trips across all modes and the additional demand from Games-time visitors was estimated to bring an extra 3.1% and 2.1% trips, for the Olympics and Paralympics respectively (TfL, 2012c). However, it is argued by TfL that many of these additional trips were focused upon certain areas (or 'hotspots') in London (TfL, 2012c). Such hot-spots included key transport stations/interchanges and event venues, where high numbers of travellers were anticipated.

3.1.3 Location of Olympic and Paralympic venues

Before exploring the three different categories of the transport strategy, it is useful to establish where the London Olympic and Paralympic venues were located. This helps to provide context around which the transport measures were implemented. In order to meet the objective of a public/non-motorised transport orientated Games, a large number of events were held in the Olympic Park in East London and this was a focal point for spectator travel. There were several other event locations in London, for example, the equestrian at Greenwich Park, the archery at Lord's cricket ground and the tennis at Wimbledon. Figure 3.2 provides an overview of the Olympic venues in and around London and Figure 3.3 presents those for the Paralympics.

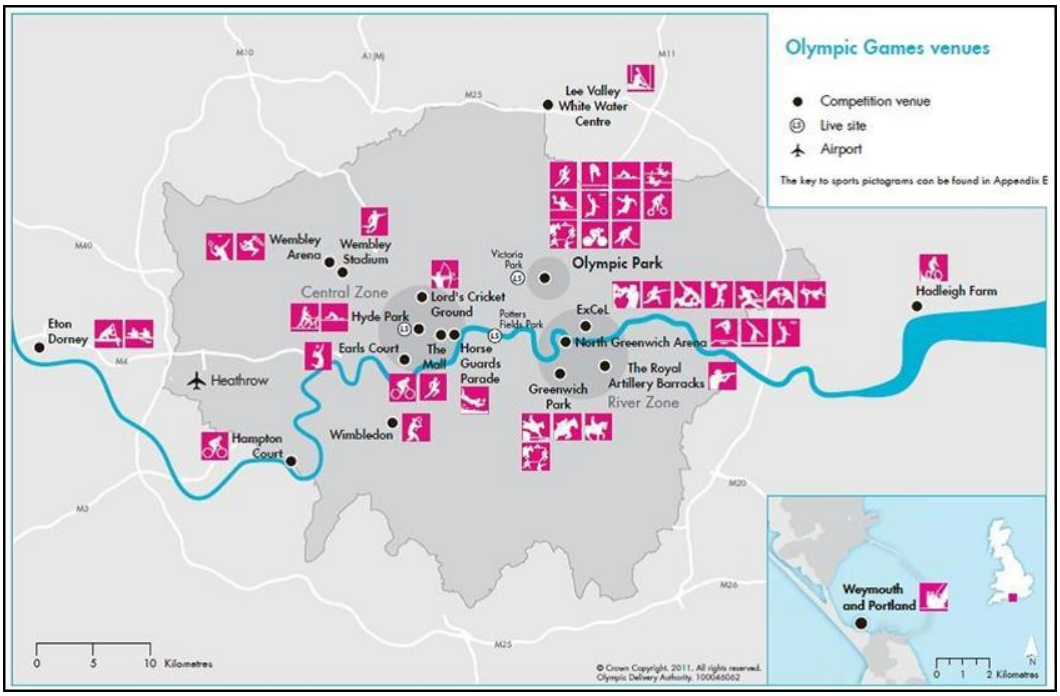

Figure 3.2: Location of Olympic venues in London. Source: ODA (2011)

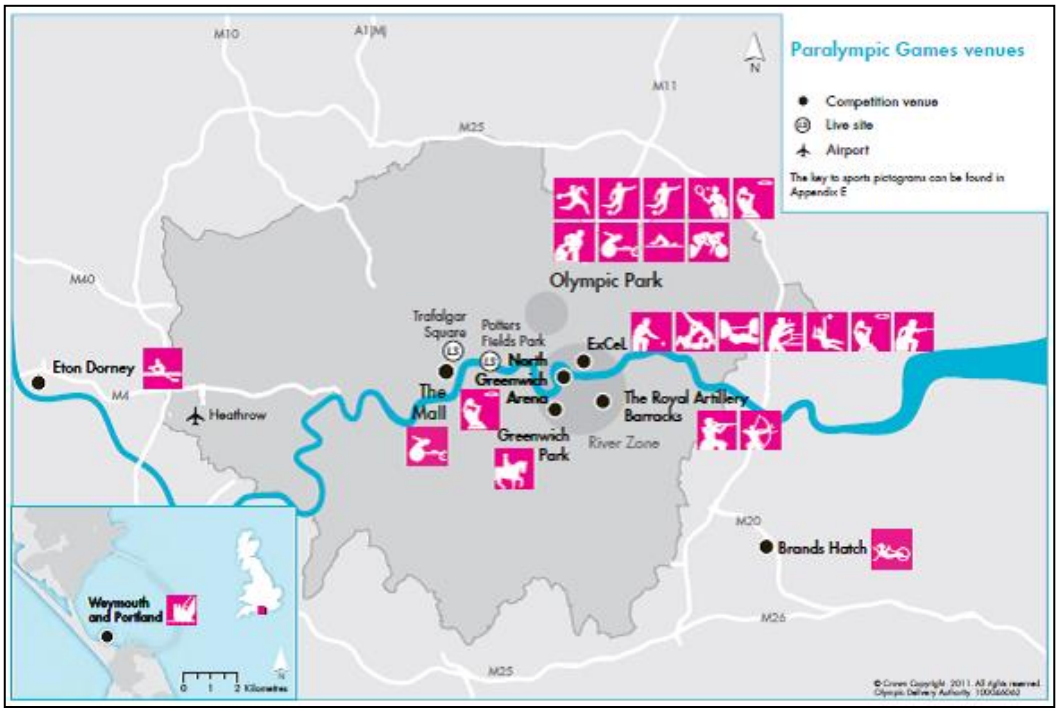

Figure 3.3: Location of Paralympic venues in London. Source: ODA (2011)

3.1.4 Travel hot-spots

The London 2012 Transport Plan acknowledged that pre-Games forecasting showed that at certain times and in certain locations, the available capacity on both the public transport and

road network would be exceeded by demand. These locations were known as travel hotspots and were mainly located in the centre of the city. They included areas of the road network, but also public transport stations. As an example, Figure 3.4 provides an overview of the anticipated hot-spots on the road network on the 3rd August 2012. The red patches indicate locations where congestion was predicted to be extremely high. Figure 3.10, later in this chapter, demonstrates an example of which London Underground locations were predicted to be exceptionally busy during the Games.

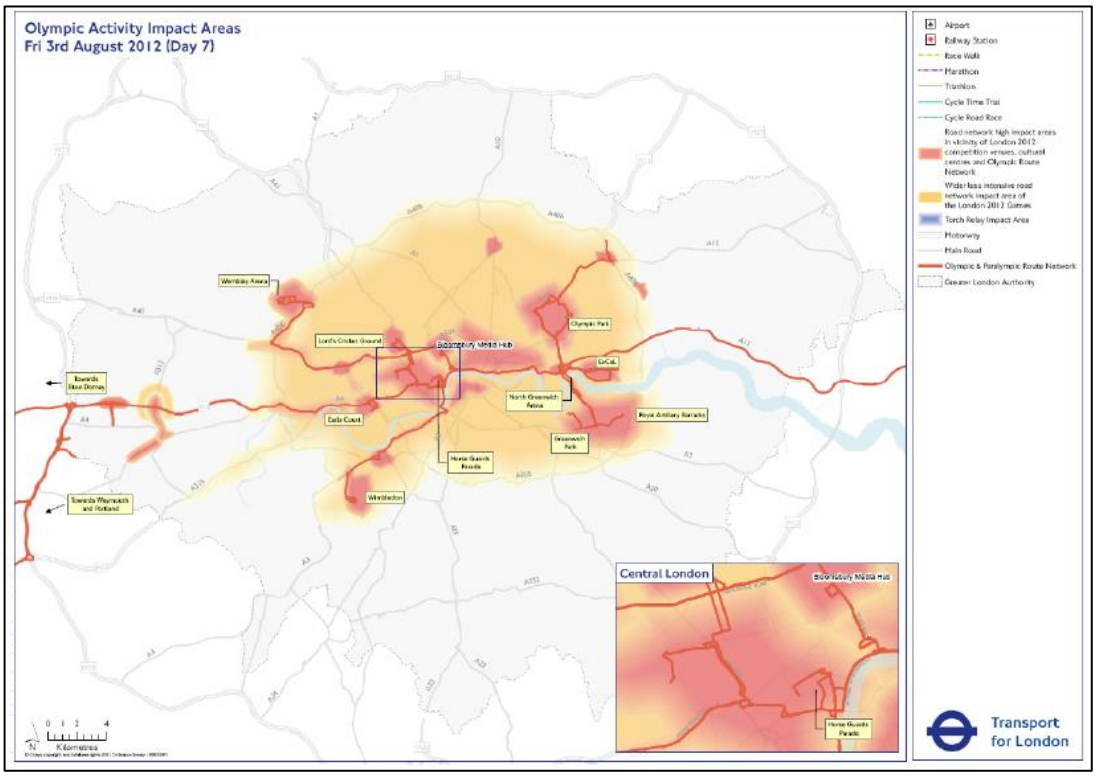

Figure 3.4: Anticipated congestion hot-spots on the road network - 3rd August 2012.
Source: TfL (2012c)

These hot-spot locations were an important focus for the organisers as they presented the areas where the system was most at risk of failing. Travellers were encouraged, through various means (that will be described in Section 3.2.3.1) to avoid placing pressures on these locations by travelling through different stations or areas, by different means, at alternative times, or even by travelling less.

3.2 London 2012 transport strategy

There are several key, overarching requirements that Olympic transport planning must meet, as posited by Bovy (2004) and presented in Kassens-Noor (2012). These are that:

- transport must be safe and secure
- transport must be "absolutely" reliable
- transport must be efficient, comfortable, convivial and must guarantee short travel time especially for athletes and the media
- transport must be flexible to mitigate risk of interruptions
- transport shall be environmentally friendly
- transport shall contribute to a strong host city and regional mobility legacy

How these requirements - and also the objectives of LOCOG (London Organising Committee of the Olympic and Paralympic Games) and ODA (Olympic Delivery Authority) - would be met was detailed through a London 2012 transport strategy. The key objectives of the strategy are presented in the Transport Plan for the London 2012 Olympic and Paralympic Games (ODA, 2011) as:

- ensuring that athletes were the top priority
- aiming to achieve almost 100% of ticketed spectators travelling to competition venues by public transport, walking or cycling
- keeping London and the UK moving during the Games
- ensuring that the Games were accessible from all parts of the UK
- leaving a lasting, positive legacy
- achieving maximum value for money

This strategy contributed to the specific transport measures that were initiated for the Games. These are described in detail in the London 2012 Transport Plan (ODA, 2011) and summarised succinctly by Currie et al. (2013) in Figure 3.5.

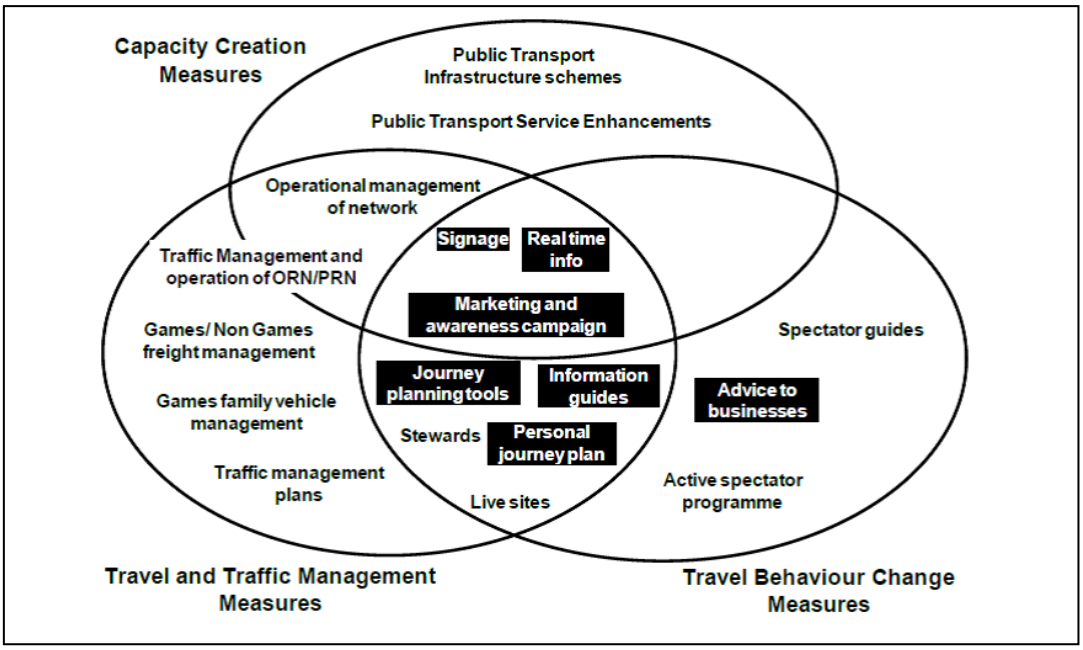

Figure 3.5: London 2012 transport strategy measures (including TDM measures, highlighted) (Currie et al., 2013)

Figure 3.5 shows how there are a range of measures included in the London 2012 transport strategy. These are divided into three categories but, as the figure demonstrates, these are not distinct and measures do overlap. This figure is a useful starting point for providing an overview of the transport strategy and the different elements of the planning and preparation for the Games.

3.2.1 Capacity creation measures

The first category of the transport strategy relates to infrastructure improvement projects. These appear to be a common feature of hosting the Games, and this was no different for London, which despite an existing modern transport system needed significant investment. Kassens-Noor (2012) asserts that the extent of the IOC requirements means that they cannot be met solely by the existing infrastructure and investment is necessary. The need for investment is also recognised by Bovy (2004) - cited in Kassens-Noor (2012) – who states that major public investment in transport infrastructure is often required as part of the organisation of a mega-event. Interestingly, Bovy also notes that this requires the compression of 25 years of projects into five years. Despite the pressure this places on stakeholders, the Games can act as a catalyst for bringing existing planned transport projects forward, as was the case in London (Sumner, 2012).

The need for infrastructure improvements is clearly a central element of the Games transport plan. In London, there were numerous infrastructure projects carried out to make the improvements and capacity expansions necessary for the Games. This chapter is not seeking to provide a comprehensive review of these projects, but rather provide an outline of the range carried out. A number of these projects are examined below:

- **Stratford station enhancements**

This was a notable project as this was the main Olympic Park station and therefore crucial to the flow of spectators to and from the Park. In fact, Stratford station was used by approximately half of the people visiting the Olympic Park each day during the Games (Sumner, 2012). The improvements made to the station were comprehensive and included: increased capacity, improved access and signal changes (Sumner, 2012; Kassens-Noor, 2012). This project, particularly in reference to the increased capacity, was seen by the ODA as an important contributor to the transport legacy of the Games (Kershaw, 2012).

- **Docklands Light Railway upgrade**

Investments were made to increase the capacity on the Docklands Light Railway (DLR) as well as infrastructure improvements across the network (Sumner, 2012; Kershaw, 2012). For example, the extension of the DLR from Canning Town to Stratford, which was designed to benefit the local area both during the Games and in the longer-term (ODA, 2011).

- **Jubilee line improvements**

The Jubilee line runs to the East of London, terminating at Stratford. This made it an important link to the Olympic Park and therefore benefitted from improvements in time for the Games. This included increased frequency, greater capacity and improved signalling, with the longer-term objective being a legacy for access to employment and the connectivity for East London (Kershaw, 2012).

- **New cycle ways and walking routes**

Infrastructure for walking and cycling was invested in for the Games (ODA, 2011) and this was focused on routes leading to the competition venues (Kershaw, 2012). This was to meet increased demand during the Games, as part of making active travel a key part of the transport strategy. Figure 3.6 provides an example of the new infrastructure. The

ramp shown was created (along with a lift) to provide improved access to the Greenway (a walking and cycling path), which could be used to travel to the Olympic Park.

Figure 3.6: New access ramp to the Greenway (Craven, 2012)

3.2.2 Travel and traffic management measures

Travel and traffic management measures were the second aspect of the transport strategy and refer to the more temporary elements of the transport management for the Games. The Olympic Route Network (ORN) and Paralympic Route Network (PRN) are rooted in this group of measures and are perhaps one of the most recognisable policies of the Games-time transport strategy. The ORN and PRN are the designated routes by which members of the Games Family were moved between various locations including: competition venues, accommodation and other key venues (ODA, 2011). At the busiest points along the routes, specific 'Games Lanes' were designated (operating in the same way as bus lanes), which were accessible only to the Games Family at certain times (ODA, 2011). Once the Games had concluded the Games lanes were removed and the road network returned to normal. Figure 3.7 and Figure 3.8 provide examples to show how the use of the Games lanes and how they were advertised to road users.

Figure 3.7: Images of London 2012 Games Lanes , left: Hawgood (2012), right: Holt (2012)

Figure 3.8: TfL Games Lanes poster (Source: TfL)

The Transport Coordination Centre (TCC) is a further example of traffic management during the Games. This centre was used to provide a central point through which transport operations could be managed during the Games and was on a unprecedented scale for London (ODA, 2011).

3.2.3 Travel behaviour change measures

Travel behaviour change measures were the final category of the Games transport strategy and the one that is of most interest in this thesis. This category includes many measures that were part of the TDM programme initiated for the Games (as shown by Figure 3.5) but also further elements such as stewards and spectator guides. Measures relating to the TDM programme included marketing and awareness campaigns, information guides, and journey planning tools. The TDM programme for London 2012 is regarded as the largest ever developed for an event (Currie et al., 2013) and was driven by the need to "balance demand with available capacity" (ODA, 2011, p.223).

The TDM programme was launched by the ODA in 2010 with the first year comprising the planning of the programme. TfL took over responsibility in 2011, which coincided with the transition into the implementation stage. The focus of the TDM programme was to promote short-term travel behaviour change across the summer of 2012 (ODA, 2011), which would help to spread the demand on the system to avoid major disruptions at the hotspot locations that were identified. The remainder of this section will examine how the travel behaviour

change measures were put in place to encourage changes in behaviour amongst different users of the system. This includes regular users, spectators, and the advice that was given to businesses.

3.2.3.1 Travel advice for regular users and spectators

Managing transport during the Games required tailored advice for the different individuals using the network. Even regular users of the network may have had limited knowledge of the alternatives available to them, which means that the advice provided needed to be broad-ranging. Raising awareness was recognised as an important first step in the process of achieving a shift in behaviour amongst both regular and temporary users of the network. Figure 3.9 shows two examples of the numerous posters used by TfL to advertise the need to change journeys during the Games period.

Figure 3.9: TfL posters used for awareness raising (Source: TfL)

To support both regular users of the network and visitors to alter their behaviour during the Games, a range of tools were made available. The ‘Get Ahead of the Games’ website - along with related social media accounts and advertising - was created to provide travel advice for all users and was managed by TfL. The main aim of this tool was to highlight the hotspots that were identified and to encourage travellers to avoid them. An example of this is shown in Figure 3.10. This was an interactive tool that allowed travellers to identify the busiest locations on a particular time and day, with the aim being to encourage them to avoid these locations by re-planning their travel.

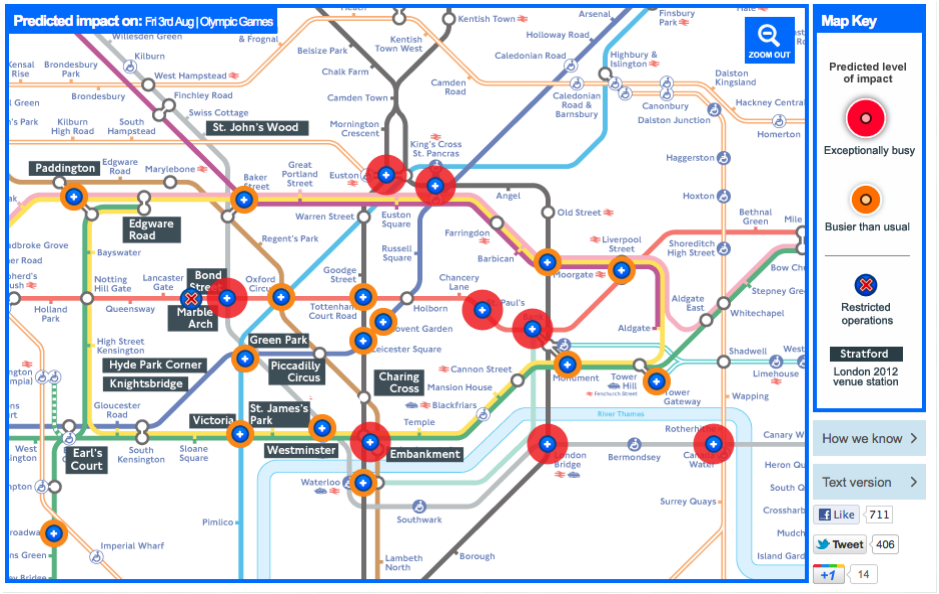

Figure 3.10: Computer screenshot of the interactive map available on the Get Ahead of the Games website (Urban Times, 2012)

The Get Ahead of the Games twitter account also provided a channel through which travel advice was communicated. This meant that TfL were able to provide targeted measures, sometimes responding to congestion/delays in real-time, to help manage demand on the network. Figure 3.11 includes examples of such messages.

Figure 3.11: Examples of tweets from the Get Ahead of the Games twitter account, left: Get Ahead of the Games (2012b), right, Get Ahead of the Games (2012a)

Spectators were provided with further tools to support them in travelling during the Games. A dedicated 'Spectator Journey Planner' was available through the London 2012 Games official website. Ticketed spectators were also provided with a free day travel pass that was given to them with their tickets to help achieve the public transport orientated Games objective. Travel guides were also created to provide information on the various ways spectators could travel to their event venues. Figure 3.12 and Figure 3.13 show examples of the travel guide and the day travel pass.

Left: Figure 3.12: Spectator travel guide (Page, 2012b). Right: Figure 3.13: Spectator day travel pass (Page, 2012a)

An interesting final point to note is how the TDM measure initiated through the advice to regular users and spectators can combine with media speculation to form 'the big scare'. This is concept was identified by Currie (1997) and, as the name suggests, helps to contribute to an environment where there is a greater perception of the potential negative impacts to travel. The outcome being that this constructively influences travel behaviour, to elicit a greater decrease in the base load travel demand (Currie and Shalaby, 2012).

3.2.3.2 Travel advice for business

A large 'travel advice to business' campaign was initiated for the Games, which provided support and advice to businesses and organisations in London to help them operate as closely to normal as possible during the Games (ODA, 2011). This was launched in November 2010 (Department for Transport, 2010).

Businesses and organisations across London were targeted with awareness of the need to re-think travel through web-based and postal advertising (e.g. 42,000 information packs were sent to businesses) (Currie et al., 2013). Further engagement was made through workshops and utilising existing channels (ODA, 2011). Individualised travel planning was available to organisations close to travel hotspots and also larger organisations across London (Currie et al., 2013; ODA, 2011).

A further element of the advice given to business related to freight transport. An 'Olympic Road Freight Management Team' based at TfL helped support businesses to adapt their travel and provided an information source. This involved deliveries, but also wider freight transport within London. The engagement and tools available ranged from freight travel advice workshops, an online journey planner, maps and information, and encouraging an expansion to night-time deliveries (TfL, 2013a; TfL, 2012b; ODA, 2011).

3.2.4 Summary of the London 2012 transport strategy

The Olympic and Paralympic Games presented London with a vast transport problem that received significant levels of investment of time and resources as the host's sought to address the challenges faced. This saw a range of measures being introduced. Clearly the physical infrastructure improvements were a highly visible aspect of these measures. However, the largest ever TDM programme also helped create an environment where travellers were given high levels of support to make changes, at least for short-term period of the Games.

3.3 Conclusion

Prior to the Games, 25.5 million trips were made on an average day on the London transport network. The organisers of the Games estimated an increase in trips of 3.1% for the Olympics and 2.1% for the Paralympics. A key factor of these additional trips was that they were anticipated to focus around travel hot-spots across the network, with the potential to create serious delays and congestion. To address this, a broad and far-reaching transport strategy was put in place to help the system cope with the added demand. Success of the strategy would be measured by a significant shift in the way that people normally travelled, and a broader reshaping of the transport system, if only for the short period of the Games. The remainder of this section will explain the value of examining this case study of the London 2012 Games to this study.

3.3.1 Why use London 2012 as the case study?

This chapter has demonstrated how the London 2012 Games presented a significant anticipated impact on the transport network. The vast influx of additional users to the London transport system was predicted to create significant additional demand on the network, particularly at travel hot-spots. The preparations for the Games, discussed in this chapter, demonstrate the significant efforts the organisers made to enact a broader shift in travel behaviour during the Games to avoid a failure of the system. The engagement with individuals, along with businesses and organisations sought to help create a context around which opportunities to change travel behaviour were greatly increased and supported.

It was discussed in Chapter 2 that instances where mobility provision is disrupted, such as is the case with the Games, opportunities are created both for more extensive changes to occur, but also for points of learning. The examination of the London 2012 Games presented in this chapter demonstrates that this case study would offer an ideal context through which to examine behaviour change. The scale of the Games, and its predicted impact on the network

meant that for many there may have been a necessity to change or adapt their behaviour. This emphasises the opportunity such an event presents to understand in greater detail the underlying factors involved in such changes, and therefore provide greater insights into how more radical behaviour change is achieved, and whether this also presents opportunities for sustained change.

Chapter Four

A Literature Review of Theoretical Models

4.1 Introduction

The research questions put forth in this thesis seek to examine the degree of change that occurred to individual travel behaviour during the London 2012 Games, and the reasons behind these changes. A further element of this thesis is the examination of whether, through a case study such as this; greater insights can be gained about the factors underpinning change, and importantly whether this can be used to help support longer-term shifts in travel behaviour. A key part of this is to consider possible tools of learning that may provide the insights needed, as this remains an underdeveloped area (as was discussed in Section 2.3).

Socio-psychological theoretical models have been increasingly focused upon, and applied to, the study of environmental behaviours since the 1990s (Bamberg and Schmidt, 2003). The advantage of models such as these is that they are theory driven and can provide greater insights into the behaviour studied, with the theoretical constructs they contain being central to this (Bamberg and Schmidt, 2003). A number of such models, the majority of which are drawn from the health behaviour field, have been applied to varying degrees in studies of transport and have shown value when studying this type of behaviour change. In order to meet the objectives of this research, this thesis will apply one such model, the TTM, to this research, in an effort to provide greater insights into the behaviour observed. Owing to the nature of the research in this thesis, the application of a framework is done so with a focus on examining its value as a tool for studying forced behaviour change.

With the objectives of this research concerned with individual level travel behaviour, it is pertinent to direct the examination of potential models towards individual level theoretical frameworks. Whilst there is no definitive list of such models, several notable frameworks have been applied, with varying frequency, to the study of travel behaviour. These include: the Theory of Planned Behaviour (TPB; e.g. Eriksson and Forward, 2011; Bamberg et al., 2003; Heath and Gifford, 2002), Theory of Interpersonal Behaviour (TIB; e.g. Domarchi et al., 2008), Norm Activation Model (NAM; e.g. Bamberg et al., 2011; Klockner and Blobaum, 2010; Nordlund and Garvill, 2003), Value Belief Norm theory (VBN; e.g.

Jakovcevic and Steg, 2013; Eriksson et al., 2008; Nordlund and Garvill, 2003), and Transtheoretical Model (TTM; e.g. Gatersleben and Appleton, 2007; Rose and Marfurt, 2007; Shannon et al., 2006; Beatty et al., 2002).

This chapter will first present a review and critique of these theoretical models to assess their potential use in research such as this. A summary of the application of these models to related areas of research will be provided before the final justification is given with regard to the model that was considered most appropriate to this thesis, the TTM.

4.2 Theoretical models

The theoretical models listed in Section 4.1 have been applied to studies of transport in an effort to understand the factors underpinning changes that may occur. Much of the work surrounding these theories has been related to the study of understanding what factors in particular are important to change, and also to examine the effectiveness of interventions to elicit changes in travel behaviour (Bamberg et al., 2011).

This section will first examine the NAM and the VBN, which are both focused upon pro-social behaviour. These are interesting to consider here given the shift in social context that is anticipated from large-scale disruptions such as the Games. If behaviour is considered with a focus on broader social concerns, then there are potential links with behaviour change where the wider social system is significantly altered. The section will then consider the TIB and TPB, which are centred upon the factors that influence the intention to perform behaviour. The TPB in particular has been applied widely in transport studies, and (along with the TIB) offers an alternative lens through which to study behaviour. The TTM is also examined, which is centred around the 'stages of change', which offer a temporal dimension through which to examine behaviour change (i.e. they see change as a process, with individuals progressing through a number of stages) (Prochaska and Velicer, 1997). A final model is then introduced; the Health Action Process Approach (HAPA), which is a further stage focused model. This has not featured in transport - to the knowledge of the researcher – but provides an interesting further model to consider.

4.2.1 Norm Activation Model

The NAM – first introduced by Schwartz (1977) and Schwartz and Howard (1981) - was developed with a focus on explaining pro-social, altruistic behaviours. The core element of the model relates to 'personal norms' and the role of these as a determinant of the behaviour patterns observed (Bamberg et al., 2007; Bamberg and Schmidt, 2003; Schwartz, 1977). De Groot and Steg (2009) provide an overview of the NAM and the elements that comprise it in

its simplest form (see Figure 4.1). Other studies have included schematics that differ slightly from this, although the core elements remain consistent, for example Harland et al. (2007) (Figure 4.2). These core elements are displayed in the De Groot and Steg diagram, and include the 'personal norms' and 'behaviour' already mentioned, along with 'awareness of consequences' and 'ascription of responsibility'.

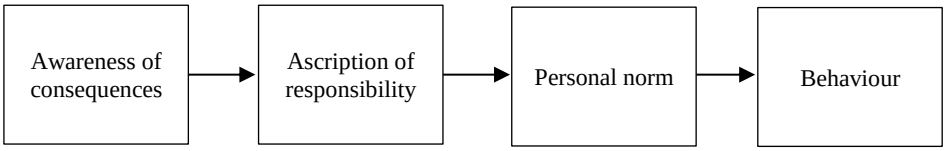

Figure 4.1: The Norm Activation Model – De Groot and Steg (2009)

The awareness of consequences element of the model relates to the individuals awareness of the problems their current behaviour causes (Dijst et al., 2013). Ascription of responsibility arises as the individual recognises their responsibility for the negative consequences of their actions (Dijst et al., 2013; De Groot and Steg, 2009). These two elements are described as the 'activators' for the personal norms that ultimately lead to the pro-social behaviour the model predicts (Dijst et al., 2013; Harland et al., 2007).

Harland et al. (2007) present a more detailed version of the NAM, with four additional 'situational activators' included, which is shown in Figure 4.2. These are 'awareness of need', 'situational responsibility' 'efficacy', and 'ability'. Whilst these additional activators are grounded in the initial work of Schwartz (Schwartz, 1977; Schwartz and Howard, 1984), the consensus amongst studies appears to be for the model posited by, for example, De Groot and Steg (2009).

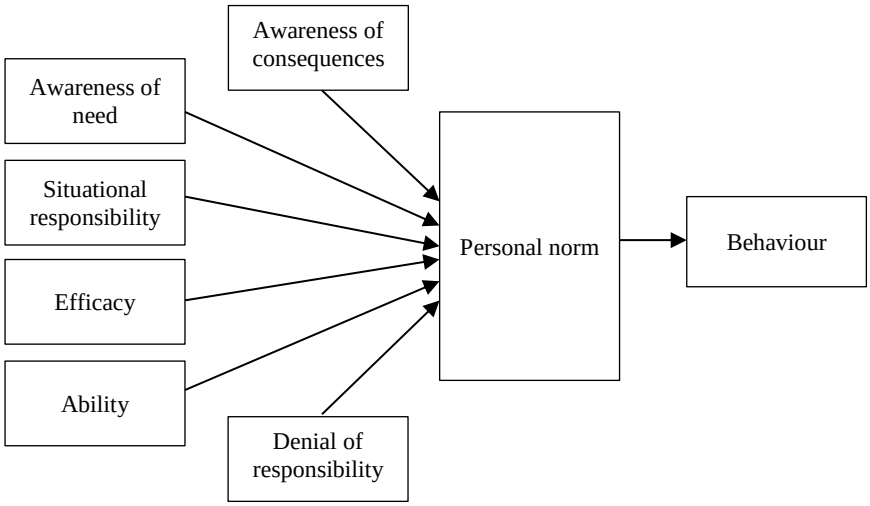

Figure 4.2: The Norm Activation Model – Harland et al. (2007)

The altruistic focus of the NAM means examples of the inclusion of the theory (including in an adapted form) in transport studies has been with an emphasis on pro-environmental travel behaviour. This includes: reducing car use (Nordlund and Garvill, 2003; Bamberg and Schmidt, 2003) and travel mode choice (Klockner and Blobaum, 2010; Bamberg et al., 2007; Hunecke et al., 2001).

Nordlund and Garvill (2003) examined the NAM (along with the Value Belief Norm theory, see Section 4.2.2) and confirmed that personal norms were a central determinant of a reduction in car use. It was found that personal norms mediated the effects of the values and problem awareness of the willingness to reduce car use. In a separate study it was shown that ascription of responsibility had a strong effect on personal norm, whilst in contrast awareness of consequences did not (Bamberg and Schmidt, 2003). Bamberg and Schmidt (2003) compared three models (the NAM, the TPB, and the TIB) and found that, of the three models, the NAM offered less power to predict car use.

With regard to the application of the NAM to travel mode choice, Bamberg et al. (2007) examined whether personal norms influenced the decision of individuals to use public transport instead of the private car. This study applied the NAM within an adapted model that also included the TPB. In two separate study locations in Germany (Bochum/Dortmund and Frankfurt) it was found that there was a statistically significant relationship between personal norm and public transport use in both samples. However, it was also identified that the personal norms were associated indirectly with the behaviour and instead mediated by public transport use intention (Bamberg et al., 2007). This suggests that whilst personal norm offers value, there may be limitations when it is applied purely through the NAM.

What emerges from the studies applying the NAM in the study of travel behaviour is that there is a need to integrate other theoretical constructs into the model, as seen in Bamberg et al. (2007). Further studies also present such evidence. For example, Klockner and Blobaum (2010) also used the NAM in a study of travel mode choice but did so by proposing the Comprehensive Action Determination Model (CADM), which included habit into the model. The authors argue that this is due to the limitations of the NAM in predicting repetitive behaviour, as evidence by earlier work (Klöckner et al., 2003; Klockner and Matthies, 2004).

Considering the NAM in the context of this research, the scale and impact of the Games, as described in Chapters 2 and 3, encompasses a range of issues that would impact the participants own travel behaviour. Whilst the NAM may capture a number of factors (as shown in Figure 4.2) the focus on awareness of consequences and personal responsibility

would restrict the necessary study of the other factors involved (e.g. support from employers and colleagues to change behaviour during the Games) that may contribute to the wider understanding of the behaviours observed.

4.2.2 Value Belief Norm theory

The VBN was developed by Stern and colleagues (Stern et al., 1999; Stern, 2000) and built upon the foundations of existing theory to examine pro-environmental behaviour. These theories included value theory, the NAM, and the New Environmental Paradigm (NEP) (Stern, 2000). The VBN differs from the NAM most notably in the addition of 'values' and the NEP prior to the existing awareness of consequences (AC) and ascription of responsibility (AR) elements that are drawn from the NAM (this is illustrated in Figure 4.3). The values include 'biospheric', 'altruistic', and 'egoistic', and are regarded as influencing the ecological worldview (NEP) that follows in the model (Stern, 2000).

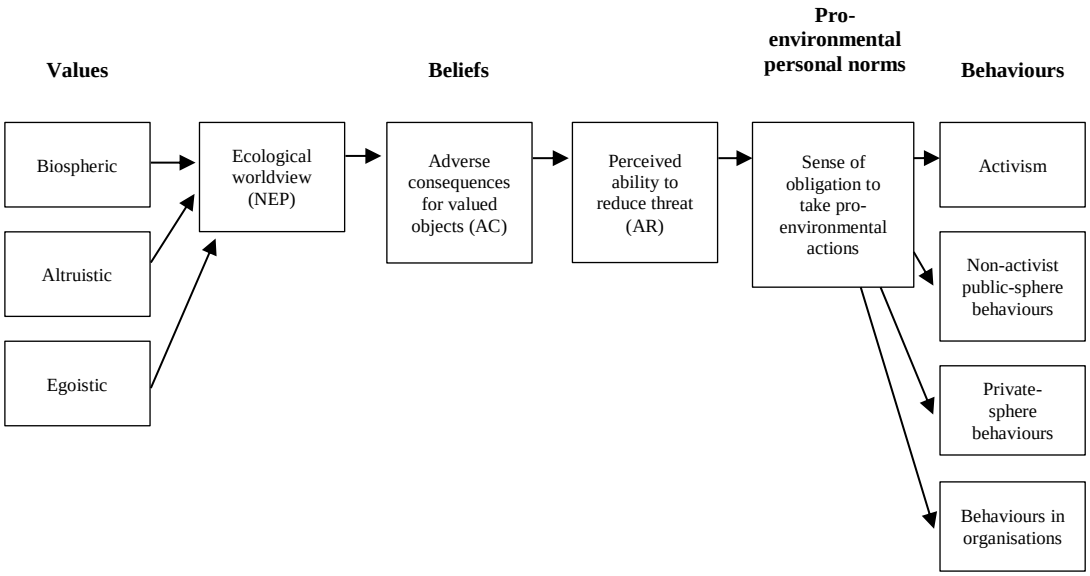

Figure 4.3: Value Belief Norm theory (Stern, 2000)

Given the altruistic and pro-environmental focus of the VBN, the application of the model in the transport field has been directed towards studies that include reducing car use (Nordlund and Garvill, 2003; De Groot et al., 2008; Jakovcevic and Steg, 2013) and wider pro-environmental transport policies (Eriksson et al., 2006; Eriksson et al., 2008).

Nordlund and Garvill (2003) utilised both the VBN and the NAM to study a reduction in car use. This confirmed that personal norms, which are included in the VBN, were indeed a

central determinant of a reduction in car use. Work by De Groot et al. (2008) demonstrated that the VBN could be applied in the transport context in relation to pricing policy and a subsequent reduction in car use. Jakovcevic and Steg (2013) replicated this study in Argentina, with similar results. The three studies presented here all demonstrated the explanatory power of the VBN, and provided evidence of the consistency in the causal structure between each element of model (i.e. AC influencing AR).

Eriksson et al. (2006) examined the value of the VBN when applied to study acceptance of TDM policies, along with a specific focus on the reduction in car use. The study found support for the use of the VBN, with pro-environmental views and an awareness of the consequences of private car use shown to be associated with personal norms, which were then related to a willingness to reduce car use (Eriksson et al., 2006). With regard to TDM policies, the study found that those with a strong willingness to reduce car use were more favourable in their view of TDM policies related to reducing car use.

Bamberg et al. (2007) stated that pro-environmental behaviours (such as changing your mode of travel) can be viewed as being influenced by either pro-social or self-interested motives. The VBN (and also the NAM) view behaviour change through a pro-social lens (e.g. changing modes to reduce your environmental impact to benefit others). Changing behaviour to avoid disruption to your journey is much more orientated towards how this affects the individual's own travel experience, which is a self-interested focus. The 'egoistic' element included in the VBN is centred on the individual's own interests, which perhaps contradicts the assessment presented here. However, this element appears to lack presence in previous studies and Stern (2000) acknowledges that it is not well understood. In summary, the nature of this research and its concern for how individuals change their travel in response to Games-time disruption suggests that a framework that can explain behaviour change more from a self-interested approach would be more suitable.

4.2.3 Theory of Interpersonal Behaviour

The TIB, developed by Triandis (1977), is a theory in which intention is regarded as playing a central role as a mediator of behaviour. Notably, it also accounts for habit, which other studies do not (e.g. the NAM or VBN). Figure 4.4 presents the model diagram, which demonstrates that performing the behaviour is influenced by three factors: habit, intention, and facilitating conditions. Intention is in turn influenced by attitude, social factors and affect.

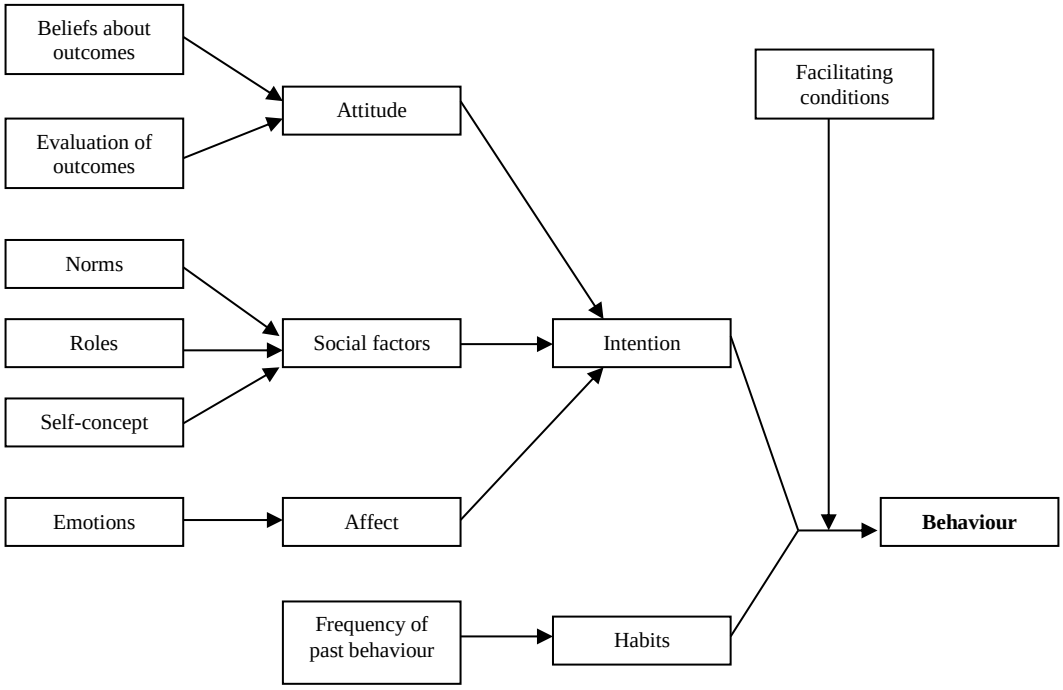

Figure 4.4: Triandis' Theory of Interpersonal Behaviour (Jackson, 2005)

The application of the TIB was initially relatively limited in favour of similar alternative models, namely the Theory of Planned Behaviour (TPB) (Bamberg and Schmidt, 2003). The TPB has been used extensively in studying behaviour change, including in the transport field and will be examined in Section 4.2.4. The application of the TIB has increased more recently, reflecting the greater focus within broader social research on habits (Bamberg et al., 2003). The numbers of studies in transport are limited however, and have focused upon mode choice, and in particular car use.

Domarchi et al. (2008) applied the TIB in an attempt to understand more about the psychological factors influencing mode choice. This particularly focused on the examination of the effect of habit, attitudes, and affective appraisals (related to emotions) on car use. The model was found to provide useful insights, particularly in demonstrating the influence of habit on the behaviour performed. Verplanken et al. (1994) also applied the TIB, in this instance to understand the comparison between attitudes and habits as predictors of mode choice. The authors demonstrated the trade-off between habit and attitude. More specifically, it was showed that when habit is stronger the relationship between attitude and behaviour is weaker. The opposite is true when habit is weak.

In terms of this research, the TIB appears to offer a potentially useful tool to study the underlying processes of behaviour in this context. The inclusion of habit in the model means

that an understanding may be gained of how the relationship between the individuals existing habit (which may be difficult to change) and how they respond to a disruption such as this. An identified problem with the TIB, which perhaps explains its lack of application, is the complexity of the model (Jackson, 2005) and the range of specific factors it involves. A further drawback of the TIB, when considering the applicability of it in this research, is that it does not examine the process of behaviour change. This research is seeking to understand the impact of a major-event as an opportunity to elicit greater shifts in travel behaviour, so a model that can observe this at a more specific level is needed.

4.2.4 Theory of Planned Behaviour

The TPB (Ajzen, 1991; Ajzen, 1985) was developed as an extension of the Theory of Reasoned Action[4] (TRA) (Ajzen and Fishbein, 1980; Fishbein and Ajzen, 1975). This extension was considered necessary due to the limitations of the TRA in examining behaviours where the individual did not have complete volitional control (Ajzen, 1991). The TPB is a more simplistic framework, for example, when compared to the TIB. The TPB, shown in Figure 4.5, considers intention to be the immediate antecedent of behaviour. Intention is then influenced by three separate factors; attitude toward the behaviour, subjective norm (perceived social pressure to perform or not to perform the behaviour) and perceived behavioural control (perceived ease or difficulty of performing the behaviour) (Ajzen, 1991). Perceived behavioural control may also have a greater direct influence on behaviour than attitudes or the subjective norm, depending on how closely the perceived control reflects actual control (Ajzen, 1991; Bamberg et al., 2003).

[4] The TRA is not examined in detail in this chapter owing to its similarity to the TPB, which is a much more commonly applied model and therefore warrants critique.

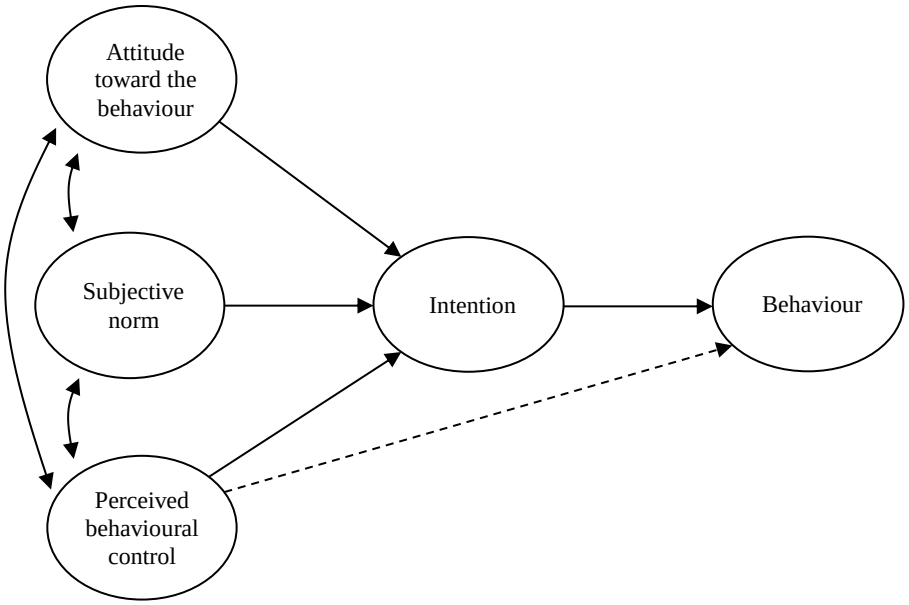

Figure 4.5: The Theory of Planned Behaviour (Ajzen, 1991)

The TPB has been applied widely to study a range of behaviours including smoking, alcohol consumption, physical activity (McEachan et al., 2011; Jackson, 2005). In transport, it has also been applied extensively, including in the examination of car use (Eriksson and Forward, 2011; Bamberg and Schmidt, 2003), active travel (Panter et al., 2011; De Bruijn et al., 2009), travel time (Jain and Lyons, 2008), and mode choice (Bamberg and Schmidt, 1998; Ahern, 2002; Bamberg et al., 2003). Despite its extensive application, there are no studies known to the author that have focused on system wide travel disruption.

In terms of a more detailed discussion of the application of the TPB in transport, the evidence shows how authors have tailored and expanded how the model is applied. For example, Bamberg et al. (2003) (travel mode choice) investigated the effect of a pre-paid bus ticket on increased bus use of students, but incorporated habit into the study. The study observed that the intervention raised attitudes, subjective norms, and perceived behaviour control with regard to using the bus, and thereby influenced intention to perform the behaviour. Eriksson and Forward (2011) examined travel mode choice (specifically car, bus, and bicycle) and argued for the inclusion of additional social norms into the model, which essentially allowed for the inclusion of both subjective and descriptive norms. This provided greater support for the study of multiple modes of travel, rather than just one.

The need to expand the model - which occurs often in the literature - emphasises the relative simplicity of the TPB. This becomes apparent when compared to other models such as the TIB, but is also something that has been acknowledged in the literature (Baum, 1997; Anable et al., 2006). The simplicity of the model is also observed in the link between

intention and actual behaviour, and the fact that it is not apparent how the individual operates at this point, as their intention becomes action (Baum, 1997). In the context of this thesis, this is a clear key negative, as the ability to examine in greater detail the entire behaviour change process would be valuable for understanding behaviour over a sustained period.

4.2.5 The Transtheoretical Model

The TTM was developed by Prochaska and DiClemente in the late 1970s and early 1980s. It originated in the health behaviour field and was developed to unify a number of health behaviour theories (Prochaska and DiClemente, 1983; 1982). It comprises four constructs: the stages of change, the processes of change, self-efficacy, and decisional balance, and has been used widely to study problem behaviours including, for example, smoking cessation and increasing physical exercise. The TTM differs from the other theories examined so far in this chapter because it sees change as a process over time, with the stages depicting the individuals' gradual progression towards behaviour change. Importantly, it also accounts for the considerable activity the individual goes through beneath the surface before any noticeable change is observed (Jones and Sloman, 2003) which could be useful given the substantial pre-Games programme of messages and supporting measures.

