Encouraging healthy and sustainable travel in a university setting and beyond

Bosehans, Gus

Award date:
2018

Awarding institution:
University of Bath

Encouraging healthy and sustainable travel in a university setting and beyond

Bosehans, Gus

Award date:
2018

Awarding institution:
University of Bath

Encouraging healthy and sustainable travel in a university setting and beyond

Gustav Bösehans

A thesis submitted for the degree of Doctor of Philosophy

University of Bath

Department of Psychology

January 2018

Encouraging healthy and sustainable travel in a university setting and beyond

Table of contents

Table of Figures

Abstract

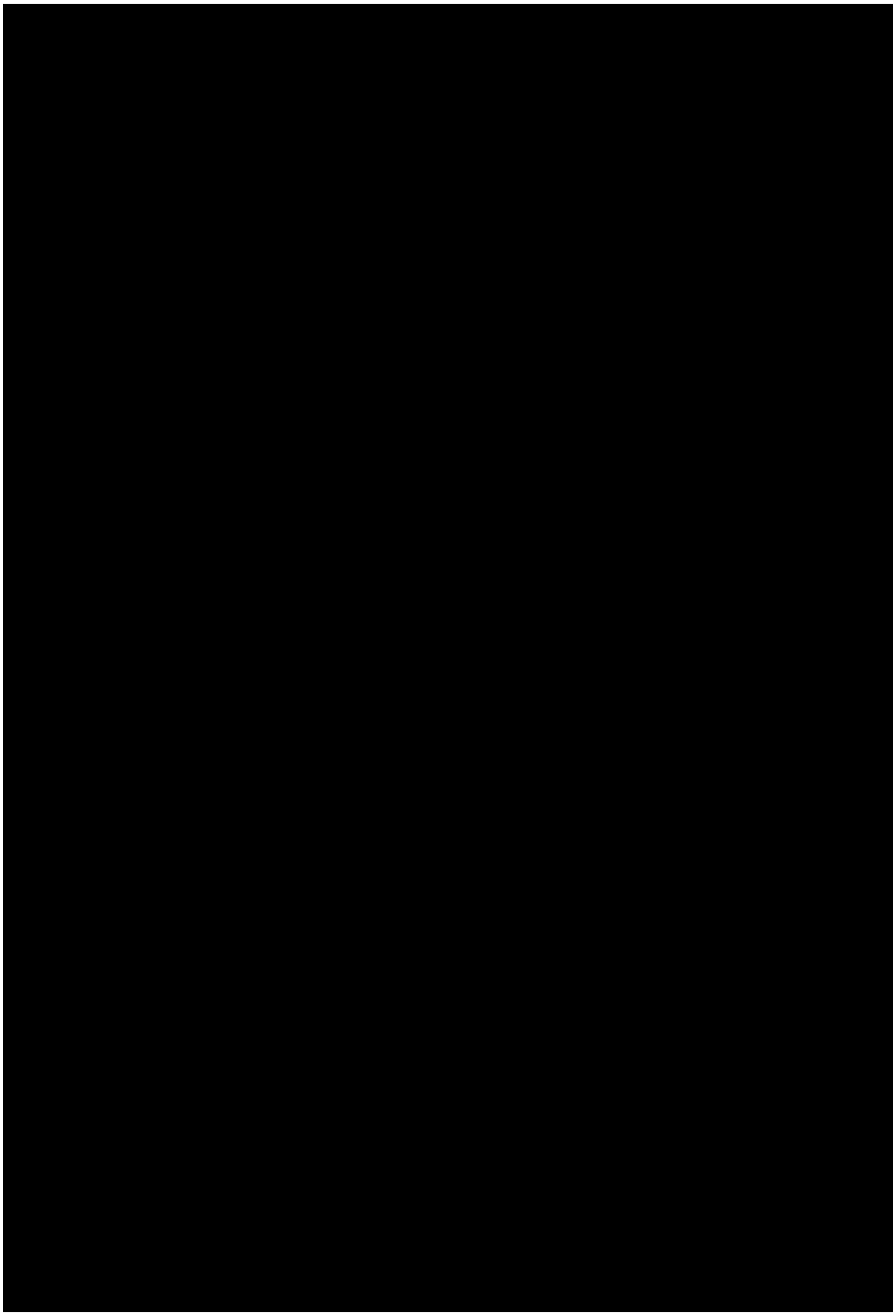
Higher education institutions are major trip generators and thus contribute significantly to local greenhouse gas emissions that accelerate the global warming effect. The present research has been funded with the specific aim of finding ways to encourage healthy and sustainable travel in a university setting. To this end, the thesis commences by providing the reader with important contextual and theoretical information that is needed to understand people's travel behaviour in a review of relevant literature.

The first part of the thesis, consisting of a series of three studies, then addresses a real-world applied problem involving public transport users. Contrary to popular belief, the research presented in the first part of the thesis suggests that, despite usually being regarded as a desirable alternative to the car, public transport is actually not a desirable means of transportation for particular groups, especially given that healthier and more sustainable alternatives (i.e. walking and cycling) are available. The first study examines students' experiences and motivations with regard to bus use, which were subsequently used to segment bus users into distinct groups (Study 2). Based on Studies 1 and 2, a small-scale intervention to promote walking to campus was administered (Study 3), suggesting that most public transport trips could be replaced by active travel, if users are sufficiently motivated and informed prior to making other commitments, such as purchasing a bus pass. Using the university as a case study, the thesis then moves on to consider more abstract topics, including supra-modal mobility styles and implicit affective associations between travel modes and specific positive versus negative emotions.

A continuously growing body of research proposes the influence of various psychological factors on travel behaviour and mode choice including psychological constructs such as attitudes, environmental concern or social norms. At the same time, social marketing approaches, distinguishing different groups of travellers based on their individual attitudes and travel behaviour, have gained in popularity to identify groups of users with varying mode switching potential. The work presented in the second part of this thesis (Study 4) develops this issue further, yet not by distinguishing mobility types based on people's attitudes towards particular modes of travel or their travel behaviour per