The stages of change are the central construct within the model and relate to the position the individual is in within process of behaviour change. Table 4.1 provides an overview of the five stages of change, which an individual will move through as they transition towards changing behaviour (Prochaska and Velicer, 1997). An individual in the latter stages, for example action, has progressed to a point where they have a greater ability to change their behaviour in comparison to any previous stage (Hirvonen et al., 2012). These individuals are expected to make a change soon and find it easier to do so than those in the earlier stages. A sixth 'termination' stage is sometimes included within the stages of change, although this essentially links to the removal of any potential relapse to the previous behaviour (Prochaska and Velicer, 1997), and is not frequently included as it is often not relevant to the behaviour being studied. Notably, the TTM sees change as something which occurs in a spiral – meaning that it is not necessarily definitive and linear, accounting for relapses in behaviour (Prochaska et al., 1992).

Table 4.1: The Stages of Change (adapted from Prochaska and Velicer, 1997)

Pre-contemplation	**Contemplation**	**Preparation**	**Action**	**Maintenance**
Not aware of the need to change and therefore has no intention of changing in the next 6 months.	More aware of the issues and therefore intend to change in the next 6 months.	Intending to change behaviour in the near future (1 month) and have therefore taken steps to prepare (e.g. bought a bicycle).	Make changes to behaviour although it is not consistent change.	Have made the changes to their behaviour and have managed to increase the consistency of this and now trying to prevent relapsing into old ways.

The second construct of the TTM are the processes of change, which are described as the activities an individual engages in as they progress through the stages (Prochaska and Velicer, 1997). Through their work to develop the TTM, Prochaska and DiClemente brought together a range of ideas from various health behaviour theories, which in part led them to establish the processes of change (Prochaska and DiClemente, 1994; Prochaska and Velicer, 1997). The ten processes can be divided into five experiential and five behavioural processes. The five experiential processes are consciousness raising, dramatic relief, self-re-evaluation, social liberation and environmental re-evaluation. The five behavioural processes include self-liberation, counter conditioning, stimulus control, contingency management and helping relationships (Mutrie et al., 2002). It is argued that to facilitate a change in behaviour the individual engages in these activities at different stages over the behaviour change process. The list of processes, along with more detailed descriptions is displayed in Table 4.2.

Table 4.2: The processes of change descriptions

Process name	Description
Consciousness raising	Occurs when the individual's awareness of a need to change increases and they become conscious of what methods may be available to help them enact this change.
Dramatic relief	Helps to measure the emotional aspect of behaviour change. For example, how the individuals reacts emotionally to the potential disruption to their work journey.
Self-re-evaluation	Refers to the image an individual has of themselves and how they might wish to change this.
Social liberation	Opens up more opportunities to consider changing their behaviour. This is particularly focused on social opportunities and may refer to discussing other travel options with colleagues or friends.
Environmental re-evaluation	Reflects the influence an individual may have by being a role model for other potential changers. For example, how the individual might encourage others to change too.
Self-liberation	Refers to the belief and commitment the individual have in themselves to change.
Counter-conditioning	Involves the individual believing that the learning of more positive behaviours (in this instance changing the way they travel) to replace what could be considered more negative behaviours will improve their overall experiences.
Stimulus control	Prompts the individual to change their behaviour by adding additional support to help them make the change. This may be through the individuals themselves planning their time better in advance to enable them to make the change more easily.
Contingency management	Highlights how the individual sees the potential benefits of changing their behaviour.
Helping relationships	Refers to the support network the individual has that may enable them to make changes to their behaviour. This network may include the individual's family, friends or employer.

The third construct of the TTM is self-efficacy. This relates to the confidence an individual has in their own ability to cope with the situation they are faced with (Prochaska and Velicer, 1997). As the individual moves through the stages, this is matched by increases in their self-efficacy until it peaks in the maintenance stage, which highlights the importance the framework places on confidence in the behaviour change process. Decisional balance is the final construct and, put simply, refers to the perceived pros and cons of changing behaviour and can relate to both the individual and others who may be directly or indirectly affected (Prochaska and Velicer, 1997; Janis and Mann, 1977).

Figure 4.6 provides an overview of the four constructs and how the literature believes them to interrelate. As the figure demonstrates, different processes of change are considered to be more relevant depending on the stage of change. For example, those in the preparation stage would be engaging with particular processes as they seek to take steps to be able to act on

their intention to change behaviour soon. It also shows how the constructs of decisional balance and self-efficacy alter as the individual moves through the stages. In the earlier stages the cons of changing behaviour generally outweigh the pros but during the latter stages this balance shifts in the opposite direction. As the individual progresses through the stages, their confidence continues to increase contributing to their ability to change.

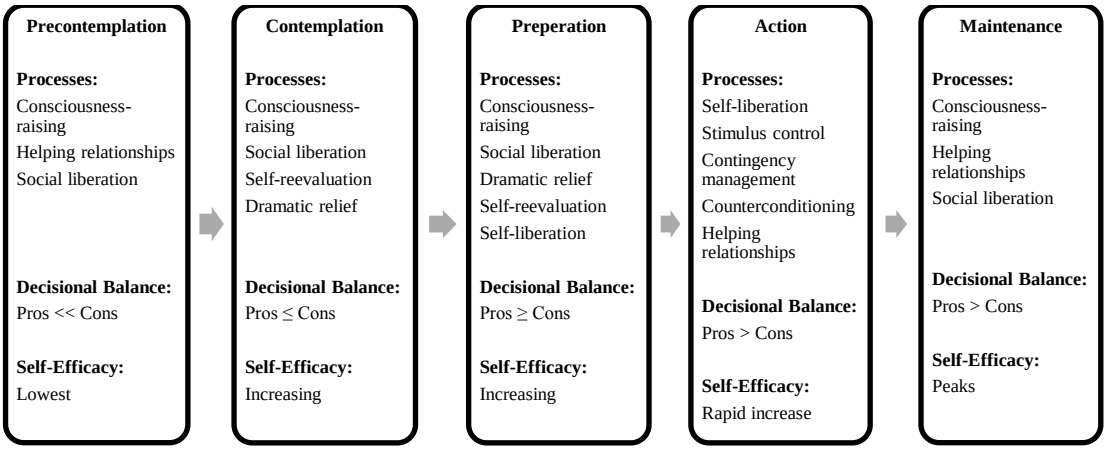

Figure 4.6: The Transtheoretical Model (adapted from Nigg et al., 2011; Burkholder and Nigg, 2002)

A reported advantage of the TTM is that it provides an insight into the process of behaviour change experienced by the individual (Anable et al., 2006). In transport, it has been applied to study specific modes, e.g. cycling (Nkurunziza et al., 2012a; Rose and Marfurt, 2007; Gatersleben and Appleton, 2007) and car use (Bamberg, 2007; Beatty et al., 2002), along with wider modal change (Shannon et al., 2006). The TTM has typically been used to tailor stage specific interventions to help facilitate changes in behaviour. For example, Gatersleben and Appleton (2007) studied cycling to work, using the stages of change to group participants. This enabled them to then explore the motivations of each group, allowing them to build a picture of what interventions would be needed to encourage a greater degree of cycling from the sample.

The model has also been applied in the study of one-off events. Whilst there are no studies specifically examining major sporting events such as the Games, the work by Beatty et al. (2002) is the most relevant example in the context of this paper. The authors applied the TTM in adapted format the study the impact of the 2000 UK fuel shortage on drivers' willingness to reduce car use. This found that many people had the ability to reduce their car use in the short term but that pre-contemplators (those least likely to consider reducing car use) were least likely to change stage, which would be anticipated. Rose and Marfurt (2007) examined behaviour change in the context of a promotional 'cycle to work day' that occurred annually and found that 28% of the sample had progressed in their stages of

change (between March 2004 and March 2005), with many of these being first-time riders highlighting the potential impact of such an event.

Adaptation of the TTM is common in studies in the transport field. Many examples have only used the stages of change construct of the model (Nkurunziza et al., 2012b; Gatersleben and Appleton, 2007; Rose and Marfurt, 2007). Shannon et al. (2006) used only the stages of change and self-efficacy constructs in their study of active commuting in a university setting. Beatty et al. (2002) used a more comprehensive application of the TTM but only used six of a possible 10 processes of change. Furthermore, some studies are shown to have used certain elements of the TTM as part of a wider adapted model (Bamberg et al., 2011; Bamberg, 2007; Jones and Sloman, 2003).

The description of the stages of change construct of the TTM shows how its application would offer a potentially more insightful view of the preparedness of the individual to respond to a disruption. Although not applied to a disruption, Shannon et al. (2006) studied the propensity to change of commuters through the stages of change. There are some criticisms of the stages of change however. Sutton (2001) highlights the arbitrary nature of the time-periods within which the stages are placed (see Table 4.1 for an example of these), and suggests that different results may emerge when different time-periods are considered.

In examples of the application of the TTM in transport, such time periods appear varied, for example, Nkurunziza et al. (2012a) did not include a specific time-period within the stages, whereas Gatersleben and Appleton (2007) referred to six months. Furthermore, the suitability of the number of stages has been questioned (Bamberg, 2007) with some studies seeking to expand upon the typical five stages (e.g. the TAPESTRY project, see for example Jones and Sloman, 2003; TAPESTRY, 2003). There is not a consistent message however as to what the most appropriate number of stages there are. The study by Beatty et al. (2002), which examined willingness to change in response to a fuel shortage, reported ‘erratic’ stage movements. Whilst the cause of this is not fully clear, it is something to note taking the TTM forward and applying it to a disruptive event.

The TTM has been examined widely in transport, and the stages of change, whilst attracting criticism have formed the basis of studies examining the propensity for change (e.g. Shannon et al., 2006) and guiding interventions to encourage changes in behaviour (e.g. Jones and Sloman, 2003). What stands out about the TTM is the focus on the process of change and the movement between stages, in contrast to a one-step process (Bamberg, 2007), which characterises models such as the TPB and TIB. Also important are the

different constructs and how some might be more relevant, or be more engaged with, for individuals at different stages in the behaviour change process.

4.2.6 Health Action Process Approach

The Health Action Process Approach (HAPA) was developed by Schwarzer (2008; 2001; 1992) and has been applied in the study of a number of behaviours including: physical activity (Scholz et al., 2009; Lippke et al., 2010), food hygiene (Chow and Mullan, 2010), and smoking (Radtke et al., 2012). The researcher is not aware of examples of the application of the HAPA to a transport context. Whilst this means that it is untested in this context, it was included in this examination of potential models to provide a further example of a stage model (and therefore similar to the TTM), which may be applied.

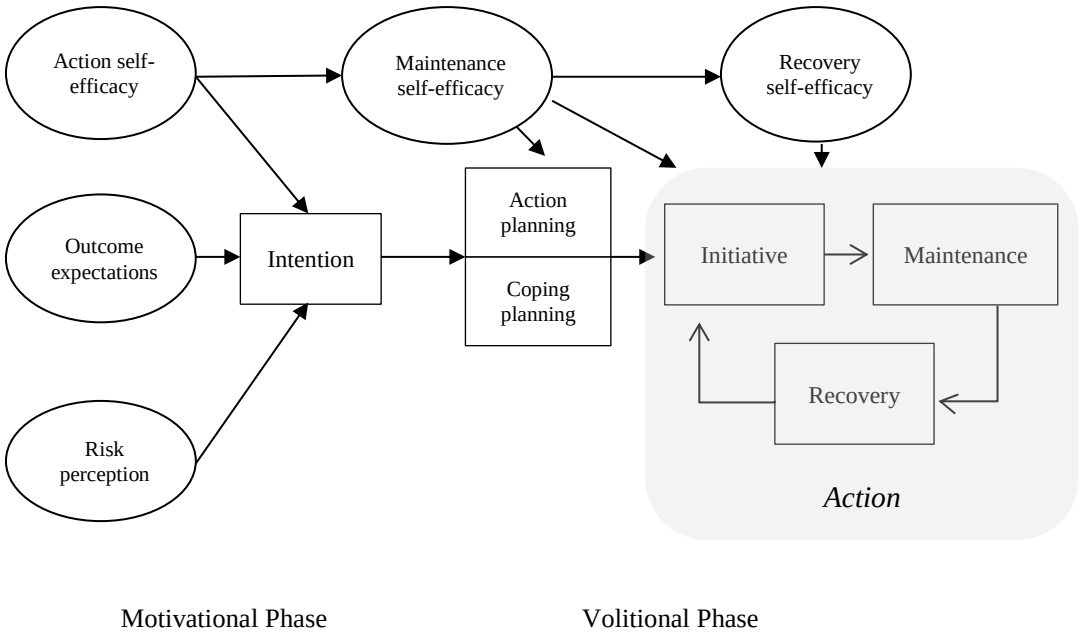

Figure 4.7: The Health Action Process Approach (Schwarzer, 2008)

The HAPA has two distinctive stages, 'motivational' and 'volitional', which are shown in the model diagram in Figure 4.7. The motivational phase relates to the formation of intention, with three elements contributing to this. This includes risk perception, which relates to threat the individual perceives to their health (Garcia and Mann, 2003) (e.g. "I am at risk for cardiovascular disease") and outcome expectations (e.g. "If I exercise five times per week, I will reduce my cardiovascular risk") (Schwarzer, 2008), which both contribute to the individual progressing from pre-intention. Self-efficacy also forms part of the model

and supports the individual in moving from pre-intention, intention, and then acting on their intention.

If the person develops the intention to change then they arrive in the second phase; volition (Schwarzer, 2008). This phase begins with the individual planning the action they will take which is a necessary step as they move towards changing. This bridges the gap between intention to change and actually performing the behaviour (Chow and Mullan, 2010). The inability to focus in more detail on the post-intention element of behaviour was considered to be a drawback of the TPB in this research, but the HAPA shows how a stage model can perhaps demonstrate a greater level of detail when examining the process through which behaviour changes, which reiterates the discussion around the TTM. As individuals changing their behaviour are likely to relapse, the final part of the model incorporates a cycle within which the attempt to change behaviour can be repeated. Multiple relapses may occur before the individual can succeed in maintaining the new behaviour.

In the context of the potential disruption caused by the London Games, once the concern about disruption is removed (post-Games), the individual may relapse their new behaviour because they never intended for it to be a long-term change. This is interesting to consider in the context of a relatively short-term disruption, as it shows that behaviour that was only ever meant to be temporary could be accounted for, which may add to the understanding of longevity of change in this context.

A criticism of the HAPA in the literature relates to the lack of incorporation of social factors into the model (Chow and Mullan, 2010). This occurs in, for example, the TPB, where the influence of important people is considered. This may hinder the HAPA when applied to the context of the Games, where social factors (e.g. support from significant individuals) are likely to have played a role in influencing and supporting behaviour change. This research is particularly interested in the process of change and the staged approach of the HAPA is relatable to this. However, the HAPA is vague in terms of the volitional phase and how the model operates in terms of the points through an individual moves (Armitage and Conner, 2000), for example in the latter part of the model, labelled action. Despite its criticisms, the HAPA appears to offer a potentially useful model through which to study change in this thesis. Ultimately however, the model is unproven in the transport context. Given the exploratory nature of the application of a model in this research - in terms of applying it to a large-scale disruptive event – it is necessary that the model applied has some proven application in the transport sector. This would provide a more stable foundation from which to apply it in the context of the Games, as opposed to a model that is unproven.

4.2.7 Summary table

Table 4.3 provides an overview of the different theoretical models discussed in the chapter, to demonstrate the relevant research areas that they have been applied in. The table does not seek to be an exhaustive overview of the studies conducted, but rather show where there are examples and where there are not. For example, the lack of application of the HAPA in pro-environmental/pro-social and transport studies is evident in the table. In contrast, there is more widespread application in both transport and health behaviours for the TPB and TTM. The pro-social/pro-environmental focus of the NAM and VBN is also clear from the table. It should be noted that studies examining these two models, whilst tending to focus on reducing car use, did as a result incorporate the study of active travel modes. However, the researcher is not aware of examples where active travel was the primary focus of the study.

Table 4.3: Summary of the relevant research areas the theoretical models have been applied to

Research area the model has been applied in	Theoretical Models					
	Norm Activation Model	**Value Belief Norm theory**	**Theory of Interpersonal Behaviour**	**Theory of Planned Behaviour**	**Transtheoretical Model**	**Health Action Process Approach**
Car use	Nordlund and Garvill (2003); Taniguchi et al. (2003); Bamberg and Schmidt (2003)	Jakovcevic and Steg (2013); De Groot et al. (2008); Eriksson et al. (2008); Nordlund and Garvill (2003)	Domarchi et al. (2008); Bamberg and Schmidt (2003)	Eriksson and Forward (2011); Bamberg and Schmidt (2003)	Beatty et al. (2002); Bamberg (2007);	---
Active travel	---	---	---	Panter et al. (2011); De Bruijn et al. (2009)	Rose and Marfurt (2007); Shannon et al. (2006); Mutrie et al. (2002); (Nkurunziza et al., 2012b)	---
Travel mode choice	Klockner and Matthies (2004); Hunecke et al. (2001)	(Verplanken et al., 2008)	Tudela et al. (2013)	Bamberg et al. (2003); Ahern (2002); Bamberg and Schmidt (1998)	Fu et al. (2012); Jones and Sloman (2003)	---
Pro-social/pro-environmental behaviour	De Groot and Steg (2009); Onwezen et al. (2013); Harland et al. (2007); Wiidegren (1998)	Steg et al. (2005); Stern (2000); Stern et al. (1999);	---	Chan (1998); Harland et al. (1999)	Waygood et al. (2012); Chib et al. (2009)	---
Smoking cessation	---	---	---	Rise et al. (2008); Higgins and Conner (2003); Godin et al. (1992)	Prochaska and DiClemente (1983); Perz et al. (1996)	Radtke et al. (2012)
Increasing exercise	---	---	Valois et al. (1988)	Rhodes and Courneya (2003); Terry and O'Leary (1995)	Hirvonen et al. (2012); Nigg et al. (2011); Bulley et al. (2007)	Lippke et al. (2010); Scholz et al. (2009); Schwarzer et al. (2007)

4.3 Conclusion

The models examined in this chapter seek to explain and predict behaviour through a number of constructs, with different models placing greater emphasis on different constructs. These theories are oriented around individual level behaviour change, which was deemed a suitable approach to take in determining the appropriate model to be applied. The common factor in these models is that they seek to provide a greater, theoretical depth of understanding of the factors involved in behaviour change. This is particularly relevant in this thesis as it may help to improve the understanding of what factors underpin behaviour change in the context of a disruption, and how this might provide greater opportunities to learn from such events.

As Table 4.3 shows, the models have been applied to a range of areas of study. The NAM and VBN, for instance are orientated around pro-social and pro-environmental behaviours. This is also the case for when they have been applied in transport (e.g. willingness to reduce car use). The TIB, TPB and TTM have featured to differing degrees in both the transport and health behaviour field. The HAPA - the final model examined - features in health behaviour studies but has not been applied to the study of transport.

The NAM is focused on altruistic behaviours, with behaviour considered to be mediated through personal norms. The NAM has been examined in the transport literature, although it was shown by Bamberg and Schmidt (2003) to have less predictive power than both the TPB and TIB. What is interesting to note about the possible application of the NAM in this thesis, is that the pro-social, altruistic focus may have been of value for understanding the shift in social context that is suggested to occur as a result of a large-scale disruption. Taking Figure 4.2, for example, the expanded elements included in the diagram by Harland et al. (2007) demonstrate the factors the NAM may have measured. Ultimately however, the application of the NAM would have meant the approach of this thesis would need to be altered significantly, and the ability to capture the process of change individuals in the sample engaged with would have been diminished.

The VBN is very similar to the NAM, although it has a greater focus on the pro-environmental, such as the individual's ecological worldview. The use of the VBN is supported in the transport literature, but given the pro-environmental approach it takes, these studies have largely focused on reducing car use specifically, rather than accounting for wider changes in travel behaviour. Similarly to the NAM, the altruistic focus of the VBN may have provided an interesting application to this thesis. Ultimately, the greater emphasis the VBN places on pro-environmental behaviour through, for example, the ecological

worldview, means that it may be more limited in the application in this context, if it is unable to encompass the wider behaviour change pressures faced as a result of the Games, and the more self-interested changes in behaviour that may be evident.

The TIB and TPB both differ from the NAM and VBN through the inclusion of intention. The TPB has, in particular, shown popularity in its widespread application in many fields including transport and health behaviours. A criticism of the TPB is its simplicity, although this may also be a factor in its popularity. The TIB is more complex, as shown by the model diagram (Figure 4.4), as it incorporates habit into the model, unlike the TPB. A point relating to both these models, along with the NAM and VBN, is that they examine change as one single step and do not account for a more staged movement towards behaviour change.

The TTM and HAPA are both stage based models, and theoretically offer a more detailed overview of the process the individual goes through as they make a change in their behaviour. The HAPA was assessed to be of potential value in this thesis but the lack of application to transport or pro-environmental behaviours, as demonstrated in Table 4.3, led to it being discounted. This was due to the decision to apply a model that had evidence of application in the transport field.

The decision to therefore adopt the TTM in this thesis was driven by the focus of the model on the temporal process of behaviour change. The temporal dimension can show how the individuals' predisposition to change alters over time, when exposed to a large-scale disruption. This therefore may help to show in greater detail the behavioural changes and response observed in the longer-term.

The TTM has been applied in studies to examine both the existing predisposition of the individual to change at a certain point in time and to provide an insight into how an intervention may influence their movement along the stages to finally performing the new behaviour. The further constructs of the TTM also provide insight into the underlying factors that can help to explain the behavioural response of the individual. This combination of constructs may help to provide valuable insight into a range of psychological factors important to change in the context of a disruption.

Chapter Five

Methodology

5.1 Introduction

The research questions that this thesis seeks to address (as shown in Figure 5.1) require a methodological design that allows for an examination of travel behaviour over a long-term period, along with the incorporation of constructs from the TTM. This chapter will provide a critical review of the formation of this methodology and how it has been implemented.

Research Questions

1. How did travel behaviour change as a result of the London 2012 Games?
    a. Commute journeys
    b. Non-work journeys
    c. Business travel

2. If travel behaviour changed as a result of the London 2012 Games, what were the reasons for these changes?
    a. Commute journeys
    b. Non-work journeys
    c. Business travel

3. What role did employers have in influencing the behaviour change of their employees during the London 2012 Games?

4. If changes in travel behaviour occurred during the London 2012 Games, how and why were these sustained?

5. What did the London 2012 Games teach us about the longevity of travel behaviour change?

6. How applicable is the Transtheoretical Model, and other relevant behaviour change models, for studying travel behaviour change in the context of a large-scale disruptive event?

Figure 5.1: Research questions

The research presented in this thesis was enabled through data collected as part of a four-wave panel survey. This utilised a fixed panel[5] approach meaning that individual participant data was collected for the entire four waves. The four-wave approach was part of the methodology from the outset of this research, although the data collection is more appropriately described in two relatively distinct stages. Firstly, Waves 1 to 3 were carried out by AECOM, a multi-national consultancy firm, who were commissioned to do so by TfL. The author contributed to the development of the surveys and subsequent analysis of the data. The fourth survey wave formed the second stage, which was conducted by the author in partnership with TfL (AECOM were not involved in this wave).

Although these surveys offer a coherent data set, there are differences in how the surveys were deployed, which is why they will be discussed as two separate sections in this chapter. Section 5.3 will describe and examine Waves 1 to 3. Section 5.4 will then explore the fourth survey wave. The conception and development of the surveys will be described in detail along with an overview of their deployment to the panel. Prior to this, Section 5.2 will detail the original methodological concepts, how they were designed in order to answer the research questions and how they evolved to the final methodology.

5.2 Developing the methodology

As the research questions shown in Figure 5.1 indicate, this thesis is interested in both the short-term travel behaviour changes that arose from the Games and whether any of these changes were sustained in the long-term. In order to answer the research questions posed, it was important that the methodological design of this study would be able to examine travel behaviour over this longer period of time, which led to the decision to study the Games over four waves.

Commuters were chosen as the main focus of the research for several reasons. Firstly, they were an important element of the TDM (Travel Demand Management) programme of the Games (employers were approached to assist in changing their employees' usual travel practices during the Games, e.g. by allowing more working from home). This was a reflection of the demand commuters can place on a transport system, particularly around the traditional morning and evening peaks. A further motivation for focusing the research on commuters relates to the habitual nature of this particular journey purpose, which results

[5] A fixed panel involves collecting data from the same units on multiple occasions Smith et al. (2009).

from its frequent repetition (DfT, 2011). It was of particular interest to understand what impact the Games (a large and far-reaching disruption) had on how people usually travelled.

The TTM has been examined in detail in Chapter 4, which highlighted the motivations for applying the framework in this research. Ultimately, the interest is in exploring how useful the TTM is for studying travel behaviour change in the context of this large-scale disruption, of which there is a lack of knowledge. The advantage of applying the TTM (as opposed to alternative frameworks) lies in its approach to the temporal dimension of behaviour change. The framework considers movement between 'stages' over time making it an appropriate model for seeking to describe individual behaviour within a longitudinal panel study. TTM items are included in the surveys, the details of which will be examined in more detail later in this chapter.

At the beginning of this study, prior to any collaboration with TfL, the author began the process of developing a version of the first-wave questionnaire. The main focus of this initial questionnaire was gathering information about the respondents' socio-demographics, their usual commute journey, and how they anticipated travelling during the Games. Crucially, this involved creating a number of TTM items, which were grounded in the existing literature.

In developing this questionnaire, it was quickly understood it would be advantageous to seek collaboration with TfL. TfLs involvement in the organisation of the Games and their responsibilities for managing transport in London made them well placed to be a valuable partner in this study. Collaboration also meant that there was greater potential to access a far larger sample than was previously anticipated in this study. TfL were approached in early 2012 to pursue a research partnership. Ensuing negotiations eventually led to an agreement that the author would contribute to a series of questionnaires that formed part of the 'TfL Olympic Panel Study' (TfL, 2013b). TfL commissioned AECOM to conduct a three-wave panel study examining the period before, during and shortly after the Games. As these were now TfL commissioned questionnaires there were anticipated concessions that would need to be made in terms of the items that would be included. However, the large range of data TfL were gathering and the similarities in research aims meant that much of the data expected from the authors own questionnaire was going to be collected by TfL.

The most important area where agreement was needed on the inclusion of items related to the TTM. The use of the TTM was driven by the author and therefore TfL needed to be convinced of the value of including it in the panel survey. The TTM items that were proposed were those that were developed for the author's original questionnaire but some

amendments were required by TfL prior to their inclusion in the survey. These changes will be discussed in more detail in the relevant forthcoming sections of this chapter. The original versions of the TTM items developed by the researcher are also included in Appendix A, to provide the reader with a further insight into the development of the TTM items. Ultimately, the concessions that were made were done so to ensure that the items were included in the questionnaires. The main motivation being that this meant inclusion in a large, longitudinal panel study, which would have been very difficult to achieve outside of the collaboration with TfL.

5.3 Waves 1-3: TfL Olympic panel study

The purpose of the first three survey waves was to provide a before, during and after picture of the travel behaviour displayed by those in the sample. This concerned their preparedness to change during the Games, how they actually responded, and what influence this had on their travel after the Games had ended. The panel study examined all those individuals who travelled in London regularly (workers, residents, regular visitors), although the main focus was on commute journeys (TfL, 2013b).

5.3.1 Participant recruitment

The recruitment of survey participants was not influenced by any factors other than the requirement that they resided, worked or regularly visited London (TfL, 2013b). The sample was recruited primarily from the TfL customer database. This database includes individuals registered with Oyster card, Congestion Charge users, Barclays Cycle Hire users and any other individuals who registered to be contacted by TfL for such research purposes (TfL, 2013b). The use of the TfL customer database does not mean that the sample is restricted to only London residents as registration with these systems is available to those outside of London. However, to reduce potential bias against car users, further on-street recruitment was conducted in order to include more car-users in the sample. This on-street recruitment was undertaken at anticipated travel hotspots in London to include those who were more likely to be affected by the travel disruption from the Games.

5.3.2 Ethical approval

Whilst the Wave 1-3 surveys were conducted by AECOM and TfL, ethical approval was sought by the researcher from the University of Leeds for the purposes of this thesis. This was to ensure that the process through which the surveys were being conducted reflected the ethical procedures required by the University of Leeds. The application for ethical approval

was successful and was granted by the Environment and LUBS (AREA) Faculty Research Ethics Committee (reference: LTTRAN-012).

5.3.3 Piloting

5.3.3.1 Original TTM items

The piloting of the original TTM items occurred as part of the wider piloting of the original questionnaire developed by the researcher prior to the collaboration with TfL. This was done through testing the survey with 10 individuals to assess the average completion time, coherence of the survey structure, and any problems experienced in responding to survey questions.

5.3.3.2 Waves 1-3 surveys

The Wave 1-3 surveys were piloted by AECOM but it was difficult to ascertain the exact piloting process conducted as the researcher did not have direct contact with AECOM. Clearly this is a limitation of such collaborative work. It is however understood that the items included in the surveys were drawn largely from existing TfL survey items, and therefore would have already been subject to testing and piloting.

5.3.4 Survey delivery

The TfL Olympic Panel Survey (Waves 1-3) was conducted by AECOM on behalf of TfL. The researcher was not responsible for the delivery of the surveys and collection of the data in these waves. The Wave 1-3 surveys were delivered online with each participant allocated a unique ID number to enable data from each wave to be linked to the individuals whilst ensuring anonymity. Conducting the surveys online raises concerns of sampling bias, although 88% of the London population had reported that they had experience of internet use by the time the surveys were conducted in mid-2012 (ONS, 2012).

Online surveys are advantageous in this context as they allow for fast delivery and return of the survey, whilst keeping costs low (Bryman, 2012), which allows for a larger sample to be targeted. Filtering respondents was also an active part of these surveys to ensure that the questions being asked were relevant to each individual based on their previous responses. Online surveys also enable respondents to complete their responses at their own preferred location and at their own convenience (Roberts, 2007), helping to contribute to a good response rate. The key drawback of this design is that it requires the respondent to have online access, although the use of the TfL customer database as the main source for

sampling limits this issue[6]. It was anticipated that the surveys (in Waves 1-3) would each take approximately 25-30 minutes to complete.

5.3.5 Sampling

As this research was only interested in individuals who travelled in London regularly, the sampling method is considered purposive. As Bryman (2012, p.418) asserts, "the goal of purposive sampling is to sample cases/participants in a strategic way, so that those sampled are relevant to the research questions that are being posed". Whilst purposive sampling is suitable for this research, the consequence of this is that it is not possible to generalise to the wider population, which this research will therefore not aim to do. Instead, this research will provide a detailed examination of a large-scale disruption to understand the travel behaviour implications of such events, with a particular focus on long-term change. The application of the TTM is done so with a view to exploring the frameworks value in such a context (although this can be extrapolated to other disruptive events), which contributes to the knowledge about the TTM.

Table 5.1 provides an overview of survey timeframe and the number of responses from each wave. The first survey wave was deployed immediately prior to the start of the Olympic Games in July 2012. This survey was active for 9 days and garnered a response of 7,194 individuals, as shown in Table 5.1. Wave 2 took place between the end of the Olympic Games and the start of the Paralympics. There was a considerable reduction in the number of respondents in the second wave, although 2,805 responses is still considered a large sample. The third wave was conducted two months after the end of the Paralympic Games, culminating in 1,799 individuals responding to all three waves. There was clearly considerable attrition, particularly between Waves 1 and 2. The short period of time (one month) between the first two waves suggests that participant non-response is unlikely to have occurred because of changes in contact details (as would be expected for longer panel studies, Laurie et al., 1999). It was therefore concluded that this attrition was largely attributable to the length of the Wave 1 survey, which likely deterred respondents from completing the subsequent waves.

[6] The sources from which the TfL customer database is formed (e.g. Oyster card) are all mainly accessed online, suggesting that the majority of these users have access to the internet and were thereby able to access the online survey.

Table 5.1: Waves 1-3 survey delivery and responses

Key event	Dates	Responses
Wave 1	18th to 26th July 2012	7,194
Olympic Games	**27th July to 12th August 2012**	
Wave 2	10th to 28th August 2012	2,805
Paralympic Games	**29th August to 9th September 2012**	
Wave 3	8th November to 3rd December 2012	1,799

An acknowledged problem associated with sampling for methodological approaches that involve surveys is the issue of self-selection bias. In this study, the sample was mainly drawn from individuals who had expressed an interest in participating in research conducted by, or on behalf of, TfL. As a result, there may be a higher proportion of individuals with a vested interest in issues around the transport network, which may ultimately bias the sample. Furthermore, it should also be noted that the prominence of the Games in London, and the contentions associated with it might also draw bias in the responses observed. It is important that these potential issues are noted and it is acknowledged that they may affect the results. For example, there may be a bias towards more negative views of the support to employees given by organisers and employers to change behaviour.

5.3.6 Wave 1 survey design

The purpose of the first wave was to gather extensive data on how the individual was currently travelling, prior to the Games. The main focus of the questionnaire was on the commute journey but also included were other journeys (e.g. shopping, leisure) and business travel (e.g. travelling for a meeting). Items for the TTM were included along with questions relating to preparations for coping with potential disruption during the Games. The development of the TTM items for Wave 1 (and the subsequent surveys) was grounded in the existing TTM literature in both transport and exercise. Exercise was chosen over other health behaviours (e.g. smoking cessation) as it was deemed to align closest with transport.

The Wave 1 survey was developed by AECOM alongside TfL. The researcher contributed to the design of this survey by providing the original TTM items that had been developed prior to the collaboration with TfL (see Appendix A). These were included, in amended form, in the Wave 1 survey (the amendments to these are discussed in this section). The researcher was also able to provide comments on the overall design of a full draft of the Wave 1 survey.

The following paragraphs will provide a broad outline of the key sections in the questionnaire, roughly following the order of how they appeared to the respondent.

Usual journey to work: Respondents were asked to provide a detailed overview of their usual journey to work. This included their usual working pattern (i.e. number of days spent at their usual workplace), where they lived, and where they worked. Also considered was: what their usual outward and return commute journeys involved and if, and how, they varied their journey (e.g. "Thinking about your journey to work, which of the following applies to you?", scored: Always make journey in the same way/always try to make this journey in the same way and only change when have to/sometimes vary the way I make this journey/often vary the way that I make this journey, select one only). The stages of change and self-efficacy items were also introduced part of the survey but they will be described in more detail later in this section.

This section was valuable for answering the first of the research questions shown in Figure 5.1 in Section 5.1. It was vital that a detailed picture of commuter travel was developed and this series of questions informed the pre-Games aspect of this.

Travelling to work during London 2012: This section sought to examine how the individual was planning to travel during the Games. This included questions on the individual response and support offered by the employer (e.g. "Has your employer encouraged or allowed you or your colleagues to temporarily adjust your working patterns during the London 2012 Olympic and Paralympic Games with any of the following?", scored: work more flexible hours/work from home etc.). Reducing, re-timing, rerouting and re-moding were all included in the questioning. The processes of change questions were included in this section but they will also be described in more detail separately. This section contributes to the first and second research questions of this study, seeking to understand about the preparedness and motivations respondents had to change their travel behaviour during the Games.

Business journeys: This section included questions to examine the current travel patterns of those making business journeys including whether they varied their travel (e.g. "On average, how often do you make business journeys in or through Greater London?", scored: '5 or more days a week' to 'never'). Respondents also answered questions on how they anticipated travelling during the Games. This section gathered less detailed data than for the commute journey, which was a result of the greater focus on commute journeys.

Other journeys: This section examined how respondents travelled for other journeys and whether they had prepared to change these during the Games. The particular type of travel

this section was interested in included shopping, leisure, education and personal business (e.g. "How often do you make the following journeys in or though Greater London during a normal week?", for shopping/leisure/education/personal business/other, scored: 'more than 5 days a week' to 'never'). The brevity of this section was again a reflection of the reduced focus on these types of journeys.

The 2012 Games: Respondents were asked about whether they intended to participate in the Games (e.g. attending events during the Games), what their perceptions of the organisation of the Games was and how they were/planned to interact with the social media and marketing campaign (e.g. "Will you or are you very likely to use the 'Get Ahead of the Games'[7] website to plan your journeys at during the Games?", scored: yes/no).

Socio-demographics: Individuals were asked to provide data about their employment (occupation, sector and business size), themselves (age, gender, ethnicity and mobility issues) and their household (household composition, income, access to cars/vans and access to bicycles).

Stages of change: The stages of change were examined through one question in the form of statements (shown in Figure 5.2), with respondents asked to select which statement best described them. To add further support to the development of this item, literature from exercise as well as transport was used as the grounding upon which it was developed. This included: Callaghan et al. (2010), Rose and Marfurt (2007), Gatersleben and Appleton (2007), Beatty et al. (2002), and Mutrie et al. (2002).

[7] 'Get Ahead of the Games' was the main marketing programme through which the organisers communicated to travellers about altering their journeys during the Games.

Thinking in general about your usual journey to work which of the following statements best describes you?

- ☐ I am not considering changing* the way I normally travel to work [Pre-contemplation]
- ☐ I am considering changing* the way I normally travel to work but I am not in a position to make this change yet [Contemplation]
- ☐ I am doing things to prepare myself to change the way I travel to work [Preparation]
- ☐ I have tried changing* the way I travel to work once or twice since the beginning of this year [Action]
- ☐ I have regularly tried changing* the way I travel to work since the beginning of this year [Maintenance]

**By changes we mean do you ever use a different mode of transport, take a different route, travel at different times of the day, avoid travelling and work from home etc.*

Figure 5.2: Wave 1 stages of change item

Processes of change: The processes of change items included in the first wave questionnaire (and subsequent waves) were developed from several sources. Work by Prochaska and Velicer (1997) described each process of change and provided a basis upon which to build the questionnaire items. Processes of change items used for examining exercise behaviours, which were developed by Nigg et al. (1999)[8], were adapted for the purpose of this research. This involved rewording of statements - Prochaska and Velicer (1997) was relied upon as a guide for this – and reducing the number of statements per process (three down to one) to help reduce survey length. Some further slight changes to the wording of statements were requested by TfL but this did not undermine the purpose of the items and were therefore agreed with. See Figure 5.3 for the final version presented in Wave 1.

Two processes were not included in the surveys. These were dramatic relief and consciousness raising. Dramatic relief was omitted because items were already included in the surveys relating to the emotional reasons for changing behaviour, and the omission therefore ensured that repetition was avoided. Consciousness raising was not included owing to the context of the disruption being studied. The organisation of the Games ensured that the vast majority of the sample would have been aware of the potential need to change and this would have been expected to skew any responses to this item.

[8] These items were sourced from the Cancer Prevention Research Center, University of Rhode Island (CPRC, no date-a).

To what extent do you agree or disagree with the following statements about travelling to work during the 2012 Games?

	Strongly agree	Agree	Neither	Disagree	Strongly disagree
Changing the way I travel to work might encourage others to change [Environmental re-evaluation]					
Colleagues/friends are discussing changing the way they travel [Social liberation]					
My employer has encouraged me to change the way I travel to work [Helping relationships]					
I can change the way I travel to work if I try hard enough [Self-liberation]					
Changing the way I travel during the Games will improve my travel experiences [Counter-conditioning]					
I will plan my time during the Games so that I am able to change my work travel [Stimulus control]					
Changing the way I travel may have the added benefit of finding new or better options for my journey to work [Contingency management]					
I believe that changing the way I travel during the Games will show me to be a proactive person [Self-re-evaluation]					

Figure 5.3: Wave 1 processes of change items

Self-efficacy: The self-efficacy items for the study were originally derived from the exercise measures provided by the CPRC (Cancer Prevention Research Center) at the University of Rhode Island (CPRC, no date-b). However, these were adapted considerably to suit the context of this research and the different types of change in travel that were available to the respondent. The adapted items focused on (a) the confidence to change a particular behaviour (e.g. mode) and (b) the ability to overcome personal or structural barriers to change. TfL further changed the items to simplify them for the purposes of the survey but the end result (shown in Figure 5.4) was considered to be an appropriate compromise as they were rooted sufficiently in the items proposed by the author.

Please say how easy or difficult it is for you to make the following changes to your usual journey to work?

	Very easy	Easy	Neither	Difficult	Very difficult
Arrive at work earlier than I normally do					
Arrive at work later than I normally do					
Finish work earlier than I normally do					
Finish work later than I normally do					
Travel by an alternative route (for example using different tube line or roads)					
Use a different mode of transport (for example using the bus instead of the tube, walking or cycling instead of driving etc.)					
Work from home instead					

Figure 5.4: Wave 1 self-efficacy items

Decisional balance: This construct was originally studied in the first wave of the survey, although with a focus on the pros of varying the journey to work. The question design is shown in Figure 5.5. However, owing to difficulties with the transferability of these items to the post-Games context they were omitted from the further surveys. The changes that would have been necessary would have made comparisons between the waves ineffective. Therefore the decision was made to omit them in order to produce a more succinct survey to maximise responses.

Why have you varied your usual journey to work? Tick all that apply

	Select all that apply
To avoid delays that I knew about in advance	
To reduce stress	
To reduce costs	
I felt like a change to my usual routine	
To avoid bad weather	
To avoid a big event taking place	
To avoid delays that I found out about when I arrived at the station/stop	
To avoid overcrowding on public transport	
To avoid service disruptions	
To avoid high temperatures on public transport	
To avoid congestion on the roads	
I like to walk to work sometimes	
I like to cycle to work sometimes	
Don't know	
Other	

Figure 5.5: The pros of varying the commute journey

5.3.7 Wave 2 survey design

The second survey wave examined changes to behaviour made during the Games. The main focus was to compare how travel had changed in comparison to the first wave, the extent to which individuals had been impacted by the Games and what their behavioural response had been.

Owing to time constraints relating to the development of the Wave 2 survey in time for the Games in the summer of 2012, TfL were unable to provide the researcher with the opportunity to contribute to the design of the Wave 2 survey. As a result the researcher did not make any contribution to the design of this survey wave.

Work journeys during the Games: This was the main section of this survey, seeking information about if, and how, the respondent changed their travel behaviour during the Games. Working from home, working at other locations and commuting to the usual workplace were all considered, along with an examination of the reasons why such changes were made (e.g. "Have you worked from home more, less or about the same amount as you

usually did before the Games started?", scored: more/less/the same amount). As with the first wave, the questions focused on changes to mode, route and time of travel along with reductions in the number of journeys made. This section contributes to answering the first and second research questions of this study.

Business journeys during the Games: This section examined whether respondents were travelling differently during the Games as they did in the first wave. Changes in travel were explored, as were the motivations for making such changes (e.g. "When was it decided that you would make fewer business journeys than normal during the London 2012 Olympic Games?", scored: before the Games/during the Games). There was also interest in the journey experience during the Games. This section also contributed to answering the first, second and third research questions.

Other journeys: This short section examined how the respondent was travelling for their other journeys in comparison to their pre-Games behaviour (e.g. "How often did you make the following journeys in or though Greater London during a normal week?", shopping/leisure/education/personal business/other, scored: 'more than 5 days a week' to 'never'). The section was interested in the types of changes that were made and the reasons why such changes were made, or not. This section meets the non-work journey aspect of the first and second research questions.

Holidays: The items in this section sought to understand the extent of the use of annual leave and whether individuals still travelled in London during this time (e.g. "Since the start of the London 2012 Olympic Games, how many days of your holiday/annual leave did you spend…", scored: at home/in Greater London/elsewhere in the UK/outside the UK).

London 2012 Games: This section examined how the respondents were engaging with the Olympics. Notably, this included their assessment of the transport situation in London during the Games. Further questions were included to examine how they sought information about travel to help plan their journeys (e.g. "Which mobile applications (apps) did you use to help plan your journey?", scored: London 2012 (Official)/Catch That Bus/National Rail Enquiries etc.).

TTM: Notably, the second wave did not include items relating to the TTM. This was due to the researcher not being directly consulted on the development of this wave prior to its deployment. This clearly highlights a drawback of ceding control of the survey to an external partner. However, with the third wave including the TTM items (see Section 5.3.8), it was concluded that a before and after application of the TTM would still allow a valid examination of the value of the framework.

5.3.8 Wave 3 survey design

The third survey wave was conducted two months after the conclusion of the Paralympic Games. The purpose of this survey was to assess the impact on travel behaviour both during the Games and in the time since they had ended. The researcher was able to contribute to the Wave 3 survey to a similar degree as Wave 1. Amended TTM items were included in this survey and the researcher was also asked to provide comments on the overall design of the survey.

Work journeys since the end of the Games: This section was again the largest and gathered detailed data around the travel behaviour since the end of the Games. Working from home, working at other locations and the usual commute to work were all examined, again through the types of changes that were made (reduce, re-mode, re-route and re-time). Notably, as the third wave was designed to assess the level of sustained change, there was also the inclusion of a number of items to examine this (e.g. "Do you currently travel to work by the same modes as you did before the Games or have you changed the way you travel?", scored: I have changed the way I travel compared to before the Games/I have not changed the way I travel). This section addresses the fourth and fifth research questions of this study.

Business journeys: This section sought to examine business travel post-Games to understand whether any changes that were made during the Games had been sustained (e.g. "To what extent has your decision to travel this way since the end of the Games been influenced by your experiences of travelling during the Games?", scored: 'to a large extent' to 'not at all'). This included the number of business journeys made, the time, route and mode of travel used. This contributes to the fourth and fifth research questions.

Other journeys: As with business journeys, this section was interested in examining travel behaviour for non-work journeys made since the Games had ended. This examined the number of journeys being made, and the time, route and mode that was being used and how this compared to during the Games (e.g. "Do you still travel using the same methods as you did during the Games when making other journeys in or through Greater London?", scored: yes/no). This also contributes to the fourth and fifth research questions.

Travel information: This section deals with understanding how the respondent accessed information about their journeys after the Games and how this differed to before or during the Games (e.g. "Have you been checking for travel disruptions/delays more, less or for about the same number of times as you used to in typical week before the Games?", scored: more/less/same).

Future disruption: The items included in this section relate to how the individual would respond to a potential future planned or unplanned disruption to their travel (e.g. "Which of the following statements best describes how you would most likely respond if there were unexpected major disruptions and delays on your normal route to work in the next four weeks?", scored: I would work from home/I would change my time of travel etc.). It aims to examine the legacy of the Games in terms of how respondents deal with future disruptions and therefore helps to contribute to the fifth research question.

Stages of change: The stages of change item included in the third survey wave, shown in Figure 5.6, was almost identical to the first wave. The main change that was made related to altering the wording to fit the post-Games context. A further statement was added ("I have changed the way I travel to work since the end of the Games"), which relates to the 'termination' stage of the stages of change. This was not appropriate to include in first wave as the Games had not yet taken place.

Thinking about your usual journey to work, which of the following statements best describes you?

- ☐ I am not considering changing* the way I normally travel to work [Pre-contemplation]
- ☐ I am considering changing* the way I normally travel to work but I am not in a position to make this change yet [Contemplation]
- ☐ I am doing things to prepare myself to change* the way I travel to work [Preparation]
- ☐ I have tried changing* the way I travel to work once or twice since the end of the Games [Action]
- ☐ I have regularly tried changing* the way I travel to work since the end of the Games [Maintenance]
- ☐ I have changed* the way I travel to work since the end of the Games [Termination]

**Changes might include using a different mode of transport, take a different route, travel at different times of the day, avoid travelling and work from home etc.*

Figure 5.6: Wave 3 stages of change item

Processes of change: As with the stages of change, the processes of change items included in the third wave were very similar, albeit with alterations made to suit the post-Games context. Some further items were included by TfL but those relevant have been highlighted in grey for the benefit of the reader (see Figure 5.7). The format of the processes of change question remained the same to enable comparison between waves.

To what extent do you agree or disagree with the following statements about your journey to your usual work place?

	Strongly agree	Agree	Neither	Disagree	Strongly disagree
It was only practical to change the way I travelled for this short period					
The experience of the Games helped me to try different ways of travel [Contingency management]					
By trying different ways of travelling during the Games, I have been able to improve my journeys to work [Counter-conditioning]					
The experience of travelling differently during the Games means that I am better able to deal with disruption to my normal journey					
I am better informed through travel information so can plan my journeys to work [Stimulus control]					
Changing the way I travelled to work during the Games might encourage others to change [Environmental re-evaluation]					
Colleagues/friends are now discussing changing the way they travel [Social liberation]					
My employer encouraged me to change the way I travelled to work during the Games [Helping relationships]					
I can change the way I travel to work if I try hard enough [Self-liberation]					
I believe that changing the way I travelled to work during the Games showed me to be a proactive person [Self-re-evaluation]					
I was inspired by the athletes to walk and cycle more					
I am walking and cycling more now than I was before the Games					
I intend to walk and cycle more in the future					
I found it useful during the Games to know where crowded and congestion hotspots were so that I could avoid them.					

Figure 5.7: Wave 3 processes of change items

Self-efficacy: The items included in the third wave (shown in Figure 5.8) were almost identical to the first wave. The only addition was a further statement ("To work from a different location") that was included by TfL. The consistency in these items allowed for easier comparisons between waves.

How easy or difficult it is for you to make the following changes to your usual journey to work permanently?

	Very easy	Easy	Neither	Difficult	Very difficult
To arrive at work earlier than I normally do					
To arrive at work later than I normally do					
To finish work earlier than I normally do					
To finish work later than I normally do					
To travel by an alternative route (for example using different tube line or roads)					
To use a different mode of transport (for example using the bus instead of the tube, walking or cycling instead of driving etc.)					
To work from home					
To work from a different location					

Figure 5.8: Wave 3 self-efficacy items

5.4 Wave 4: Follow-up survey

As was highlighted in the introduction to this chapter, the fourth survey wave was designed and conducted by the researcher. A fourth survey wave was always planned from the beginning of this research but no concrete terms were attached to how it would be conducted. In 2013, ITS (Institute for Transport Studies) approached TfL with a proposed survey document that would examine the travel behaviour of the panel (largely focused on the commute journey) in the long-term. This was developed by the researcher, and was based on the previous survey waves. The content of the final version of this survey will be discussed but first the details of the participants and delivery of the survey will be examined. The fourth wave survey was conducted between 18th February and 11th March 2014.

5.4.1 Participants

The participants for the fourth wave survey were drawn from those in the existing sample who had agreed to be contacted again for further research (n = 399). The recruitment of the sample was detailed in Section 5.3.1. The follow-up group was approached by email, which explained why they were being contacted, the purpose of the follow-up survey and how they could access the survey if they wished to do so.

5.4.2 Ethical approval

When ethical approval was sought for the initial three waves of the panel survey, the Ethics Committee were informed that a fourth wave would occur, although the researcher was at that time unable to specify as to when this would be. Once the details of the fourth wave were confirmed, and it was known when and how the wave would be conducted, the researcher applied (in December 2013) for an amendment to the original ethical approval. This ensured that the ethical issues for the fourth wave were also scrutinised. Approval for the amendment was granted by the Environment and LUBS (AREA) Faculty Research Ethics Committee (reference: LTTRAN-012, Amendment Dec 2013).

5.4.3 Piloting

Piloting of the fourth wave survey was carried out with seven individuals and was conducted using an online survey tool (see Section 5.4.4 for more details of this). This was to firstly ensure that the survey tool operated as required, and that the respondents were able to complete the surveys. Secondly, this also meant that the survey items could be scrutinised to ensure that respondents understood them, confirm that the items were able to gather the necessary data, and to also establish the average length of time to complete the survey.

5.4.4 Survey delivery

The author was the sole researcher involved in the delivery of the survey to participants and the collection of data. This wave was also conducted online[9] to ensure maximum outreach to potential participants. This also meant that the submitted survey responses were easily accessed as one coherent data set. The potential participants received a personalised survey link which ensured that their anonymity was protected whilst allowing the fourth wave data to be matched to the previous survey waves. This was crucial to enable individual level behaviour to be traced across the four waves. The Wave 4 survey was anticipated to take responded approximately 20 minutes to complete, which was established through the piloting of the survey.

[9] Bristol Online Surveys (https://www.survey.bris.ac.uk/) was the survey tool used to collect the fourth wave data. This is the survey system recommended for use by the University of Leeds.

5.4.5 Wave 4 survey design

The fourth wave survey followed a similar format to the previous waves although it was deliberately shorter in an attempt to limit the anticipated attrition. A notable addition to this survey wave was the inclusion of a range of items that investigated the February 2014 London Underground workers strike. The inclusion of these strike questions meant that respondents were also asked about a further, topical disruption, which would therefore provide a coherent set of data for an alternative disruption in this study. Importantly, the disruption was post-Games and the conditions were very different, which meant that the data captured was of interest to understand how the lessons and experiences from the Games were transferred. This added a further dimension to the contribution of this research.

Changes to commute journey: This was one of the main sections of the survey and sought to examine what changes there had been in the commute journeys of respondents since the third survey wave. To limit the number of questions, the respondents were asked to state whether they had changed their travel behaviour since wave three - and if so, how - with the researcher then able to match their changes to how they were previously travelling (e.g. "Since the 3rd December 2012, have you changed the main mode you use for your commute to and from work? (i.e. that is, the one that covers the longest distance)", scored: changed permanently/frequently/occasionally/rarely/never). This section contributes to answering the fourth and fifth research questions, specifically with regard to the longevity of change. The stages of change, processes of change and self-efficacy items, which contribute to the sixth research question, were included in this section but will be discussed in more detail below.

Tube strike: As the tube strike occurred over two days, the respondents were asked to detail how they responded to the disruption on each of these days for their commute travel (both for the outward and return journey). Respondents were asked if, and how, they were disrupted and how they changed their travel in response to this (e.g. "Was your journey to work on the 5th February 2014 affected by the tube strike whether or not you would normally use the underground?", scored: yes/no). Questions focusing on employers, family and friends, other (non-work) activities, how they accessed information during the strike, and whether they used experiences of the travel during the Games to cope with the strike were also presented to respondents.

Stages of change: The fourth survey wave did not seek to alter the TTM items considerably from how they were presented to respondents in the previous waves. Therefore, the item shown in Figure 5.9 is almost identical to the previous waves with the exception of some rewording to suit the different context.

Thinking in general about your usual journey to work, which of the following statements best describes you?

- ☐ I am not considering changing* the way I normally travel to work [Pre-contemplation]
- ☐ I am considering changing* the way I normally travel to work but I am not in a position to make this change yet [Contemplation]
- ☐ I am doing things to prepare myself to change* the way I travel to work [Preparation]
- ☐ I have tried changing* the way I travel to work once or twice in the last 12 months [Action]
- ☐ I have regularly tried changing* the way I travel to work in the last 12 months [Maintenance]
- ☐ I have changed* the way I travel to work in the last 12 months [Termination]

**By changes we mean do you ever use a different mode of transport, take a different route, travel at different times of the day, avoid travelling and work from home etc.*

Figure 5.9: Wave 4 stages of change item

Processes of change: The processes of change items in this wave were based on those in the first wave and therefore did not include the additional statements that were presented in the third wave. The items in this question (shown in Figure 5.10) were very similar, although references to the Games were omitted.

To what extent do you agree or disagree with the following statements about travelling to work? Please tick one box on each line only.

	Strongly agree	Agree	Neither	Disagree	Strongly disagree
Changing the way I travel to work might encourage others to change [Environmental re-evaluation]					
Colleagues/friends are discussing changing the way they travel [Social liberation]					
My employer has encouraged me to change the way I travel to work [Helping relationships]					
I can change the way I travel to work if I try hard enough [Self-liberation]					
Changing the way I travel will improve my travel experiences [Counter-conditioning]					
I will plan my time so that I am able to change my work travel [Stimulus control]					
Changing the way I travel may have the added benefit of finding new or better options for my journey to work [Contingency management]					
I believe that changing the way I travel will show me to be a proactive person [Self-re-evaluation]					

Figure 5.10: Wave 4 processes of change items

Self-efficacy: The self-efficacy items in this wave focused on re-moding and re-timing as this was deemed to be of most value, based on the previous waves. In this instance the items were split into two separate questions that were presented to the respondents at different points in the survey. Self-efficacy in relation to changing mode was presented in the format shown in Figure 5.11. Shortly afterwards in the survey, respondents were asked about self-efficacy for changing time (Figure 5.12).

Please say how easy or difficult it is for you to use a different mode of transport for your journey to work?

- Very easy
- Easy
- Neutral
- Difficult
- Very difficult

Figure 5.11: Wave 4 self-efficacy item (changing mode)

Please say how easy or difficult it is for you to make the following changes to your usual journey to work?

	Very easy	Easy	Neither	Difficult	Very difficult
Arrive at work earlier than I normally do					
Arrive at work later than I normally do					
Finish work earlier than I normally do					
Finish work later than I normally do					

Figure 5.12: Wave 4 self-efficacy items (changing time)

5.5 Analysis

As part of the research collaboration with TfL, the researcher was provided with the complete data from the three survey waves conducted by AECOM. This, along with the Wave 4 data collected by the researcher, enabled the original analysis that was necessary for this thesis to be conducted. The analysis presented in this thesis is almost entirely derived from original analysis conducted by the researcher as part of this thesis. Where appropriately referenced, analysis is derived from a TfL report published from this panel survey (TfL, 2013b), although the use of this is limited to headline findings.

The four-wave panel study collected a range of different types of data through the surveys, including ordinal, discrete, categorical and nominal. A range of statistical tests were be conducted by the researcher to analyse the data collected. These will be introduced in the analysis chapters (Chapters 6, 7 and 8) at their first use but will be briefly summarised here initially, specifically those relevant to the analysis of the TTM.

In terms of the TTM, previous studies have analysed the data derived from the constructs in several ways. This has included: ANOVAs (Beatty et al., 2002; Shannon et al., 2006), descriptive statistics (Gatersleben and Appleton, 2007), Fisher's exact test (Hirvonen et al., 2012), Kruskal-Wallis tests (Hirvonen et al., 2012), Logistic regression (Nkurunziza et al., 2012a), Mann-Whitney tests (Beatty et al., 2002), MANOVAs (Jordan et al., 2002; Callaghan et al., 2010; Bamberg, 2007), Pearson's chi-square test (Crawford et al., 2001), Spearman's correlation (Hirvonen et al., 2012), t-tests (Shannon et al., 2006).

Much of the data collected for the TTM was ordinal, and where relevant was therefore tested using non-parametric tests in line with the literature (Sheskin, 2003). Where data has

been treated as non-parametric in previous studies (Hirvonen et al., 2012; Beatty et al., 2002; Crawford et al., 2001), Pearson's chi-square, Fisher's exact test, Mann-Whitney, Kruskal-Wallis, and Spearman's correlation have been used. The nature of this thesis and the focus on multiple types of change places it somewhat apart from previous studies. This meant that the analytical approach was orientated around statistical comparisons between the TTM items and the types of change studied, which meant that tests such as Pearson's chi-square and Mann-Whitney tests were appropriate.

5.6 Conclusion

The development of the methodology detailed in the chapter began with work by the author to create a survey that would effectively collect the necessary data for this research. This involved the development of a set of TTM items to support the application of the model in the research. The original TTM items that were produced from this initial work are included in Appendix A.

The subsequent collaboration with TfL that occurred provided the opportunity to gather a far more extensive dataset whilst still including the necessary data needed for this study. It has been recognised that concessions were made to the final design of the TTM items, and the researcher was also not able to greatly influence the wider design of the survey. However, the research between projects was closely aligned meaning that the data collected was still highly appropriate for this research. Furthermore, the access to a large data set was a significant positive factor, which would have been difficult to achieve on the resources of the PhD research alone.

Chapter Six

Understanding Commuter Travel Behaviour Relating to the London 2012 Games

6.1 Introduction

This chapter presents a detailed examination of the results from the first three waves of the Olympic panel survey, covering the situation before, during and shortly after the London 2012 Games. It will report on how and why commuter travel behaviour changed during the Games, the degree of this change, and whether this was sustained once the Games had ended, which will contribute to addressing the first, second and fourth research questions of this study (as discussed in Chapter 1).

The scale of the Games and its impact on the transport network is a well-known and acknowledged consequence that the host city must address. The literature examined in Chapters 2 and 3 has highlighted extensively how the influx of people to the city, along with the measures applied to cope with this added demand have been shown to generate travel behaviour change, at least for the duration of the Games.

With this in mind, it is reasonable to hypothesise that the London 2012 Games achieved extensive changes in travel behaviour during the period of the Games. More specifically however, it may also be hypothesised that there would be noticeable differences in the level of change observed amongst the different types of change (which include reducing, re-timing, re-routing and re-moding). This may be influenced by the support available to commuters and the specific circumstances within which they made a change. It may also relate to psychological factors that underpin the behaviours observed. A final hypothesis relates to how long any changes were sustained after the Games had ended. There is uncertainty as to the longevity of travel behaviour change resulting from the Games, and similar disruptive events, although the literature suggests that it would be anticipated to be limited. Therefore, it is hypothesised that sustained change post-Games was not extensive.

A core element of this chapter will be the analysis of the value of the TTM as a tool to study travel behaviour change in the context of a large, forced disruption, such as the Olympic and Paralympic Games. This is a crucial step as there is a clear lack of understanding of this in the literature. This relates to the sixth research question in this thesis, which is interested in

the applicability of such theoretical models to the context of disruption. An examination of the role of employers in travel behaviour change during the Games will also be presented in the chapter, contributing to the third research question.

The total sample of commuters is examined first. This will include establishing the degree of change that occurred, followed by analysis of the different elements of the TTM (stages of change, processes of change, self-efficacy and decisional balance). Also considered will be the role of 'intention to change' and its efficacy as a predictor of actual behaviour change. The role of employers in influencing change will also be explored given the potentially influential position they occupy. This analysis will then be replicated, where relevant, amongst the different types of changes made during the Games to explore whether there are any distinctions between them: Reduce (Section 6.4), Re-time (Section 6.5), Re-route (Section 6.6) and Re-mode (Section 6.7). Further analysis, through a two-step cluster analysis, will also be conducted to items from the TTM, which is presented in Sections 6.9 and 6.10.

6.2 The sample

The final number of responses for the initial three-waves was 1,799. However, the sample that was analysed in this thesis consisted of 1,132 individuals from this group. This was due to the focus of this work on the travel behaviour of commuters and on the TTM items, which meant that only those respondents who were in employment, and responded to the stages of change items in Waves 1 and 3 were included in the analysis. As a result it is considered a purposive sample, which does not seek to be representative to the wider population (De Vaus, 2013; Bryman, 2012). As a result the variables used in the analysis were not weighted.

6.2.1 Key socio-demographics

This section will describe the key socio-demographics of the sample to understand more about those who were included. It will also provide a comparison to the wider London population, allowing a greater appreciation of the context within which this sample is placed. Table 6.1 presents the descriptive statistics of a number of socio-demographic variables, along with London data drawn from the UK 2011 Census (ONS, 2011).

The data presented in Table 6.1 shows that within the sample there was a greater proportion of younger people (62.8% aged 18-44) in comparison to the wider population (45.8% aged 18-44). There was also a notable difference in the number of those aged over 65. In the sample, this was only 0.8% in comparison to the wider population, of which 10.9% were

over 65. This reflects the inclusion in the sample of only those in employment. The gender split did not differ greatly between the sample and the population, with females slightly more common in both.

There were a greater proportion of households consisting of couples (61.8%, either with or without children) in the sample compared to the population (46.5%). This contrasted with higher proportions of one person and lone parent households in the wider population (31.6% and 10.0% respectively) compared to the sample (19.4% and 3.1% respectively). There are also differences in the distribution of occupations between the sample and the wider population. In the sample, there were a far greater proportion of individuals (65.7%) in more senior positions (including: mangers, senior officials, and professional occupations) compared to the wider population (34.1%). Furthermore, the table also highlights how there was an over representation of individuals from the financial and business sector in the sample (23.9%) compared to the wider population (7.7%). There were also more multiple vehicle households in the sample (23.7%) than the wider population (17.8%).

Whilst the sample does not seek to be representative, it is important to note the differences that do exist between the sample and the wider population. It is acknowledged that this may have an impact on the travel behaviour observed (for example the greater numbers of multiple car access observed in the sample).

Table 6.1: Descriptive statistics for key socio-demographic variables

Socio-demographic	Sample (%)	London (%)
Age		
18-24	4.0	10.1
25-34	31.2	20.0
35-44	27.6	15.7
45-54	25.0	12.4
55-64	11.4	8.7
> 65	0.8	10.9
Gender		
Male	47.9	49.3
Female	52.1	50.7
Household structure		
One person household	19.4	31.6
One family household - Couple with no children	34.1	26.2
One family household - Couple with children	27.7	20.3
One family household - Lone parent with children	3.1	10.0
Two or more unrelated adults	13.2	-
Multi-family households	2.5	-
Household income		
Lower (£0 – 40,000)	20.5	-
Middle (£40,000 - £80,000)	45.6	-
Upper (> £80,000)	33.9	-
Occupation type		
Manager and senior official	29.8	11.6
Professional occupation	35.9	22.5
Associate professional and technical occupation	7.1	16.3
Administrative and secretarial occupation	18.1	11.7
Skilled trades occupation	1.2	8.3
Personal service occupation	0.6	7.9
Sales and customer service occupation	2.6	7.5
Process plant and machine operative	0.1	4.7
Elementary occupation	0.4	9.6

Socio-demographic	Sample (%)	London (%)
Industry sector		
Agriculture and Fishing	0.1	0.1
Mining and Quarrying	0.2	0.1
Manufacturing	2.0	3.2
Electricity; gas and water supply	0.9	0.7
Construction	4.8	6.6
Wholesale and retail trade; repair of motor vehicles	3.7	13.1
Hotels and Catering	1.9	6.3
Transportation	3.8	5.0
Financial and Business services	23.9	7.7
Real estate; renting and business activities	1.8	2.0
Public administration and defence	10.2	5.0
Education	9.7	9.6
Health and social work	7.2	10.7
Creative Industries	10.1	5.9
Charity/Not for profit	3.2	-
ICT	5.1	6.9
Law	3.2	-
Other	8.3	-
Num. employed in business		
< 250	40.5	-
> 250	59.5	-
Num. of cars/vans with access to		
None	33.0	41.6
1	43.2	40.5
2	17.7	14.0
3	4.6	2.9
> 4	1.4	0.9
Num. bicycles with access to		
None	51.9	-
1	23.9	-
2	15.1	-
3	5.1	-
> 4	4.0	-

6.3 Travel behaviour change amongst the whole sample

Commute journeys are commonly clustered in a morning and evening peak, where the high concentrations of travellers contribute to increased problems of congestion and longer travel times. A key element of the TDM programme, initiated by the Games organisers, was to encourage a change in commuter behaviour (by reducing, re-timing, re-moding and re-routing journeys) to decrease the background demand on the transport network and thereby reduce the risk of the system failing during the Games. As was highlighted in Chapter 3, it was imperative that the system ran as well as possible to enable all involved in the Games to move easily around London. Given the important position of commuters within the TDM programme, this segment of travellers is of particular interest to contribute to the understanding of both the short and long-term impacts of the Games. This section will examine the overall sample of commuters, first examining what change occurred before presenting the analysis of the TTM constructs, the role of intention, and the influence of employers in encouraging changes in travel behaviour.

6.3.1 Did people vary their journeys before the Games?

A useful starting point is to understand how individuals travelled prior to the Games, specifically whether they usually varied how they travelled for their commute journey. Analysis of this data indicated that 23.8% of commuters made the same journey in the same way every day. A larger proportion (45.5%) stated that they always sought to make the same journey but changed only if they needed to. A further 26.8% sometimes varied how they made their journey whilst the final 4% stated that they often varied it. These figures suggest that over 75% of individuals expressed some ability to vary their journey to work although only 30.8% did so out of choice. Further exploration of these sub-groups, using the Pearson's chi-square test[10] indicated that significantly more individuals who often varied their commute journey had no access to a car or van ($\chi^2\,(12) = 23.752, p < .001$) suggesting more flexibility amongst those reliant on public transport or other modes such as walking and cycling.

6.3.2 Did change occur?

54% of people made at least one change to their usual journey to work during the Games (TfL, 2013b) with 24.8% in the sample making more than one change. Analysis of this

[10] Pearson's chi-square tests have been used throughout this chapter for the purpose of making initial examinations of the differences between those that changed and those that did not.

group using Pearson's chi-square tests indicated that there were no significant associations between the key socio-demographic variables and whether changes were made (the results of which are detailed in Figure 6.2).

Table 6.2: Results from chi-square tests for socio-demographics by change

Variable	χ^2 - value	p - value
Age	2.035	.154
Gender	7.441	.190
Ethnicity	9.554	.847
Household structure	9.865	.079
Household income	18.948	.062
Num. employed in business	6.184	.103
Job position	16.236	.062
Industry employed in	21.998	.185
Access to bicycle	2.728	.604
Access to car	.702	.951

6.3.3 The stages of change

At the core of the TTM are the stages of change, in which individuals are placed depending on how they currently consider their preparedness to change their travel behaviour. In order to examine the value of the TTM in the context of this study, it is useful to reflect on how the model operates here compared to how the literature indicates it is expected to. A first point to examine is the pre-contemplation stage. It is understood that those in pre-contemplation are not considering making changes to their current behaviour (Prochaska and Velicer, 1997). The descriptive statistics (shown in Table 6.3) indicate that prior to the Games, 68.4% of individuals placed themselves in this stage. During the Games however, 55.2% of the individuals in this particular stage did go on to make a change to their commute journey.

Table 6.3: Descriptive statistics for stages of change and the degree of changes made

Stage of Change	Pre-Games allocation (%)	Degree of travel behaviour change	
		Changed (%)	Did not change (%)
Pre-contemplation	68.4	55.2	44.8
Contemplation	8.9	77.3	22.7
Preparation	8.6	78.7	21.3
Action	8.6	74.5	25.5
Maintenance	5.5	73.3	26.7

If the TTM is to have explanatory power then it would be expected that fewer people in pre-contemplation would change their behaviour than in other stages. When compared to the degree of change made by people in each of the remaining four stages, it is apparent that the pre-contemplation group differs. These four stages all witnessed changes made by between 73.3% and 78.7% of the individuals in the group, which is at least 18.1% more than the pre-contemplation stage.

To investigate this further a Pearson's chi-square test was conducted and found that there was a statistically significant relationship between stages of change and whether changes were made to work journeys ($\chi^2\ (4) = \ 44.835, p < .001$). More specifically, this indicated that for pre-contemplation fewer people made a change than would have been expected had there been no association with the stage the individual occupied. The opposite finding was true for the remaining four stages. This confirms the hypothesis that the TTM has some explanatory power, given that whilst a large proportion of change occurred across all stages, those in pre-contemplation were less likely to change.

It is also expected that there would be distinctions between the remaining four stages. Table 6.3, above, indicates that these four stages are all similar in terms of the proportion of people within each stage, and also with regard to the number of people making a change. At a descriptive level this may imply that the other four stages are indistinct, but further analysis is necessary to explore this. Other indicators will provide further information on the difference between the stages and these will be examined throughout this chapter.

The socio-demographic characteristics of the stages were explored. Pearson's chi-square tests indicated that in two stages there was a significant association with certain age groups. Firstly, in the contemplation stage, there were significantly more 25-34 year olds than would be expected had there been no relationship between age group and stage choice ($\chi^2\ (20) = \ 34.945, p < .05$). Secondly, in the maintenance stage, 35-44 year olds made up a significantly greater proportion of the stage group ($\chi^2\ (20) = \ 34.945, p < .05$). No further significant associations were found with other socio-demographics. Comparable studies have not highlighted relationships between age and stage occupation although further examination of the stages in this study may provide insights to explain their relevance.

6.3.4 Intention to change during the Games

The role of intention to change travel behaviour during the Games was a focus of the panel survey and understanding whether intention would translate to actual change was of particular interest. Intention to change here has been established based on whether the

individuals stated that they were considering changing their commute journey specifically during the Games (note this was unconnected to the stages of change question). Although the TTM does seek to address intention through the stages of change (Kosma et al., 2007; Nigg, 2005; Marcus et al., 1994), by also examining it separately it is possible to compare directly with the stages of change (De Vet et al., 2007, applied a similar approach in a study of fruit intake).

This section will first analyse how intention related to actual change during the Games. It will then examine intention when compared to the stages of change directly. Finally, it will analyse four separate groups of individuals, determined by their stage of change and intention to change as stated prior to the Games. These groups will be examined with regard to a number of factors that may influence their intention to change to establish whether any differences exist.

6.3.4.1 Does intention lead to actual change?

Prior to the Games, 60.1% of the sample stated that they intended to make a change to their commute journey during the Games. 76.3% of those with an intention to change did go on to make a change during the Games. Further analysis, using Pearson's chi-square tests, indicated that there was a significant association between intention to change and whether change actually occurred ($\chi^2\,(1) = 144.890, p < .001$). More specifically, this indicated that those with an intention to change their commute journey during to the Games, were significantly more likely to have made a change than those without such intentions. To help to further demonstrate these differences the odds ratio was calculated. Table 6.4 shows the figures from which the odds ratio was calculated. The calculations were made by the researcher following guidance presented in the literature (Field, 2009; Bland, 2000) and the final odds ratio was derived from the statistical notation shown.

Table 6.4: Contingency table for intention by actual change

	Changed		Did not change		Total
Intended to change	**a**	501	**c**	156	657
Did not intend to change	**b**	175	**d**	261	436
Total		676		417	1093

$$Odds\ ratio = \frac{a/c}{b/d}$$

$$Odds\ ratio = \frac{501/156}{175/261}$$

$$Odds\ ratio = 4.79$$

The calculation of the odds further supported the role of intention as a predictor of change by demonstrating that the odds of an individual changing their commute journey were 4.79 times higher if they had a prior intention to do so.

6.3.4.2 Intention and the stages of change

In terms of the relationship between intention and the stages of change, a notable difference was found between those in pre-contemplation and those in the remaining stages. A Pearson's chi-square test was conducted to establish whether there were differences between the different stages and whether there was an intention to change. This showed that those in pre-contemplation were significantly less likely to have an intention to change ($\chi^2\ (4) = 94.064, p < .001$). This finding offers support to the TTM given that those who were, theoretically, not considering changing their commute journey were also more likely to have no intention to change during the Games. However, it is also clear from the data that a large proportion of individuals in the sample who placed themselves in pre-contemplation indicated an intention to change during the Games (and therefore displayed flexibility to change). This prompts a key question to be considered, whether in this context the stages are too categorical and do not account for the flexibility to respond to short-term disruption demonstrated by this sample. This lack of support for the discrete stages posited by the theory is reflective of previous studies (De Vet et al., 2007; Bamberg, 2007).

6.3.4.3 The stages of change and intention to change: Defining groups

The findings in the previous section indicate a relationship between the stages of change and intention. To investigate this further, analysis was conducted on four separate groups of commuters within the wider sample to examine differences between the groups. The criteria for group allocation are:

- **Easy Adaptors:** In pre-contemplation with an intention to change
- **Consciously Unengaged:** In pre-contemplation with no intention to change
- **Flexible Intenders:** In the other stages with an intention to change
- **Flexible Non-Intenders:** In the other stages with no intention to change

The characteristics of each group are detailed in Table 6.5. The decision to separate pre-contemplators from the remaining stages is driven by the finding discussed in Section 6.3.4.2 that specifically those in pre-contemplation were significantly less likely to have an intention to change during the Games.

Table 6.5: Matrix to show characteristics of the stages of change and intention groups

	Pre-contemplation	**Other stages**
Intention	**Easy Adapters n = 393** • 26% always travelled in the same way and 22% sometimes varied their journey. • 71% changed commute journey during the Games • 37% did not know whether they would need to change during the Games • 11% decided to change and had planned how they would • Degree of change: - 45% reduced the number of commute journeys - 12% re-moded - 19% re-routed - 38% re-timed	**Flexible Intenders – n = 288** • 8% always travelled in the same way and 41% sometimes varied their journey. • 83% changed commute journey during the Games • 26% did not know whether they would need to change during the Games • 18% decided to change and had planned how they would • Degree of change: - 39% reduced the number of commute journeys - 29% re-moded - 32% re-routed - 52% re-timed
No Intention	**Consciously Unengaged – n = 379** • 35% always travelled in the same way and 20% sometimes varied their journey. • 38% changed commute journey during the Games • 47% did not know whether they would need to change during the Games • 0% decided to change and had planned how they would • Degree of change: - 20% reduced the number of commute journeys - 8% re-moded - 11% re-routed - 16% re-timed	**Flexible Non-Intenders – n = 72** • 14% always travelled in the same way and 35% sometimes varied their journey. • 49% changed commute journey during the Games • 57% did not know whether they would need to change during the Games • 0% decided to change and had planned how they would • Degree of change: - 15% reduced the number of commute journeys - 13% re-moded - 20% re-routed - 26% re-timed

Table 6.5 shows that there are some notable differences in the characteristics between groups. It also, importantly, indicates support for 'intention' as a predictor of behaviour change. This is shown through the greater levels of actual change - along with more evidence of knowledge and plans of how to change – amongst those with an intention to change. The 'Flexible Intenders' show a slightly higher response to these variables, although the results of the 'Easy Adapters' suggests that this is not heavily influenced by the stages of change. Planning how to change was more common amongst the Flexible Intenders (18% of the sub-group doing so), although 11% of the Easy Adapters had also done so. None of

those in the 'Consciously Unengaged' or 'Flexible Non-Intenders' groups had decided to change or planned how they would do so prior to the Games.

6.3.5 The processes of change

The processes of change are the second element of the TTM to be analysed. The literature presents the processes of change as the tools by which individuals support their behaviour change and it is understood that certain processes will be used at different times depending on the individuals current position along the stages of change (Nigg et al., 2011). In the first wave of this panel survey, respondents were presented with one statement per process and asked to state their level of agreement or disagreement with it. These statements are presented in Table 6.6.

Table 6.6: The Processes of Change

The Processes of Change
Environmental Re-evaluation Changing the way I travel to work might encourage others to change
Social Liberation Colleagues/friends are discussing changing the way they travel
Helping Relationships My employer has encouraged me to change the way I travel to work
Self-liberation I can change the way I travel to work if I try hard enough
Counter-conditioning Changing the way I travel during the Games will improve my travel experiences
Stimulus control I will plan my time during the Games so that I am able to change my work travel
Contingency management Changing the way I travel may have the added benefit of finding new or better options for my journey to work
Self-re-evaluation I believe that changing the way I travel during the Games will show me to be a proactive person

As a starting point in understanding the role of the processes of change, it is appropriate to examine their use at the broadest level. This was done by comparing the processes of change responses of those who changed and those who did not. This comparison was carried out using Mann-Whitney tests[11] and examined the differences in responses to the eight statements shown above. Reponses to these statements were measured on a 5-point Likert

[11]As the data under examination was ordinal, it was treated as non-parametric and thus the Mann-Whitney U test was chosen.

scale of agree or disagree, with those agreeing or strongly agreeing considered to be utilising the process.

The results of these tests (shown in Table 6.7) indicated that in five processes there were significant differences in the responses. For three processes (social liberation, self-liberation and self-re-evaluation) the median scores all clearly illustrate that those individuals that changed were significantly more likely to have agreed with the statements than those that did not change. For the other two processes (counter-conditioning and stimulus control) however, the median scores are the same. In counter conditioning the scores are 4, indicating that in fact both groups were more likely to have disagreed with the statement. With stimulus control, both medians were 3 although further investigation of the descriptive statistics showed that 44% of people who changed either agreed or strongly agreed with the statement compared to 22.9% of those who didn't change. It can therefore be concluded that those that changed were significantly more likely to have agreed with the statement. The effect sizes were calculated and showed that for all of the processes (with the exception of helping relationships) there was only a small effect. A full table with the results from the analysis of all the types of change can be found in the Appendix C at the end of this chapter.

Table 6.7: Mann-Whitney tests of the use of processes of change by whether changes were made

Process	**Mann-Whitney U**	**Z**	**Sig.**	**Effect size (*r*)**	**Median**	
					Change	No Change
Environmental re-evaluation	125382.000	-1.634	.102	-0.05	3	4
Social liberation	105207.500	-4.565	**<.001**	-0.14	2	3
Helping relationships	124706.000	-1.330	.183	-0.41	2	2
Self-liberation	117447.000	-2.526	**.012**	-0.08	2	3
Counter-conditioning	121537.000	-2.332	**.020**	-0.07	4	4
Stimulus control	98630.500	-7.349	**<.001**	-0.23	3	3
Contingency management	127940.000	-1.281	.200	-0.04	4	4
Self-re-evaluation	118149.500	-3.300	**<.001**	-0.10	3	4

This analysis highlights the implications of studying change in this context. When faced with the potential disruption of the Games, individuals placed less importance on actually improving the journey to work (counter-conditioning and contingency management). This is an interesting point as it may emphasise the relevance of the short-term nature of the disruption and the individual's belief that their changes need not be long-term.

6.3.5.1 The relationship between the processes and stages of change

To further explore the role of the processes of change in understanding the change that occurred it is necessary to compare them to the stages of change. As was earlier stated, different processes are expected to link in particular to certain stages. This is explained visually in Figure 6.1.

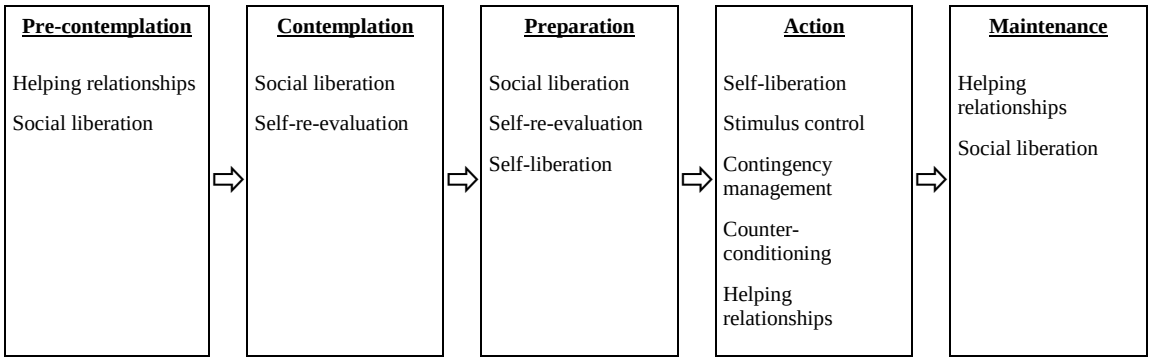

Figure 6.1: The processes and stages of change (adapted from Nigg et al., 2011; Burkholder and Nigg, 2002)

Social liberation, for example, is a process that theoretically links closely with all stages except Action. Therefore, when analysed it would be expected that this process is found to be utilised significantly less by those in the Action stage. Table 6.8 provides an overview of the median responses to each process for all five stages of change (scored on a Likert scale of 1 = Strongly agree and 5 = Strongly disagree). This shows that the use of processes did not meet with the expectations of the theory.

Table 6.8: Analysis of the relationship between the stages and processes of change

Processes of change[a]	**Stage of Change**					**Mann-Whitney test result[b]**
	PC	**C**	**P**	**A**	**M**	
	Median score					
Environmental re-evaluation*	4	3	3	3	3	C<PC, P<A, P<PC
Social liberation*	2	2	2	2	2	P<PC
Helping relationships	2	2	2	2	2	
Self-liberation*	3	2	2	2	2	P<PC, M<PC, P<C, P<A, M<C, M<A
Counter conditioning*	4	3	3	3	3	P<PC, M<PC
Stimulus control*	3	3	2	3	2	C<PC, P<PC, A<PC, M<PC
Contingency management*	4	4	4	4	3	C<PC, P<PC, A<PC, M<PC
Self-re-evaluation*	4	3	3	3	3	C<PC, P<PC, A<PC, M<PC

PC = Pre-contemplation; C = Contemplation; P = Preparation; A = Action; M = Maintenance
a. Kruskal-Wallis tests showed that there were significant differences in responses based on stage (*$p < .05$)
b. Post hoc Mann-Whitney test results. Bonferroni correction was applied so all results are reported at .005 level of significance.

Table 6.8 indicates that the use of processes appeared to be more consistent across the stages rather than between stages. For example, social liberation has a median of 2 across all stages and contingency management has a median of 4 in all stages. This differs from the anticipated response from the literature which would observe more varied median scores in each stage per process. This is as opposed to different median scores occurring within each process, which may have been expected had the use of processes occurred as expected from the literature. For example, Figure 6.1 indicates that social liberation would not be expected to be important for those in Action, yet as Table 6.8 shows, the median response was 2 (Agree) suggesting that it was in fact important to those in this stage.

In order to statistically analyse this, Kruskal-Wallis tests[12] were conducted to establish whether there were significant differences in the agreement or disagreement with processes between the stages of change. This would indicate whether certain stages were in fact statistically more likely to have agreed or disagreed with the process statements. These tests found that for all processes, with the exception of helping relationships, there was in fact a significant effect on process use between the stages. Post hoc Mann-Whitney tests were subsequently conducted to explain where the significant differences in utilisation were.

These tests showed that those in pre-contemplation were significantly less likely to utilise several processes compared to the remaining stages. This was particularly evident for stimulus control, contingency management and self-re-evaluation. Furthermore, it was found that individuals in the preparation stage were consistently utilising the processes more than the pre-contemplation stage. This may suggest that the preparation group in particular were making most use of the processes of change. These findings provide further evidence supporting the potential to collapse the five stages of change into two, pre-contemplators and post-contemplators.

6.3.5.2 The relationship between the processes of change and self-efficacy

To further examine the TTM, the relationship between processes of change and self-efficacy was explored in order to understand whether there were links between the constructs. As the data included were ordinal, Spearman's correlation coefficient tests[13] were conducted on the variables included in both these constructs. This found there were significant correlations between many of the variables, both within and between the processes of change and self-

[12] Kruskall–Wallis tests were used due to the ordinal nature of the data.

[13] The Spearman's correlation coefficient test is the appropriate test when the data investigated is non-parametric (Field, 2009).

efficacy constructs. These findings are presented in Table 6.9. Those results highlighted in dark grey all have a correlation coefficient over r_s 0.3 to distinguish only those with a medium or large effect size. Those results highlighted in a lighter grey have a lower effect size but still over r_s 0.1. All results highlighted are significant at the 0.01 level.

A key point to identify from this analysis is that both self-efficacy and the processes of change correlate with each other which may suggest a link between the two constructs. The table does indicate however, that the higher strength correlations are grouped within constructs rather than between indicating that there is some distinction between the two constructs.

Table 6.9: Spearman's correlation coefficient for processes of change and self-efficacy constructs

	Environmental Reevaluation	Social Liberation	Helping Relationships	Self-Liberation	Counter Conditioning	Stimulus Control	Contingency Management	Self-re-evaluation	Arrive for work earlier	Arrive for work later	Finish work earlier	Finish work later	Travel by an alternative route	Use a different mode of transport	Work from home instead
Environmental Reevaluation	1.000														
Social Liberation	.323**	1.000													
Helping Relationships	.028	-.094**	1.000												
Self-Liberation	.218**	.283**	-.107**	1.000											
Counter Conditioning	.381**	.254**	-.036	.322**	1.000										
Stimulus Control	.341**	.296**	-.067*	.306**	.395**	1.000									
Contingency Management	.372**	.160**	.077*	.293**	.553**	.318**	1.000								
Self-re-evaluation	.469**	.240**	-.014	.314**	.495**	.455**	.506**	1.000							
Arrive for work earlier	.114**	.192**	-.102**	.248**	.154**	.152**	.152**	.087*	1.000						
Arrive for work later	.132**	.197**	-.153**	.276**	.155**	.174**	.144**	.138**	.457**	1.000					
Finish work earlier	.139**	.198**	-.149**	.216**	.156**	.229**	.132**	.144**	.458**	.659**	1.000				
Finish work later	.116**	.177**	-.142**	.223**	.118**	.154**	.153**	.095**	.610**	.500**	.432**	1.000			
Travel by an alternative route	.101**	.145**	-.020	.325**	.240**	.150**	.279**	.160**	.358**	.293**	.239**	.339**	1.000		
Use a different mode of transport	.168**	.170**	-.087*	.386**	.253**	.124**	.311**	.169**	.307**	.265**	.205**	.331**	.583**	1.000	
Work from home instead	.137**	.187**	-.126**	.171**	.181**	.270**	.137**	.126**	.246**	.387**	.447**	.293**	.193**	.188**	1.000

**Correlation is significant at the 0.01 level (2-tailed)
*Correlation is significant at the 0.05 level (2-tailed)

6.3.5.3 Company size and employer support

Employers can play a key role in influencing the travel patterns of their employees, for example by allowing flexitime, working from home or simply by offering information to encourage travel behaviour change. TfL sought to utilise this role and engaged closely with organisations to offer advice and assistance regarding how they could ensure the continuity of their operations during the Games period by encouraging their employees to alter their travel patterns (ODA, 2012). Larger organisations were provided with a TfL advisor with whom they could correspond directly to develop their Games-time strategy (ODA, 2012). Smaller businesses were provided with information and written advice to support their Games-time continuity. In this sample 40.5% of individuals worked in companies with fewer than 250 employees.

In this study individuals were questioned on the support they received from their employers to alter their travel behaviour during the Games. Pearson's chi-square tests were conducted and found significant differences in responses between the larger and smaller businesses. Respondents were asked – two weeks before the Games - to indicate what allowances their employers were providing to temporarily adjust working patterns. This found that individuals in businesses over 250 employees were significantly more likely to be offered a number of key opportunities during the Games (shown in Table 6.10).

Table 6.10: Pearson's chi-square tests showing difference in support between large and small businesses

Measure	χ^2 **- value**	p **- value**
Work more flexible hours	18.692	< **.001**
Start and/or finish work at a different time	13.352	< **.001**
Work from home	34.665	< **.001**
Work from a different location	70.682	< **.001**

Further to this, it was found that there was a significant difference between company sizes and whether employers had provided information and advice to help employees plan travel during the Games. Individuals in smaller companies (less than 250 employees) were significantly less likely to have received such information or advice from their employer ($\chi^2\ (2) = 100.025, p < .001$). The findings, shown in Figure 6.2, indicate a trend of more support and opportunities for employees in larger businesses. The engagement by TfL certainly focused on the larger employers, but there are likely to be other factors involved. Smaller companies by their nature may have fewer opportunities to change. For

example, working from a different location (such as another company office) might not be an option that smaller employers can offer.

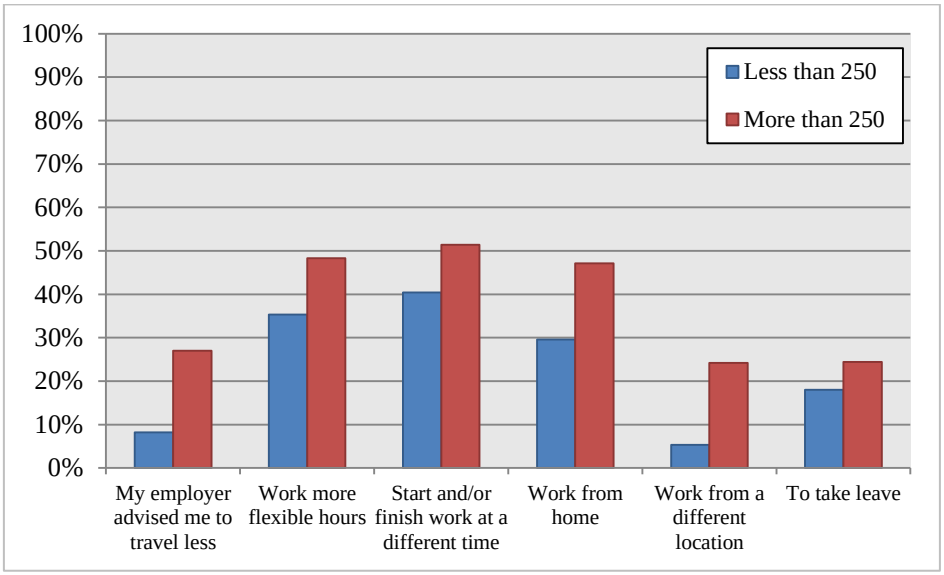

Figure 6.2: Differences in advice/support and the number of employees

Whilst the findings highlight more opportunities for employees of larger businesses, whether this translates to actual change is a further point to consider. Interestingly, it was found – through Pearson's chi-square tests - that there was no significant difference in whether an individual in the sample changed during the Games and the size of business they were employed in ($\chi^2\ (1) = 3.588,\ NS$). This suggests no clear difference in whether an individual changed and the number of employees in their organisation.

Mann-Whitney tests were also conducted on the processes of change to examine the differences in agreement between different sized organisations. These results, shown in Table 6.11, indicated that the utilisation of only one process was found to be significantly different. For social liberation, which relates to "colleagues/friends are discussing changing the way they travel", it was found that people were significantly more likely to agree with the statement when they were employed in a company of over 250 people. This could be a result of there being more opportunities to discuss travel in larger companies.

Table 6.11: Mann-Whitney tests of the use of processes of change by company size

Processes	Mann-Whitney U	Z	Sig.	Effect size (*r*)	Median	
					Less than 250	More than 250
Environmental re-evaluation	143459.000	-.303	.762	-0.01	3	3
Social liberation	119657.000	-3.584	**<.001**	-0.11	3	2
Helping relationships	139448.500	-.551	.582	-0.02	2	2
Self-liberation	136739.000	-.671	.502	-0.02	2	2
Counter-conditioning	137220.000	-1.451	.147	-0.04	4	4
Stimulus control	144309.500	-.064	.949	-0.00	3	3
Contingency management	143942.000	-.405	.685	-0.01	4	4
Self-re-evaluation	137808.500	-1.589	.112	-0.05	3	3

6.3.6 Self-efficacy

The self-efficacy construct provides information related to the confidence the individual has that they can alter their behaviour. Minimal differences were found between the self-efficacy of those who changed and those who did not. The only exception was working from home, where those that did not change considered working from home to be more difficult. However, as Table 6.12 shows, the median for both groups was 4 indicating working from home was in fact considered difficult by both groups. Arriving for work earlier and departing work later were both found to have a median of 2, suggesting that respondents considered these to be easier changes to have made. Given that these are both likely to be changes met with least resistance by employers, it is unsurprising to find this.

Table 6.12: Mann-Whitney tests results for self-efficacy by whether the individual changed their journey

Self-efficacy	Mann-Whitney U	Z	Sig.	Effect size (*r*)	Median	
					Changed	Did not change
Arrive for work earlier	73631.500	-1.014	.311	-0.04	2	2
Arrive for work later	70942.000	-.317	.751	-0.01	3	3
Finish work earlier	72681.500	-.277	.782	-0.01	3	3
Finish work later	71991.500	-.102	.918	-0.01	2	2
Alternative route	74858.500	-.525	.600	-0.02	3	3
Alternative mode	74484.000	-.647	.518	-0.02	3	3
Work from home	62358.500	-4.152	**<.001**	-0.15	4	4

6.3.7 The pros of changing

Decisional balance is the final construct of the TTM and was examined to a degree in the surveys. Items that allowed an understanding of the pros of changing behaviour were included in Wave 1. The theory suggests that when an individual moves through the stages of change their awareness of the pros of changing behaviour increases, so those in the latter stages are more likely to acknowledge the pros of changing. This section will deal with the pros of changing behaviour with specific focus on those who, prior to the Games, stated that they at some point had varied their journey to work. Those who did vary their journey were questioned about the positive reasons they placed on making this change. This was done through a single question where a number of statements were presented to the individual with them required to select all that applied to them. These results have been compared with the stages of change to understand how responses varied across the stages and whether any statements were significantly associated with certain stages.

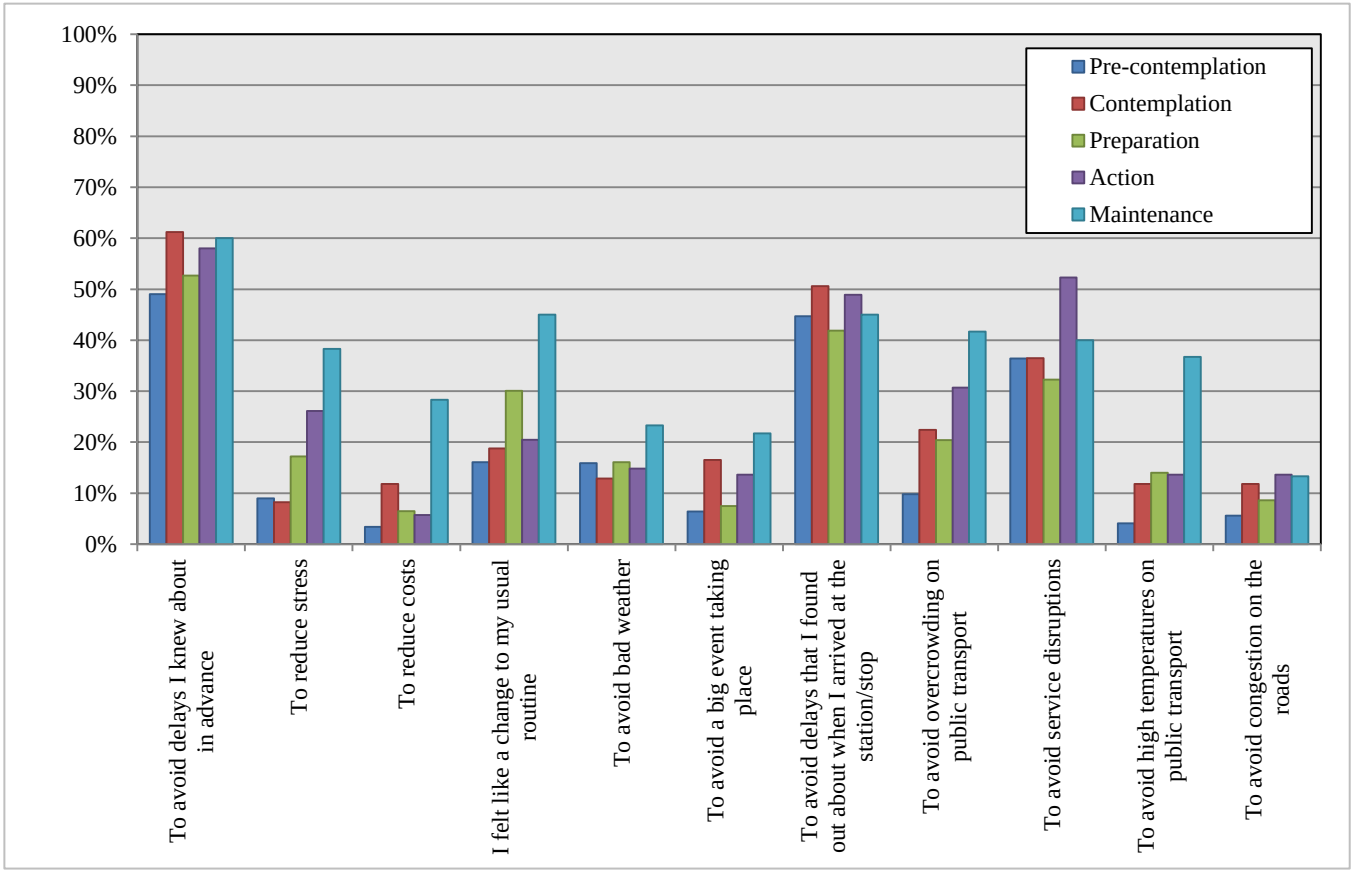

Figure 6.3: The pros of changing behaviour pre-Games

Figure 6.3 shows that for many of the statements there is a trend for a greater proportion of individuals in the latter stages to select these positive statements as applying to them, which appears to match the literature. Analysis of this data through Pearson's chi-square tests confirmed several statements as being significantly associated with the stages of changes. However, these relationships were the result of significant differences between the pre-contemplation stage and the remaining stages, which reiterates the finding of two stages rather than five.

Table 6.13: Pearson's chi-square test results for pros of changing pre-Games

Variable	χ^2 - value	p - value
To avoid delays that I knew about in advance	7.615	.107
To reduce stress*	55.620	**<.001**
To reduce costs*	59.424	**<.001**
I felt like a change to my usual routine*	33.892	**<.001**
To avoid bad weather	3.081	.544
To avoid a big event taking place*	23.729	<.**001**
To avoid delays that I found out about when I arrived at the station/stop	1.923	.750
To avoid overcrowding on public transport*	61.087	**<.001**
To avoid service disruptions	9.684	**.046**
To avoid high temperatures on public transport*	75.912	**<.001**
To avoid congestion on the roads	11.979	**.018**

* Significantly fewer pre-contemplators agreed with this statement

6.3.8 Were changes sustained?

6% of individuals sustained the changes they had made to their commute journey during the Games (TfL, 2013b). This figure suggests that for some individuals, the changes they made during the Games benefitted their commute journey in such a way as to warrant a continuation of the behaviour. However, TfL (2013b) argued that this sustained change may be attributable to 'churn' in the transport network. Churn may be caused by changes to personal circumstance, which can influence travel patterns. This might include such factors as a change in employment, moving home or buying a car. TfL are not clear on whether the 6% that sustained changes did so as a result of other changes in their circumstances. In fact it is difficult to unpick what factors ultimately led to these individuals to sustain their behaviour. Sustained change within the sample will be examined and discussed, although the Wave 4 survey that will be presented in Chapter 8 should provide further insights into the churn in their behaviour.

6.3.9 Numbers of people making each type of change

24.8% of the sample made more than one change to their commute journey during the Games. Table 6.14 presents an overview of the number of people who made the different possible combinations of change. 7.2% of the sample both reduced and re-timed. This is higher than the remaining multiple change combinations, although this is not unexpected given the considerably larger number of individuals either reducing or re-timing, as has been discussed throughout this section of the chapter. Notably, there are lower numbers of individuals only changing mode or route. This is also understandable as these may be more likely to be made along with another change (e.g. changing mode would be likely to require a change to route as well).

Table 6.14: Number and combination of changes made

Combination of changes possible	%
Reduce only	18.6
Re-time only	11.6
Re-route only	3.4
Re-mode only	2.5
Reduce + Re-time	7.2
Reduce + Re-route	1.3
Reduce + Re-mode	0.5
Re-time + Re-route	2.8
Re-time + Re-mode	1.2
Re-route + Re-mode	2.7
Reduce + Re-time + Re-route	2.1
Reduce + Re-time + Re-mode	0.8
Reduce + Re-route + Re-mode	0.7
Re-time + Re-route + Re-mode	3.4
All changes	1.8

6.3.10 Summary diagram

A final point in this section is to present a summary diagram, which encapsulates the behaviour changes made across the three waves of the panel study discussed. Figure 6.4 presents the timeline of travel behaviour change amongst the whole sample. Whilst the diagram reiterates much of what has been discussed in this section, it provides a useful visualisation of the behavioural response to the Games.

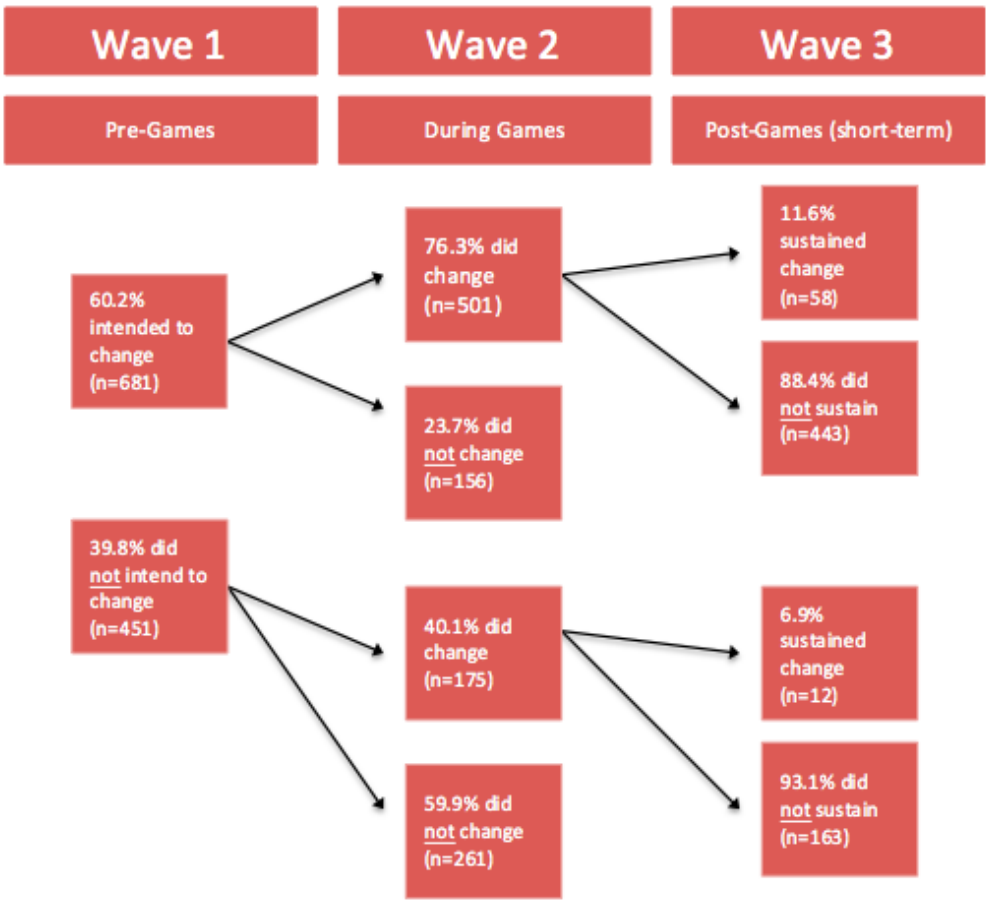

Figure 6.4: Summary diagram for behaviour change across Waves 1-3[14]

[14] Where the sample sizes do not sum to the total shown in the preceding wave this is due to non-responses.

6.4 Reducing commute journeys during the Games

6.4.1 Did people reduce?

The first group that will be examined in more detail are those people that reduced the number of journeys they made to work during the Games. This was the most common way by which individuals changed their travel behaviour, with TfL (2013b) reporting that 31% of all commuters made this particular change. Of these, 27% achieved this by making fewer journeys to their usual workplace (instead of working from home or at alternative locations). The remaining 4% chose to take annual leave as a direct consequence of the Games.

This group was first investigated to assess what the relationship was between socio-demographics and whether travel was reduced. The results from this analysis are shown in Table 6.15. It was found that household income was significantly associated with whether people reduced or not. Those with a higher household income (£80,000 or more) were more likely to reduce the number of journeys they made than those on lower incomes ($\chi^2\ (11) = 26.536, p < .01$). Given this result, further analysis was conducted on the relationship between income and job type. As expected, this indicated that there was a significant association between these two variables with individuals in households with an income over £80,000 more likely to hold positions as managers, senior officials or in professional occupations ($\chi^2\ (18) = 95.568, p < .001$). The greater seniority of these positions is likely to result in greater flexibility in travel choices thereby enabling individuals to make fewer journeys, which is reflected in the result above.

The size of the individual's business (in terms of number of employees) was shown to be significantly associated with whether people reduced. Those people employed by businesses with more than 250 employees were more likely to reduce than would be normally expected ($\chi^2\ (3) = 17.810, p < .001$). This trend is likely to have been influenced by the fact that TfL engaged more with larger companies, as described in Section 6.3.5.3.

Table 6.15: Results from chi-square tests for socio-demographics by whether journeys were reduced

Variable	χ^2 - value	p - value
Age	13.296	**.021**
Gender	2.533	.111
Ethnicity	10.287	.801
Household structure	9.005	.109
Household income	26.536	**.005**
Num. employed in business	17.810	**<.001**
Job position	22.236	**.008**
Industry employed in	32.658	**.012**
Access to bicycle	5.947	.203
Access to car	8.766	.067

6.4.2 The stages of change

Analysis of the stages of change indicated that, in contrast to the overall sample, there was no association between whether the individuals reduced their journeys or not and the stage of change they occupied prior to the Games. This finding may suggest that reducing journeys was a more feasible change to make given that, unlike the overall sample, those in pre-contemplation were just as likely to have made this change. The ability to reduce commuter travel is heavily influenced by employers' willingness to allow their employees to be flexible in their travel. Therefore the role of employers will be examined in more detail later in this section. This should provide further insight into why pre-contemplators were equally as likely to have changed.

6.4.3 How important was 'intention to change'?

6.4.3.1 With regard to the stages of change

As the previous section has illustrated, there was no association between the stages of change and actual change. 'Intention to change' was also explored but on this occasion found that significantly fewer people in the pre-contemplation stage had intended to reduce their commute journeys during the Games compared to the remaining for stages which all had the opposite finding ($\chi^2\,(4) = 32.694, p < .001$). This suggests that although pre-contemplators were behaving more as anticipated prior to the Games (with less intention to reduce), when the Games did occur their propensity to change was more similar to that of the other stages. This suggests that the distinctions between stages, as anticipated in the literature, were not evident when it came to whether people actually reduced during the

Games. This demonstrates limitations in the stages of change in this context, which will continue to be examined in this chapter.

6.4.3.2 Does intention to reduce lead to actual change?

It has been highlighted that there was no significant association between the stages of change and actual change. In contrast however, intention to change was shown to be significantly associated with change. Therefore, examining how intention to reduce actually compared to change is a useful task in order to further understand the role of intention. A Pearson's chi-square test was conducted and found there to be a significant association between intention to reduce and whether people actually reduced their commute journeys ($\chi^2\ (1) = 178.111, p < .001$). This showed that those with the intention to reduce were significantly more likely to do so during the Games. The odds ratio was calculated[15] and showed that the odds of an individual reducing their commute journeys were 5.96 times higher if they had stated prior to the Games that they had the intention to do so.

6.4.4 The processes of change

The use of the processes of change was examined for the overall sample and showed that some processes were more likely to be agreed with than others. This was examined for those that reduced and also indicated that some processes were significantly more likely to be agreed with. Mann-Whitney tests were carried out and found that there were significant differences in four processes, which included social liberation, helping relationships, counter-conditioning and stimulus control. These results are presented in more detail in Table 6.16. Exploring these four processes further, it was found that those individuals that reduced their commute journeys were significantly more likely to agree with these processes. This indicates how these processes were particularly important for supporting reductions in the number of journeys.

[15] The odds ratio was calculated using the same process as detailed in Section 6.3.4.1. This also applies for the remaining odds ratio's presented in this thesis.

Table 6.16: Mann-Whitney tests of the use of processes of change by whether journey numbers were reduced

Process	Mann-Whitney U	Z	Sig.	Effect size (*r*)	Median	
					Reduced	Did not reduce
Environmental re-evaluation	129851.000	-.070	.944	-0.00	3	3
Social liberation	107770.500	-3.378	**.001**	-0.10	2	2
Helping relationships	117134.500	-2.329	**.020**	-0.07	2	2
Self-liberation	124963.500	-.035	.972	-0.00	2	2
Counter-conditioning	120944.500	-1.975	**.048**	-0.06	3	4
Stimulus control	109271.500	-4.415	**<.001**	-0.13	3	3
Contingency management	130695.000	-.124	.902	-0.00	4	4
Self-re-evaluation	129242.000	-.352	.725	-0.01	3	3

6.4.4.1 Company size

It has already been discussed (in Section 6.3.5.3) that employers played a role in supporting those that reduced the number of journeys they made during the Games. Evidence from the analysis of the total sample has also found that individuals in larger companies were more likely to be able to utilise social relationships with colleagues to support their behaviour change.

Examining this question but in the context of those that reduced commute journeys, similar findings emerge. Again, only social liberation showed a significant relationship between the size of the business showing that the findings from the total sample are also applicable for this particular sub-group. For the social liberation process, both groups had a median of 2 in their responses but further exploration of these results shows that 68.8% of respondents employed in companies larger than 250 employees agreed or strongly agreed with the social liberation statement. This is in comparison to 51.9% in companies with less than 250 employees. These descriptive statistics indicate that employees in larger businesses were significantly more likely to utilise social liberation.

Table 6.17: Mann-Whitney tests of the use of processes of change by company size (Reduce)

Process	Mann-Whitney U	Z	Sig.	Effect size (*r*)	Median	
					Less than 250	More than 250
Environmental re-evaluation	12858.500	-.563	.573	-0.03	4	3
Social liberation	10151.000	-2.979	**.003**	-0.16	2	2
Helping relationships	12775.000	-.172	.864	-0.01	2	2
Self-liberation	12039.500	-.757	.449	-0.04	2	2
Counter-conditioning	13493.000	-.019	.985	-0.00	3	3
Stimulus control	12632.000	-.761	.447	-0.04	3	3
Contingency management	12999.000	-.599	.549	-0.03	4	4
Self-re-evaluation	12914.500	-.558	.577	-0.03	3	3

6.4.5 Self-efficacy

With regard to self-efficacy, only working from home and finishing work earlier were found to be significantly associated with whether individuals reduced or not. Mann-Whitney tests were conducted to analyse this and the results are presented in Table 6.18. These results suggested that those reducing their travel were more likely to find it easier to work from home or finish work earlier.

Working from home in particular is of interest here as it has a direct relationship with reducing work journeys. To understand these results further a Pearson's chi-square tests were conducted and found that those individuals who had been encouraged by their employer to work from home were significantly more likely to have reduced the number of journeys they made to their normal workplace during the Games ($\chi^2\,(1) = 58.502, p < .001$). Further examination of this group (using a Mann-Whitney test) showed that individuals who had been encouraged to work from home were significantly more likely to have regarded working from home as easier (Mdn = 3) compared to those with no encouragement to do so (Mdn = 5) ($U = 31542.500, -16.599, p < .001$). These results indicate that employer support played an important role in people's perceived ability to work from home more during the Games.

Table 6.18: Mann-Whitney tests results for self-efficacy by whether the individual reduced their journeys

Self-efficacy	Mann-Whitney U	Z	Sig.	Effect size (*r*)	Median	
					Reduced	Did not reduce
Arrive for work earlier	80980.000	-.540	.589	-0.02	2	2
Arrive for work later	75280.500	-1.011	.312	-0.04	3	3
Finish work earlier	72736.500	-2.230	**.026**	-0.08	3	3
Finish work later	77223.000	-.226	.790	-0.01	2	2
Alternative route	81751.500	-.091	.928	-0.00	3	3
Alternative mode	81646.500	-.206	.837	-0.01	3	3
Work from home	58878.500	-6.908	**<.001**	-0.24	3	4
					Encouraged to WFH	Not encouraged to WFH
Work from home	31542.500	-16.599	**<.001**	-0.57	3	5

6.4.6 Summary diagram

Figure 6.5 displays an overview of the reductions made to commute journeys during the Games. Approximately a third of the sample intended to reduce during the Games, and two-thirds of this particular group did go on to make that change. 20.3% of those who had no intention to reduce made the change during the Games. Interestingly, of those who sustained working from home or working elsewhere, the majority were drawn from those who had initially intended to change, although it should be noted that these numbers are small (n=21).

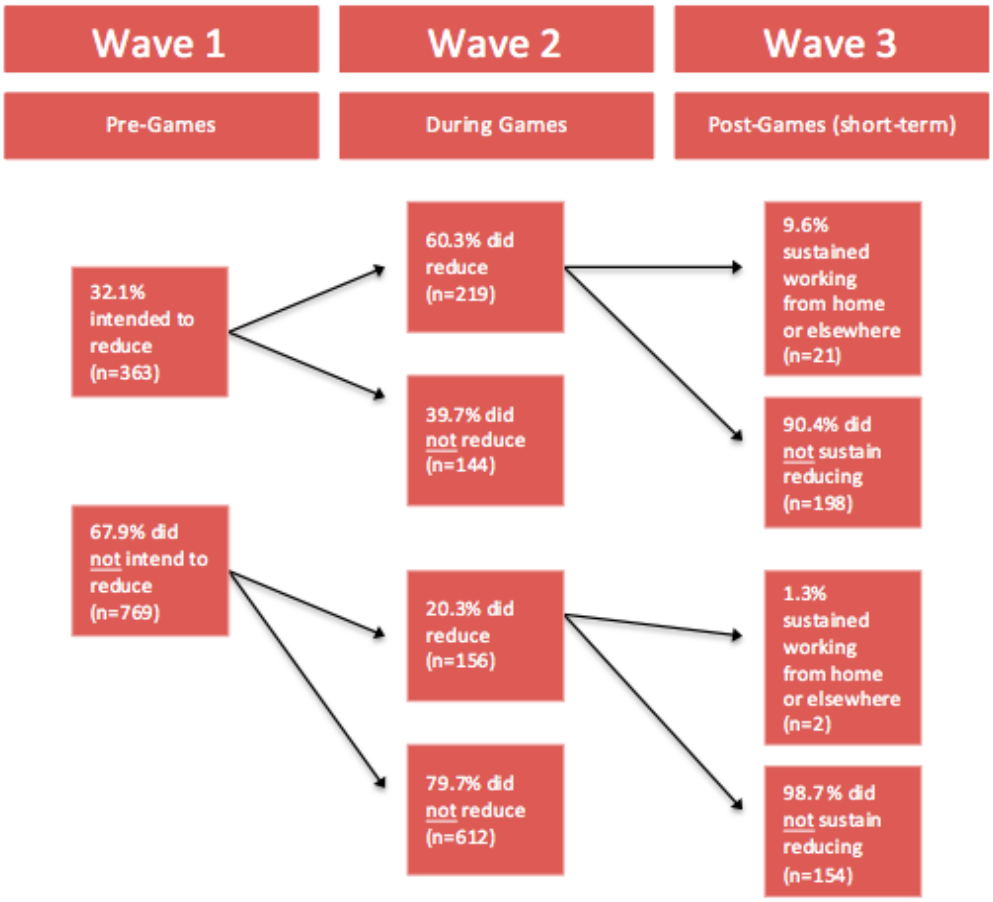

Figure 6.5: Summary diagram for 'Reduce' across Waves 1-3[16]

6.5 Re-timing commute journeys during the Games

6.5.1 What change occurred?

In terms of changing the time at which journeys were made, 25% of people did so during the Games (TfL, 2013b) . Those people that changed to an earlier travel time during the Games tended to travel to work on average earlier (07:40) prior to the Games than those who changed to depart later than usual (08:15) (TfL, 2013b). A similar trend was found for the return journey from work, indicating that those that tended to travel earlier in the peak decided to travel even earlier and those that normally travelled later were found to delay their journeys and travel later.

[16] Where the sample sizes do not sum to the total shown in the preceding wave this is due to non-responses.

Table 6.19: Results from chi-square tests for socio-demographics by whether re-timed

Variable	χ^2 - value	p - value
Age	3.220	.666
Gender	6.606	**.010**
Ethnicity	18.693	.228
Household structure	3.253	.661
Household income	6.915	.806
Num. employed in business	1.152	.765
Job position	10.128	.340
Industry employed in	20.287	.260
Access to bicycle	7.345	.119
Access to car	.963	.915

Further analysis of this group indicated that there was a significant association between gender and whether people re-timed. In this instance females were found to be significantly more likely to have re-timed their journeys.

6.5.2 The stages of change

Analysis of the stages of change further illustrated the trend that those who placed themselves in the pre-contemplation stage were significantly less likely to make a change to their behaviour ($\chi^2\ (4) = 43.529, p < .001$). This echoes the findings of the overall sample, and contrasts with what was observed in the reduced group. Although there remains the question of whether there are two stages (pre-contemplators and post-contemplators) rather than five.

6.5.3 How important was 'intention to change'?

It was found that there was a significant relationship between intention to re-time and the stage of change an individual occupied prior to the Games. As with the previous types of change, those who were in pre-contemplation were significantly more likely to have no intention to change the time at which they travelled for their commute journey ($\chi^2\ (4) = 15.357, p < .005$). Intention to change may also offer insights into the actual change that was observed. In the previous types of change examined, it has been shown that there is evidence that those with an intention to change were significantly more likely to go on to make a change. This trend continues with re-timing and a Pearson's chi-square test showed that there was a significant relationship between intention and actual change ($\chi^2\ (1) =$

$90.708, p < .001$). Based on the calculation of the odds ratio, individuals who had the intention to change were four times more likely to go on and make a change.

6.5.4 The processes of change

Analysis of the processes of change showed that the stimulus control and self-re-evaluation statements were both significantly more likely to have been agreed with by those re-timing their journeys. Interestingly, these two processes referred to time management and proactivity, which it can be argued links closely with the needs of re-timing. Those that re-timed were also found to be significantly more likely to agree with the environmental re-evaluation and social liberation process statements. As Table 6.20 shows, these two processes are similar and both concerned with social relationships.

Table 6.20: Mann-Whitney tests of the use of processes of change by whether journeys were re-timed

Processes	**Mann-Whitney U**	**Z**	**Sig.**	**Effect size (*r*)**	**Median**	
					Re-timed	Did not re-time
Environmental re-evaluation	100924.000	-4.449	**<.001**	-0.14	3	4
Social liberation	88384.000	-5.869	**<.001**	-0.18	2	2
Helping relationships	116389.000	-.331	.740	-0.01	2	2
Self-liberation	108990.000	-1.598	.110	-0.05	2	2
Counter-conditioning	115157.500	-1.076	.282	-0.03	4	4
Stimulus control	87797.000	-7.256	**<.001**	-0.22	2	3
Contingency management	114757.000	-1.485	.138	-0.05	4	4
Self-re-evaluation	104399.000	-3.738	**<.001**	-0.12	3	4

6.5.5 Self-efficacy

When the self-efficacy of this group was analysed it was found that there was no relationship between this construct and whether a change was made. It was useful to explore whether individuals already displayed an ability to change the time at which they made their journey to work. Of those who made some variation to their usual commute journey (pre-Games), only 4.8% stated that they never changed the time at which they departed for work. Furthermore, 7.2% never changed the time at which they returned home. This highlights that a large proportion of the sample already displayed some ability to change the time at which they travelled (whether this was only when necessary or out of choice). This supports the findings that those that re-timed were not influenced by a significantly greater ability to change their departure or return times.

Table 6.21: Mann-Whitney tests results for self-efficacy by whether the individual re-timed their journey

Self-efficacy	Mann-Whitney U	Z	Sig.	Effect size (*r*)	Median	
					Re-time	Did not re-time
Arrive for work earlier	69788.000	-1.311	.190	-0.05	2	2
Arrive for work later	66097.500	-.782	.434	-0.03	3	3
Finish work earlier	70480.500	-.027	.979	-0.00	3	3
Finish work later	66998.000	-.726	.468	-0.03	2	2
Alternative route	71055.500	-.631	.528	-0.02	3	3
Alternative mode	68128.500	-1.639	.101	-0.06	3	3
Work from home	67927.000	-1.335	.182	-0.05	4	4

6.5.6 Summary diagram

To summarise this section, Figure 6.6 has been created to demonstrate the degree of change made to the time at which individuals travelled for work. This shows how over half of those who intended to re-time did go on to make the change during the Games. In contrast, only a quarter of those who did not intend to re-time went on to change during the Games. The diagram also reiterates how only a small proportion of those who changed sustained their change after the Games.

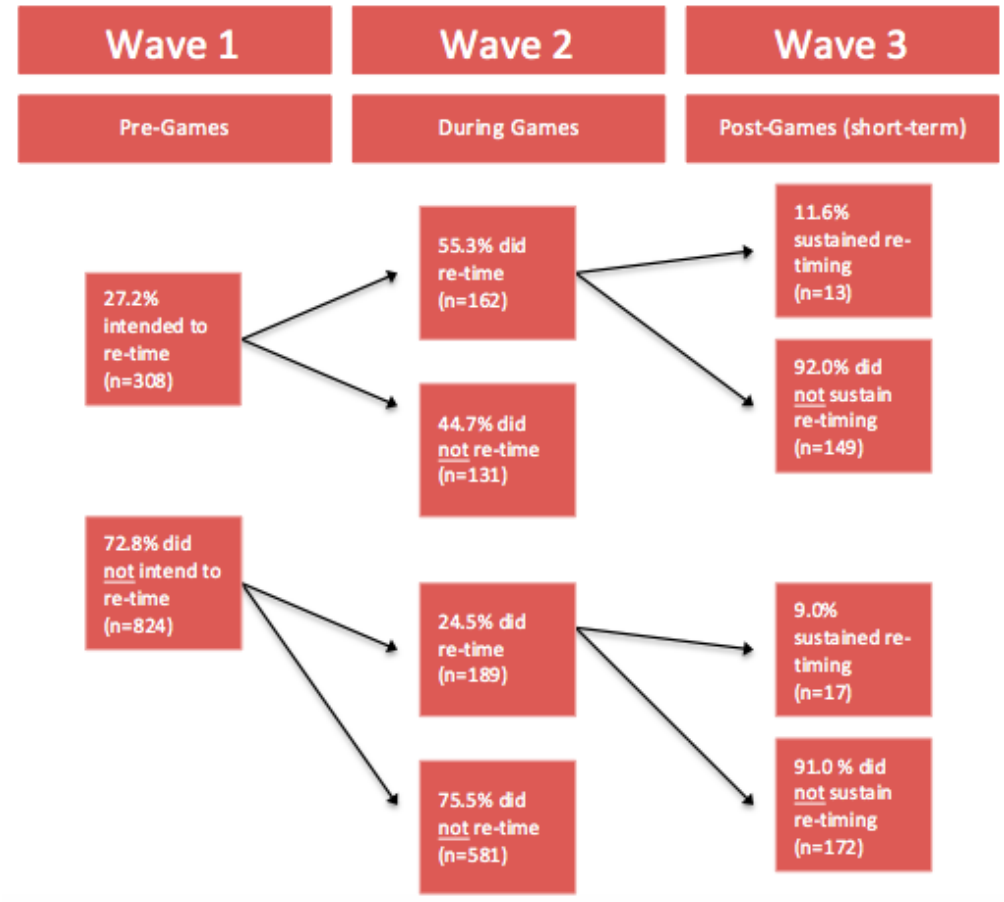

Figure 6.6: Summary diagram for 'Re-time' across Waves 1-3[17]

6.6 Re-routing commute journeys during the Games

6.6.1 What change occurred?

16% of people changed their usual route to work during the Games (TfL, 2013b) and analysis of this group showed that there were no significant associations with key socio-demographics.

[17] Where the sample sizes do not sum to the total shown in the preceding wave this is due to non-responses.

Table 6.22: Results from chi-square tests for socio-demographics by whether re-routed

Variable	χ^2 - value	p - value
Age	6.815	.235
Gender	.444	.505
Ethnicity	13.394	.572
Household structure	1.774	.879
Household income	11.162	.430
Num. employed in business	.353	.950
Job position	4.027	.910
Industry employed in	13.834	.679
Access to bicycle	3.263	.515
Access to car	5.808	.214

6.6.2 The stages of change

The results from the analysis of the stages of change found that, similarly to re-moding, those in the pre-contemplation stage were significantly less likely to make changes to their route than those in the four other stages ($\chi^2\ (4) = \ 32.157, p < .001$). Re-routing can be argued to require more preparation than reducing commute journeys and the findings reflect this.

6.6.3 How important was 'intention to change'?

In examining the role of intention to change, it was found that there was a significant relationship with the stages of change. The analysis showed that, as with the previous types of change, significantly fewer individuals in pre-contemplation intended to change their route for their commute journey than if there were no relationship between intention and stages ($\chi^2\ (4) = \ 32.063, p < .001$).

In terms of the role of intention to change, the analysis conducted indicated that individuals with an intention to change were significantly more likely to go on to make a change. To examine the importance of this relationship but in the context of re-routing, a Pearson's chi-square test was conducted. This found that, as with the previous sections, there was a significant relationship between intention to re-route and whether the individual went on to do so during the Games ($\chi^2\ (1) = \ 37.188, p < .001$). The calculation of the odds ratio showed that people who intended to re-route were three times more likely to go on to do so during the Games.

6.6.4 The processes of change

Mann-Whitney tests were conducted and found that there was a significant difference in agreement with the processes of change statements between those that changed their route and those that did not. These included social liberation, self-liberation, stimulus control and self-re-evaluation and are shown in Table 6.23. There are some clear overlaps with the significant processes here and those found in the re-moding sub-group (Table 6.26). Notably, with the exception of social liberation, the remaining three processes were all significantly associated with those that re-moded. Social liberation, whilst not showing a significant difference between the changers and non-changers, still had a median of 2 indicating that there was agreement with this statement. This suggests that there are similarities in how those re-moding and those re-routing responded to the processes of change.

Table 6.23: Mann-Whitney tests of the use of processes of change by whether journeys were re-routed

Processes	**Mann-Whitney U**	**Z**	**Sig.**	**Effect size (*r*)**	**Median**	
					Re-routed	Did not re-route
Environmental re-evaluation	84749.000	-.111	.911	-0.00	4	3
Social liberation	72455.000	-2.434	**.015**	-0.08	2	2
Helping relationships	80704.500	-.603	.546	-0.02	2	2
Self-liberation	74932.000	-2.090	**.037**	-0.07	2	2.5
Counter-conditioning	84470.500	-.301	.764	-0.01	4	4
Stimulus control	77120.000	-2.222	**.026**	-0.07	3	3
Contingency management	83409.000	-.755	.451	-0.02	4	4
Self-re-evaluation	75604.000	-2.707	**.007**	-0.08	3	3

6.6.5 Self-efficacy

In terms of self-efficacy, no statistical relationship between the ease or difficulty of re-routing and whether the individual actually changed their route during the Games was found (through conducting Mann-Whitney tests, shown in Table 6.24). However, by comparing to the extent to which the sample already varied their usual route to and from work, it was possible to determine that there was an existing level of flexibility in route choice. Of the 812 people who indicated that they made some degree of change to their usual commute journey, only 12.7% never changed their route to work pre-Games. In contrast, 57.3% either occasionally or frequently changed their route. This suggests that there was a good degree of familiarity with the network and the alternative routes that could be used. This helps to

explain why there is no difference between self-efficacy to change route and whether the individual did actually change.

Table 6.24: Mann-Whitney tests results for self-efficacy by whether the individual re-routed their journey

Self-efficacy	**Mann-Whitney U**	**Z**	**Sig.**	**Effect size (*r*)**	**Median**	
					Re-routed	Did not re-route
Arrive for work earlier	53957.500	-.815	.415	-0.03	2	2
Arrive for work later	46741.500	-1.717	.086	-0.06	3	3
Finish work earlier	51472.000	-.787	.431	-0.03	3	3
Finish work later	45858.500	-2.162	**.031**	-0.08	2	2
Alternative route	52925.500	-.908	.364	-0.03	3	3
Alternative mode	55299.000	-.038	.969	-0.00	3	3
Work from home	49915.000	-1.717	.086	-0.06	4	4

One statistically significant difference was found through the analysis. This showed that those who re-routed were significantly more likely to have found finishing work later an easier change to make. This may suggest that some of those who did re-route were able to combine this more easily with re-timing.

6.6.6 Summary diagram

Figure 6.7 shows that there were a low proportion of individuals intending to re-route during the Games (19.5%). Interestingly, of those who did re-route, more had no intention to do so prior to the Games. The diagram also highlights how the sustainment of re-timing was very limited. Similar proportions of those with an intention or no intention to change continued to sustain the change they made.

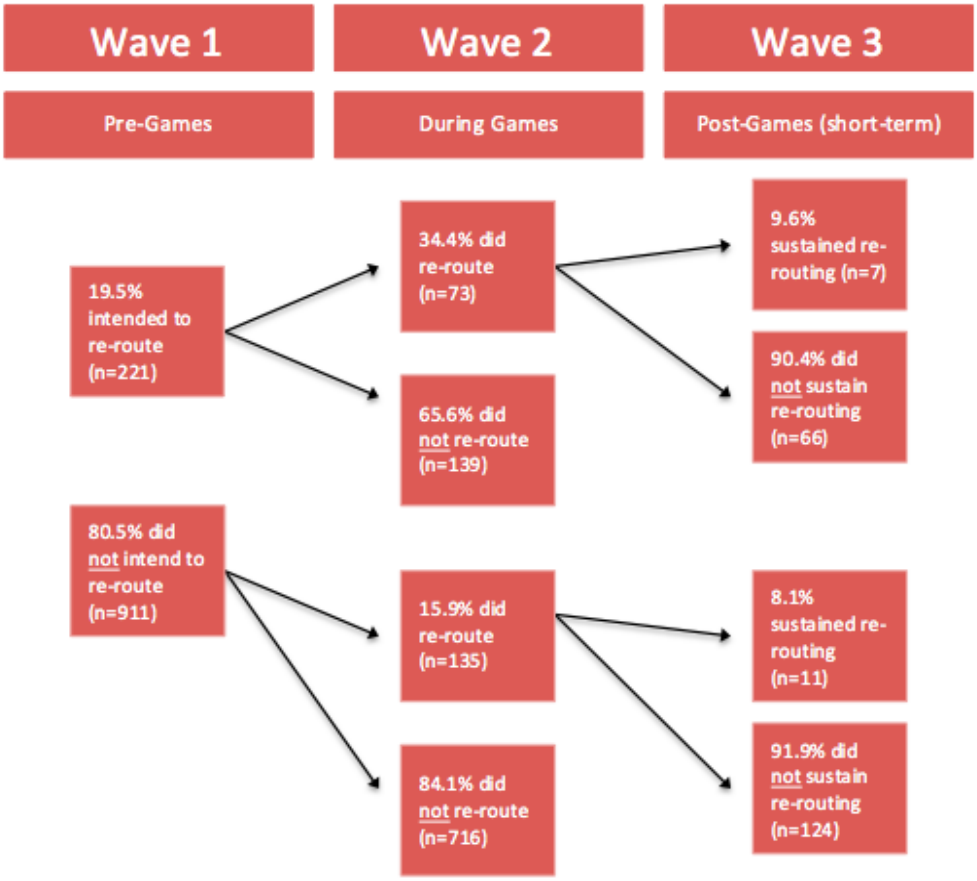

Figure 6.7: Summary diagram for 'Re-route' across Waves 1-3[18]

6.7 Re-moding commute journeys during the Games

6.7.1 Did change occur?

During the Games, 11% of commuters changed the means by which they would have normally travelled to work prior to the Games (TfL, 2013b). Additional statistical analysis applying Pearson's chi-square tests indicated that key socio-demographics were not associated with whether a person changed their mode or not with the exception of access to a bicycle. It was found that those people with access to one bicycle were significantly more likely to have re-moded than expected ($\chi^2\ (4) = 10.459, p < .05$). TfL (2013b) explored what the variances were in the main mode used and observed a 7% increase in walking and cycling, which was contrasted by an 8% decrease in use of the London Underground and Docklands Light Rail (DLR).

[18] Where the sample sizes do not sum to the total shown in the preceding wave this is due to non-responses.

Table 6.25: Results from chi-square tests for socio-demographics by whether re-moded

Variable	χ^2 - value	p - value
Age	4.318	.505
Gender	.483	.487
Ethnicity	16.065	.378
Household structure	2.216	.818
Household income	8.878	.633
Num. employed in business	.616	.893
Job position	7.554	.580
Industry employed in	23.241	.142
Access to bicycle	10.459	**.033**
Access to car	4.422	.352

6.7.2 The stages of change

This type of change provided some further interesting insights with regard to the stages of change. It was found that there was a significant association between the stages of change and whether people re-moded. In the pre-contemplation stage, significantly fewer people re-moded than expected were there no association between stages and behaviour change. The opposite was true for the remaining four stages ($\chi^2\ (4) = \ 51.718, p < .001$), echoing the findings from the overall sample of commuters.

6.7.3 How important was 'intention to change'?

When intention to re-mode was analysed, the findings were similar with a significant association between intention and the stages of change. It was evident that, as with actual change, there was a significant association with those in pre-contemplation less likely to have an intention to change than anticipated and those in the remaining stages being more likely to have the intention to change than if there were no relationship between stage choice and intention ($\chi^2\ (4) = \ 78.667, p < .001$).

It was shown in Section 6.4.3.2, that an individual with the intention to reduce their commute journey was six times more likely to have gone on to make that change during the Games. This has also been explored for this re-mode sub-group and similar results emerged. A Pearson's chi-square test was conducted and found that there was a significant association between intention and actual change ($\chi^2\ (1) = \ 90.739, p < .001$). Further calculation of the odds ratio showed that an individual who had stated an intention to re-mode before the Games was five times more likely to have re-moded during the Games.

6.7.4 The processes of change

Evidence was again found indicating that those who changed their behaviour were significantly more likely to have agreed with certain processes of change. As Table 6.26 indicates, those who re-moded had a lower median score for both self-liberation ("I can change the way I travel to work if I try hard enough") and counter conditioning ("changing the way I travel during the Games will improve my travel experiences") showing that these individuals were more likely to agree with those statements. For the remaining significant results, the findings are less clear but further investigation shows that for stimulus control and self-re-evaluation individuals who re-moded had a greater amount of agreement with the statements. For stimulus control, 46.1% agreed or strongly agreed compared to 34.1% of non-changers who agreed or strongly agreed. For self-re-evaluation these figures were 27.6% and 17.7% respectively. Finally, although there was a significant difference in the use of contingency management, both groups were found to have disagreed with the statement. 61.1% of people who re-moded disagreed or strongly disagreed whilst this figure was 69.8% for non-changers.

Table 6.26: Mann-Whitney tests of the use of processes of change by whether journeys were re-moded

Processes	**Mann-Whitney U**	**Z**	**Sig.**	**Effect size (*r*)**	**Median**	
					Re-moded	Did not re-mode
Environmental re-evaluation	61714.000	-1.912	.056	-0.06	3	3
Social liberation	59329.000	-1.756	.079	-0.06	2	2
Helping relationships	64848.500	-.626	.531	-0.02	2	2
Self-liberation	55042.500	-3.504	**<.001**	-0.11	2	3
Counter-conditioning	60170.500	-2.428	**.015**	-0.08	3	4
Stimulus control	58484.500	-2.748	**.006**	-0.09	3	3
Contingency management	59507.000	-2.777	**.005**	-0.09	4	4
Self-re-evaluation	54563.000	-3.996	**<.001**	-0.12	3	3

6.7.5 Self-efficacy

Examination of self-efficacy indicated that individuals who re-moded their journeys were significantly more likely to consider it easier to use a different mode for their work journeys than those who did not change. As Table 6.27 indicates, the median responses to this particular question were both 3 (neither easy nor difficult). However, further examination showed that 47.3% of individuals who re-moded stated that this was easy or very easy whereas only 27.6% of those who did not re-mode responded in this way.

Table 6.27: Mann-Whitney tests results for self-efficacy by whether the individual re-moded their journey

Self-efficacy	Mann-Whitney U	Z	Sig.	Effect size (*r*)	Median	
					Re-moded	Did not re-mode
Arrive for work earlier	42029.500	-1.018	.309	-0.04	2	2
Arrive for work later	39819.000	-.649	.516	-0.02	3	3
Finish work earlier	39731.000	-1.208	.227	-0.04	3	3
Finish work later	39321.500	-.592	.554	-0.02	2	2
Alternative route	39795.000	-1.750	.080	-0.06	3	3
Alternative mode	32671.500	-4.696	**<.001**	-0.17	3	3
Work from home	40386.500	-.898	.369	-0.03	4	4

These highlight a key point that re-moding was a behaviour change that required an extra level of ability in order for the change to occur. As was shown for re-routing and re-timing, such ease of changing is not necessarily a determining factor. It may therefore be concluded that ability to re-mode over the short-term, during such disruptive events may be in part dependent on already finding changing mode to be an easier task.

6.7.6 Summary diagram

Figure 6.8 shows that the intention to re-mode drew similar results as with re-routing. The difference between those who changed their mode and whether they intended to do so was more pronounced however, which is perhaps a reflection of the greater difficulty in changing mode (as shown by the self-efficacy results).

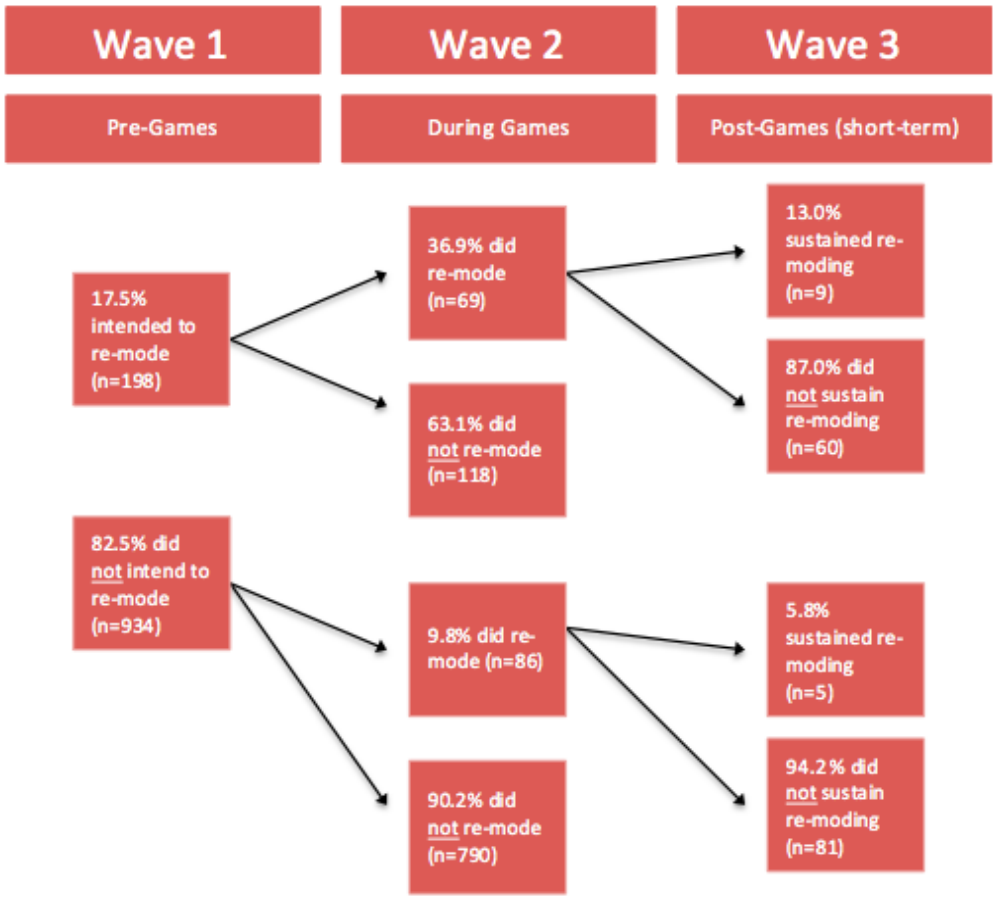

Figure 6.8: Summary diagram for 'Re-mode' across Waves 1-3[19]

6.8 A reflection on the application of the TTM

A key aspect of the analysis presented in this chapter has been the assessment of the constructs from the TTM. In terms of the stages of change, the key observation has been the apparent two stages rather than the five traditionally considered in the literature. It was shown through the allocation of the self-reported stages of change that a large proportion of the sample considered themselves to be in the pre-contemplation stage immediately prior to the Games. When the stages were compared to a number of other factors, including actual change, intended change, and the processes of change it was apparent that the stages of change were more appropriately considered as two stages, pre-contemplation and post-contemplation. This raises questions about limitations of the stages of change to account for changes in behaviour in the context of a large disruption such as this, where there is an

[19] Where the sample sizes do not sum to the total shown in the preceding wave this is due to non-responses.

imperative to change. Notably in contrast, the simple 'intention to change during the Games' question that was also included appeared to be a good predictor of actual change.

The processes of change and self-efficacy items were shown to not operate within the model as the literature posits they do. This provides further indication of the limitations of the wider TTM in understanding behaviour change in this context. Despite this, the processes of change and self-efficacy items did provide insight and this warranted further investigation in the analysis. Therefore, a two-step cluster analysis was conducted, the findings of which are discussed in detail in Section 6.9.

6.9 Two-step cluster analysis

The analysis of the TTM in this chapter has shown that there are significant limitations in the application of the model in this context. Analysis of the stages of change indicated that, rather than the five (or more) stages advocated in the literature, there appears to be two distinct groups. To further examine the value of the TTM in this study, it is useful to establish how individuals are grouped based on how they interact with the wider TTM constructs. For example, individuals in the pre-contemplation stage are expected to utilise particular processes and have a low self-efficacy. Bamberg (2007) argues that empirical testing is necessary when applying the TTM, something that is inconsistent in previous examples of the application of the TTM in the transport domain. Therefore a cluster analysis was conducted to establish the responses to the processes of change and self-efficacy constructs and how they link to the stages of change. A cluster analysis seeks to generate homogenous groups from the variables used and in this study these will then be compared to the self-reported stages of change to assess their value.

6.9.1 Description of the cluster analysis procedure

A two-step cluster analysis was conducted in IBM SPSS Statistics 19. This method of cluster analysis was chosen due it being identified as more appropriate for larger samples (Norušis, 2008, Mooi and Sarstedt, 2011). A total of 15 variables (eight for the processes of change and seven for self-efficacy) were examined in the analysis.

The procedure for conducting the analysis was informed by the literature, namely Mooi and Sarstedt (2011). Using the SPSS statistical software, the relevant criteria were inputted using the Two-Step Cluster Analysis dialog box. All variables were entered as categorical, which then influenced the use of the log-likelihood distance measure (the alternative, 'Euclidean Distance', is only suitable when all variables are continuous). The exact number of expected clusters was not entered, as a key purpose of this analysis was to examine what clusters

emerged through further examination of the processes of change and self-efficacy variables. Bayes information criterion (BIC) was used for the clustering criterion.

The results showed that there were four clusters that emerged based on the analysis of the processes of change and self-efficacy. The results did indicate that there was a poor solution quality (0.1), which suggests that the variables did not differentiate very clearly. This is not completely unsurprising given, for example, the consistencies observed in the responses to the self-efficacy variables (see, for example, Table 6.12). However, given such results some care must be taken when considering the broader impact of the clusters in these results.

Figure 6.9 shows line graphs for each cluster highlighting the median scores for each cluster and how they differ across the 15 variables of the processes of change and self-efficacy. Please note that for the eight processes of change items (environmental re-evaluation - self-re-evaluation) the Likert scale is: 1 = Strongly agree to 5 = Strongly agree. For the seven self-efficacy items (arrive for work earlier - work from home instead) the Likert scale is 1 = Very easy to 5 = Very difficult.

6.10 Characteristics of the clusters

The clusters will now be examined in more detail to understand the characteristics of the groups and to establish how they differ. This will firstly involve an examination of the responses to the processes of change and self-efficacy constructs, upon which the clusters are based. The socio-demographics of each cluster are then discussed, which will be followed by an examination of changes in commuter travel behaviour during the Games.

6.10.1 The clusters and the TTM

Figure 6.9 shows the median responses of each cluster to the processes of change and self-efficacy items. This provides an insight into how the clusters were formed and begins to indicate groups that may be more predisposed to change.

The *Reluctant Changers* consist of a group of individuals that were more neutral in their responses to the processes of change and self-efficacy statements. *Easy Re-moders* on the other hand show a greater agreement with the processes of change constructs, with no median values being less than 3 (neither agree nor disagree) and the types of change were regarded as being easy to make. For the *Difficult Adapters*, the median scores show a group of individuals who were more likely to disagree with the processes of change and find changes difficult to make. The *Able Inactive* found changes easy to make, particularly re-

timing, although the responses to the processes were more mixed with some median scores indicating disagreement with the statements.

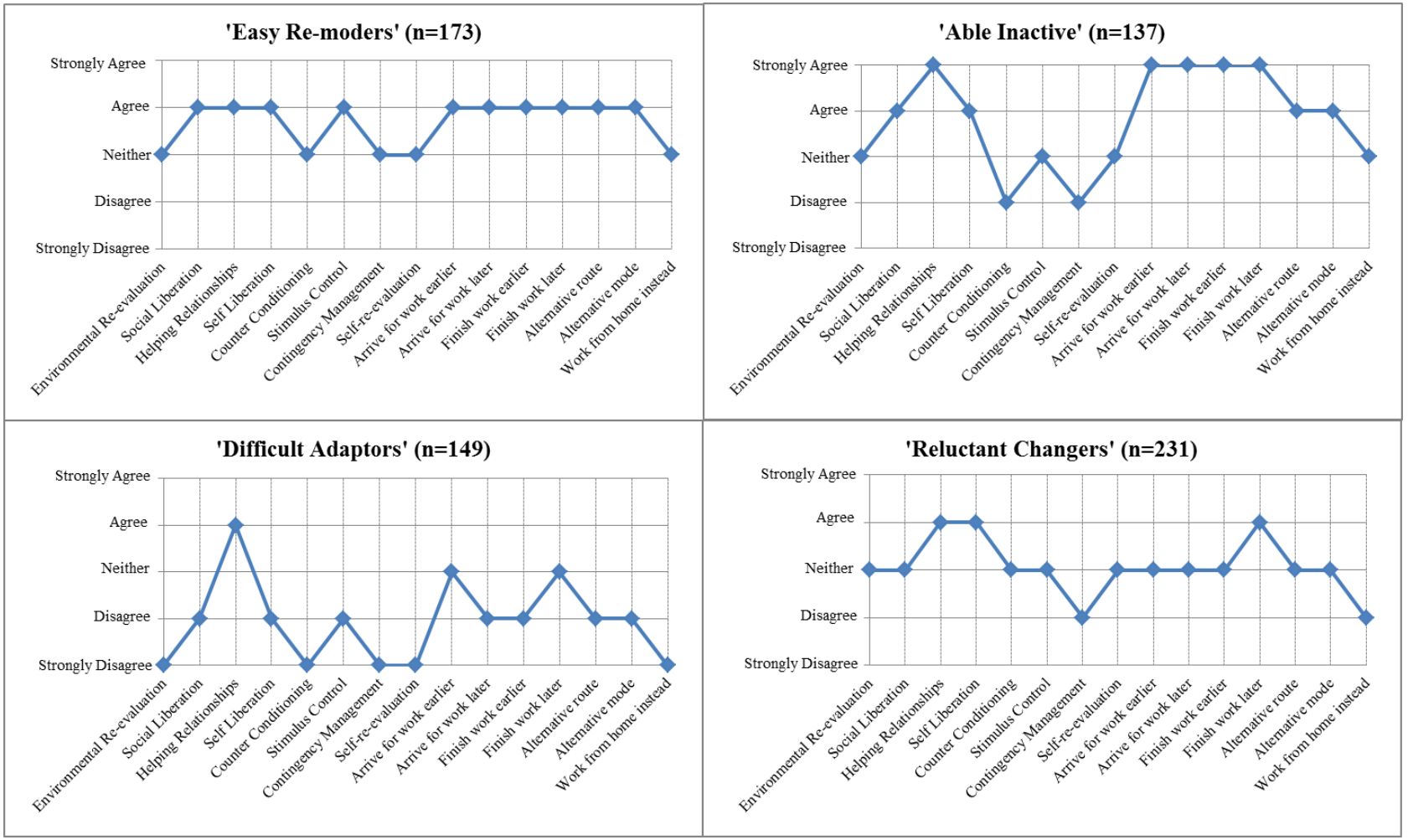

Figure 6.9: Clusters generated from the processes of change and self-efficacy items

Despite the observed limitations of the stages of change construct, there is value in comparing the self-reported stage allocation to the clusters that emerged from the analysis. The TTM posits that each stage of change is characterised by differing responses to the processes of change and the levels of self-efficacy. The results displayed in Figure 6.9 demonstrate how the clusters differ, yet it is not clear how they link to the stages of change. Therefore, it is appropriate to compare the clusters to the self-reported stages of change that were established prior to the Games. Figure 6.10 presents this data. This shows clearly that individuals in each cluster were not unified in their stage of change choice prior to the Games. Instead, the findings show that individuals from all four clusters occupy all five stages of change to varying degrees.

One trend that emerges is that the *Easy Re-moders* appeared to occupy a higher proportion of the preparation and maintenance stages. This is contrasted by a smaller proportion of individuals in the pre-contemplation stage. A Pearson's chi-square test was conducted and confirmed that there was a significant association between the clusters and stage of change $(\chi^2\ (12) = \ 49.445, p < .001)$. In particular; it was found that the *Easy Re-moders* were significantly less likely to be in the pre-contemplation stage. Comparing this to the results presented in Figure 6.9, there is an indication that those in this group may be more pre-disposed to change.

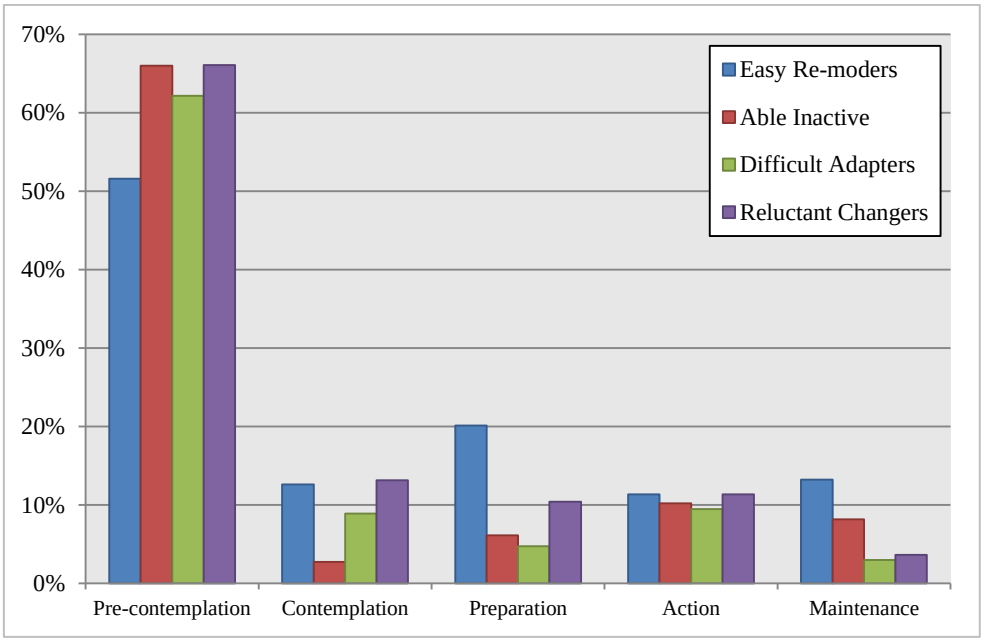

Figure 6.10: Clusters and the stages of change

6.10.2 Socio-demographics

The socio-demographic variables of each cluster were examined and are presented in Table 6.28. In all of the clusters, there were more females than men, with the exception of the *Able Inactive* cluster where there was a higher proportion of males (54.1%). The *Easy Re-moders* had the greatest proportion of 18-34 year olds (44.8%). However, 39.6% of the *Reluctant Changers* were in this age group which indicated that there was no trend for younger people to be present within one cluster. The *Able Inactive* group was shown to have the lowest proportion of individuals in one person households (14.7%) and the highest of those in households consisting of couples (65.4%).

Both the *Easy Re-moders* and *Able Inactive* groups were more likely to be in higher income households (over £80,000 annual income) (37.4% and 44.3% respectively). This is in contrast to the *Difficult Adaptors* and *Reluctant Changers* who had much greater proportions of lower income households (less than £59,999 annual income) (51.3% and 52.6% respectively). The financial and business services sector is over represented in the sample, as demonstrated in Table 6.1, and this is again emphasised in Table 6.28. However, it is also shown that there are differences between clusters in terms of the numbers of individuals in this particular sector. This is most notably seen with 31.1% of those in the *Able Inactive* group being employed in this sector compared to 20.7% of the *Reluctant Changers*. The *Easy Re-moders* and *Able Inactive* were shown to have the higher proportions of individuals in management and senior positions (35.1% and 40.1% respectively) whereas *Difficult Adaptors* and *Reluctant Changers* had higher proportions of individuals in manual, service, and administrative roles (25.7% and 32.9% respectively).

Easy Re-moders were shown to have the highest degree of access to no cars or only one car (83.6%) (*Difficult Adaptors* were the next closest group with 79.2%). This suggests that there was a slightly greater propensity for those with less access to private vehicles to make changes to their mode of travel. There were no clear differences between clusters in terms of access to bicycles or cars. The differences in the size of company they were employed in did not differ greatly, although slightly fewer *Difficult Adapters* or *Reluctant Changers* were employed in larger businesses.

Table 6.28: Socio-demographics of the clusters

Socio-demographics	Easy Re-moders (n = 173)	Able Inactive (n = 137)	Difficult Adaptors (n = 149)	Reluctant Changers (n = 231)
Gender				
Male	44.7	54.1	42.9	46.3
Female	55.3	45.9	57.1	53.7
Age				
18-24	7.0	2.9	2.7	6.1
25-34	37.8	27.0	30.9	33.5
35-44	23.8	33.6	34.2	23.9
45-54	22.7	22.6	24.2	26.1
55-64	8.1	12.4	7.4	10.0
65+	0.6	1.5	0.8	0.4
Household Structure				
One person household	21.6	14.7	23.8	18.4
One family household - Couple with no children	34.5	35.3	34	33.3
One family household - Couple with children	22.2	30.1	28.6	26.8
One family household - Lone parent with children	2.9	2.9	2.0	3.1
Two or more unrelated adults	16.4	14.0	9.5	15.4
Multi-family households	2.3	2.9	2.0	3.1
Household Income				
Up to £19,999	1.4	0.0	3.6	2.3
£20,000 up to £39,999	16.5	10.7	20.7	20.2
£40,000 up to £59,999	20.8	21.2	27.0	30.1
£60,000 up to £79,999	23.7	23.9	17.1	18.4
£80,000 up to £99,999	15.1	12.4	14.4	11.6
£100,000 or more	22.3	31.9	17.1	17.3
Industry Sector				
Agriculture and Fishing	0.0	0.0	0.0	0.0
Mining and Quarrying	0.0	0.0	0.0	0.4
Manufacturing	0.0	0.7	1.3	4.0
Electricity; gas and water supply	2.3	0.7	0.7	0.9
Construction	3.5	3.7	2.0	7.0
Wholesale and retail trade; repair of motor vehicles	2.9	3.0	5.4	2.2
Hotels and Catering	1.2	1.5	0.7	1.8
Transportation	2.9	3.0	4.0	1.3
Financial and Business services	29.8	31.1	24.2	20.7
Real estate; renting and business activities	1.8	2.2	3.4	0.9
Public administration and defence	9.9	12.6	10.1	11.5
Education	10.5	9.6	9.4	9.7
Health and social work	4.7	5.2	9.4	8.8
Creative Industries	13.5	8.9	6.7	9.7
Charity/Not for profit	4.1	3.7	2.0	3.1
ICT	4.7	3.0	6.7	5.3
Law	2.3	3.0	3.4	3.1
Other	5.8	8.1	10.7	9.7
Employment position				
Manager & Senior Official	35.1	40.1	27.0	23.5
Professional & Associate Professional	40.9	45.9	47.3	43.5
Admin, Secretarial & Skilled Trades	17.6	12.4	13.5	23.0
Personal Service, Sales & Customer Service	3.5	0.7	2.0	5.2
Process Plant Machine Operative, Elementary & Other	2.9	0.7	10.2	4.7
Access to cars				
None	39.2	34.3	36.9	32.6
1	44.4	40.9	42.3	43.9
2	12.3	18.2	18.1	16.5
3	4.1	5.1	0.7	5.2
4+	0.0	1.5	2.0	1.7

Table 6.28 continued.

Socio-demographics	Easy Re-moders (n = 173)	Able Inactive (n = 137)	Difficult Adaptors (n = 149)	Reluctant Changers (n = 231)
Access to bicycles				
None	55.2	43.0	55.7	51.3
1	22.1	25.9	22.8	30.0
2	16.9	17.0	13.4	11.3
3	3.5	6.7	1.3	4.3
4+	2.3	7.4	6.7	3.0
Num. employed in business				
< 250	34.1	35.0	40.9	39.4
>250	65.9	65.0	59.1	60.6

6.10.3 Travel behaviour changes within the clusters

Whilst the clusters are derived from analysis of the processes of change and self-efficacy constructs of the TTM, it is important to examine behaviour change during the Games to explore whether differences in responses exist. Table 6.29 shows the proportion of each cluster making changes to their usual commute journey during the Games. Although many of these figures are similar, the *Easy Re-moders* stand out as displaying a greater amount of change. In terms of whether they made any type of change, 72% of this cluster did so during the Games. This equates to between 7-11% more than the remaining clusters. As the name suggests, this group were shown to make a noticeably greater degree of changes to mode than the remaining clusters. Linking this to their higher agreement with the processes and ease of making changes, this suggests links between the identified characteristics of the clusters and their ability to make changes in this context.

Further investigation of the clusters, and the changes to mode that were observed, showed that the most significant shift was made by the *Easy Re-moders*. More specifically, between Waves 1 and 2, there was an increase from 3 to 11 individuals who travelled by bicycle as their main mode for their commute journeys. This shift is notable given that those who re—moded within this group totalled 40 individuals. Although the numbers are quite small, these results do support the assertions that the *Easy Re-moders* appeared to have a greater ability to make such changes to mode. It may also link to lower access to private vehicles shown in this particular group, and the fact that such a circumstance may be a reflection of a greater flexibility to change modes.

Table 6.29: Percentage of clusters making a change

Type of change made	**Easy Re-moders** (n = 173)	**Able Inactive** (n = 137)	**Difficult Adapters** (n = 149)	**Reluctant Changers** (n = 231)
Any Change	72.0	65.2	63.4	61.3
Reduce	38.7	32.8	33.6	34.6
Re-mode	24.7	10.4	12.0	15.9
Re-route	21.0	17.2	21.8	21.5
Re-time	43.2	32.8	29.6	34.1

To investigate these findings further, Pearson's chi-square tests were conducted to examine whether there were statistically significant differences in the observed changes. These results, shown in Table 6.30, found that there was a significant difference in the amount of mode change observed between the clusters. More specifically, it was shown that the *Easy Re-moders* were significantly more likely to have changed their mode during the Games ($\chi^2\ (3) = \ 13.817, p < .005$).

Table 6.30: Results from chi-square tests of clusters by type of change made

Variable	χ^2 **- value**	p **- value**
Any Change	5.006	.171
Reduce	1.483	.686
Re-mode	13.817	**.003**
Re-route	1.220	.748
Re-time	6.969	.073

A summary of each cluster is included in Table 6.31, which helps to provide a description of the different characteristics of the clusters.

Table 6.31: Profiles of the four clusters

Easy Re-moders Consistent agreement with processes of change and self-efficacy items. Reflected by a greater amount of travel behaviour change by this cluster, particularly in relation to mode.	***Able Inactive*** Change is easier for these individuals, particularly re-timing. The least amount of re-moding amongst the clusters despite higher agreement with self-efficacy. This is the only group where there are more males than females. Typified by higher earners, and in more senior employment positions.
Difficult Adapters This group finds change more difficult and has less engagement with the processes of change. Low levels of re-moding and re-timing.	***Reluctant Changers*** These individuals are more moderate, with no strong agreement or disagreement with the process of change and self-efficacy items. Re-timing and reducing are the most common changes in line with the remaining clusters.

6.11 Discussion

At the beginning of this chapter, several hypotheses were introduced in relation to the degree of change that was expected to occur to commute journeys. Firstly, it was hypothesised that there would be a substantial degree of change to commute journeys during the Games and that there would be clear differences between the types of change being undertaken. The data presented has demonstrated that that there was indeed a large degree of change to commute journeys, which reflected the observed changes in previous Games. The data also indicated that reducing and re-timing journeys were the most common changes made, although changes to mode and route were also evident but to a lesser degree. A final hypothesis that was introduced was that there would be a limited degree of sustained change resulting from the Games. This chapter has explored this, and shown that 6% of the sample continued with their changes after the Games had ended. A lack of previous evidence relating to sustaining changes post-Games means that it is difficult to place this figure within context. However, when compared to the large degree of change made during the Games, it is clear that for many people the return to their previous behaviour was the

most common option. The longevity of change will be examined in greater detail in Chapter 8.

A further point that has emerged from this chapter relates to the intention to change behaviour. Immediately before the Games (Wave 1), respondents were asked whether they intended to make changes to their usual commute journey during the Games. 76.3% of those with an intention to change did go on to make a change, which indicates that intention was a relatively reliable predictor of actual change.

The examination of the application of the TTM was a key element of this chapter and this has provided several discussion points. Firstly, the stages of change have been shown to have limitations when studying behaviour in this context. It was shown that the model can be collapsed to pre or post-contemplation stages. The pre-contemplators were found to be significantly less likely to have made a change, although a large amount of change was still observed in this group. Considering the remaining stages as 'post-contemplators' was motivated by the lack of distinction between these stages in the analysis conducted. These factors indicate that the model was unable to account for the ability of individuals to change when there was an imperative to do so.

The processes of change offered an insight into the tools individuals use to help enable change. Table 6.32 provides a summary of the significant relationships that were identified in the analysis. This shows that stimulus control, social liberation and self-re-evaluation were the three processes that individuals who changed were significantly more likely to agree with. The process statements, (Table 6.6 in Section 6.3.5) show that these processes are related in part to individuals' social relationships (social liberation: colleagues/friends discussing change) (self-re-evaluation: shown as a proactive person). It is also apparent that providing themselves with a stimulus to change through preparedness was also important (stimulus control: planning own time to enable change). The processes of change, whilst providing some insights, did not respond as the theory predicts them to. Certain processes should align with different stages of change but this was not the case suggesting limitations in its application in this study.

Table 6.32: Summary of statistically significant relationships between processes of change and types of change

Processes of change	Reduced	Re-timed	Re-routed	Re-moded
Environmental Re-evaluation	✗	✓***	✗	✗
Social Liberation	✓**	✓***	✓*	✗
Helping Relationships	✗	✗	✗	✗
Self-Liberation	✗	✗	✓*	✓***
Counter Conditioning	✓*	✗	✗	✓*
Stimulus Control	✓***	✓***	✓*	✓*
Contingency Management	✗	✗	✗	✗
Self-re-evaluation	✗	✓***	✓*	✓***

*Significant at < .05 **Significant at < .005 ***Significant at < .001

The self-efficacy construct showed that for some types of change, ease of changing was a more important element of whether the change took place. For those who reduced the number of commute journeys, working from home was considered to be an easier change to make. Also, for the re-moding group, changing the mode of travel was significantly more likely to be considered easier by those that did re-mode. In contrast, for re-routing and re-timing journeys, there was no significant difference between individuals that changed and those that did not, and whether they found making the change easier or more difficult. Interestingly, analysis of the pre-Games variability in commute journeys found that individuals in the sample were less likely to occasionally or frequently change their mode suggesting that this type of change is more limited to those with a greater self-efficacy.

The initial findings from the analysis prompted further analysis of the data through a two-step cluster analysis. These were created based on the responses to the processes of change and self-efficacy items. This showed that these clusters did not relate to the self-reported stages of change suggesting that they were independent of the stages. Importantly, the clusters have provided greater insights into the constructs of the TTM that may be more appropriate for understanding change in this context. Furthermore, this research has also demonstrated that the types of change related in different ways to the processes of change and self-efficacy items, indicating how these may need to be considered differently when approaching travel behaviour change.

The next two chapters of this thesis will examine the following two points of interest. The first chapter will examine the non-work and business journeys of the sample. This is to understand whether changes observed for commute journeys were mirrored in other types of

journeys that were made. The second chapter will present the findings from the fourth wave of the panel survey in order to establish the longitudinal travel behaviour of the sample.

Chapter Seven

Non-work and Business Journeys

7.1 Introduction

Chapter 6 has provided a detailed analysis of commute journeys during the London 2012 Olympic and Paralympic Games. It has shown that a large proportion of the sample made a change to their commute journey. Owing to the large scale and wide-ranging impacts of the Games, it is reasonable to also expect large amounts of change for non-work and business travel. It is therefore hypothesised that, similarly to the commute journey, there would be an extensive amount of change to both business travel and non-work journeys during the Games. Business travel relates to the trips made as part of the individuals job and can include trips for meetings (e.g. to another office or with a customer) or to visit suppliers. Non-work journeys in this case refer to journeys made for shopping, leisure, and personal business. Journeys for education are a further potential trip that could have been studied. This was not included here however because (a) the sample included only those in employment and (b) the majority of the Olympics and Paralympics period took place during school holidays and therefore vastly reducing the occurrence of such trips.

This chapter will assess the types of change that occurred for these different journeys to provide a comparison to the levels of change observed in the commute journeys. This includes: reducing, re-moding, re-timing and re-routing journeys. This will help to show the extent to which non-work journeys and business travel were affected, and whether the sample responded to the disruption in similar ways as they did for the commute. The more discretionary nature of these journeys means that reducing travel may be a far more common change although this is not certain.

The first part of the chapter will examine business travel before moving on to explore other non-work journeys. The TTM was a central element of the previous chapter but was not asked in the context of non-work journeys or business travel and therefore does not feature in this chapter. The sample examined in this chapter is the same as in Chapter 6 and therefore the characteristics of the sample, as detailed in Section 6.2.1, are identical.

7.2 Business travel

Not all individuals are required to make business journeys and the extent to which people must travel for work may vary from person to person. Assessing the frequency at which individuals in the sample travelled prior to the Games is the first step in understanding the extent of change that occurred during the Games. Table 7.1 shows that 16.3% of the sample reported making business journeys at least 5 days per week prior to the Games. In fact, a total of 36.4% of the sample regularly travelled for business, making at least one journey per week.

A large proportion of the sample travelled infrequently, suggesting that they were far less likely to have been affected by the shorter-term nature of the Games time disruption. For example, 13.5% reported making journeys at least once per month but less often than once per fortnight. In total 33.1% of the sample were classed as travelling infrequently. The remaining 30.5% of the sample travelled rarely or never with a large proportion of this sub-group never making business journeys.

Table 7.1: Frequency of business journeys pre-Games

Frequency of business journeys	%	Sub-group
5 or more days a week	16.3	Travel Regularly
3 or 4 days a week	7.2	
2 days a week	7.2	
1 day a week	5.7	
Total	36.4	
At least once a fortnight	8.9	Travel Infrequently
At least once a month	13.5	
At least once a year	10.7	
Total	33.1	
Less than once a year	4.3	Travel Rarely/Never
Never	26.1	
Total	30.5	

Analysis of how individuals in the sample responded to the Games indicated that 32.8% made a change to how they usually travelled for business travel. This compares to 54% of people who made a change to their commute journeys during the Games (TfL, 2013b). This difference is undoubtedly affected by the fewer numbers of individuals who actually make business journeys (not all will be required to do so as part of their job). Of the 32.8% who changed their business travel during the Games, 74.4% were those individuals who reported making at least one business journey per week (Travel Regularly). This suggests that a large

proportion of regular travellers found themselves making a change during the Games. Further investigation of this, using Pearson's chi-square tests[20], found that individuals in the 'Travel Regularly' group were significantly more likely to have made a change to their business travel during the Games ($\chi^2\ (2) = \ 383.655, p < .001$).

An analysis was made of the key socio-demographic variables that may have an underlying relationship with whether a person changed their business travel or not. Pearson's chi-square tests were conducted and showed that there were no significant differences, which suggests that these variables were not important factors in determining whether change occurred. These results are shown in Table 7.2.

Table 7.2: Key socio-demographics by change in business travel

Variable	χ^2 - value	p - value
Age	9.091	.154
Gender	1.529	.216
Household structure	5.987	.308
Household income	15.499	.161
Num. employed in business	.615	.893
Access to bicycle	9.424	.051
Access to car	7.831	.098

The adaptability of travel was also examined, focusing on whether individuals had made a change to their business journeys over the previous 12 months in response to disruptions or delays. The analysis of this showed that changing mode was the most common response to disruption with 30.1% doing so. Delaying journeys was also a common method of response with 13.4% of the sample postponing their business travel. Furthermore, 12.0% of the sample cancelled journeys in response to disruptions. These findings indicate that many people in the sample were already able to make changes to business travel in response to disruption.

Having first outlined the changes to business travel at the broader level, this chapter will now move on to examine the specific types of change available to individuals during the Games. This will establish whether there are any relationships between changing for the commute journey and for business travel.

[20] Pearson's chi-square tests have been used for the purpose of making examinations of the differences between those that changed and those that did not.

7.1.1 Reducing business journeys

The previous chapter illustrated that reducing the number of journeys was the most common change that was made to commuter travel during the Games (31% of individuals doing so). The analysis conducted found that even individuals with less preparedness to change (pre-contemplators) were still likely to reduce travel. This suggests that it was a highly feasible change for all individuals to make. In terms of reducing business travel, 28.5% of individuals in the sample reported travelling less than usual during the Games. This means that nearly all of those who changed business travel (32.8% of the total sample) did so by reducing the number of journeys they made. These findings suggest that reducing journeys was the dominant change made and this therefore leads to questions as to why this was the case. Although it should be noted that individuals may have made more than one type of change.

It was found that there was a significant relationship between reducing commute journeys and reducing business travel. The analysis showed that 41.6% of those who reduced their business travel had also reduced their commute journeys. Pearson's chi-square tests indicated that significantly more individuals than expected (were there no association between the variables) reduced both business and commute journeys ($\chi^2\,(1) = 14.532, p < .001$). It should also be noted that reducing business travel is potentially influenced by other individuals. For example, if another person reduces their travel, then the possibility of a meeting occurring may diminish.

Pearson's chi-square tests were also conducted for key socio-demographic variables and whether individuals reduced the number of journeys they made during the Games. As with overall change, there were no significant associations found with these key variables suggesting that they did not influence whether the number of journeys were reduced, as shown in Table 7.3.

Table 7.3: Key socio-demographics by reduction in business travel

Variable	χ^2 - value	p - value
Age	6.688	.245
Gender	1.038	.308
Household structure	4.490	.481
Num. employed in business	.339	.953
Access to bicycle	6.055	.195
Access to car	4.726	.317

7.1.2 Re-timing business journeys

Changing the time at which people travelled for commute journeys during the Games was a popular change that was made with 25% of people doing so (TfL, 2013). In comparison, only 2.7% of the sample altered the time at which they made business journeys during the Games. This significantly reduced figure suggests that re-timing was a far less practical or relevant change to make for business travel. These journeys would be likely to be made outside of the morning and evening peaks and therefore, on the occasions they were made, it is likely it was less necessary to re-time.

In order to understand more about the relationship between change for business travel and for the commute journey, a Pearson's chi-square test was conducted. This indicated that there was a significant relationship between these two types of change. More specifically, this showed that individuals who had changed the time at which they travelled for their commute during the Games were significantly more likely to have changed the time at which they travelled for business journeys ($\chi^2\ (1) = \ 14.181, p < .001$). As in the previous sections of this chapter, Pearson's chi-square tests have again been conducted to examine whether there are differences in the socio-demographics of those changing and those not. For the re-timing of journeys, it was found that there were no significant differences between these two groups. The results of this analysis are shown in Table 7.4.

Table 7.4: Key socio-demographics by re-timing business travel

Variable	χ^2 - value	p - value
Age	4.570	.471
Gender	.951	.329
Household structure	5.394	.370
Num. employed in business	2.139	.544
Access to bicycle	4.791	.309
Access to car	6.608	.158

7.1.3 Re-routing business journeys

As with re-moding, changing the route of travel for commute journeys was shown to be a less common change to make owing to the greater ability needed to make the change. This was reflected by the 16% who made a change during the Games (in contrast to the 31% who reduced commute journeys). 2.6% of individuals in the sample changed their route for business travel, highlighting that this was a far less utilised option for changing business travel.

With regard to the comparison between changing route for commute journeys and for business travel, Pearson's chi-square tests were conducted and found that there was a significant association. More specifically, this showed that individuals who re-routed their commute journeys during the Games were significantly more likely to have also changed their route for business travel ($\chi^2\ (1) = \ 41.768, p < .001$).

The examination of the differences in socio-demographics for those that changed their route and those that did not indicated that there was a significant difference in terms of age. More specifically, Pearson's chi-square tests (displayed in Table 7.5) showed that significantly more individuals aged between 55 and 64 than expected stated that they changed their route for business journeys during the Games.

Table 7.5: Key socio-demographics by re-routing business travel

Variable	χ^2 - value	p - value
Age	16.021	**.007**
Gender	.632	.427
Household structure	5.308	.379
Num. employed in business	1.645	.649
Access to bicycle	5.834	.212
Access to car	3.684	.450

7.1.4 Re-moding business journeys

In Chapter 6 it was reported that 11% people made a change to the mode they used for their commute journeys. This is a smaller figure than the numbers that reduced their commute journeys and reflected the need for an extra level of ability to be able to make changes to the mode used. In terms of business travel, only 2.7% of the sample changed the mode by which they travelled. The modal shift observed, shown in Figure 7.1, indicated that there was a move away from the London Underground/DLR and an increase of walking and cycling during the Games. Interestingly, this was similar to the modal shift that occurred in commute journeys. However, the small proportion of individuals changing mode during the Games (n= 31) means that there is only limited value in examining the amount of modal shift.

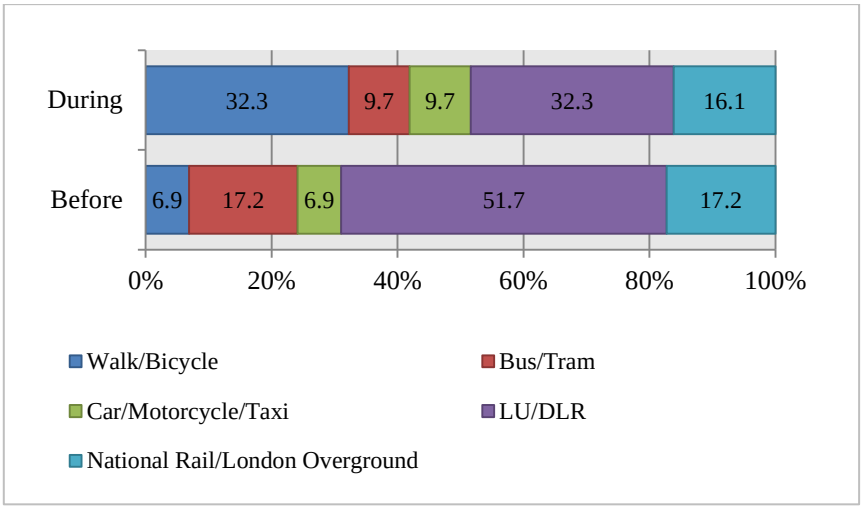

Figure 7.1: Modal-shift for business travel before and during the Games

Examination of the relationship between re-moding for commute journeys and for business travel showed that there was a significant association. A Pearson's chi-square tests found that those individuals who re-moded their commute journeys were significantly more likely to have also re-moded for their business journey ($\chi^2\ (1) = 53.978, p < .001$). Pearson's chi-square tests were also conducted to examine whether there were differences in the socio-demographics of those that re-moded for business and those that did not. These results are displayed in Table 7.6, and these showed that, as with reducing journeys, there were no significant differences in these variables.

Table 7.6: Key socio-demographics by re-moding business travel

Variable	χ^2 - value	p - value
Age	8.240	.143
Gender	.617	.432
Household structure	2.563	.767
Num. employed in business	.339	.953
Access to bicycle	3.576	.466
Access to car	.836	.934

7.3 Non-work journeys

This chapter will now consider non-work journeys in order to establish how they differ from both business travel and commute journeys. TfL (2013b) highlight that non-work journeys account for 76% of all journeys on an average day in London. However, unlike the daily commute, these journeys do not have clear morning and evening peaks. The non-work

journeys considered here include three different possible journey purposes: leisure, shopping and personal business.

Prior to the Games, the majority of individuals in the sample made these non-work journeys regularly. Table 7.7 provides an overview of the frequency at which these journeys were made, split by the three journey purposes considered. Travel for leisure purposes was shown to have the highest number of people travelling, with 85.6% of the sample making a journey for this purpose. 53.5% of the sample travelled for leisure purposes at least once a week. In terms of shopping, the figures are similar albeit with fewer people reporting travelling at least once a week (42.8%). Finally, with regard to personal business, far more individuals reported never making journeys for this purpose and only 30.5% made personal business journeys once a week or more. This indicates that personal business was a far less common journey to be made on a weekly basis.

Table 7.7: Frequency of travel for non-work purposes

	Leisure		**Shopping**		**Personal Business**	
	Freq. of travel (%)	Change (%)	Freq. of travel (%)	Change (%)	Freq. of travel (%)	Change (%)
More than 5 days a week	2.3	28.0	2.2	37.5	2.3	52.2
5 days a week	1.1	41.7	0.8	55.6	0.7	57.1
4 days a week	3.7	27.5	0.7	25.0	1.6	68.8
3 days a week	8.6	30.9	3.4	35.1	3.8	63.2
2 days a week	15.1	31.5	10.3	27.4	7.5	53.9
Once a week	22.7	49.0	25.4	49.5	14.6	59.2
Less than once a week	32.1	8.3	39.7	6.2	32.2	6.2
Never	14.4	7.0	17.6	2.6	37.4	4.0

During the Games, 23.4% of the sample made a change to how they travelled for their leisure journeys. Those travelling more frequently (at least once a week) were shown - based on the descriptive statistics in Table 7.7 – to be more likely to have changed their travel for leisure journeys. The group that made one journey per week were shown in particular to have a large proportion of change with nearly 50% doing so. This accounts for just over 10% of the total sample. Pearson's chi-square tests (shown in Table 7.8) demonstrated that individuals travelling once or twice a week for such journeys were significantly more likely to have changed during the Games. There were no significant differences between change and no change for those travelling more frequently (3 days per week or more). For these individuals change may not have been an option or relevant to them.

20.3% of the sample made a change to how they travelled for shopping trips. The group of most interest are those that reported travelling for one journey per week, which made up 25.4% of the sample. Nearly half of this sub-group made a change to how they travelled for shopping trips. As the result in Table 7.8 show, Pearson's chi-square tests confirmed this difference was statistically significant.

Changing behaviour for personal business journeys followed a similar trend to that observed for leisure and shopping journeys. During the Games, 18.9% of the sample made a change to how they travelled for these journeys, which sits between the changes made for leisure and for shopping. Personal business journeys were far less common than leisure or shopping (69.6% of the sample either travelling infrequently or never). During the Games, large proportions of the frequent travellers made changes to how they travelled, even more so than for leisure and shopping (although the small numbers of people travelling in these categories should be noted). A Pearson's chi-square test was conducted and this showed that those travelling more frequently were significantly more likely to have changed how they travelled during the Games.

Table 7.8: Pearson's chi-square test results for change to non-work journeys

Variable	χ^2 - value	p - value
Leisure	165.344	< **.001**
Shopping	251.686	< **.001**
Personal Business	366.919	< **.001**

To examine whether there were differences in the socio-demographics of those who changed for non-work journeys and those that did not, Pearson's chi-square tests were conducted. This showed that, unlike business travel, there were some variables that were found to differ significantly between changers and non-changers. For travel for leisure purposes, it was found that there was a significant difference in terms of household structure. More specifically, individuals in a couple with children were significantly less likely to have changed for this purpose. On the other hand, those individuals who were a lone parent with a child or in a household with two or more unrelated adults were significantly more likely to have changed their leisure travel. This suggests that there may be more flexibility for parents to adapt for such journeys when there is more likelihood of a significant other to share responsibilities with. Table 7.9 also shows that there was a significant difference with regard to access to bicycles. Interestingly, this indicated that individuals in households with access to one or two bicycles were significantly less likely to

change their travel for leisure journeys. This suggests that access to bicycle was not an influencing factor in whether travel behaviour changed.

Table 7.9: Socio-demographic variables and non-work journeys

Variable	Leisure		Shopping		Personal Business	
	χ^2 - value	p - value	χ^2 - value	p - value	χ^2 - value	p - value
Age	8.594	.126	7.326	.197	1.337	.931
Gender	2.816	.093	6.956	**.008**	.121	.728
Household structure	24.460	**<.001**	11.991	**.035**	4.540	.475
Num. employed in business	3.486	.323	3.781	.286	2.281	.516
Access to bicycle	18.005	**<.001**	4.289	.368	8.212	.084
Access to car	3.730	.444	5.034	.284	2.853	.583

The other significant relationships that were found related to changes for shopping trips. It was shown that there was a gender split for those making a change for these journeys, with females significantly more likely to have changed during the Games. There was also found to be a significant relationship between household structure and whether change occurred. More specifically, this showed that significantly more individuals in a household with two or more unrelated adults changed how they travelled for shopping than would have been expected were there no relationship.

With few socio-demographic variables demonstrating significant differences between those who changed and those that did not, it is apparent that these factors are less relevant to change occurring. With regard to making changes to travel, between 20.9% and 24.3% made changes to non-work journeys. This compares to 36.4% changing business travel and 54% changing their commute journey. Furthermore, the changes observed for non-work journeys highlights the increased need for those more regular travellers to change during the Games. Given the short-term nature of the Games, it would be expected that those individuals who normally travelled less may well have had less exposure to disruption for these particular journeys thereby explaining the behaviour observed. The chapter will now examine changes to non-work journeys more specifically.

7.1.5 Reducing non-work journeys

Reducing journeys has been shown to be the most common change that was made for both commute journeys and business travel. In terms of non-work journeys, 14.8% of the sample reduced the number of leisure journeys they made during the Games. Over three-quarters of this group (76.1%) were frequent leisure travellers (usually travelling at least once per

week) who did not travel at all during the Games. The remaining proportion of this group included those that still travelled but reduced the number of journeys. A similar proportion of the sample reduced the number of shopping journeys (13.8%). 11.4% were regular travellers that did not travel and 2.4% were those that reduced journeys. 14.6% of the sample reduced their personal business journeys. The majority of this group were regular travellers who did not travel during the Games indicating that there was an emphasis on not travelling at all during the Games for these purposes.

Pearson's chi-square tests were conducted to examine whether there was a relationship between changing for the commute journey and also reducing non-work journeys. As Table 7.10 shows, there were no significant relationships observed, which meant that those who reduced during the Games were no more likely to have reduced their non-work journeys than their commute journeys during the Games.

Table 7.10: Pearson's chi-square test results for reducing non-work journeys

Variable	**χ^2 - value**	**p - value**
Leisure	1.220	.543
Shopping	5.158	.076
Personal business	.897	.639

To establish whether there were any relationships with key socio-demographics, comparisons were made with each of the non-work journeys examined. It was shown earlier in this section that few socio-demographic variables had significant relationships when compared to overall change for these non-work journey purposes. As Table 7.11 shows, the Pearson's chi-square tests that were conducted indicated that the results from the overall change were reflected for reducing journeys with no significant differences between those that reduced and those that did not.

Table 7.11: Socio-demographic variables and reducing non-work journeys

Variable	**Leisure**		**Shopping**		**Personal Business**	
	χ^2 - value	p - value	χ^2 - value	p - value	χ^2 - value	p - value
Age	10.119	.430	5.502	.855	3.704	.960
Gender	1.078	.583	4.214	.122	.059	.971
Household structure	15.489	.115	11.365	.330	12.629	.245
Num. employed in business	7.232	.300	5.420	.491	8.539	.201
Access to bicycle	14.643	.066	13.810	.087	10.273	.246
Access to car	13.942	.083	12.288	.139	9.378	.311

7.1.6 Re-timing non-work journeys

Changing the time of travel for commute journeys was a prominent change that was made during the Games with 25% doing so. Far fewer individuals changed their time of travel for business journeys (2.7%). For leisure travel this figure was similar with 2% re-timing their travel for this purpose. 2.8% changed the time at which they travelled for shopping trips, and 1.9% changed for personal business.

Continuing the comparisons being made to commute journeys, Pearson's chi-square tests showed that there was no relationship between re-timing for leisure purposes and for commute journeys; the same was applicable for shopping journeys. In contrast, it was found that those who re-timed their commute journey were significantly more likely to have re-timed for personal business. These results are shown in Table 7.12.

Table 7.12: Pearson's chi-square test results for re-timing non-work journeys

Variable	**χ^2 - value**	**p - value**
Leisure	2.217	.136
Shopping	3.496	.062
Personal business	8.358	**.005**

Continuing the approach of this chapter, socio-demographic variables were examined to establish whether there was a significant difference in terms of those that changed and those that did not. These results are shown in Table 7.13. As with reducing journeys, there were no significant relationships found, which may indicate that those who re-timed their non-work journeys were not distinguished by their socio-demographics.

Table 7.13: Socio-demographic variables and re-timing non-work journeys

Variable	**Leisure**		**Shopping**		**Personal Business**	
	χ^2 - value	p - value	χ^2 - value	p - value	χ^2 - value	p - value
Age	2.045	.843	.642	.986	1.688	.890
Gender	1.009	.315	.006	.937	.210	.647
Household structure	7.180	.208	1.568	.905	5.889	.317
Num. employed in business	1.938	.585	3.602	.308	.892	.827
Access to bicycle	2.977	.562	.343	.987	2.280	.684
Access to car	5.344	.254	4.576	.334	4.409	.353

7.1.7 Re-routing non-work journeys

Re-routing was found to be one of the least common changes made to both commute journeys and business travel during the Games. Continuing this trend, few people made changes to the route they used for non-work journeys during the Games. 3.7% of the sample changed their route for leisure journeys and 2.5% changed for personal business purposes. Only 1.9% made a change to their route for shopping trips.

The Pearson's chi-square tests that were conducted demonstrated that there was a link between re-routing for leisure and personal business and re-routing the commute journey. The results presented in Table 7.14 demonstrate that there was a statistically significant relationship, with those who changed their route during the commute more likely to have also done so for these particular journey purposes. In contrast, no relationship was found for shopping journeys, although this may be attributable to the low proportion of the sample making this change (2.6%).

Table 7.14: Pearson's chi-square test results for re-routing non-work journeys

Variable	χ^2 - value	p - value
Leisure	12.633	**<.001**
Shopping	1.059	.303
Personal business	11.805	**<.001**

Table 7.15 provides an overview of the results of the Pearson's chi-square tests that were conducted to examine whether there were any significant differences in the key socio-demographics of those that re-routed compared to those that did not. This indicates that, whilst there were no significant relationships for leisure and shopping trips, age and household structure did produce significant results for personal business travel. More specifically, this indicated that individuals aged 45-54 were significantly more likely to have changed their route for personal business trips. Furthermore, individuals in lone parent with children households were found to be significantly more likely to have altered their route for personal business journeys, which indicates an emerging trend amongst this sample. Individuals in this particular household have also been found to be significantly more likely to have made a change for leisure trips and also, more specifically, for re-moding their leisure journeys.

Table 7.15: Socio-demographic variables and re-routing non-work journeys

Variable	Leisure		Shopping		Personal Business	
	χ^2 - value	p - value	χ^2 - value	p - value	χ^2 - value	p - value
Age	4.246	.515	4.301	.507	11.250	**.047**
Gender	2.012	.156	.593	.441	.017	.897
Household structure	7.411	.192	9.565	.089	22.583	**<.001**
Num. employed in business	3.311	.346	1.292	.731	4.228	.238
Access to bicycle	6.640	.156	6.284	.179	6.382	.172
Access to car	6.272	.180	7.574	.109	2.997	.558

7.1.8 Re-moding non-work journeys

Making changes to mode for non-work journeys during the Games was shown to be limited to only a small proportion of the sample, echoing the findings from business travel. 4.8% of the sample changed mode for their leisure journeys. 3.3% of the sample changed their mode for shopping journeys, whilst only 2% changed for personal business.

Pearson's chi-square tests identified a relationship between those changing for non-work journeys and those who changed mode for the commute during the Games. As Table 7.16 shows, the tests indicated that there was a statistically significant relationship, with those who re-moded during the Games more likely to have also re-moded for non-work purposes.

Table 7.16: Pearson's chi-square test results for re-moding non-work journeys

Variable	χ^2 - value	p - value
Leisure	16.340	**<.001**
Shopping	8.321	**.004**
Personal business	366.919	**.002**

Further analysis was conducted to examine the relationship between changes in mode and key socio-demographics, shown in Table 7.10. These indicated that on only two instances were there significant differences in those that changed mode and those that did not, as examined through Pearson's chi-square tests. Firstly, for changes to leisure journeys, lone parents with children were significantly more likely to have re-moded. This mirrors the findings from overall change to leisure journeys, as detailed in Table 7.8. Secondly, for journeys for shopping purposes, individuals aged 18 to 24 were significantly more likely to have changed mode.

Table 7.17: Pearson chi-square tests for socio-demographic variables and re-moding non-work journeys

Variable	Leisure		Shopping		Personal Business	
	χ^2 - value	p - value	χ^2 - value	p - value	χ^2 - value	p - value
Age	8.121	.150	11.825	**.037**	.413	.995
Gender	.523	.469	2.941	.086	.000	.996
Household structure	11.617	**.040**	2.480	.780	1.555	.907
Num. employed in business	1.052	.789	1.529	.676	.586	.900
Access to bicycle	4.979	.289	3.119	.538	5.367	.252
Access to car	6.596	.159	1.110	.893	.879	.928

7.4 Conclusion

The results presented in this chapter have shown that much smaller proportions of individuals in the sample were found to have changed their business travel and non-work journeys, in comparison to the degree of change observed for commuter journeys. This is perhaps most likely to be a reflection of both the context within which these journeys were made (i.e. mainly outside of the peak period), and the more discretionary nature of these journeys.

Considering business travel first, the majority of people who changed their business travel did so by reducing their journeys, as shown in Table 7.18. This suggests that the cancellation or postponement of journeys was a common occurrence, which reiterates the more discretionary nature of these trips. People may have also chosen to teleconference instead, which would have contributed to a reduction in journeys.

Table 7.18: Frequency of changes made to all types of journeys

Type of change	Journey purpose (%)				
	Commute[a]	Business Travel	Leisure	Shopping	Personal Business
Overall change	54.0	32.8	23.4	20.3	18.9
Reduced journeys	31.0	28.5	14.8	13.8	14.6
Changed mode	11.0	2.7	4.8	3.3	2.0
Changed route	16.0	2.6	3.7	1.9	2.5
Changed time	25.0	2.7	2.0	2.8	1.9

[a] Figures sourced from TfL (2013b)

Making changes to business travel by re-moding, re-timing or re-routing were very uncommon changes, which suggests that they were either not affected by the Games or the

trip was reduced rather than the individual find alternative modes of travel, different routes, or altering the time at which they travelled. Where changes to mode did occur, it was observed that there was an increase in walking and cycling, which echoed that of the commute journey suggesting that there was a broader trend of movement towards these modes during the Games. Interestingly, in the 12 months prior to the Games, 30.1% of the sample had changed their mode for business travel in response to a disruption. In contrast, 13.4% had delayed a business journey and 12% had cancelled it. This suggests that, whilst re-moding is typically a feasible option for responding to a disruption to a business journey, the conditions during the Games greatly decreased the likelihood of changes to mode occurring, with reducing a more favourable option.

Overall, changes to non-work journeys were less common during the Games than commute or business travel. Between 18.9% and 23.4% of the sample made changes to non-work journeys. Reducing was again the most common change, which reflects the discretionary nature of these trips. What is of most note is that changes to mode, route or time of travel was similar to the degree of these change observed for business travel. In fact, as Table 7.18 shows, changes to mode and route for leisure journeys were more common than those made for business travel. The same was found for re-moding shopping trips. Whilst these figures do not differ greatly, it does help to demonstrate the differences in how people responded to business travel and non-work journeys.

At the beginning of this chapter, it was hypothesised that similar proportions of change would occur to business travel and non-work journeys to those observed for commute journeys. This chapter has shown that whilst reducing was clearly a highly popular option of change for all journey types studied in this research, the other types of change available were far less likely to be used than they were for commute journeys. Business travel and non-work journeys may have been less affected by the Games owing to the location the trips are made and the time of day they occur. However, it is clear from the degree of change in these journeys that many individuals believed there was a need to change (specifically by reducing), and therefore did so.

Given the much smaller proportions of individuals making changes to the mode or route used and the times at which other journeys were made it is reasonable to conclude that in this context, postponing or cancelling travel was the more plausible change to make over the relatively short-term period the Games took place.

Chapter Eight

An Examination of the Longer-Term Travel Behaviour

8.1 Introduction

This chapter reports on the findings of the fourth wave of the panel survey, and also provides a more detailed discussion of the evidence of sustained behaviour change. This survey wave was conducted in February and March 2014, 15 months after the third wave. The purpose of this fourth survey was to examine the current commuter travel patterns in the sample, which can contribute to the understanding of longer-term travel behaviour in the context of a large-scale disruption. The survey also featured items to examine the behavioural response of individuals in the sample to a further disruption; the London Underground workers strike in February 2014 (BBC, 2014b).

This chapter will present analysis of these surveys items, which helps to build a picture of the situation in London a significant period of time after the Games had ended. The chapter will first examine the travel behaviour of commuters, as reported in Wave 4. It will then present the analysis of the data collected relating to the London Underground strike. Finally, the chapter will conclude by discussing the salient points relating to sustained behaviour change, reflecting on the evidence from the wider panel survey.

8.2 The Wave 4 survey

The content of the survey has been described in detail in Chapter 5. However, briefly summarised, it includes examining the current travel patterns of commuters, and changes in circumstances since the third wave survey. Items relating to the TTM were also included in this wave, which provided an understanding of how individuals engaged with the TTM items outside of the Games-time context. The London Underground workers strike that took place at the beginning of February 2014 is also examined through a number of items. This is in order to examine how individuals responded to a further disruption to their travel, although on this occasion it was a disruption that occurred over a different time-scale and had a very different impact on the provision of services in comparison the Games-time situation.

Given the sustained period of time since the end of the previous survey wave (December 2012), a high attrition rate was anticipated. Ultimately, 399 individuals could be contacted

to complete the fourth survey wave. 167 valid responses were received providing a 42% response rate. The survey responses across the four waves are shown in Table 8.1.

Table 8.1: Panel attrition over Waves 1-4

Wave Number	Dates	Sample Size
Wave 1	18th – 26th July 2012	7,194
Wave 2	10th – 28th August 2012	2,805
Wave 3	8th November – 3rd December 2012	1,799[a]
Wave 4	19th February – 9th March 2014	167

a Note that the analysis conducted by the researcher in Chapters 6 and 7 were based on a sub-sample (n = 1,132) of the final Wave 1-3 sample.

The sample from the previous waves of the panel survey, which has been used in the analysis in Chapters 6 and 7, contained only those in employment (this will be referred to hereafter as the 'main sample'). Of the 167 respondents in the follow-up sample, 154 had been in employment at some point over the course of the panel survey, although not necessarily in employment at the time of Wave 4. The remaining 13 people reported not being in employment at all during this period and were omitted from the analysis. The final number of individuals examined in this chapter is therefore 154.

It is acknowledged that due to the much lower sample in the fourth wave, the inferences that can be made are more limited. However, the ability to compare directly to individuals who whose travel behaviour was also examined immediately after the Games is valuable. Unlike the previous three waves, no analysis of the fourth wave survey has been published by TfL to date. Any findings in this chapter, unless referenced, are the result of original analysis conducted by the author for the purposes of the thesis.

8.3 The Wave 4 sample

Although all individuals in the follow-up sample had been in employment at some point during the panel study, 87% of the sample reported being in employment when completing the Wave 4 survey (84% full time, 8% part-time, and 8% self-employed). Since December 2012, 18% of the sample had moved home and 21% had changed the location of their workplace. These two changes in circumstance appear relatively unconnected, with only 5% of the sample reporting that they had experienced both. This suggests that approximately a third of the sample had experienced a significant change in circumstance since the previous survey. Further investigation is warranted to understand how this has impacted on any travel behaviour changes that have been observed.

The variability in peoples work journeys prior to the start of the Games was examined in Chapter 6. Individuals in the fourth wave were asked the same questions to understand whether this aspect of peoples travel had changed over the course of the panel survey. Table 8.2 details the results from both waves. This shows that the proportions of the sample are similar in both waves, although there is a slightly higher proportion of individuals travelling in the same way every day in the fourth wave.

Table 8.2: Variability in usual commute journey (Wave 1 and 4)

Variability in commute journey	**Wave 1 (%)**	**Wave 4 (%)**
Always travel in the same way to work	24	30
Always try to travel to work in the same way and only change when they have to	45	38
Sometimes vary the way they make their journey	27	28
Often vary the way that they make their journey	4	4

The descriptive statistics were explored to understand the background to the sample and the characteristics of the individuals within it. Table 8.3 provides an overview of the key socio-demographic variables with the main sample data also included to add a comparison. The follow-up sample has slightly fewer younger people and fewer males. There is also a more even distribution amongst the different levels of household income in the Wave 4 sample; with the main sample having a higher proportion of higher earners. The occupation types and industry sector individuals were employed in were also similar; as was the size of the business employed in (58% of the sample was employed by larger businesses). Access to cars and bicycles was also very similar between the two samples.

Table 8.3: Descriptive statistics for key socio-demographic variables (Waves 1-3 and Wave 4 samples)

Socio-demographic	Wave 4 sample (%)	Sample (%)
Age		
18-24	5.8	4.0
25-34	25.3	31.2
35-44	28.6	27.6
45-54	24.7	25.0
55-64	13.6	11.4
> 65	1.9	0.8
Gender		
Male	44.8	47.9
Female	55.2	52.1
Household structure		
One person household	21.6	19.4
One family household - Couple with no children	29.4	34.1
One family household - Couple with children	26.1	27.7
One family household - Lone parent with children	3.9	3.1
Two or more unrelated adults	13.1	13.2
Multi-family households	5.2	2.5
Household income		
Lower (£0 – 40,000)	30.1	20.5
Middle (£40,000 - £80,000)	39.0	45.6
Upper (> £80,000)	30.9	33.9
Occupation type		
Manager and senior official	32.0	29.8
Professional occupation	34.6	35.9
Associate professional and technical occupation	7.8	7.1
Administrative and secretarial occupation	12.4	18.1
Skilled trades occupation	0.0	1.2
Personal service occupation	1.3	0.6
Sales and customer service occupation	5.2	2.6
Process plant and machine operative	0.0	0.1
Elementary occupation	0.0	0.4

Socio-demographic	Wave 4 sample (%)	Sample (%)
Industry sector		
Agriculture and Fishing	0.0	0.1
Mining and Quarrying	0.0	0.2
Manufacturing	1.9	2.0
Electricity; gas and water supply	1.9	0.9
Construction	5.1	4.8
Wholesale and retail trade; repair of motor vehicles	3.2	3.7
Hotels and Catering	3.8	1.9
Transportation	3.2	3.8
Financial and Business services	20.5	23.9
Real estate; renting and business activities	1.3	1.8
Public administration and defence	8.3	10.2
Education	9.0	9.7
Health and social work	8.3	7.2
Creative Industries	5.8	10.1
Charity/Not for profit	3.8	3.2
ICT	2.6	5.1
Law	1.9	3.2
Other	19.2	8.3
Num. employed in business		
< 250	42.2	40.5
> 250	57.8	59.5
Num. of cars/vans with access to		
None	31.8	33.0
1	42.2	43.2
2	19.5	17.7
3	3.9	4.6
> 4	2.6	1.4
Num. bicycles with access to		
None	55.8	51.9
1	22.7	23.9
2	15.6	15.1
3	4.5	5.1
> 4	1.3	4.0

8.4 Commuter travel behaviour post-Games

The first step in developing an understanding of the longer-term travel behaviour situation is to explore the most recent travel patterns of the sample. The Wave 4 survey sought to establish how individuals were currently travelling and whether they had made changes to their travel since December 2012 (the date that the third survey wave ended). This was with the purpose of understanding (a) what the broader travel patterns were amongst the sample in the longer-term and (b) whether changes made during the Games had continued to be sustained. The former will be examined in this section, whilst the sustained change will be discussed in Section 8.7.

In the fourth survey wave respondents were asked to detail the amount of time they spent at different locations during their working week. This showed that the sample was spending, on average, 4.2 days per week at their usual workplace, 0.6 days at home and 0.4 days working elsewhere. These results will be examined further later in the chapter in comparison with the previous surveys to seek to understand more about sustained change in the travel patterns of the sample.

8.1.1 Mode

During the Games there were shifts in the modes used for commute journeys, with TfL (2013b) reporting that, for example, there was a greater utilisation of walking and cycling. Figure 8.1 below illustrates the mode split in Wave 3, a short while after the end of the Games. In the fourth wave respondents were asked to state whether they had made any changes to their main mode since the end of the Games. 57.0% of the sample stated that they had changed their mode at some point although only 11.3% had done this more than occasionally. This includes the 8.6% of the sample who had changed modes permanently. Interestingly, when compared to whether an individual had moved homes during the same period, it was shown that 6.5% of those who had moved had also changed their mode of travel permanently. This suggests a correlation between changes in circumstance and changes in mode of travel.

Figure 8.1 provides an overview of the mode share amongst the Wave 4 sample in both the third and fourth waves. It also includes the alternative mode that those who changed, either occasionally or permanently, had used instead. Considering the Wave 3 and Wave 4 mode split, this shows that there was a relatively limited degree of change at the aggregate level. The only discernible change was a slight increase in the use of London Underground/National Rail and a decrease in use of Bus/Tram and London

Underground/DLR. However, given that 48.4% of the sample changed their mode (but not permanently); this indicates that there is a degree of fluidity in the mode choice of individuals. This is shown in the final column in the chart, which relates to the alternative main mode. This shows that the mode split for this differs perceptibly from the broader Wave 4 split. Interestingly, there is greater demand for walking, cycling, buses and trams whilst use of the London Underground/DLR decreases. The increases in use of these modes may suggest that it is these transport options that individuals turn to when they are unable to travel as they usually would (for example, if their usual London Underground line was disrupted).

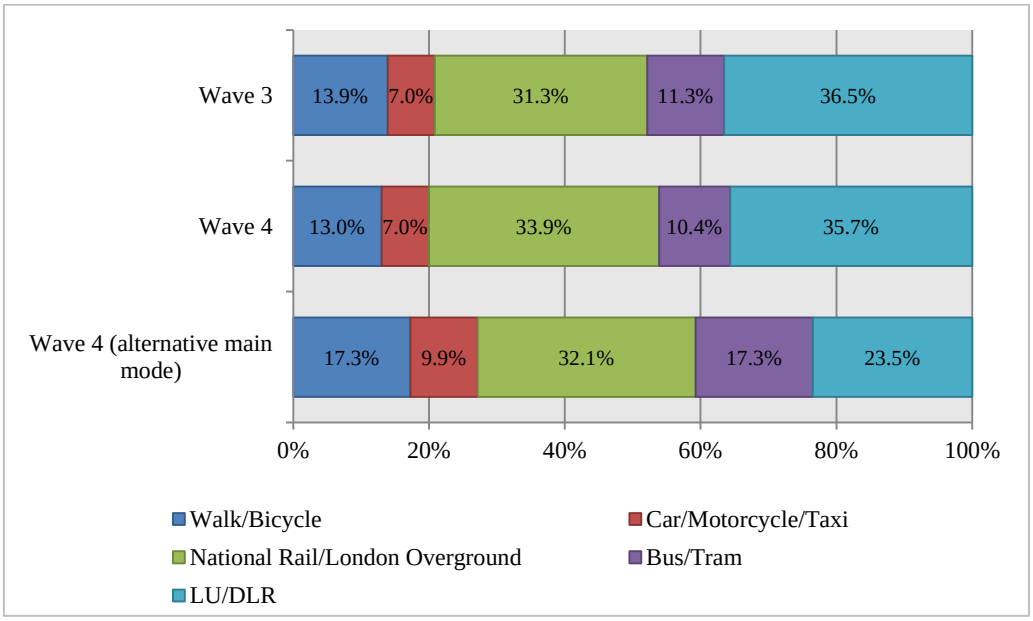

Figure 8.1: Main mode for work - A comparison between Waves 3 and 4

The reasons why changes to mode were made are shown in Figure 8.2. This indicates how avoiding delays on public transport was the most common reason for changing the mode used for commute journeys. However, it is evident that there was no dominant reason why people changed. Avoiding delays, disruption and congestion were clearly common motivations for changing but reducing costs and improving health was also cited, as was feeling like a change to the usual routine.

Figure 8.2 also shows the reasons given for not changing by those individuals who had never or rarely changed their main mode. There was more distinction in this range of questions with 'happy with current modes' by far the most common reason for not changing, suggesting that individuals were largely content with the modes they were using. There being no alternative mode available was the second most common reason, although

some of those selecting this particular reason may have been unaware of the alternatives that were available.

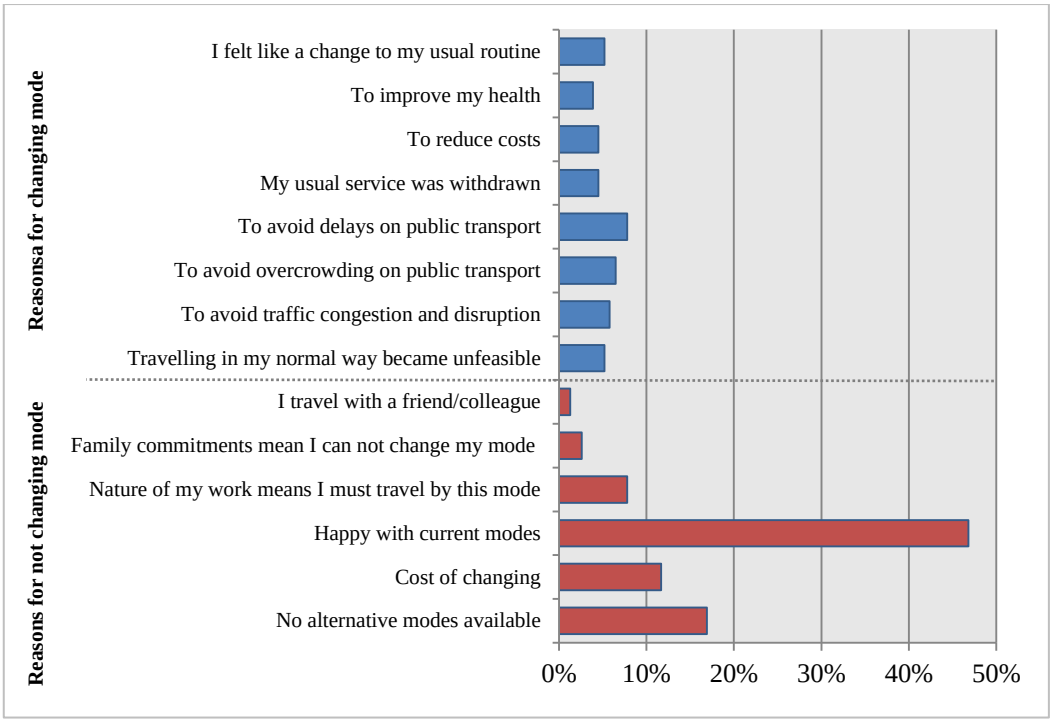

Figure 8.2: Reasons for changing or not changing main mode for commute

In order to understand what differentiates those who changed their mode and those that did not, an examination of the key socio-demographic variables was conducted. Pearson's chi-square tests were carried out on of a number of variables to establish whether there were any significant differences between the two groups. The findings from these statistical tests indicated that there were no statistically significant differences between the two groups, suggesting that these factors did not influence whether change occurred or not. This echoes the findings in the analysis of the sample during the Games, presented in Section 6.3.2.

Table 8.4: Key socio-demographics by change to mode in Wave 4

Variable	χ^2 - value	p - value
Age	3.637	.603
Gender	.734	.392
Household structure	5.809	.325
Num. employed in business	.302	.960
Access to bicycle	9.266	.055
Access to car	1.935	.748

The evidence presented in this section shows that there has been only minor changes to the permanent main mode that individuals used for their commute journeys since the end of the Games. It is apparent that a large proportion of the sample made temporary changes to their usual main mode for commute journeys over the past 15 months. The frequency of these temporary changes in behaviour does vary, but ultimately these findings add further emphasis to the conclusions presented in Chapter 6; that there is a great deal of flexibility in how individuals in the sample travel. Where changes to the main mode have been made, there was a greater focus on walking, cycling, buses and trams.

8.1.2 Time

Altering the time of travel for commute journeys was shown to be a common change during the Games with 25% of people doing so. In the fourth survey wave, the majority of the sample travelled to and from work during peak commute hours. Figure 8.3 shows the usual departure time for the same individuals (n = 109) from the sample in both Wave 1 and 4. In terms of the Wave 4 travel patterns, the figure shows that leaving for work was most common between 07:00 and 07:59. For the return journey, 47.1% of the sample departed from work between 17:00 and 17:59. In contrast to the pre-Games travel times however, there are noticeable differences in when people departed and returned from work, showing how these have altered over time, which demonstrates the churn in travel patterns. Specifically, in the outward journey there is an increase in those who departed for work earlier. For the return journey, the differences are less apparent, although there is a slight increase in those departing later in Wave 4.

Figure 8.3: Usual departure time/return time in Wave 1 and 4

Respondents were asked about what their current working pattern was (i.e. what restrictions they had on the time at which they could arrive at or depart their workplace). This showed that almost half of the sample (45%) was expected to arrive at work at the same time every day. 24.8% were allowed to arrive within a certain timeframe (in this instance between 08:00-10:00). The remainder of the sample included 10.1% who were shift workers and 18.8% who worked 'flexitime', and were therefore unlikely, or unable, to travel at the same time every day. A comparison of the responses between the first and fourth wave of the survey is shown below. A feature of the Games was that a greater amount of flexibility was awarded by employers to enable their employees to adapt their travel behaviour. Given both the unique and short-term nature of the Games, employers were far more willing to allow flexibility in travel during the Games. This was not however anticipated to be a long-term change in how businesses operated, not on a significant scale at least. The findings shown in Figure 8.4 indicate that there has been a slight shift in travel patterns since before the Games, with evidence of more employees having greater flexibility in their travel.

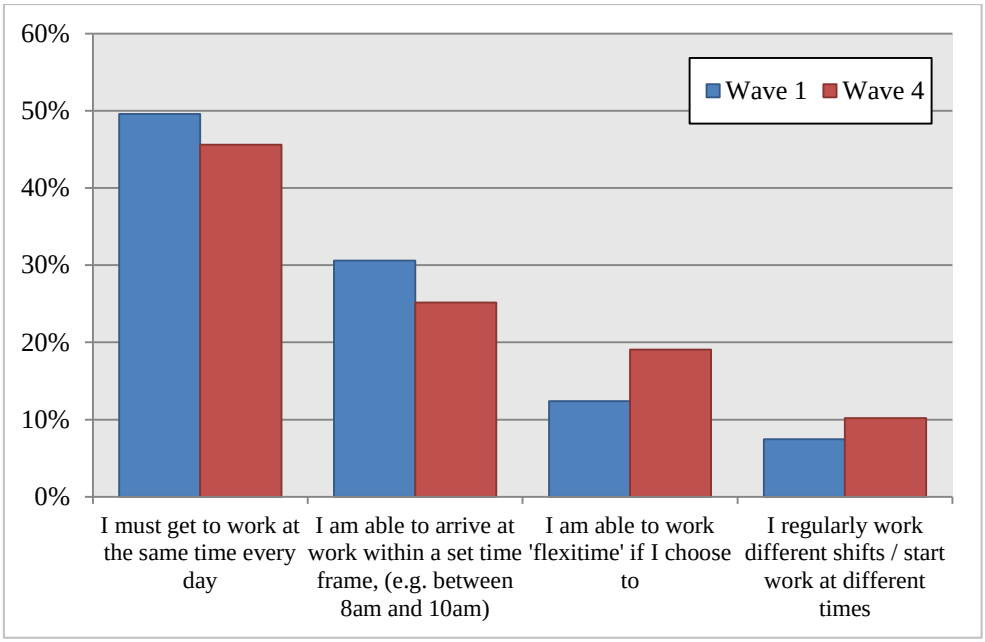

Figure 8.4: Comparison of travel patterns – Wave 1 and Wave 4

In terms of changes in behaviour since the third survey wave, analysis conducted showed that frequent or permanent changes in the time journeys were made were less common (echoing the findings for changes to mode). Figure 8.5 indicates that leaving for work later and departing work earlier were the changes that were more likely to have been made rarely or never. These two changes are more reliant on employer co-operation as they would infringe on the typical hours of the working day. Given that a large proportion of the sample stated that their employers expected them to arrive and depart at certain times, these findings are not unexpected. Interestingly, departing from work later was shown to be a considerably more common change in those changing occasionally or frequently. This suggests that delaying the return journey is more feasible for those displaying flexibility in their travel. In contrast, those who changed permanently were least likely to do so by leaving later.

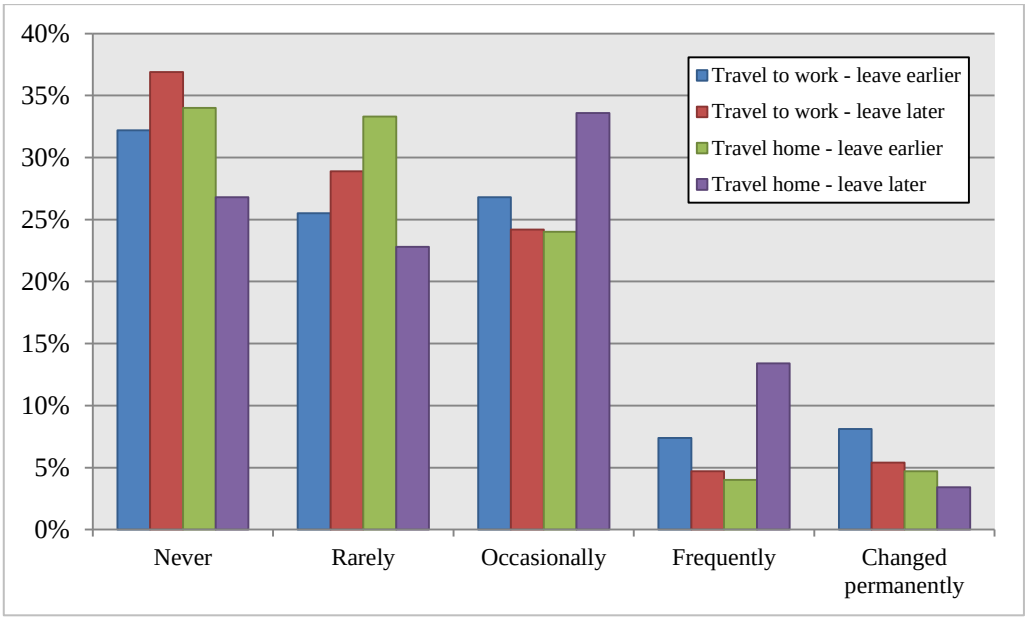

Figure 8.5: Changing time of commute journey

The reasons for making changes to time were considered in order to understand what motivations may have led to the changes observed since the end of the Games. As shown by Figure 8.6, avoiding overcrowding, congestion and disruption were found to be the more common reasons for changing time, as was changing for the purposes of altering the usual travel routine and to reduce stress. Notably, changing due to advice from employers was very uncommon suggesting minimal input from employers. This highlights how, post-Games, the level of support offered by the employer appears low, contrasting with the wide-ranging support that was observed during the Games (see Figure 6.2 in Section 6.3.5.3).

In terms of those that did not change their time of travel, or did so rarely, happiness with the usual routine was shown to be the most common reason. In this instance, the input of employers was shown to be important with restrictions placed on arrival and departure times preventing flexibility in travel.

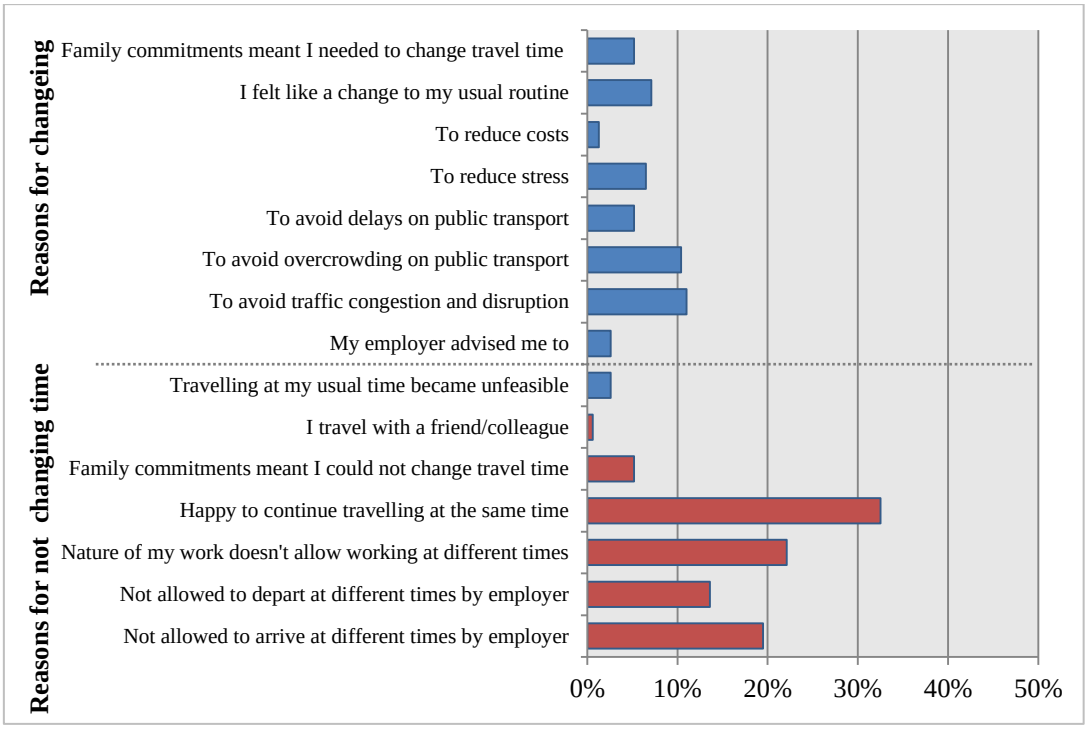

Figure 8.6: Reasons for changing or not changing time for commute

In Section 8.1.1, socio-demographic variables were compared - through Pearson's chi-square tests - with the individuals that changed mode and those that did not. This was repeated for re-timing commute journeys and produced similar results. These showed that there were no statically significant differences between the two groups, which suggests that that these factors did not help explain whether changes to the time of travel occurred or not.

Table 8.5: Key socio-demographics by change to time in Wave 4

Variable	χ^2 - value	p - value
Age	2.121	.832
Gender	.711	.399
Household structure	4.086	.537
Num. employed in business	.368	.947
Access to bicycle	2.609	.625
Access to car	2.378	.667

8.5 The Transtheoretical Model

The analysis presented in Chapter 6 has raised questions about the application of the TTM in this particular context. For example, the stages of change were shown to be more appropriately described as 'pre-contemplation' and 'post-contemplation', and they were not able to account for the adaptability of the sample in response to a disruption. This prompted the cluster analysis that was conducted in Chapter 6, which contributes significantly to the assessment of the TTM in this thesis. In this chapter the application of the TTM constructs in Wave 4 - which was far-removed from the Games-time disruption – will be analysed.

8.1.3 The stages of change

Figure 8.7 presents the stages of change occupied by individuals over the course of the panel study. This includes only individuals who responded to the Wave 4 survey. The figure clearly demonstrates that there were fluctuations in the occupation of the stages of change before and after the Games although pre-contemplation remains by far the most common stage for individuals to occupy.

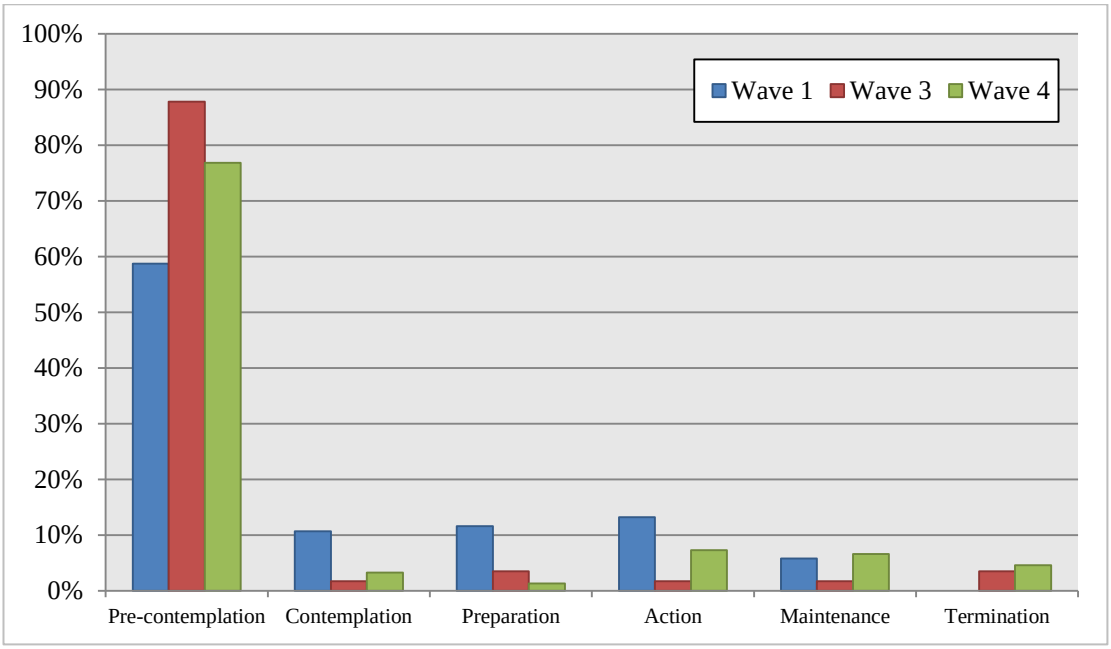

Figure 8.7: Stages of change across the panel study

Analysis of those that changed mode or time of travel since the third survey wave shows that there was a significant relationship between the stage of change occupied in the fourth wave and whether a change was made. Whilst a Pearson's chi-square test would normally have been appropriate, the smaller sample size examined here meant that low expected frequencies made a Pearson's chi-square test unfeasible. Therefore, as directed by the

literature (Field, 2009), Fisher's exact test was conducted instead as this ensures accuracy when the sample size is small. The results of this test indicated that there was a statistically significant relationship between the stages of change and whether a change was made to the commute journey ($p = 0.008$). More specifically, this showed that individuals who considered themselves to be in the pre-contemplation stage were significantly less likely to have made a change. This finding echoes that which was presented in Chapter 6, where there was shown to be an increased likelihood of not changing during the Games for those in the pre-contemplation stage pre-Games.

8.1.4 The processes of change

To examine the use of the processes of change, the sample will again be considered by whether they have made a change or not. The processes of change statements are shown in Table 8.6. These differed very slightly from those presented in the first survey wave as references to the then forthcoming Games were removed. Their relevance in the fourth wave relate to the insights they may provide as to the tools and activities the individual may use as they seek to make a change to their behaviour. Mann-Whitney tests[21] were conducted to examine whether the responses to the processes differed between the group that changed commute travel and those that did not.

[21] The data examined in this instance is ordinal and treated as non-parametric. Therefore Mann-Whitney tests were conducted.

Table 8.6: The Processes of Change – Wave 4

The Processes of Change – Wave 4
Environmental Re-evaluation Changing the way I travel to work might encourage others to change
Social Liberation Colleagues/friends are discussing changing the way they travel
Helping Relationships My employer has encouraged me to change the way I travel to work
Self-liberation I can change the way I travel to work if I try hard enough
Counter-conditioning Changing the way I travel will improve my travel experiences
Stimulus control I will plan my time so that I am able to change my work travel
Contingency management Changing the way I travel may have the added benefit of finding new or better options for my journey to work
Self-re-evaluation I believe that changing the way I travel will show me to be a proactive person

Table 8.7: Mann-Whitney tests of the use of the processes of change by whether changes were made post-Games

Process	Mann-Whitney U	Z	Sig.	Effect size (*r*)	Median	
					Change	No Change
Environmental re-evaluation	2519.500	-0.316	.752	-0.03	4	4
Social liberation	2401.500	-0.801	.423	-0.07	4	4
Helping relationships	2271.500	-1.142	.253	-0.09	4	4
Self-liberation	1796.000	-3.176	**.001**	-0.26	2	3
Counter-conditioning	1941.500	-2.481	**.013**	-0.20	3.5	4
Stimulus control	2405.500	-1.960	**.050**	-0.16	3	4
Contingency management	1955.500	-2.315	**.021**	-0.19	3	4
Self-re-evaluation	1918.000	-2.400	**.016**	-0.20	3	4

The results of the Mann-Whitney tests are presented in Table 8.7 and illustrate that there were significant differences in the median responses of those that changed and those that did not for five processes. Interestingly, this showed that a clear shift in the agreement with the processes of change associated with the Games (see Section 6.3.5) and those observed in Wave 4. For example, in Chapter 6 (Table 6.7) it was shown that environmental re-evaluation, social liberation and helping relationships (which relate to the social context) were important to supporting change. However, as Table 8.7 shows, these appear far less important outside of the disruption conditions. This shows that the shift in the social context,

anticipated as part of a disruption, may create conditions in which individuals are more likely to rely on social relationships and support from others. A further interesting finding from the processes of change is that those changing their commute journeys are more likely to have agreed with counter conditioning and contingency management. As Table 8.6 shows, these processes are both concerned with improving travel experiences, which were more likely to be disagreed with in relation to the Games (see Table 6.7). The fact that those making changes after the Games were more likely to have agreed with the statements suggests that there is more awareness of how changing travel behaviour may provide improved travel options in the longer-term when a large-scale disruption is not faced.

8.1.5 Self-efficacy

Self-efficacy is the third construct of the TTM that is considered here. In the fourth wave survey, respondents were asked about their self-efficacy for changing mode and time of travel. Mann-Whitney tests were applied in order to establish whether the responses to the 5-point Likert scale (1 = Very easy, 5 = Very difficult) were significantly different amongst those that changed their behaviour and those that did not.

In terms of mode, it was found that there was a significant difference in responses to the self-efficacy constructs between those that changed mode and those that did not (U 1279.500, −4.396, $p < .001$). This showed that individuals who had changed their mode since December 2012 were significantly more likely to have considered using a different mode for their commute journey to be easier (Mdn = 2), in contrast to those who did not change their mode (Mdn = 4). This is not surprising as it was also found to be particularly relevant during the Games as discussed in Chapter 6 (see Table 6.27).

With regard to the ease or difficulty of changing the time of travel, the respondents were asked to state their ease or difficulty of making the following changes to their usual commute journey: arriving earlier, arriving later, departing earlier and departing later. These items applied the same Likert scale as with mode and were again analysed through Mann-Whitney tests. The results, presented in Table 8.8, indicated that there were no significant differences in the responses to these self-efficacy items. Examination of the median responses of the two groups indicates that the majority of individuals in the sample considered changing time to be an easy change to make. The exception to this is ‘depart earlier’, which is perceived to be a more difficult change to make.

Table 8.8: Mann-Whitney tests of self-efficacy by whether changes were made post-Games

Process	Mann-Whitney U	Z	Sig.	Effect size (*r*)	Median	
					Changed	Did not change
Changing mode	1279.500	-4.396	**<.001**	-0.36	2	4
Changing time – arrive earlier	2348.000	-1.072	.284	-0.09	2	2
Changing time – arrive later	2165.000	-1.809	.070	-0.15	2	2
Changing time – depart earlier	2112.500	-1.800	.072	-0.15	3	4
Changing time – depart later	2174.000	-1.633	.103	-0.14	2	2

8.5.1 Summary

The constructs of the TTM presented in this section have shown similarities to the application of the model during the Games. This is particularly relevant in both the apparent binary composition of the stages of change, but also the insight provided by the processes of change and self-efficacy. The observation that there are differences in the agreement with the processes of change between Wave 4 and the Games is particularly interesting. This emphasises the differing social context within which change was supported in these two situations. During the Games, the agreement with processes related to social relationships and support, and indicated that these were particularly important for supporting change in large-scale disruptions. This is emphasised by the disagreement with such processes outside of the context of a large-scale disruption.

8.6 The London Underground workers strike – 5th and 6th February 2014

A two-day strike by workers on the London Underground began in the late evening of Tuesday 4th February 2014. The impact of this was a much reduced and infrequent service running on the network over the 5th and 6th February. This led to significant overcrowding and delays to passengers journeys. Media reports (see, for example, BBC, 2014b; The Telegraph, 2014) highlighted the problems experienced by travellers, with commuters being significantly affected during the peak travel times.

The motivation for including the London Underground strike in the fourth wave survey was to provide insights into the responses of the sample when faced with a further, forced disruption. It has been discussed throughout this thesis that a disruption can provide a significant shift in the social context within which travel behaviour occurs. The London Underground strike was very different to the Olympic and Paralympic Games, although it still had the potential to cause wide-spread disruption. Here, rather than high demand

coupled with improved provision as occurred with the Games, the service availability was significantly reduced over the two-day period. As a result, it was hypothesised that that a high degree of mode shift would occur during this disruption, which would reflect findings from previous strikes (e.g. Van Exel and Rietveld, 2009; Coindet, 1998).

This section will first provide an overview of the two days of the strike to provide insight into the behavioural response to this disruption. It will then summarise the findings within the context of comparable studies to demonstrate how the impact of the strike relates to other disruptions such as this.

8.1.6 Day 1 – 5th February 2014

80.1% of the sample was intending to make a journey to work on the first day of the strike and 38.5% of the sample was intending to use the London Underground for at least part of their journey. Of the remaining 19.9% of the sample - who were not intending to travel to work on this day – less than half stated that they had intended to work from home on this day anyway.

Two-thirds of the sample (65.8%) was affected by the strike on the 5th February and they responded to this disruption in a range of ways. Notably, only 5.8% of those affected continued to travel without making any changes. This highlights two interesting points: (1) it emphasises the far-reaching impact of this disruption on travellers and (2) it reiterates the flexibility in making small changes to travel that has already been observed in the sample. A summary of the changes made to travel is shown in Figure 8.8.

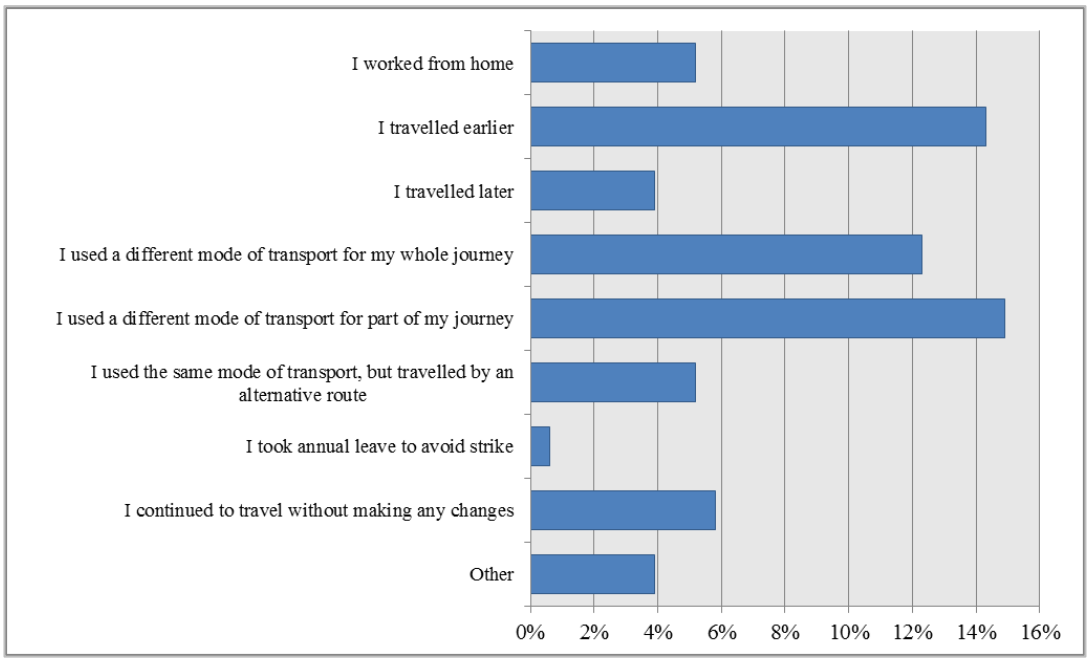

Figure 8.8: Changes made to outward commute journey – Day 1

Of those who made changes to their journey to work, there was a clear focus on altering the mode of travel (either for the whole journey or just part of it) or departing for work earlier than usual. As Figure 8.9 indicates, walking and using the bus were the two modes most likely to have been used by those changing their mode for their outward journey on day one of the strike. Travelling by car instead (either as a driver or passenger) was uncommon, reflecting the context of the strike and the fact that there are many alternatives available to commuters in London. Regarding changing the time of travel, travelling earlier was shown to be by far the more common change to make. Those who did travel earlier departed their home on average 34 minutes earlier than usual. Those individuals who changed their mode or route were also asked about their previous experience of travelling in that way. 65.9% stated that they sometimes travelled in this alternative way when they needed to (for example, when faced with a disruption).

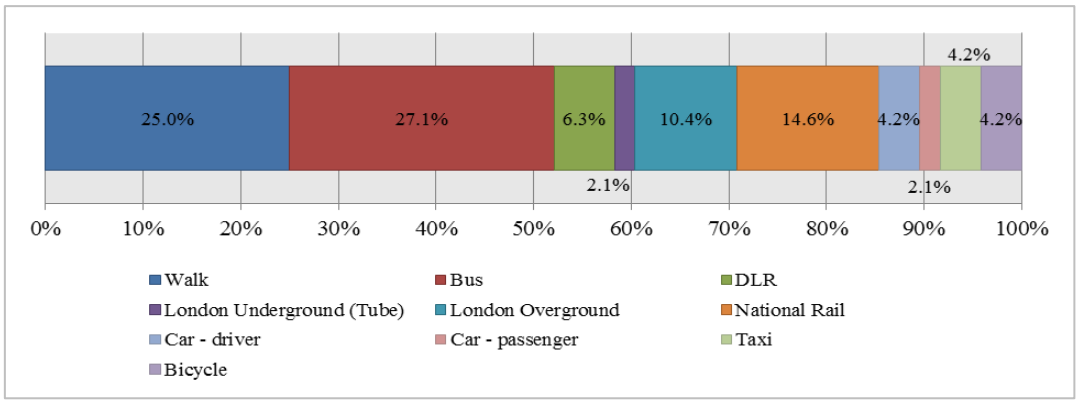

Figure 8.9: Alternative modes for outward commute journey – Day 1

The impact the changes that were made had was generally regarded as negative. Only 14.5% of the sample felt that the changes they made had a positive impact on them, and within this group the majority felt this impact was only small. Nearly half of those who changed their travel experienced a longer than usual journey to work, with journeys taking on average 37 minutes longer than usual.

In terms of the return journey home on the first day of the strike, a similar proportion of individuals were found to have been affected by the disruption. Overall, 59.5% of the sample reported that their journey was affected (a slight decrease on the outward journeys). 89.4% of those that were affected were also affected in their outward journey to work. Figure 8.10 highlights that the response to the disruption for the journey home was very similar. Two interesting features emerge. Firstly, that a greater proportion of individuals were departing work earlier than usual suggests that employers may have allowed more flexibility in travel time in response to the Games. Secondly, in comparison to the outward journey, more individuals reported that they travelled as normal for this journey. This may be the result of individuals finding their outward journey was less disrupted that anticipated meaning that they reverted back to their usual travel for their return journey.

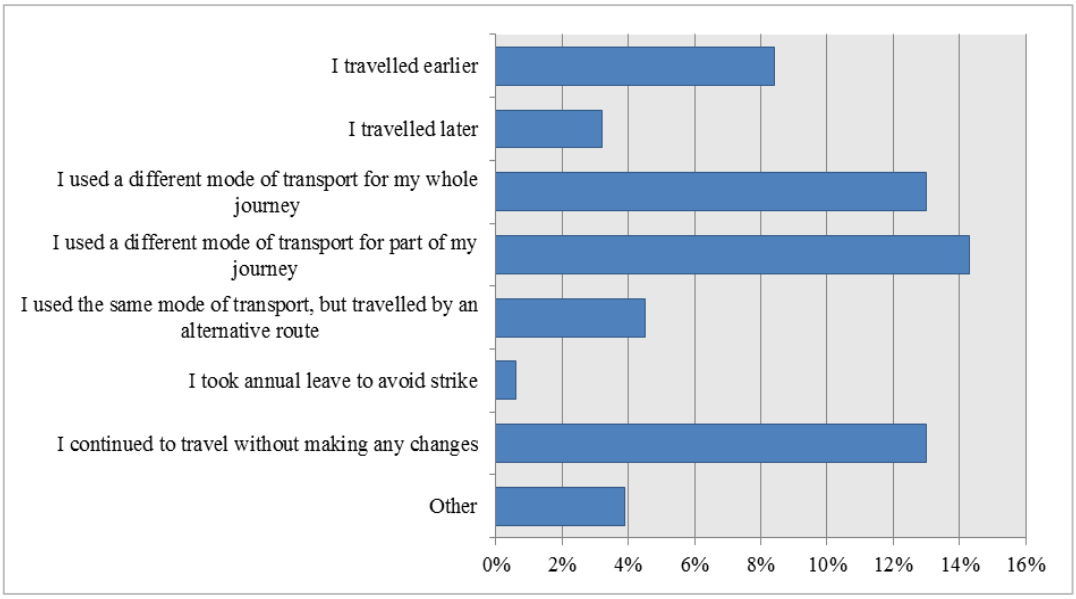

Figure 8.10: Changes made to return commute journey – Day 1

As Figure 8.10 illustrates, changing mode was the most common change individuals made. As with the outward journey, many people decided to walk instead (30% of those that changed mode did so), as shown in Figure 8.11. Bus travel was less popular on the return journey with increases in the use of the London Overground and National Rail. It was highlighted previously that there were a number of individuals who departed work earlier. Further examination of this group indicated that individuals departed on average 37 minutes earlier than usual.

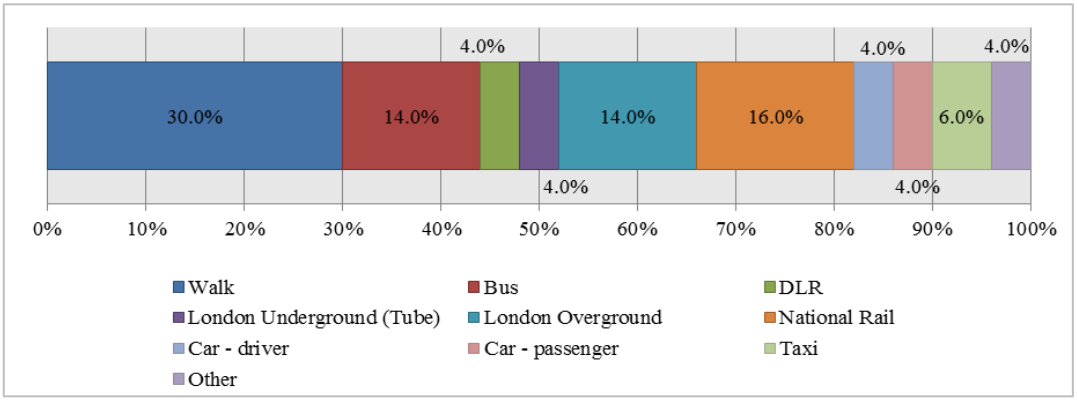

Figure 8.11: Alternative modes for return commute journey – Day 1

8.1.7 Day 2 – 6th February 2014

On the second day of the strike 79.5% of the sample was intending to travel to work, an almost identical figure to the 80.1% who had intended to travel to work on day one. Of the remaining 20.5% who had not intended to travel, nearly two-thirds had not intended to work from home. On the second day, 42.2% had planned to use the London Underground for at least part of their journey. Ultimately, the commute journeys of just over half of the sample were affected.

In response to the disruption that was faced, individuals in the sample again made changes to their commute journey. Figure 8.12 shows that departing home earlier and altering the mode of travel were both the most common changes that were made. A similar proportion worked from home instead of traveling although fewer individuals continued to travel as they usually would.

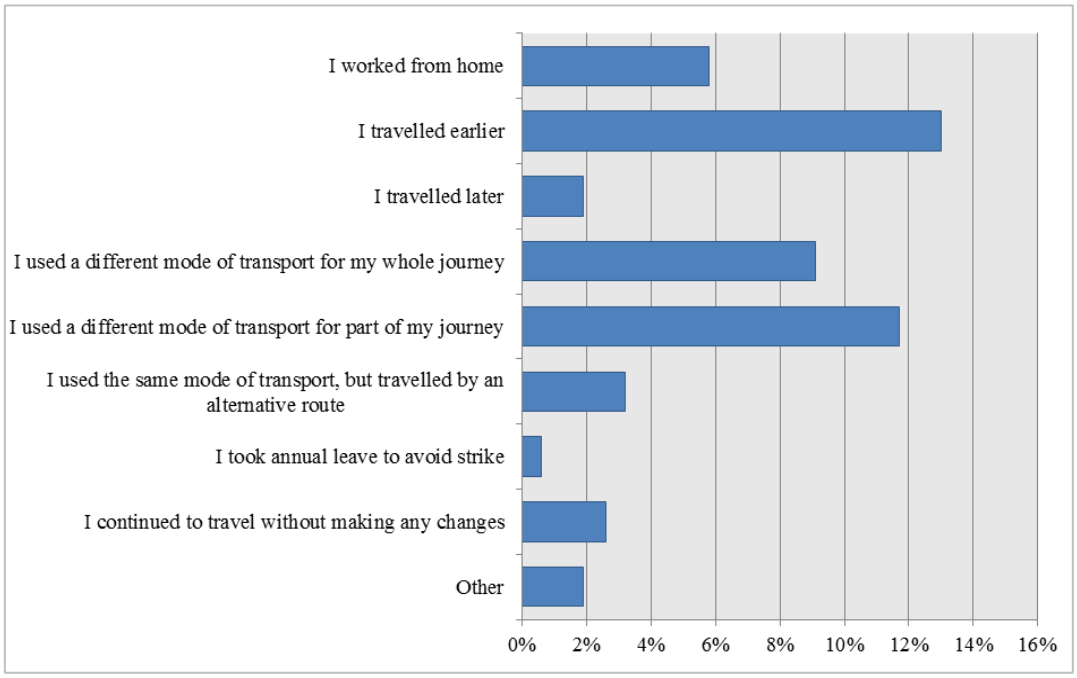

Figure 8.12: Changes made to outward commute journey – Day 2

The individuals that travelled earlier departed their home on average 36 minutes earlier than usual, which echoed that of day one of the strike. Figure 8.13 highlights how walking was again a common choice for those changing mode, although the use of the bus was noticeably lower. In contrast to this there was an increase in use of National Rail and even the London Underground (some individuals may have experienced less disruption than anticipated on the first day).

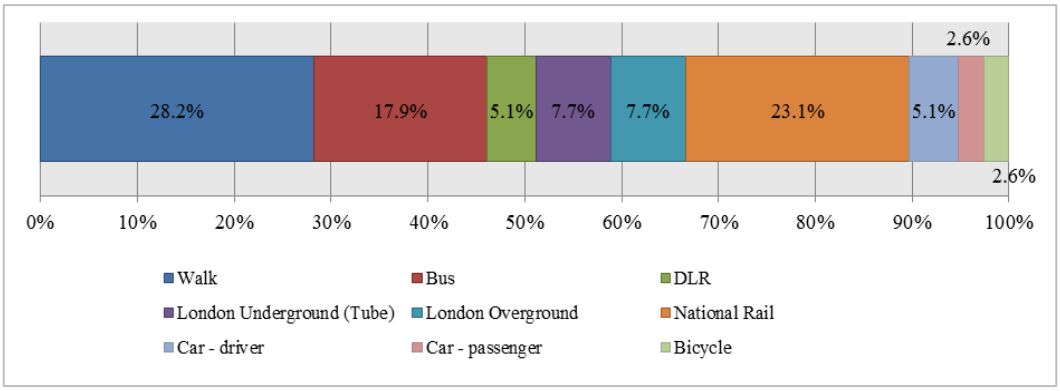

Figure 8.13: Alternative modes for outward commute journey – Day 2

The experiences individuals had of travelling on the second day of the strike closely resembled that of the first day. Of those who changed, a similar proportion considered the changes they had made to have had a positive impact on them (13.8%) and fewer people experienced a longer than usual journey (in comparison to the first day of the strike). Of those who reported journeys being longer than usual, there was a decrease in the average time that was added onto the journey (26 minutes) compared to the first day of the strike (37 minutes).

The way that individuals in the sample responded to the second day of the strike echoed that of the first day. A similar proportion of the sample was intending to make a journey home on this day (76.2%) and a similar amount was planning on using the London Underground for at least part of their journey. Figure 8.14 shows that changing mode was a common change that was made, as it had been over the two days of the strike. Interestingly, a higher proportion again chose to travel as normal for their return journey (as observed on day one). A similar proportion changed their route whilst continuing to travel by the same mode. More individuals departed earlier than usual on day one, although this was the opposite on the second day.

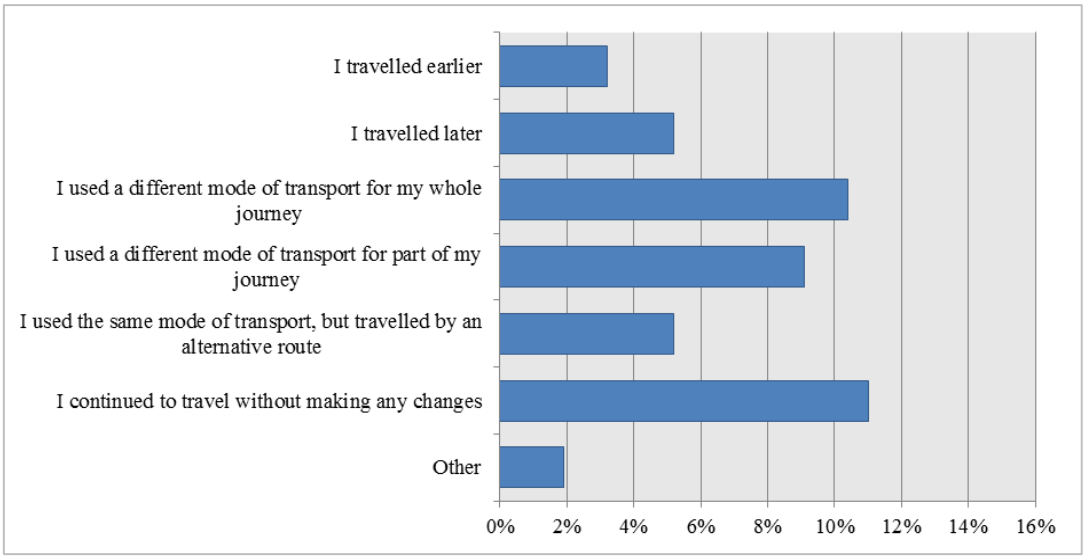

Figure 8.14: Changes made to return commute journey – Day 2

Walking has been shown to be a popular alternative mode for those making a change during the strike, as shown in Figure 8.15. This is again evident in the return journey on day two with it being the most common alternative mode. The mode split for the return journey was very similar to the outward journey.

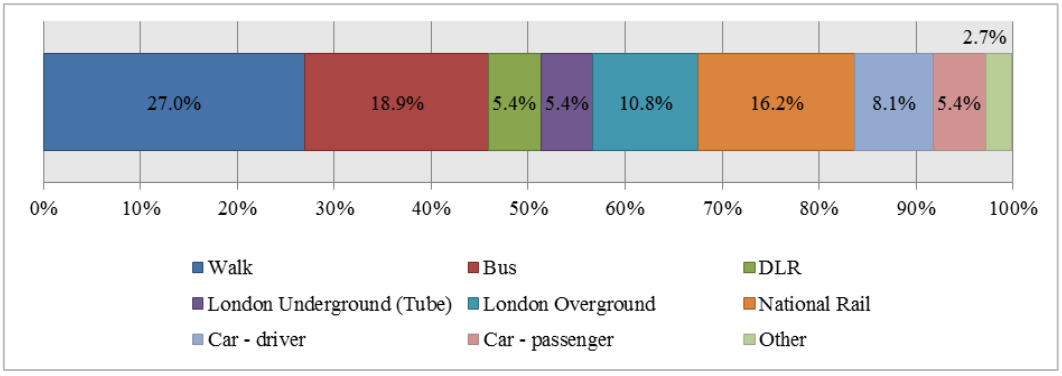

Figure 8.15: Alternative modes for return commute journey – Day 2

8.6.1 Summary of the London Underground strike

The London Underground strike had a large impact on the travel of the Wave 4 sample. On Day 1 of the strike, nearly two-thirds reported being affected by the strike. Only 5.8% of those individuals affected continued to travel as normal highlighting the large amount of change that occurred. Slightly fewer individuals were affected by the strike on Day 2, and a slightly higher proportion had intended to use the London Underground. Overall, the impact, and the behavioural response over the two days was relatively similar, which shows that the benefit of experience from the first day did not significantly impact on behaviour.

The main behavioural responses to journeys that continued to be made were to re-mode - which would be anticipated in the context - and travel earlier. Interestingly, taking leave was the least common change, with only a very small number doing so. This may be attributable to the time of year the strike took place (i.e. in the winter months) but also the relatively limited advance knowledge of the strike, which was less than one month (BBC, 2014a). The degree of those working from home instead of travelling in response to the strike was 16.2% on the first day and 18.1% on the second, demonstrating how this was a highly feasible change to have made.

Comparing the London Underground strike to other studies is difficult as there is a lack of recent comparable work. Van Exel and Rietveld (2009) provide an example of a one day national rail strike in the Netherlands. The authors reported that changes to commute were largely centred on travelling by car instead of train or working from home. In London, a large proportion of those changing mode did so by walking instead, which reflects the difference in context. Coindet (1998) provides a further example of a public transport strike. This was in the Île-de-France region in France, which includes the city of Paris. The strike was in fact a series of strikes over a two month period in 1995 and affected public transport provision. In comparison to London, Coindet found that there was also a trend of travelling earlier for the outward commute journey. In terms of mode, half of those who would have normally travelled by public transport changed to car (either as a passenger or driver). Walking accounted for approximately 25% of usual public transport trips.

The study of this further disruption has demonstrated how the sample responded to a different disruption to their travel. Given the nature of the disruption, changes to mode were expected, but working from home was also shown to be highly feasible. This indicates that individuals in the sample were able to adapt their travel to reduce journeys in the short-term.

8.7 Sustained changes in behaviour

This section will draw on both the Wave 1 to 3 sample and the Wave 4 sample to present the findings related to sustained change more broadly within the thesis. In Chapter 6 it was stated that 6% of people sustained the change they made to their commute journeys after the Games had ended (TfL, 2013b). This included 3% who sustained changes to the time at which they commuted, 1% who sustained mode changes, 2% who sustained changes to route, and 2% who continued working from home or elsewhere more than they did before the Games (note that individuals could have sustained more than one type of change).

The socio-demographics of both those who sustained their changes shortly after the Games and those that did not were investigated to examine whether there were any notable differences in these two groups. Pearson's chi-square tests were conducted in order to show whether any differences between the groups were statistically significant. Table 8.9 provides an overview of each group and the results of the statistical tests. This shows that there were no statistically significant differences ($p < .05$) between those that sustained and those did not.

With regard to the Wave 4 sample, 8.4% reported changing their main mode of travel for commute journeys during the Games. Given the smaller sample size in the fourth wave, the 8.4% equates to 13 individuals. From the data available, it was shown that 6 of these 13 have continued to travel by the same main mode since the Games. This indicates that there is evidence of changes that were made continuing to be sustained over a longer-term period, although only a very small number. With regard to sustained changes to time, 28% of the follow-up sample made a change during the Games but none of these individuals sustained the change that they made once the Games had ended. Only 19.5% of the sample made no change to their time of travel either during or after the Games indicating that there is a great deal of fluidity in this particular behaviour, perhaps explaining the lack of sustained change observed.

Prior to the Games, individuals in the Wave 4 sample spent on average 4.6 days per week at their usual workplace. After the Games there was a slight decrease, with an average of 4.4 days per week being spent at the usual workplace. In Wave 4, this figure stood at 4.2, which indicates continued sustainment of these levels. An interesting outcome of these figures is that there is an observed increase in the amount of time spent working from home by those in the sample. Prior to the Games, only an average of 0.2 days per week was spent working from home. However, after the Games this increased to 0.4 and then in the longer-term an average of 0.6 days per week were spent working from home.

Table 8.9: Socio-demographic variables and sustained change in Wave 3

Socio-demographic	Sustained (any change)	Did not sustained (any change)	χ^2 - value	p - value
Age				
Male	44	48	.389	.533
Female	56	52		
Gender				
18-24	6	4		
25-34	31	31		
35-44	34	27	3.146	.678
45-54	20	25		
55-64	10	12		
> 65	0	1		
Household structure				
One person household	24	19		
One family household - Couple with no children	31	34		
One family household - Couple with children	30	28	3.779	.582
One family household - Lone parent with children	1	3		
Two or more unrelated adults	14	13		
Multi-family households	2	3		
Num. bicycles with access to				
None	54	52		
1	20	24		
2	23	15	6.496	.165
3	4	5		
> 4	0	4		

Socio-demographic	Sustained (any change)	Did not sustained (any change)	χ^2 - value	p - value
Occupation type				
Manager & Senior Official	35	30		
Professional & Associate Professional	42	43		
Admin, Secretarial & Skilled Trades	16	20		
Personal Service, Sales & Customer Service	3	3	2.516[a]	.986[a]
Process Plant Machine Operative, Elementary & Other	0	1		
Num. of cars/vans with access to				
None	34	33		
1	48	43		
2	17	18	3.192	.526
3	1	5		
> 4	0	2		
Household income				
Up to £19,999	0	2		
£20,000 up to £39,999	16	19		
£40,000 up to £59,999	25	26		
£60,000 up to £79,999	22	20	7.431[a]	.773[a]
£80,000 up to £99,999	16	13		
£100,000 or more	20	21		

[a.] Fisher's exact test applied owing to more than 5 cells with expected count of less than 5.

8.8 Conclusion

The longer-term picture after the Games, measured through the third and fourth wave surveys emphasises how the significant shift in behaviour experienced during the event largely disappeared shortly after it had ended. Prior to the Games it was shown that individuals in the sample already reported a degree of adaptability in their travel, as demonstrated by the fact that slightly over 75% of the sample reported varying their journey during the Games.

The Wave 4 survey demonstrated how there had been some variance in commute journeys over time. Between Wave 1 and Wave 4, it was shown (in Figure 8.3) that the usual departure time to work had shifted to earlier in the peak in Wave 4. There was also a reported increase in 'flexitime' working and shift work. Mode share had remained relatively stable, although the alternative modes sometimes employed by individuals demonstrated greater walking and cycling and use of the bus and tram network when changes were made.

A valuable finding from the analysis of the TTM constructs was that the processes of change items reflected shifts in the conditions the individuals were experiencing. Outside of the disruption of the Games, individuals reported more disagreement with the processes more relevant to social context and supporting relationships. In contrast there was more agreement with processes that related to finding improved journey options, which suggests that the individuals were more conscious of these benefits when the system was operating normally.

The Wave 4 survey also provided further insight into the longer-term travel behaviour in the sample in terms of the response to an additional disruption. Whilst not seeking to directly compare the levels of change observed to the Games, owing to the vast differences in these two disruptions, the strike did help to further demonstrate the ability of individuals to adapt their travel behaviour in response a disruption, and to do so in different ways.

Chapter Nine

Discussion

9.1 Introduction

The four waves of the panel study produced an extensive amount of data and insights into the travel behaviour of the sample across the waves, and in response to the Games. This chapter will draw together the key findings from the analysis, which will demonstrate how the research questions first posed in Chapter 1 have been addressed. The chapter will also help to show how the findings relate to the existing studies in this field and the implications of these findings to the wider knowledge in the research area.

Research Questions

1. How did travel behaviour change as a result of the London 2012 Games?
    a. Commute journeys
    b. Non-work journeys
    c. Business travel

2. If travel behaviour changed as a result of the London 2012 Games, what were the reasons for these changes?
    a. Commute journeys
    b. Non-work journeys
    c. Business travel

3. What role did employers have in influencing the behaviour change of their employees during the London 2012 Games?

4. If changes in travel behaviour occurred during the London 2012 Games, how and why were these sustained?

5. What did the London 2012 Games teach us about the longevity of travel behaviour change?

6. How applicable is the Transtheoretical Model, and other relevant behaviour change models, for studying travel behaviour change in the context of a large-scale disruptive event?

Figure 9.1: Research questions

This chapter will address the research questions of this thesis, displayed in Figure 9.1, to demonstrate how the findings provide answers to the questions posed and therefore make a contribution to existing knowledge. The chapter will first discuss the different types of change made during the Games, taking each one in turn to help demonstrate the distinctions that exist between them. The role of employers will then be discussed with a specific focus on the differences that exist between the larger and smaller sized businesses. The sustained changes that occurred will then be examined to contribute to the discussion of the longevity of behaviour change. The chapter will then provide an examination of the contribution of the TTM constructs to this study, and the potential value they offer along with a discussion of the clusters that have emerged from the two-step cluster analysis.

9.2 How did commuter travel behaviour change during the Games, and what were the reasons for this?

How and why travel behaviour changed in response to the Games are fundamental questions posed in this research, which is reflected in the first and second questions listed in Figure 9.1. This section will discuss what changes were observed during the Games to address and discuss these two overarching questions in order to understand more about the behavioural response to the disruption. The question of 'why' changes occurred is also addressed by the wider set of questions included in Figure 9.1. For example, the insights gained from the TTM constructs - which are discussed in Section 9.6 - will help to answer the question of why the travel behaviour changed as it did.

What is clear from the findings presented in this thesis is that there was a substantial shift in the travel behaviour of commuters during the 2012 Games. In total, 54% made a change to their usual commute journey during the Games, although underlying this there appears to be distinctions in how the types of change are approached. This section will first examine the overall sample, before examining in turn the different types of change studied in the analysis. The non-work journeys and business travel of the sample are also considered in the subsequent section (Section 9.3). It should be noted that the purposive sampling applied as part of this research means that the results discussed here do not seek to be representative to the wider population. This chapter does however provide a valuable discussion of the behavioural implications of the Games, and how this relates to the sample studied.

9.2.1 Overall change

The analysis presented in Section 6.3.2 has indicated that 54% of people made a change to how they usually travelled to work during the Games. This finding reflected previous Olympic and Paralympic Games, where significant shifts in travel behaviour have also been

observed (Giuliano and Prashker, 1986; Brewer and Hensher, 2001). It is difficult to draw quantified comparisons of overall change with previous research owing to the small number of such studies, and the differences in methods and contexts. However, what is clear is that the broader amount of change displayed in London was a reflection of that exhibited in previous Games and discussed in the literature (Currie and Delbosc, 2011; Kassens-Noor, 2010; Liu et al., 2008; Hensher and Brewer, 2002; Currie, 2008). The specific types of change made may provide more insights into where differences exist, and these will be examined later in this section.

Focusing on overall change, a particularly interesting insight that emerged from the pre-Games survey was that there appeared to be an existing variance in journeys to work amongst a large proportion of the sample. It was discussed in Section 6.3.1 that 76.3% of the sample stated that they already sometimes made changes to their journey to work, either only when they needed to (45.5%) or out of choice (occasionally 26.8%, regularly 4%). This highlights that – despite two-thirds of the sample stating that they always tried to travel in the same way – many displayed some ability to be able to change. This is important because it suggests that there was a potential for some to be better placed to deal with the disruption to their journeys during the Games. This is not something that appears to have been acknowledged in the wider literature but such understanding is fundamental to interpreting behaviour change during and after the Games.

The socio-demographic attributes of the sample were collected and examined in Section 6.3.2, which showed that there were no significant differences between those that changed their travel and those that did not. This indicates that, overall, the socio-demographics were not a crucial factor in determining the behaviour observed. This is supported by Ajzen (2011), who argued that, in the context of a theoretical understanding of behaviour, socio-demographics are accounted for through attitudes.

The stages of change construct is used to establish whether there is an intention for the individual to make a change, and the application in this study focused upon changes to the usual journey to work. A further question was included in the first survey wave focusing specifically upon intention to change during the Games. This was treated separately to the stages of change and has been shown to be a useful predictor of change. It was found that those who had an intention to change their commute journey during the Games (60.2% of the sample) were significantly more likely to have gone on to make the change. Whilst not a perfect predictor of likelihood of changing, intention was important with 76.3% of those who intended to change going on to make a change. This is not typically found in studies of non-event based behaviour change (Bamberg, 2013).

9.2.2 Reducing or relocating

Reducing or relocating was the most prominent change made during the Games, closely followed by re-timing. In total, 31% of people reduced their journeys during the Games (TfL, 2013b), which included 20.8% taking annual leave, 15.4% working from home more, and 5.1% working elsewhere more. Comparable studies have demonstrated a similar degree of change. Brewer and Hensher (2001) studied the Sydney 2000 Olympics and found that 26.7% of the respondents in the study (n = 429) took annual leave during the Games. 3% telecommuted for the first time during the Games and 5% worked elsewhere. This shows evidence of similarities in the responses of individuals in Sydney and London. The greatest disparity is between working from home, although it should be noted that Brewer and Hensher only included those who telecommuted for the first time rather than also including those who had increased their time spent working from home.

A further study that examined a sample of commuters was conducted by Giuliano and Prashker (1986). This research was focused solely on the Olympics and studied the responses of employees from four businesses in Los Angeles during the 1984 Games. Across the two weeks of the Games, each day (Monday-Friday) saw an average of 15.5% of the sample (n = 476) reduce or relocate their journeys. This included 11.1% taking annual leave, 3.2% working at an alternative workplace, and 1.2% working a modified work week (note that the authors do not specify what constitutes a 'modified work week').

What these different studies demonstrate is that the degree of change can, and has, varied between different Games. What is interesting to note, however, is that the specific ways of changing tend to follow similar paths, i.e. taking annual leave is most common option whilst working at an alternative workplace is less so. A further point of note is the much higher proportion of individuals in London working from home more than usual during the Games. This was 15.4%, yet the figures are much lower in the other two studies. It is difficult to determine what has influenced this, although the fact that the Los Angeles, Sydney and London Olympics all involved support from employers to reduce journeys suggests that it may be improvements in technology over time. Improved technology makes working from home much more feasible now than in 2000, and even more so than in 1984.

Socio-demographics were shown to have little explanatory power across the overall sample in terms of change (Section 6.3.2). However, for reducing or relocating journeys, it was shown in Section 6.4.1 that there appears to be a greater focus towards higher earners in more senior positions. This suggests that making this particular change was more feasible for such individuals, perhaps because they have greater control over their working patterns.

Interestingly, in contrast to the findings of the stages of change - which demonstrated no difference between the pre-contemplators and post-contemplators and whether journeys reduced or relocated – it was found that intention was a more useful predictor of change. Specifically, this related to the finding that individuals with an intention to reduce were significantly more likely to go on to reduce.

9.2.3 Re-timing

Re-timing was an equally common change that was made to commute journeys during the Games, with 25% doing so (TfL, 2013b). As was discussed in Section 6.5, 24.2% re-timed their outward journey, the majority of whom did so by travelling earlier (19.2%). Prior to the Games, the average departure time for those who travelled earlier during the Games was 07:38. This changed to 07:23 during the Games. 5% of the sample departed for work later than usual during the Games. The average departure time for this group before the Games was 08:03 but this changed to 08:41 during the Games. These figures demonstrate that those who travelled earlier were already travelling on average earlier compared to those who changed to depart later.

With regard to returning home from work, 19.6% of the sample re-timed when they departed during the Games. This included 13.6% who left work earlier and 6% who departed later. The average times for both those who departed earlier and those who departed later echoed those of the journey to work. Prior to the Games, those who travelled earlier departed on average at 17:12 and this changed to 15:57 during the Games. Those who travelled later travelled on average at 17:46 pre-Games with this changing to 18:32 during the Games.

The study conducted by Giuliano and Prashker (1986) showed that during the Los Angeles Games travelling earlier was also a more common change amongst those altering their departure time to work. Of the 23.3% of the sample (n = 1668) that did travel earlier, over half (13.6%) departed within 30 minutes of their usual travel time. 11.6% of the sample departed later. 26.1% of the sample (n = 1676) changed the time they travelled from work, with 17.9% travelling earlier and 8.2% travelling later. This again reflects the findings from London with approximately two-thirds departing earlier. The study by Brewer and Hensher (2001) examining the Sydney Games showed further evidence of the ‘flattening’ of the morning and evening peaks of travel during the Games.

9.2.4 Re-routing

In comparison to reducing and re-timing, making changes to the route of travel was far less common during the Games. In total, 16% of people made this particular change. This type of change was less commonly featured in the literature, for example, Brewer and Hensher (2001) did not consider it. The study by Giuliano and Prashker (1986) did show that 10% of the sample of commuters in Los Angeles changed route although this was focused on altering the route of travel for car journeys, which is a reflection of the transport context of the city.

Socio-demographics were shown to not differ between those who made changes to their route and those that did not. This was the first specific type of change that mirrored the overall sample in this respect and highlighted how changing route across all journey purposes was not influenced by the socio-demographics. Route appears to offer somewhat less value here owing to the focus on all aspects of the journey. For example, it is much more relevant in studies of active travel owing the greater importance of a safe and secure route for encouraging change (Shannon et al., 2006; Crawford et al., 2001). Finally, intention was also shown to be a good predictor of change, which echoed that of re-timing and providing further support for its value in this study.

9.2.5 Re-moding

Changing the mode of travel for commute journeys was the least common change that was made during the Games, with 11% of people having made this particular change. Analysis of the main mode for work journeys showed that, at the aggregate level, there was a decrease in the use of the London Underground, DLR, and the private car for these journeys. This was contrasted mainly by increases in use of National Rail and the London Overground, along with cycling. These findings were different to other sample-based studies of mode during the Olympic Games, where changes to mode appear less extensive (Brewer and Hensher, 2001; Giuliano and Prashker, 1986). This is likely to be attributable to the conditions and context of the different host cites. For example, London in 2012 has a very different level of provision of modes than Los Angeles in 1984.

The analysis of the socio-demographics of the group of re-moders showed that there were no significant differences between those that changed and those that did not with the exception of bicycle ownership. More specifically, this showed that those individuals with access to one bicycle were significantly more likely to have re-moded.

In comparison to reducing or re-timing, changes to the degree of changes to mode were relatively small, which suggests that this was a less feasible or relevant change during the Games. Giuliano and Prashker (1986), also noted that changes to mode during the Los Angeles Games were far less common in comparison to the other changes studied, which echoes the situation in London.

9.3 Business travel and non-work journeys

Business travel and non-work journeys were a lesser focus of this thesis but still warranted investigation as part of contributing to the wider understanding of travel behaviour change of the sample in this context. The main purpose was to establish whether there were any differences in the changes made for these journeys in comparison to the commute.

In terms of business travel, it was found that 32.8% of the sample made a change to how they usually travelled for business during the Games. Three-quarters of this group of changers were the individuals who travelled at least one day per week for business. Analysis of the key socio-demographics showed that there were no significant differences between those who changed and those who did not, which reflected the results for commute journeys.

Non-work journeys were examined by three different journey purposes in the thesis: leisure, shopping, and personal business. Fewer changes were made to these journeys, in comparison to commute or business travel. This suggests that these particular journeys were less affected; this is likely to be a reflection of these being more likely to occur outside of the hot-spot locations identified, and therefore the need to change was less.

9.3.1 Reducing business travel and non-work journeys

28.5% of individuals in the sample reduced their business travel during the Games. This meant that nearly all of those that did make a change to their business travel (32.8% of the sample) changed, in part, by reducing their journeys. It is not clear the specific ways in which these journeys were reduced, although it is likely to include using teleconferencing instead, postponing meetings, or combining trips.

For non-work journeys, a smaller proportion of the sample reduced how they travelled for leisure, shopping and personal business than with business travel. 14.8% and 13.8% reduced their leisure and shopping trips respectively, and 14.6% reduced their trips for personal business. The reasons why reducing business and non-work travel were the most common changes made for these types of journeys is likely to be closely linked to the discretionary nature of such travel, and the short-term nature of the event. There is also likely to have

been the utilisation of other tools, for example online shopping, to help avoid making journeys.

9.3.2 Re-timing, re-routing and re-moding business travel and non-work journeys

These three types of change are considered together here for both business travel and non-work journeys owing to the similarities in the degree of the sample that utilised these changes. Table 7.18 in Section 7.4 shows how none of these types of travel reported more than 5% of the sample making the change. This highlights how these were far less necessary or useful changes to make, which is also shown through the prevalence of reducing journeys for these types of journeys.

A final, further point of note relates to changes in mode for business travel. Whilst only a small proportion of the sample made a change to the mode they used for their business travel during the Games (2.7%), the changes followed the trend of commute journeys. Specifically, that the use of the London Underground and DLR decreased in favour of walking and cycling during the Games. Previous studies have largely focused on mode shift in terms of commuters and visitors, and therefore there is a lack of discussion of how modes change for business travel.

9.4 The role of employers

The question of what role employers played in influencing change is particularly interesting in this thesis owing to the close relationship that employers have to commute journeys. It was shown that employers were found to offer more support for reducing and re-timing commute journeys during the Games. Slightly more than 20% of those who reduced had been given advice and support from their employer to do so. Similar results were found for those who re-timed. In contrast however, less than 5% of the re-moders and re-timers received support from their employer to make this change. This shows that employers focused on what they had greater control and influence over, and support for changing mode and route came more from other sources (e.g. the awareness raising campaign initiated by TfL). This emphasises the limitations employers may have in encouraging wider behaviour changes amongst their employees. Brewer and Hensher (2001) found a similar trend in their study of the Sydney Games, with the overall sample describing similar focuses of their employers on encouraging flexibility in travel time.

Study of the contrast between larger (more than 250 employees) and smaller (less than 250 employees) businesses is lacking in the literature but is particularly relevant for the London

2012 case study due to the differing engagement initiated by the organisers. The size of the business may influence the degree of support available to support change. For example, in the case of travel plans (which have similar needs of engagement by the employers) Rye (2002) demonstrated that larger businesses were more equipped in resources – along with a greater awareness of the impact of their employees - to support travel plans.

Within the sample, 59.5% of employees were employed in larger businesses. The analysis showed that these individuals were significantly more likely to have been offered a number of opportunities and support to enable them to make a change during the Games although, as the next paragraph shows, this did not significantly affect whether they did actually change. The support provided included: working more flexible hours, working from home more, and working from a different location. Further to this, it was also found that individuals in larger businesses were significantly more likely to agree with the social liberation statement from the processes of change. This showed that these individuals had more access to colleagues and friends discussing changing the way they travel, suggesting that there were more opportunities for these individuals to learn from those around them (see Section 6.3.5.3).

Despite the obvious differences with the degree of opportunities between larger and smaller businesses, it was found that there were no overall statistically significant differences in whether change actually occurred. Those in larger businesses were however found to be more likely to reduce, which indicates this change may have been particularly sensitive to the greater opportunities to change they were exposed to. Currie et al. (2013) also studied the London 2012 Games and provided insights into commuter and business travel. This study was focused on consultations directly with employers as opposed to employees and is useful to demonstrate how behaviour change was actually supported by businesses during the Games. The study found that there was a 30% reduction in employee attendance in their workplace, which corresponds with the findings in this research. The relevance of discussing this study within the section examining the role of employers is that in comparing larger and smaller businesses, the authors identified differences in the type of support offered. For example, smaller businesses (less than 250 employees) tended not to encourage working from home and larger businesses (more than 250 employees) were more likely to have offered support for trips using alternative modes and routes. This reiterates the findings discussed, particularly that larger businesses appeared to offer more opportunities for change.

9.5 Sustaining change post-Games

The large amount of travel behaviour change demonstrated during the Games was a response to the disruption to the commute journey faced by many people in London. Kassens-Noor (2010) argues that the unique nature of the Olympic and Paralympic Games presents an environment where longer waiting times and congestion are anticipated, and potentially even accepted as a consequence. This helps to explain why the scale of change in London was so extensive. Once the Games end, and the system returns to normal, the expectations of travellers are also expected to revert (Kassens-Noor, 2010; Giuliano and Prashker, 1986). The study of longer-term change in this research showed that in the two-month period after the Games 6% of the overall sample continued to maintain the changes they had made during the Games. This indicates that whilst the majority of the individuals who changed only did so for a short period, there is evidence of the some maintaining. TfL (2013b) argued that it was likely this was attributed to 'churn' in the network although the reasons for sustaining given by some individuals pointed to a continuation based on, at least in part, the experiences from the Games.

Of the 6% who sustained in the period after the Games, there was no specific change that individuals predominantly sustained. This suggests that the reasons for sustaining were likely to be especially influenced by personal circumstances as opposed to dependent on a step change in the way the types of change are managed (e.g. a widespread increase in employers supporting flexible working). The fourth wave survey was conducted 18 months after the end of the Games showed that the majority of individuals who sustained post-Games had not continued with their change in the longer-term, adding support for the assessment that churn in the system is occurring.

Specific evidence of sustained changes as a result of previous Olympic and Paralympic Games is lacking and as a result it is difficult to draw direct comparisons to the experiences of other cities. This does however mean that this research makes a valuable contribution to understanding the longer-term impacts of such events. Other travel behaviour studies have shown that travel behaviour interventions (e.g. ride to work day events) clearly demonstrate that there is the potential to achieve sustained change post-disruption (Rose and Marfurt, 2007). However, it is argued that to achieve such maintained change it is often crucial that support continues afterwards (Rose, 2003), which has not largely been the case in London. A final point to revisit here is the variability displayed by the sample pre-Games. 76.3% of the sample stated that they changed their commute travel, at least when they were required to. This suggests that many people in the sample were well placed to adapt their usual

journey to work during the Games, and then return to their preferred travel once the disruption had ended.

The analysis of the London Underground strike data, collected in the fourth wave, provided useful insights into how the people in the sample responded to a different type of disruption. This event involved the widespread disruption to a specific mode of travel for a relatively short period of time. As would be expected in the context, there was a large degree of re-moding but also an increase in working from home. An interesting point of note when considering the longevity of change, was that there was some evidence of individuals (20.6% of the Wave 4 sample) applying experiences from changes they made during the Games to the changes they made during the strike.

9.6 The value of the TTM

The TTM was applied in this thesis with the aim of studying in greater detail the changes in travel behaviour of commuters in London associated with the Games. Three constructs of the TTM were applied, with the aim of assessing their value when applied in the context of a large, forced, but also known disruption. As has been discussed in the literature review the TTM has been applied in different forms in transport and therefore the application of it remains exploratory. This is particularly relevant in the study of disruptions where there is limited application. The following section will discuss the aspects of the TTM that were examined and how they relate, and contribute to, the existing literature.

9.6.1 The Stages of Change

The stages of change were studied across the first, third and fourth waves of the panel survey, enabling an understanding of movement between the stages over an extended period of time. This showed how the pre-contemplation stage was dominant throughout, although there was observed movement between survey waves. This is shown in Figure 9.2, which highlighted an increase in the pre-contemplation stage once the Games had concluded. This may suggest that some individuals moved into stages of contemplation onwards prior to the Games but then returned once the Game had ended.

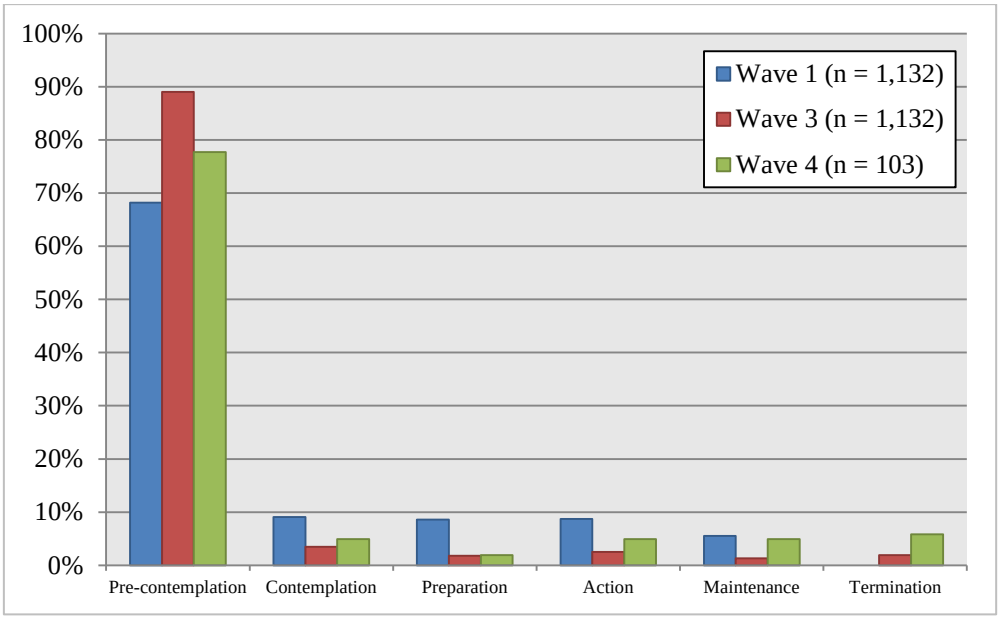

Figure 9.2: The stages of change in Waves 1, 3 and 4

The analysis of change during the Games (presented in Chapter 6) focused upon the stages of change that were self-allocated by respondents in the first wave. This was to demonstrate the pre-existing preparedness of the individual to make a change to their usual journey to work. 68.4% of the sample placed themselves in the pre-contemplation stage in this wave, indicating that a large proportion of the sample was not currently (July 2012) considering changing their usual journey to work. The remaining four stages consisted of between 5.5% and 8.9% of the sample. This distribution amongst the stages differs from many previous studies, which have found a greater proportion in the other four stages. For example, in the study of commuters' attitudes to cycling to work (at the University of Surrey, UK), Gatersleben and Appleton (2007) found that 23.6% of the sample were in contemplation and 15.7% were in preparation. Although pre-contemplation was the largest group with 38.2% of the sample. The study of employees of Staffordshire University by Beatty et al. (2002) found that, when asked about reducing their car use over the ensuing 12 months, 41% of the sample of drivers placed themselves in pre-contemplation. Notably, 23% of the sample was placed in maintenance.

The much higher proportion of the London sample being placed in pre-contemplation indicates that many individuals were not considering changing, despite this being just two weeks prior to the Games occurring. However, the variability in existing commute journeys (76.8% of the sample stated that they did change their journey to work, either when they needed to or out of choice) suggests that many people already displayed a capacity to change, but this was not accounted for in the stages. The analysis of actual change compared

to the pre-Games stages of change highlighted how many pre-contemplators did go on to make a change during the Games (55.2%), further emphasising this point. In a similar study, Beatty et al. (2002) observed 'erratic' stage movements when applied in the study of willingness to reduce car use after a fuel shortage. This further indicates that in the context of disruptions, the stages have difficulty in accounting for behaviour when there is an imperative to change, as opposed to a behaviour change intervention (e.g. a campaign to increase active travel) where the need to change is less obvious and more voluntary. This has broader importance therefore to the role of the state in steering behaviour change. If the conditions for change can be made clear, and the imperative to change demonstrated, then this will elicit a different response to the voluntary campaigns traditionally observed.

The discussion has so far focused on the pre-contemplation stages. The other four stages considered in this research are in the theory expected to be relatively distinct, and to offer a representation of the point in the change process the individual is at. From the analysis it emerged that there was not a great deal to distinguish the four stages. The four stages each comprised only a small proportion of the sample, between 5.5% and 8.9%. This small proportion is a result of the large degree of pre-contemplators but it should be noted that such similarities in the number of people in each stage is not a reflection of previous studies, including Beatty et al. (2002) and Gatersleben and Appleton (2007). This suggested that rather than the five stages of change as anticipated, the model can be collapsed to pre and post-contemplation. This suggestion was supported by the results of actual change that occurred during the Games. Pearson's chi-square tests showed that there was a statistically significant association between the stages of change and actual change variables. This indicated that significantly fewer pre-contemplators made a change to their usual journey to work than expected were there no association. The opposite was true in the remaining four stages (post-contemplators), where it was also observed that there were no statistically significant differences between these stages.

Analysis of the different types of change compared to the stages also indicated differences between pre-contemplators and post-contemplators. Pre-contemplators were shown to be significantly less likely to have re-timed, re-moded, or re-routed during the Games. The only exception was reducing or relocating, which links to the view that this was a more feasible change for the whole sample to make during the Games. The assessment that there are two stages rather than five in this context has promoted a further challenge about the efficacy of the stages of change. Such a finding does not match with previous studies of the TTM in transport, with the stages generally being treated separately. Shannon et al. (2006) did group the action and maintenance stages together in their study of active commuting. However,

this was focused upon developing stage specific interventions to encourage change and these two stages were deliberately grouped by the authors as it was argued they would require similar approaches. Bamberg - who found four clusters in their sample based on a number of variables - similarly grouped two stages, creating a 'preparation and test' (i.e. 'action') stage (2007). This allowed them to link each of the four clusters with an appropriate stage of change.

A final aspect of the analysis of the stages of change related to a comparison with intention. This involved the creation of four groups to explore the role of intention as a predictor of change in this study. Whilst the stages of change are an indicator of intention, a simple intention item was also included that related directly to the Games. Four groups were created from the comparison of these variables: 'Easy-adaptors' (pre-contemplators with an intention to change), 'Consciously unengaged' (pre-contemplators with no intention to change), 'Flexible-intenders' (post-contemplators with an intention to change), and 'Flexible-non-intenders' (post-contemplators with no intention to change). The comparisons between these groups showed that, when focused on the short-term, the simple question of intention was a much more reliable predictor of actual change. This is important to note as it suggests that when studying behaviour change in the context of a disruption, especially one that is relatively a short-run event, the stages of change do not effectively account for change.

9.6.2 The Processes of Change

The processes of change are, theoretically, expected to be more relevant at particular points across the stages of change (Nigg et al., 2011; Burkholder and Nigg, 2002). This is visualised in Figure 9.3, which shows how those moving from one stage to another should utilise certain processes. This research did not fully echo that of the majority view amongst the TTM literature, and instead showed that certain processes were more relevant amongst individuals across stages (e.g. social liberation, self-liberation, stimulus control, and helping relationships). This reflects the viewpoint of Fergusson et al. (1999) who commented that the nature of the (problem) behaviour can influence differences in which processes are particularly relevant.

Further examination of the processes that were more likely to have been disagreed with (counter conditioning, contingency management, and self-re-evaluation) showed that there was a degree of logic in terms of which processes were least relevant for the Games. These processes (as described in Table 6.6 in Chapter 6) are orientated around finding better journey options and projecting oneself as a proactive person. The results therefore suggest that many individuals were already aware of the options they had to change and were more focused on the processes that related to help and support to change. For example, social liberation and helping relationships, which are more directly related to work culture.

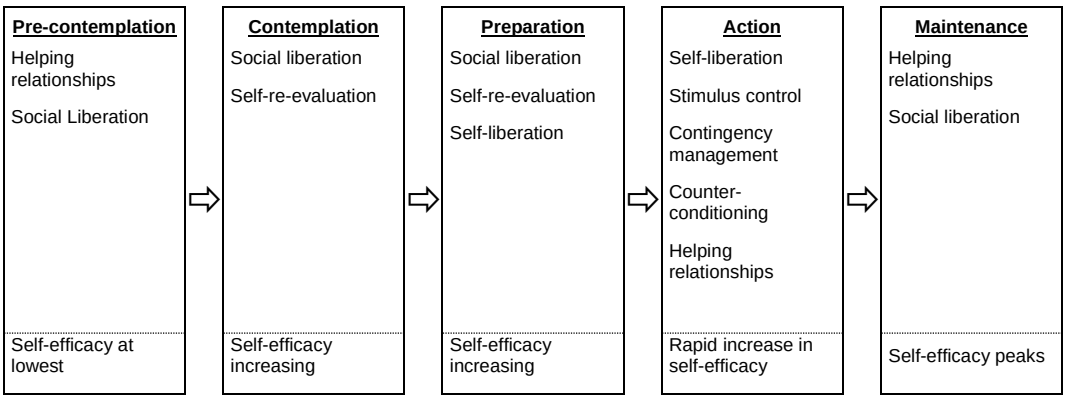

Figure 9.3: The Transtheoretical Model (adapted from Nigg et al., 2011; Burkholder and Nigg, 2002)

Table 9.1 presents the median scores for the responses to each process of change statement for both the 'change' and 'no change' groups. This reiterates which processes were more commonly agreed upon by the whole sample but also shows that there were statistically significant differences in responses to some. This indicated that social liberation, self-liberation, stimulus control, and self-re-evaluation were more likely to have received agreement from those who changed (although overall self-re-evaluation was shown to be less popular). What interestingly emerges from the processes is the disagreement with counter conditioning ("Changing the way I travel during the Games will improve my travel experiences"). This suggests that people acknowledged that they were likely to have to make compromises to their travel for the period of the Games, and possibly explains why so many people reverted back to their usual travel after the Games. This is further supported by the disagreement with the contingency management process ("Changing the way I travel may have the added benefit of finding new or better options for my journey to work") amongst both the changers and non-changers, which suggests that there is a belief that they are already making their commute journey in the best way for them.

Table 9.1: The processes of change by whether changes were made

Processes of Change	Median	
	Change	No Change
Environmental Re-evaluation	3	4
Social Liberation	2***	3
Helping Relationships	2	2
Self-Liberation	2*	3
Counter Conditioning	4*	4
Stimulus Control	3***	3
Contingency Management	4	4
Self-re-evaluation	3**	4

*Significant at < .05 **Significant at < .005 ***Significant at < .001

In terms of the specific types of change, there were certain processes that were shown to have statistically significant associations with those making a change. These are summarised in Table 9.2 and show how some processes were relevant to three or four types of change. This included social liberation, stimulus control, and self-re-evaluation, and reflected the processes that were common in the total sample. In contrast to this, there were some processes that were shown to only be relevant to people making certain changes. For example, self-liberation ("I can change the way I travel to work if I try hard enough") was significantly more likely to have been agreed with by those who changed mode or route, signifying that there was an acknowledged need for greater effort to make these changes. These findings are important as they begin to cultivate a discussion around the distinctions between different types of change and the relevance of the processes to this.

Table 9.2: Summary of statistically significant relationships between processes of change and the types of change

Processes of change	Reduced	Re-timed	Re-moded	Re-routed
Environmental Re-evaluation	✗	✓***	✗	✗
Social Liberation	✓**	✓***	✗	✓*
Helping Relationships	✗	✗	✗	✗
Self-Liberation	✗	✗	✓***	✓*
Counter Conditioning	✓*	✗	✓*	✗
Stimulus Control	✓***	✓***	✓*	✓*
Contingency Management	✗	✗	✗	✗
Self-re-evaluation	✗	✓***	✓***	✓*

*Significant at < .05 **Significant at < .005 ***Significant at < .001

The processes found to be relevant to re-moding were shown to have some comparability with previous work, namely that conducted by Mutrie et al. (2002). Although this research examined an intervention, rather than a disruption, it was found that three of the most frequently used processes were self-liberation, counter-conditioning, and self-re-evaluation. This reflects the findings in this research, which are presented in Table 9.2.

The findings from the analysis of the processes of change have demonstrated that they did not link to the stages of change as would be anticipated. Importantly however, the research has shown which processes appear most important in the face of a disruption to travel. It has also demonstrated that certain processes are more relevant to people making certain types of change, which contributes to the understanding around the different types of change.

9.6.3 Self-efficacy

Self-efficacy was the final construct of the TTM examined, which was applied in an attempt to understand how important the ease or difficulty of making a change was in this context. In terms of overall change, it was shown that there was little to differentiate those that changed and those that did not. The whole sample regarded arriving for work earlier and departing from work later - based on the median score – to be an easy change to make. The remaining types of change that were examined from this perspective mainly had a median score of 'Neither [easy nor difficult]', the exception being 'working from home' which was found to be 'Difficult'. The lack of significant differences between 'change' and 'no change', and the median scores suggested that self-efficacy did not offer a great deal of value for understanding why the changes that occurred were made. Arriving for work earlier and departing work later are not completely surprising results from the employer's perspective as it is unlikely to have required a reduction in working hours. However, from the personal perspective, it is interesting to observe that individuals considered it easy to shift their travel times in such a way. This is particularly relevant with regard to those who had other dependences on them that may influence their lifestyle, and therefore transport (e.g. child care, Van Acker et al., 2010).

With this in mind, comparisons were made between the responses from the self-efficacy items and socio-demographics to examine any underlying factors. This showed that, whilst leaving for work earlier and departing work later were considered easier changes to make overall, those individuals in households of 'couples with children' were significantly more likely to have found this a difficult or very difficult change to make. This shows that this group in particular were influenced by these external factors.

In terms of the different types of change, those who re-moded were shown to have been significantly more likely to have considered changing mode an easier change to make. This suggests that changing mode - which in this context has been shown to be the least common change – was particularly influenced by the individual's situation. This is as opposed to, for example, changing the route or time of travel. This is important to note as it shows a further distinction between the types of change made.

Working from home was found to be easier for those who reduced their journeys to work. Whilst this finding was perhaps not unsurprising, further analysis showed that those who had been encouraged to work from home by their employer were significantly more likely to have been in the reduced group. This is important as it emphasises the influence of the employer in this context. Previous studies (Bamberg, 2007; Shannon et al., 2006) show how self-efficacy is influenced by the context of the study, and this adds further weight to this.

9.6.4 Cluster analysis

Owing to the uncertainty presented by the analysis of the TTM constructs, a cluster analysis was conducted in order to understand more about the insights provided by the processes of change and self-efficacy variables. This analysis produced four clusters that were shown to be independent of the stages of change. These clusters produced groups that enabled a greater understanding of the attributes behind the responses to the disruption of the Games.

Briefly summarised, the four groups were as follows:

- *Reluctant Changers* - consisting of individuals who were more neutral in their responses to the processes of change and self-efficacy statements, they also displayed the least amount of change overall.

- *Easy Re-moders* - generally agreed more with the constructs and there were no median values that were less than 3 (neither agree nor disagree). This cluster made the greatest amount of change during the Games (72% of the cluster doing so).

- *Difficult Adaptors* - a group of individuals who were more likely to disagree with both the processes of change and self-efficacy statements, with the exception of 'helping relationships'.

- *Able Inactive* - displayed the highest agreement with the self-efficacy items but the processes of change responses are mixed with some median scores showing disagreement with the statements.

There are few studies applying a cluster analysis in this context. Perhaps most relevant is the work of Bamberg (2007) who used multiple questionnaire items to generate a four-cluster solution. These clusters were relabelled with the stage of change that was most appropriate to each group based on their attributes (preparation and action were combined). The approach to examining the association between the clusters and stages of change was

different in this thesis. The purpose was not to necessarily identify clusters that represented the stages of change, but rather to examine whether these clusters could provide greater insights into the behaviour observed. The analysis showed that the four internally homogenous groups produced were not united by a common stage of change. This is important as it highlighted the potential non-applicability of the combined TTM items in this context. This study has shown the limitations in the stages of change when applied to a short-run disruption. Given that the processes of change and self-efficacy items did provide insights, there is a question of how, moving forward, these can be utilised to improve the understanding of how people respond to disruptions, or other interventions.

9.7 Conclusion

The large amount of change that occurred to commute journeys during the Games shows a situation in London where a significant shift in the social context led to widespread changes in behaviour. The degree of change made (54% making at least one change) clearly emphasises this. One of the more salient points of this discussion is the distinction between the types of change made to commute journeys. This is shown through the differences in the degree of change made for the different types of change and shows how reducing, relocating, and re-timing were very common changes to make. Re-routing and re-moding, in comparison were less likely to have occurred. The researcher reiterates here that the sampling undertaken as part of this thesis does not seek to be representative to the wider population. The results discussed in this section do however allow us to draw meaningful conclusions as to the behavioural impacts of the Games on a sample of commuters, which is a valuable step in understanding the opportunities for change such events can provide.

The other journeys that were studied in this thesis (business travel and non-work) were primarily focused around reducing the number of such journeys in the face of the disruption caused by the Games. The much smaller amounts of change to mode, route and time of travel may reflect the more discretionary nature of these trips, where cancelling or postponing may be a highly feasible option. However, it should also be noted that such journeys may have been less impacted than the commute journeys owing to the time and location at which they take place.

In the study of disruptive events, it is not apparent that there is a behavioural model that is well suited to examine and predict change. Therefore, a key innovation in this research has been the exploratory application of the TTM, which has led to the identification of the key constructs that can provide insight into the travel behaviours examined. As Table 9.2 in Section 9.6.2, demonstrates, certain processes appeared more relevant depending on the type

of change in question. This shows where certain tools or activities that could be engaged with (the processes) were more applicable to certain types of change, which has potential implications for how change can be approached in such environments.

Chapter Ten

Conclusion

10.1 Introduction

The research presented in this thesis has provided an examination of the travel behaviour change impacts of the London 2012 Olympic and Paralympic Games, in order to further understand the potential for change such events create. Constructs derived from the Transtheoretical Model were applied to establish greater insights into the behaviour observed, but also to examine the value of these constructs in the context of a large, disruptive event. A number of research questions were presented at the beginning of this thesis and these have been responded to in detail in Chapter 9.

This final, concluding chapter will synthesise the importance of the key findings of this research. The implications of these findings will then be discussed to demonstrate the original contributions this research has made to the field, in terms of both practice and theory. The limitations of the research will then be acknowledged. Finally, the recommendations for future work will be presented.

10.2 Summary of key findings

10.2.1 Understanding the response to a large, forced disruption

This research has provided a valuable insight into the responses to a large, forced disruption in London. The degree of impact on the transport network, albeit for a fixed period of time, created an environment where, for many, change was an imperative. 54% of people did go on to make changes, with 25% having made multiple changes. This indicated that when faced with the need to change; many people were able to respond to the disruption. Crucially, this thesis has shown how individuals coped with the disruption, engaging in the possible types of change in different ways.

The established literature surrounding travel behaviour has shown that through voluntary behaviour change initiatives (e.g. active travel programmes) change is possible. However, the change achieved is often relatively small and incremental (Marsden and Docherty, 2013; Schwanen et al., 2012). This research has demonstrated that there is real potential, amongst those in London at least, for substantial shifts in travel behaviour to be achieved when faced

with an imperative to change. This research has provided the initial work to develop an innovative method (through the TTM constructs) to improve the identification of individuals who may have a greater potential to change their travel behaviour.

10.2.2 The types of change were found to be distinct

An important contribution of this research is the focus on the multiple changes available. This showed that in the context of the Olympics and Paralympics, reducing/relocating and re-timing journeys were the most feasible changes to be made. People still changed the mode and route of travel but this was to a lesser degree, and the evidence suggests that these were changes that required a greater degree of ability (either driven by the individuals or as a result of their circumstances). What is clear from this research is that there were distinctions in the factors that were important for the different types of change. This means that, rather than considering the broader term of 'behaviour change', there is a need to consider the multiple behaviours available and utilised by individuals.

The relatively short-term nature of the event meant that travelling to the usual workplace less or at a different time appeared to be more widely accepted by both the employer and the individual. In terms of the commute, taking annual leave was an option but working from home was also shown to increase, indicating a shift in how people worked. Business travel and non-work journeys were highly likely to have been reduced, which emphasised their discretionary nature. Interestingly, in response to a further disruption (one that focused upon a restriction to a particular mode) the sample demonstrated a widespread ability to easily adopt changes to travel in the short-term and then quickly revert back. Importantly, this research has provided new insights into how the different types of changes can be approached, and how people regard making these changes.

10.2.3 Intention to change provided greater understanding of the changes made

The level of engagement enacted by the organisers prior to the Games contributed to an environment where the awareness of the potential impacts of the Games on travel was widespread. This unique level of engagement undoubtedly led to a greater degree of intention amongst the sample than would have occurred was there less forewarning (e.g. an unplanned disruption). The existing variation in the commute journey may also explain why high levels of intention were observed, as many people had the skills and options to adapt their behaviour, rather than waiting for the disruption before considering their options.

For non-event based behaviour change, intention has not been a strong predictor of change, however in this study the analysis showed that there was a significant association between intention and action, showing that people with an intention to change were more likely to go on to change. Theoretically, the stages of change are also an indicator of the intention an individual has to change their behaviour. A comparison between the 'intention to change during the Games' variable and the stages of change demonstrated the pure intention variable was more effective at accounting for the behaviour that did occur during the Games. This - combined with the observed inability of the stages of change to account for the adaptability of the sample in this context - suggests that the simple intention variable would be a more effective tool for future methods of studying behaviour change in this context.

10.2.4 Socio-demographics attributes were not central to influencing change

A range of socio-demographics were examined in the panel surveys, and whilst these provided insights into the characteristics of the sample it showed that there was little to distinguish those who changed and those that did not. This echoed the arguments of Ajzen (2011) who stated that socio-demographics would be accounted for through other factors (e.g. attitudes) when studying behaviour change from a theoretical perspective. Notably, the study and comparison of different types of change in this thesis did indicate that reducing was different to the other changes. This showed that there were a number of differences between those changing and those not based on the socio-demographics. The summary of this being that higher paid employees, in more senior positions were more likely to be able to reduce or relocate their journeys. This suggests that those with arguably more control over their role were in a better position to be able to travel less.

The overall lack of insight provided by the socio-demographics further emphasised the potential to look elsewhere to understand what factors influenced the changes observed. In this thesis, this has been garnered from the self-efficacy and processes of change constructs of the TTM, which will be discussed in greater detail in the forthcoming sub-sections.

10.2.5 There were differences in the level of support from employers

Larger businesses were able to provide environments where individuals appeared to have greater support to make a change to their travel. Those employed in larger businesses were found to have more access to opportunities to change their commute journeys, particularly for reducing/relocating or re-timing. Whether this was a result of the engagement by the organisers, or a reflection of the existing situation within the business is difficult to

categorically identify. It was reported that individuals in larger business experienced more exposure to discussions about changing travel from their colleagues. Overall, it was shown that there were in fact no statistical differences between the size of business and whether changes did occur during the Games. This was with the one exception of reducing or relocating, which was shown to be more feasible for employees in larger businesses. An outcome of these findings is the awareness that there is the need for further research and a greater focus of policy on the reorganisation of working practices, when considered in the context of travel behaviour change.

10.2.6 The stages of change lacked value when applied to this short-run disruption

The stages of change have been applied in a range of transport related contexts but the application to such a large-scale, forced disruption was novel. This has therefore provided a valuable insight into the applicability of the stages of change in such a context. The study of the stages of change across the panel survey showed that the pre-contemplation stage was by far the most common stage amongst the sample. This could possibly be attributed to the context within which the study was placed. Specifically, that the existing adaptability observed in the sample (76.3% sometimes made changes to their commute journey, at least when they needed to) meant that pre-planning for the Games may not have been considered necessary.

In examining how individuals in different stages of change responded to the disruption they faced during the Games, it was shown that rather than the five stages posited by the theoretical literature, there appeared to be a binary composition amongst the stages. This produced the pre-contemplation and post-contemplation groups discussed in the analysis (Section 6.8). The pre-contemplation and post-contemplation groups were shown to be statistically different, with post-contemplators less likely to have made a change during the Games. Ultimately, the stages were unable to effectively account for the behaviour observed, which clearly limits their applicability in the context of a short-run disruption.

10.2.7 The cluster analysis showed how individuals approached change differently

The cluster analysis that was conducted provided a useful insight into the psychological factors underpinning the changes observed. This allowed for a great utilisation of the processes of change and self-efficacy items to understand how these related to the types of change observed.

Importantly, this demonstrated how the different groups engaged with the types of behaviour change. For example, the *Easy Re-moders*, as the name suggests, were significantly more likely to have changed their mode during the Games with their processes of change and self-efficacy responses (as shown in Figure 6.9 in Section 6.10.1) supporting this. On the other hand, the *Difficult Adapters* group, which represented those who largely disagreed with the processes of change and found change more difficult, was shown to have made smaller amounts of change. The *Able Inactive* group is notable as they displayed particularly low levels of change for mode and route, despite finding these types of change easier. However, a more inconsistent agreement with the processes of change may explain this, along with situational factors. For example, this group consisted of a higher proportion of individuals in more senior management positions, which may present them with greater control over their travel patterns.

The insights gained from the cluster analysis are valuable as they help to identify the potential for change amongst individuals in the sample. Certain individuals (e.g. the *Easy Re-moders*) showed a greater likelihood of making a change to their commute journey. The circumstances and characteristics influencing this particular group can help to improve how travel behaviour change is understood in such conditions, and how this may help to support change amongst those appearing less able to do so (e.g. the *Difficult Adaptors)*. At a broader level, the differences in the potential for change may help to guide more targeted interventions that can help to influence behaviour change amongst certain groups. For example, the *Able Inactive* showed the potential to change, yet made less substantial change than the *Easy Re-moders*. Further examination of the circumstance affecting these groups (e.g. whether they faced less disruption to travel during the Games) would be necessary to fully understand the factors influencing them. However, identifying such a group is a valuable first step in the improved identification of the factors affecting them, and how more effective interventions may be made that may support more substantial behaviour change.

10.2.8 In the context of a major-event, where the system returned back to normal afterwards, the longevity of change was limited

The Games brought about an extensive amount of change amongst the sample. However, the short and fixed term nature of the event meant that many of those who changed quickly reverted back to their pre-Games travel afterwards. This emphasised the flexibility that was found in the sample, and the willingness to adapt travel for a short period of time. As a result, longer-term changes in travel behaviour were limited. 6% of the sample continued with their changes in the period after the Games but by the fourth survey wave there was little evidence of the Games-time changes sustaining.

In terms of the different types of change available, there was no one change that was more likely to be sustained. This emphasised that it appears unlikely that there was a step change in how one particular type of change was support by employers or regarded by individuals. Instead, it appears that the changes that were sustained were influenced but the particular conditions and situation of the individual. The one sustained change of note relates to working from home. The evidence shows how working from home had increased on pre-Games levels after the Games and were continuing to be sustained (an average of 0.4 days per week). This has since increased again to 0.6 days per week.

An element of the pre-Games planning was to set up and support a behavioural legacy from the Games. From the commute perspective, the evidence from this research demonstrates that an extensive legacy has not emerged. The opportunity to sustain changes in the transport system and to alter working practices appears to not have been taken. The evidence during the Games highlighted the extensive engagement by employers to their employees. However, the Wave 4 survey suggested that support for change was now much lower post-Games (see Figure 8.6 in Section 8.1.2). Therefore, it is not surprising that the behavioural impact has shown limited longevity. Despite the limited legacy shown, this research has highlighted important insights about the flexibility, adaptation, and planning that the sample was able to engage to support the substantial change observed. These will be discussed in more detail in the next section.

10.3 Implications of the findings

10.3.1 Implications for practice

The findings presented in this thesis have raised a number of implications for both practice and theory. Taking practice first, there are several points that will be discussed in detail, beginning with achieving more substantial changes in travel behaviour.

10.3.1.1 Achieving more substantial changes in travel behaviour

This research has shown that, when faced with a disruption to travel, there was a high level of adaptability within the sample to make changes in response to the disruption. This was demonstrated, to some extent prior to the Games, with 45.5% of the sample stating that they had changed their usual commute journey when they needed to, for example if their usual mode was not available. After the Games, the February 2014 London Underground strike showed how a large proportion of the Wave 4 sample changed their commute journey during the two-day strike. For example, on the morning of the first day of the strike, 60% of the Wave 4 sample altered how they were intending to travel in response to the disruption

they faced. Finally, the substantial shifts in behaviour observed during the Games points to evidence that there is clear potential for significant change when there is an imperative to do so. Understanding in greater detail the factors associated with change in response to disruption is a valuable point of learning for approaching future disruptions or behaviour change opportunities.

The application of the TTM and specifically the subsequent cluster analysis has provided an alternative view of the change to travel behaviour made by the sample. For example, the *Difficult Adapters* showed a median score of 4 (disagree) with a number of key processes. Namely, social liberation ("Colleagues and friends are discussing changing the way they travel"), self-liberation ("I can change the way I travel to work if I try hard enough") and stimulus control ("I will plan my time during the Games so that I am able to change my work travel"). Such insight may help to guide more specific interventions directed at individuals that can support how they change in response to planned disruptions.

At present, generalisability to locations outside of London would require further work but the transferability has broad potential. The nature of the processes of change and self-efficacy constructs means they are tailored to the context within which they are applied, and this therefore means that expanding their use to other contexts (e.g. other major cities around the world) is feasible.

10.3.1.2 Utilising employers to support more change

The data from the panel surveys showed that up to 50% of those in larger businesses reported receiving advice and support from their employers. This was up to 40% for smaller businesses. Whilst this is mediated through employers, and is likely to be influenced by the employers' own approach to the Games, it does highlight the support to change that was in place for the Games. The differences in support and advice between larger and smaller businesses (shown in Figure 6.2 in Section 6.3.5.3) indicated that the levels of support were consistently greater for larger businesses. However, the impact of these differing levels of support are less apparent, given that there was no significant difference between larger and smaller businesses and whether changes occurred.

Once the Games had ended it appears that much of the support for employees to continue to adapt their travel declined quickly. It is not unsurprising that this support declined given that the disruption had passed and the transport network returned to the status quo. What was unique about the Games is that the travel planning support provided by employers was, in part, a result of a focus on business continuity during the disruption of the Games. Where there is a vested interest it is reasonable to expect greater employer support as a result. Roby

(2010) highlights this in the context of workplace travel plans, where travel plans have been shown to become a more proactive element of the business strategy when there is an opportunity to support business growth.

Both these points reiterate that there is a need for further research and a focus of policy to understand better the potential for change supported by employers, and particularly the reorganisation of working practices. This of course links in part to future disruptive events, but also has implications for how day to day travel may be influenced if the right measures can be put in place.

10.3.1.3 Lessons for Rio 2016 and beyond

What is clear from the existing literature around the Olympic and Paralympic Games is that every host city has specific issues and problems that must be overcome to help make the Games a success. There is perhaps no better example of this than the contrast between London and Rio de Janeiro. With very different land use patterns, transport provision, and objectives for their respective Games, these two cities have their obvious differences.

An important lesson for Rio 2016 may lie with improving the understanding of what types of change are possible associated with the Olympics and Paralympics. In London, the different types of change have demonstrated distinctions, with some options being highly feasible, and others less so. For example, businesses helped to support reducing and re-timing for commute and business travel behaviour, but this may be less feasible in Rio dependent on the types of companies in the economy. The underlying factors assessed through the TTM items have also helped to demonstrate the differences in how changes are supported at the individual level. The distinctions shown are important to understand as they help to show the intricacies between the different types of change, as opposed to considering change more broadly, which may be a useful lesson for Rio 2016.

10.3.1.4 Broader lessons for travel behaviour change

Taking into account the implications of this thesis, an important lesson has been the demonstration that there is a significant ability for individuals to respond positively to a disruption (or potential disruption). When considering behaviour change policy, specifically whether to focus efforts on changing attitudes or to use more direct ('hard') policies, it is useful to consider the lessons from this thesis. Although not a change to legislation or a new restriction put in place, the Games did present a situation where there was a significant shift in the context within which journeys were made. Whilst the Games are a particularly extreme example of an intervention to travel behaviour, the lessons that have been learnt

present support for more radical interventions (which may be balanced with voluntary behaviour change initiatives) to help elicit greater shifts in individual travel behaviour, over and above the incremental change we currently observe. An interesting comparable example may be the road space rationing policy employed by the organisers of the Beijing 2008 Olympic and Paralympic Games, which has continued to be maintained as a policy in the city, post-Games. This intervention restricts the use of cars to alternate days, thereby reducing the number of vehicles on the road (BBC, 2008). Such an intervention forces a shift in behaviour and, given the evidence presented in this thesis, may be a situation that individuals can adapt to, and thereby help to shape more substantial (and possibly longer-term) shifts in travel behaviour.

10.3.2 Implications for theory

10.3.2.1 Achieving more substantial shifts in travel behaviour

It has been discussed how traditional behaviour change initiatives, where there is a focus on voluntary change do have the potential to achieve shifts in behaviour. However, there is a recognition that there are opportunities to achieve more substantial changes in behaviour through disruptive events where the normal conditions are removed (Graham, 2010), which is evidenced in this thesis. There remain questions of how long such conditions could be sustained, for example how long individuals in London could have continued to adapt in the ways that they did, which is a point for further exploration through research.

A further point in this research relates to how change is understood in the context of disruption. Much of the literature focuses upon the habitual and fixed nature of travel (that must be 'broken' to achieve change) yet this research demonstrates that there is a greater flexibility and ability to respond to disruptions than is recognised. This therefore places this thesis amongst an emerging body of literature assessing the validity and feasibility of these arguments (Marsden and Docherty, 2013), which may ultimately shape a step change in how travel behaviour change is approached. This is particularly pertinent as more radical tools are sought to help governments reach challenging carbon emissions targets.

10.3.2.2 Applying theoretical models to the study of disruption

An important element of this research from a theoretical perspective is the contribution it makes to behavioural change theories. This relates largely to the novel application of the TTM to a large, forced disruption but there are also contributions to the wider understanding of related theories in such contexts. In terms of the TTM, this research has shown that there is particular value in applying the processes of change and self-efficacy items but not the

stages of change. The clusters generated from the processes of change and self-efficacy constructs have also been shown to offer valuable insight, particularly in terms of the distinctions between the types of change made. This is important as it can help to guide future work where there is an objective to understand the underlying psychological factors affecting change, and shows a need to consider the types of change separately. For studies approaching disruptive contexts through alternative models, there is the key lesson that disruption can mean that even those who would be least expected to change are likely to have a degree of undisclosed ability to change.

10.3.2.3 Understandings about different types of change

This research has advanced the understanding about how people respond to a disruption when there are multiple changes available. The study has shown that, in the context of a major disruption, reducing and re-timing journeys were more common changes. Importantly, the research has shown in greater detail the factors behind these changes, through the application of the TTM, which goes further than providing an overview of what occurred, which has been common in previous studies.

10.4 Limitations of the research

A key positive in this research has been the collaboration with TfL. This provided an extensive amount of data derived over an extended period of time, and from a large sample. However, this also presented a key challenge in the research, which was the balancing of the survey design (particularly with regard to the design of the TTM items) and the advantages of access to the Olympic Panel Survey commissioned by TfL. A limitation in this research was therefore the compromises that were made on the exact wording and presentation of the TTM items to ensure that they were able to be incorporated into the wider survey. Ultimately however, the final designs of the questions were agreed upon and regarded as being appropriate to meet the needs of this study.

The methodological approach of this research did not apply qualitative methods alongside the quantitative survey that was conducted. The researcher acknowledges that there would have been value in exploring in more detail some of the points that emerged from the surveys. For example, focus group or one-to-one interviews may have allowed for an improved understanding of issues affecting the sustainment of travel behaviour changes that emerged from the Games. The primary objective of the researcher was to conduct the fourth-wave survey necessary to extend the longitudinal focus of the panel study. The time and resources necessary to ensure the success of this meant that ultimately this was

prioritised over any further qualitative work. The decision to not conduct this further data collection was also justified by the large amount of data available from the four-wave panel survey, which enabled the detailed examination of travel behaviour presented in this thesis, to be achieved.

The timings of the panel survey are also a further limitation of the study. This relates specifically to the pre-Games surveying, which took place two weeks prior to the start of the Olympic Games at the end of July 2012. Despite this being before the official start of the Olympic Games, the lead up to the Games meant that the activity within London increased in the weeks before, as preparations were put in place. Therefore, to avoid any potential overlap, the Wave 1 survey may have been more appropriately conducted several weeks earlier. An additional pre-Games survey may have also been beneficial to provide a more detailed understanding of the intentions and preparations of employers and employees to make changes (as was done by Brewer & Hensher, 2001). This would have also contributed to the longitudinal element of the study, adding further understanding of the changes in travel behaviour over time.

A final point related to the surveys to note is the lack of opportunity to contact the entire sample to complete the fourth survey wave. In the third wave respondents were asked to state whether they would be willing to be contacted to complete further surveys related to this study, with 399 indicating that they would. This meant that only a smaller proportion of the wider sample could be contacted and therefore the Wave 4 sample was restricted. This still garnered a response rate of 42% (167 individuals), but the ability to contact the wider sample to complete the fourth wave would have led to a larger sample to be examined in the analysis, with greater inferences possible.

Finally, the context within which this study was conducted was a further potential limitation of this research, in terms of transferability to further UK cities. Given the differences in the transport provision in London in comparison to other UK cities, generalisability to other locations may be more difficult. However, the study of such a large-scale event meant that a city such as London would be an anticipated location for such events. These findings are still transferable - as discussed in Section 10.3.1.3 – with other major world cities of particular relevance.

10.5 Recommendations for future work

This research has provided insights into the behavioural response to a large-scale disruptive event, and the underlying factors that were found to be important to the changes that were

observed. This contributes to an emerging area of literature around the potential for learning from such disruptive events and the opportunities for change they may present. Through this research, a number of further questions have been raised that warrant further investigation to help contribute to this emerging and on-going discussion.

A first point of note relates to the TTM, and specifically to develop how this could be applied in similar, future research. In this thesis it was applied with an exploratory purpose, and therefore understandings of potential learning and adaptation from this was important. The focus on the processes of change and self-efficacy items within the subsequent cluster analysis that was presented in this thesis is an element of this. However, future work that focuses on further development of the relevant TTM items (processes of change and self-efficacy), along with additional items that may provide insight (e.g. intention to change), could create a succinct set of survey questions. Such items may be applied effectively as part of wider surveys to establish potential clusters of individuals and thereby help to identify the types of change more possible in such circumstances. An element of this would be to assess the applicability of the items to other contexts, as travellers in London benefitted from a broad range of travel options, which may not exist in other study locations.

The data presented in this thesis showed that many individuals reported support and advice from their employers to make changes during the Games but this appears to be more restricted in the longer-term after the Games. For example, only a minor proportion of those who re-timed in Wave 4 reported advice from their employer to do so. In contrast, many of those not re-timing were restricted from doing so by their employer. This raises questions about if, and how, the conditions from the Games could have been sustained to maintain an environment where change was more supported. Further research specifically investigating the effect of employer support during other examples of disruptive contexts, and to examine further the potential for longer-term support, would help to contribute to understanding more about the opportunities there are for supporting change in disruptive environments.

A final, further question is the transferability of this approach and findings to other contexts. Whilst this is relevant in terms of considering the influence of differing transport provision and planning in the city, it is perhaps of more interest to consider it in terms of the economy within which it is placed. For example, in Rio de Janeiro, a differing workplace culture and the types of businesses that may be more prevalent in the city, may offer different levels of support to commuters than observed in London. Investigating how this may influence the types of change more feasible in other cities would be a valuable contribution to

understanding more about the opportunities for different types of change that such disruptive events may present.

10.6 Final conclusions

Revisiting the broader aims of this research, which were set out in Section 1.3 in Chapter 1, this thesis has addressed a number of research questions that have contributed to meeting these aims. The study of the London 2012 Olympic and Paralympic Games provided a useful opportunity to examine the potential for behaviour change around a large-scale, forced disruption. The emerging literature around disruptions identifies events such as these as useful opportunities for behaviour change, but also key instances for learning. This thesis seeks to contribute to the literature through improving the understanding of the behavioural impacts of such major-events, and the underlying factors that may influence different types of change. The application of the TTM helped to demonstrate these underlying factors, but the exploratory approach of its application also helped to demonstrate its efficacy when applied to a context of disruption. The sample displayed flexibility, adaptation, and planning to respond to the Games, although the longevity of their changes was shown to be limited. The insights from this contributes to the understanding of travel behaviour change in the context of disruptions, and ultimately the discussion as to how more radical changes in behaviour may be achieved to meet the challenging decarbonisation targets faced in the transport sector.

Publications and Conference Papers

Below is a list of publications, conference presentations, and conference posters that were published or presented during the completion of this PhD.

Publications

Parkes, S.D., Marsden, G., Shaheen, S.A., Cohen, A.P., 2013. Understanding the diffusion of public bikesharing systems: evidence from Europe and North America. Journal of Transport Geography. 31, 94-103. http://dx.doi.org/10.1016/j.jtrangeo.2013.06.003*.

Conference Papers

Parkes, S.D. 2015. The longevity of behaviour change: A case study of the London 2012 Olympic and Paralympic Games. Presented at UTSG 2015, London, UK, 5-7 January 2015.

Parkes, S.D., G. Marsden. & A. Jopson. 2014. The longevity of behaviour change: A case study of the London 2012 Olympic and Paralympic Games. Presented at hEART 2014, Leeds, UK, 10-12 September 2014.

Parkes, S.D. 2013. The Travel Behaviour Impacts of the London 2012 Olympics and Paralympics. Presented at the World Conference on Transport Research, Rio de Janerio, Brazil, 15-18 July 2013.

Parkes, S.D. and G. Marsden. 2012. City Bike Hire Schemes - Emerging Trends in Europe. Presented at 91st Annual Meeting of the Transportation Research Board, Washington DC, US, 22-26 January 2012*.

* This research was conducted independently of the PhD research.

Appendix A: Original Transtheoretical Model items

This appendix includes the original TTM items that were developed for inclusion in the first wave of the panel survey. These questions were provided to TfL and AECOM, and were then integrated into the final surveys with some adaptations made. The final items are included in Chapter 5.

The Stages of Change

Please tick the statement below that most closely applies to you. Please tick one box only.

- ☐ I am not considering changing the way I would normally travel to work. [Pre-contemplation]
- ☐ I am considering changing the way I normally travel to work but I am not in a position to make this change yet. [Contemplation]
- ☐ I am doing things to prepare myself to change the way I travel to work. [Preparation]
- ☐ I have tried changing the way I travel to work once or twice since 1st January 2012. [Action (A)]
- ☐ I have regularly tried changing the way I travel to work since 1st January 2012. [Action (B)]

The Processes of Change

Listed below are a number of statements that represent thoughts you may have had or situations you may have been in during the run up to the Olympic and Paralympic Games.

Please circle the relevant number to show how it applies to you.	Never	Seldom	Occasionally	Often	Repeatedly
I think that if I change the way I travel to work I may encourage others to do the same [environmental re-evaluation]	1	2	3	4	5
I have noticed that more people are discussing changing the way they travel during the Olympic and Paralympic Games [social liberation]	1	2	3	4	5
I think that I can change the way I travel to work if I try hard enough [self-liberation]	1	2	3	4	5
Whilst I am hesitant to change my travel from what I am used to, I think that changing it will be the best option for me during the Olympic and Paralympic Games [counter conditioning]	1	2	3	4	5
I think that I will plan my time during the Olympic and Paralympic Games so that I am able to change my work travel [stimulus control]	1	2	3	4	5
I think that if I do change the way I travel I may have the added benefit of finding better routes to work [contingency management]	1	2	3	4	5
My work colleagues are encouraging me to change my travel during the Olympic and Paralympic Games. [helping relationships]	1	2	3	4	5
People that are important to me are encouraging me to change my travel during the Olympic and Paralympic Games [helping relationships]	1	2	3	4	5
I believe that changing the way I travel during the Olympic and Paralympics will show me as a proactive person [self-re-evaluation]	1	2	3	4	5

Self-efficacy

Listed below are actions you may be able to take during the period of the Olympic and Paralympic Games. Please tell us how much you agree or disagree with the statement by circling the relevant letter below.

	Strongly disagree	Disagree	Neutral	Agree	Strongly agree
I may be able to re-plan my route to avoid the worst of the congestion	A	B	C	D	E
It would be easy for me to re-plan my route to avoid the worst of the congestion	A	B	C	D	E
I may be able to work at home instead of travelling to my workplace	A	B	C	D	E
It would be easy for me to work at home instead of travelling to my workplace	A	B	C	D	E
I am able to use my holiday days to allow me to avoid travelling during the Olympic and Paralympic Games period	A	B	C	D	E
It would be easy for me to use my holiday days to allow me to avoid travelling during the Olympic and Paralympic Games period	A	B	C	D	E
I am able to leave for work at a different time that allows me to avoid peak times of travel	A	B	C	D	E
It would be easy for me to leave work at a different time that allows me to avoid the peak times of travel	A	B	C	D	E
<u>Please do not answer the next two questions if you already cycle to work</u>					
I may be able to cycle to my workplace instead of using my normal means	A	B	C	D	E
It would be easy for me to cycle to my workplace instead of using my normal means	A	B	C	D	E
<u>Please do not answer the next two questions if you already walk to work</u>					
I may be able to walk to my workplace instead of using my normal means	A	B	C	D	E
It would be easy for me to walk to my workplace instead of using my normal means	A	B	C	D	E
<u>Please do not answer the next two questions if you already car share to get to work</u>					
I may be able to get to my workplace by car sharing instead of using my normal means	A	B	C	D	E
It would be easy for me to get to my workplace by car sharing instead of using my normal means	A	B	C	D	E

Appendix B: Original Wave 1 survey document developed by researcher

UNIVERSITY OF LEEDS

Olympic Travel Behaviour Questionnaire

Dear Participant,

Thank you for agreeing to participate in this study which examines people's work travel choices before, during and after the London 2012 Olympic and Paralympic Games. This research is part of a PhD thesis at the Institute for Transport Studies, University of Leeds.

Please note that this questionnaire should only be answered by those who are in paid employment. This can be full-time or part-time.

Q1. Your involvement in this study is confidential and the data you provide will be made anonymous. You are free to withdraw from the study at any point and are under no obligation to provide a reason for this withdrawal. If you wish to withdraw, you can also request that we permanently delete your data from the study and again, you would be under no obligation to state a reason for this.

Please read the following statement and check the box to indicate you understand and agree.

☐ I understand my rights to withdraw and how my personal data will be treated. I agree to the data I provide being used for the purposes of this research and for future publications.

This questionnaire should take you approximately 15 minutes to complete.

If you have any further questions do not hesitate to contact us at:olympic-study@leeds.ac.uk

Section 1 – How do you get to work?

****Please read before completing the questions below**:** Throughout this questionnaire you will be asked about how you normally travel to work. Your 'normal journey to work' refers to the means of transport and the route that you use most often to get to work.

Q2. What means of travel do you use for your normal journey to work? (Select all that apply).

- ☐ Tube
- ☐ Bus
- ☐ Tram
- ☐ Train
- ☐ Bike
- ☐ Walk
- ☐ Motorcycle/scooter/moped
- ☐ Car or van (as driver)
- ☐ Car or van (as passenger)
- ☐ Coach
- ☐ Riverboat
- ☐ Taxi
- ☐ Docklands Light Rail
- ☐ I work from home
- ☐ Other, please specify: _____

Q3. What means of transport would you consider to be the <u>main</u> means by which you travel for your journey to work? Please tick the <u>one</u> that applies.

- ☐ Tube
- ☐ Bus
- ☐ Tram
- ☐ Train
- ☐ Bike
- ☐ Walk
- ☐ Motorcycle/scooter/moped
- ☐ Car or van (as driver)
- ☐ Car or van (as passenger)
- ☐ Coach
- ☐ Riverboat
- ☐ Taxi
- ☐ Docklands Light Rail
- ☐ Other, please specify: _____
- ☐ I always work from home (If yes, please go to Q10)

Now please complete the sentence below, as illustrated in the example, using the main means of transport that you have selected.

If the main mode of transport you selected was, for example, "bus" you would complete the sentence as follows:

Travelling to work by "bus" is something… *EXAMPLE*

… I do frequently A (B) C D E

… I do automatically A B (C) D E

Please circle the relevant letter to show how much you agree or disagree with each sentence.

Travelling to work by _____ is something …	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
… I do frequently.	A	B	C	D	E
… I do automatically.	A	B	C	D	E
… that would feel odd to me if I do not do it.	A	B	C	D	E
… that would require effort not to do it.	A	B	C	D	E
… I start doing before I realise I'm doing it.	A	B	C	D	E
… I would find hard not to do.	A	B	C	D	E
… I have no need to think about doing.	A	B	C	D	E
… that's typically 'me'.	A	B	C	D	E
… I have been doing for a long time.	A	B	C	D	E

Q3. What time do you normally leave your house to go to work? Please enter the time to the nearest 15 minutes (e.g. 07:15), in the box provided.

___:___

Q4. How long does your journey to work take?

☐ Less than 30 minutes

☐ 31 – 60 minutes

☐ 61-90 minutes

☐ 91+ minutes

Q5. If you travel to work by public transport, what stop or station do you <u>start</u> your journey at? Please provide the name of the stop/station or alternatively the road it is on.

Name of stop/station/road: _____

What type of stop/station is it?

☐ Tube
☐ Bus
☐ Tram
☐ Train
☐ Coach
☐ Riverboat
☐ Taxi
☐ Docklands Light Rail

If you walk to this stop/station, how long does it take you to get there from your house?

_____ minutes

Q6. What stop or station do you <u>end</u> your journey at? Please provide the name of the stop/station or alternatively the road it is on.

Name of stop/station/road: _____

What type of stop/station is it?

☐ Tube
☐ Bus
☐ Tram
☐ Train
☐ Coach
☐ Riverboat
☐ Taxi
☐ Docklands Light Rail

Q7. What is the name of the nearest underground or mainline railway station to your home? This allows us to gain a better understanding of your location in the London area.

_____ OR If this station is the same as Q5 please tick here ☐

Q8. Do you go to any other destinations during your normal journey to work (E.g. your child's school)?

☐ Yes
☐ No (If no, please go to Q10)

If yes, what is the purpose of going to these other destinations?

☐ Taking family member to separate destination
☐ Picking up colleague
☐ Shopping
☐ Other. Please specify: _____

Q9. Would travelling to this separate destination prevent you from changing the means by which you normally travel to work?

☐ Yes

☐ No

Q10. What is your occupation?

☐ Managers & Senior Officials

☐ Professional

☐ Associate Professional & Technical

☐ Admin & Secretarial

☐ Skilled Trades

☐ Personal Service

☐ Sales & Customer Service

☐ Process, Plant & Machine Operatives

☐ Labourer/Worker

Q11. Please select one choice from the following options which best describes your current employment status.

☐ Permanent

☐ Contract

☐ Agency

☐ Casual/seasonal

Please also indicate whether you work full time, part time or are semi-retired.

☐ Full time

☐ Part-time. If yes, please tell us how many days per week you work _____

☐ Semi-retired. If yes, please tell us how many days per week you work _____

Q12. Based on your past 10 working days, please tell us how many days you spent working at the different locations listed below.

If you worked at more than one location during a single day please think about the place where you spent the most time each day.

Workplace: _____ days

Worked from home: _____ day

Worked elsewhere: _____ days – Please specify: _____

Q13. Does your employer allow you to use any of the following 'smart' working practices?

☐ Flexi-time

☐ Telephone conferencing

☐ Video conferencing

☐ Compressed working week

☐ Home working

☐ Hot-desking (e.g shared desks)

☐ Other. Please explain_____

How much control do you have over using any of these 'smart' working practices?

☐ A little

☐ Some

☐ Substantial

Q14. Do you currently use any of the following public transport travelcards? Please tick all that apply.

☐ Oyster Card (pay as you go)

☐ Day Travelcard (Anytime)

☐ Day Travelcard (off-peak)

☐ 7 Day Travelcard

☐ Monthly

☐ Annual

Section 2 – Your travel during the Olympic and Paralympic Games period

Q15. Will the Olympic and Paralympic Games affect your journey to work?

☐ Yes (If yes, please go to Q16)

☐ No (If no, please go to Q17)

Q16. How much do you think the Olympic and Paralympic Games effect your journey to work?

☐ A little

☐ Some

☐ Substantially

Please tell us how you think your journey will be affected.

How my journey will be affected: _____

Q17. Please indicate whether your journey during the Olympics and Paralympics will be better, worse or the same by ticking one box in each statement below:

My journey will be… the same ☐ more ☐ or less ☐ …pleasant

My journey will be… the same ☐ more ☐ or less ☐ …stressful

Q18. Is your employer encouraging you to change the way you travel to work?

☐ Yes

☐ No (If no, please go to Q19)

Now please read the following statements and tell us how your employer has been encouraging you to change your travel to work by circling the relevant number.	Never	Seldom	Occasionally	Often	Repeatedly
They have made me aware of information and advice about altering my travel.	1	2	3	4	5
They have given me the opportunity to work at home or elsewhere during the Olympic and Paralympic Games period.	1	2	3	4	5
They have encouraged me to travel by different means to get to work.	1	2	3	4	5
They have encouraged me to use my holiday days during the Olympic and Paralympic Games period.	1	2	3	4	5
They are allowing me to alter my start and finish times for work.	1	2	3	4	5
Other – Please specify: - _____	1	2	3	4	5

Q19. Please tick the statement below that most closely applies to you. Please tick one box only.

☐ I am not considering changing the way I would normally travel to work.

☐ I am considering changing the way I normally travel to work but I am not in a position to make this change yet

☐ I am doing things to prepare myself to change the way I travel to work

☐ I have tried changing the way I travel to work once or twice since 1st January 2012

☐ I have regularly tried changing the way I travel to work since 1st January 2012

Q20. Listed below are a number of statements that represent thoughts you may have had or situations you may have been in during the run up to the Olympic and Paralympic Games.

Please circle the relevant number to show how it applies to you.	Never	Seldom	Occasional	Often	Repeatedly
I think that if I change the way I travel to work I may encourage others to do the same	1	2	3	4	5
I have noticed that more people are discussing changing the way they travel during the Olympic and Paralympic Games	1	2	3	4	5
I think that I can change the way I travel to work if I try hard enough	1	2	3	4	5
Whilst I am hesitant to change my travel from what I am used to, I think that changing it will be the best option for me during the Olympic and Paralympic Games	1	2	3	4	5
I think that I will plan my time during the Olympic and Paralympic Games so that I am able to change my work travel	1	2	3	4	5
I think that if I do change the way I travel I may have the added benefit of finding better routes to work	1	2	3	4	5
My work colleagues are encouraging me to change my travel during the Olympic and Paralympic Games.	1	2	3	4	5
People that are important to me are encouraging me to change my travel during the Olympic and Paralympic Games	1	2	3	4	5
I believe that changing the way I travel during the Olympic and Paralympics will show me as a proactive person	1	2	3	4	5

Q21. Listed below are actions you may be able to take during the period of the Olympic and Paralympic Games. Please tell us how much you agree or disagree with the statement by circling the relevant letter below.

	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
I may be able to re-plan my route to avoid the worst of the congestion	A	B	C	D	E
It would be easy for me to re-plan my route to avoid the worst of the congestion	A	B	C	D	E
I may be able to work at home instead of travelling to my workplace	A	B	C	D	E
It would be easy for me to work at home instead of travelling to my workplace	A	B	C	D	E
I am able to use my holiday days to allow me to avoid travelling during the Olympic and Paralympic Games period	A	B	C	D	E
It would be easy for me to use my holiday days to allow me to avoid travelling during the Olympic and Paralympic Games period	A	B	C	D	E
I am able to leave for work at a different time that allows me to avoid peak times of travel	A	B	C	D	E
It would be easy for me to leave work at a different time that allows me to avoid the peak times of travel	A	B	C	D	E
<u>Please do not answer the next two questions if you already cycle to work</u>					
I may be able to cycle to my workplace instead of using my normal means	A	B	C	D	E
It would be easy for me to cycle to my workplace instead of using my normal means	A	B	C	D	E
<u>Please do not answer the next two questions if you already walk to work</u>					
I may be able to walk to my workplace instead of using my normal means	A	B	C	D	E
It would be easy for me to walk to my workplace instead of using my normal means	A	B	C	D	E
<u>Please do not answer the next two questions if you already car share to get to work</u>					
I may be able to get to my workplace by car sharing instead of using my normal means	A	B	C	D	E
It would be easy for me to get to my workplace by car sharing instead of using my normal means	A	B	C	D	E

Q22. Please read the following statements and circle the relevant number to indicate how important each statement would be with respect to your decision to change your behaviour.

If you already perform one of the behaviours described in the statements please ignore that particular one can continue to complete the remaining statements.	Not at all	Not Very	Somewhat	Very Important	Extremely
I would have more time for my family and friends if I worked from home.	1	2	3	4	5
If I worked from home I would not be as productive as in the office.	1	2	3	4	5
I would feel self-conscious if I walked to work	1	2	3	4	5
I would feel healthier if I walked to work	1	2	3	4	5
If I walked to work I would save money on my travel	1	2	3	4	5
I would feel self-conscious if I cycled to work	1	2	3	4	5
I would feel healthier if I cycled to work	1	2	3	4	5
If I cycled to work I would save money on my travel	1	2	3	4	5
I would feel self-conscious if car-shared to get to work	1	2	3	4	5
Car sharing to work would save me money on my travel	1	2	3	4	5
If I re-planned my route to my workplace it would take me longer to get there.	1	2	3	4	5
I can re-plan my journey and therefore avoid the busiest areas	1	2	3	4	5
Changing the time I leave for work would disrupt my daily routine too much.	1	2	3	4	5
If I changed the time that I left for work I could get there more quickly.	1	2	3	4	5
I would feel happier if I just took a holiday during the Olympic and Paralympic period.	1	2	3	4	5
I don’t want to use up my own holiday days avoiding the potential traffic disruption.	1	2	3	4	5

Section 3 – Please tell us about yourself

Q23. Please indicate your age group

☐ 16-25
☐ 26-35
☐ 36-45
☐ 46-55
☐ 56-65
☐ 66+

Q24. What is your gender?

☐ Male
☐ Female

Q25. Do you have any long-term illness, health problem or disability which makes it difficult for you to walk for more than 10 minutes?

☐ Yes
☐ No
☐ No response

If no or no response, please go to Q26
If yes, please tick the option below that describes your situation best

☐ I make trips on foot with assistance, e.g., wheelchair, walking stick, white cane
☐ I make trips on foot without assistance
☐ I do not make trips on foot because of my long-term illness, health problem or disability

Q26. Please indicate the structure of your household:

a. Number of people in the household including yourself.

☐ 1
☐ 2
☐ 3
☐ 4
☐ 5
☐ 6
☐ 7+

b. Number of dependent children in the household <u>under 11</u> years of age.

☐ 0
☐ 1
☐ 2
☐ 3
☐ 4
☐ 5
☐ Other. Please specify _____

c. Number of dependent children in the household <u>aged 11-18 years of age.</u>

☐ 0
☐ 1
☐2
☐ 3
☐ 4
☐5
☐ Other. Please specify _____

d. Number of dependent adults (i.e. adult with care needs/elderly relative)

☐ 0
☐ 1
☐ 2
☐ 3
☐ 4

Q27. The average annual household income in London is £33,430. Please indicate whether the annual <u>pre-tax</u> income of your household is:

☐ Less than the £32,430
☐ £32,430 - £34,430
☐ More than £34,430

Q28. Which means of travel do you use for non-work journeys in a typical week?
Please tick all means of transport that apply.

- ☐ Tube
- ☐ Bus
- ☐ Tram
- ☐ Train
- ☐ Bike
- ☐ Walk
- ☐ Car or van (as driver)
- ☐ Car or van (as passenger)
- ☐ Motorcycle/scooter/moped
- ☐ Coach
- ☐ Riverboat
- ☐ Taxi
- ☐ Docklands Light Rail
- ☐ Other. Please specify:

_____

Q29. How many cars do you own or have access to within your household?

- ☐ 0
- ☐ 1
- ☐ 2
- ☐ 3+

Q30. How many adult bicycles do you own or have access to within your household? Please only include bikes that are in working order.

- ☐ 0
- ☐ 1
- ☐ 2
- ☐ 3+

Thank you again for taking the time to complete this questionnaire, your participation in this study is greatly appreciated.

If you have any questions please do not hesitate to contact us at:

olympic-study@leeds.ac.uk.

Appendix C: Processes of change analysis results – expanded table

Process	Mann-Whitney U	Z	Sig.	Effect size (*r*)	Median	
					Change	No Change
Environmental re-evaluation						
Overall Change	125382.000	-1.634	.102	-0.05	3	4
Reduced	129851.000	-.070	.944	-0.00	3	3
Re-timed	100924.000	-4.449	**<.001**	-0.14	3	4
Re-routed	84749.000	-.111	.911	-0.00	4	3
Re-moded	61714.000	-1.912	.056	-0.06	3	3
Social liberation						
Overall Change	105207.500	-4.565	**<.001**	-0.14	2	3
Reduced	107770.500	-3.378	**.001**	-0.10	2	2
Re-timed	88384.000	-5.869	**<.001**	-0.18	2	2
Re-routed	72455.000	-2.434	**.015**	-0.08	2	2
Re-moded	59329.000	-1.756	.079	-0.06	2	2
Helping relationships						
Overall Change	124706.000	-1.330	.183	-0.41	2	2
Reduced	117134.500	-2.329	**.020**	-0.07	2	2
Re-timed	116389.000	-.331	.740	-0.01	2	2
Re-routed	80704.500	-.603	.546	-0.02	2	2
Re-moded	64848.500	-.626	.531	-0.02	2	2
Self-liberation						
Overall Change	117447.000	-2.526	**.012**	-0.08	2	3
Reduced	124963.500	-.035	.972	-0.00	2	2
Re-timed	108990.000	-1.598	.110	-0.05	2	2
Re-routed	74932.000	-2.090	**.037**	-0.07	2	2.5
Re-moded	55042.500	-3.504	**<.001**	-0.11	2	3
Counter-conditioning						
Overall Change	121537.000	-2.332	**.020**	-0.07	4	4
Reduced	120944.500	-1.975	**.048**	-0.06	3	4
Re-timed	115157.500	-1.076	.282	-0.03	4	4
Re-routed	84470.500	-.301	.764	-0.01	4	4
Re-moded	60170.500	-2.428	**.015**	-0.08	3	4
Stimulus control						
Overall Change	98630.500	-7.349	**<.001**	-0.23	3	3
Reduced	109271.500	-4.415	**<.001**	-0.13	3	3
Re-timed	87797.000	-7.256	**<.001**	-0.22	2	3
Re-routed	77120.000	-2.222	**.026**	-0.07	3	3
Re-moded	58484.500	-2.748	**.006**	-0.09	3	3

Process	Mann-Whitney U	Z	Sig.	Effect size (*r*)	Median	
					Change	No Change
Contingency management						
Overall Change	127940.000	-1.281	.200	-0.04	4	4
Reduced	130695.000	-.124	.902	-0.00	4	4
Re-timed	114757.000	-1.485	.138	-0.05	4	4
Re-routed	83409.000	-.755	.451	-0.02	4	4
Re-moded	59507.000	-2.777	**.005**	-0.09	4	4
Self-re-evaluation						
Overall Change	118149.500	-3.300	**<.001**	-0.10	3	4
Reduced	129242.000	-.352	.725	-0.01	3	3
Re-timed	104399.000	-3.738	**<.001**	-0.12	3	4
Re-routed	75604.000	-2.707	**.007**	-0.08	3	3
Re-moded	54563.000	-3.996	**<.001**	-0.12	3	3

Glossary of Terms

Ability: refers to the actors' perception about the availability of the resources or capabilities that are required to perform the focal behaviour (Harland et al., 2007).

Affect: emotion or subjectively experienced feeling, such as happiness, sadness, fear or anger (Colman, 2009).

Altruism: behaviour that benefits another individual or other individuals (Colman, 2009). In this thesis it relates to pro-environmental behaviours.

Ascription of responsibility: feelings of responsibility for the negative consequences of not acting pro-socially (De Groot and Steg, 2009).

Attitude: refers to the degree to which a person has a favourable or unfavourable evaluation or appraisal of the behaviour in question (Ajzen, 1991).

Awareness of consequences: refers to a person's receptivity to situational cues of need (Harland et al., 2007).

Awareness of need: involves the extent to which a person's attention is focused on the existence of a person or a more abstract entity (e.g. the environment) in need (Harland et al., 2007).

Biospheric: reflecting a key concern with the quality of nature and the environment (Jakovcevic and Steg, 2013).

Decisional balance: reflects the individuals relative weighting of the pros and cons of changing (Prochaska and Velicer, 1997).

Denial of responsibility: refers to people's inclination to deny responsibility for the consequences of their behavioural choices for the welfare of others (Harland et al., 2007).

Efficacy (related to the Norm Activation Model): referring to the extent to which actions are identified that might alleviate the need (Harland et al, 2007).

Egoistic: reflecting a concern with costs and benefits that affect individual resources (Jakovcevic and Steg, 2013).

Fixed panel: a fixed panel involves collecting data from the same units on multiple occasions (Smith et al., 2009).

Games Family: a collection of individuals, including athletes, press and media, officials, and sponsors.

Outcome expectations: balancing the pros and cons of certain behavioural outcomes (Schwarzer, 2008).

Perceived behavioural control: refers to people's perception of the ease or difficulty of performing the behaviour of interest (Ajzen, 1991).

Personal norms: refer to an individual's conviction that acting in a certain way is right or wrong (Bamberg et al., 2007).

Processes of change: the covert and overt activities that people use to progress through the stages of change (Prochaska and Velicer, 1997).

Risk perception: relates to threat the individual perceives to their health (Garcia and Mann, 2003).

Self-efficacy: the situation specific perceived confidence and ability that an individual has to perform a behaviour, which acts as a mediator of performance on future tasks (Prochaska and Velicer, 1997; CPRC, no date-b).

Situational responsibility: links to 'awareness of need' and refers to the extent to which a person feels responsible for the consequences of that need (Harland et al., 2007).

Social factors: derive from the relationship between the individual and other people (Valois et al., 1988).

Stages of change: these form the central construct of the Transtheoretical Model. There are five stages (with an additional sixth stage included sometimes) and they represent the temporal dimension and the stages along which an individual progresses as they make changes to their behaviour.

Subjective norm: refers to the perceived social pressure to perform or not to perform the behaviour (Ajzen, 1991).

Travel hotspots (in London): identified locations in London during the Olympic and Paralympic Games where demand was forecast to outweigh supply (e.g. on the road network or public transport).

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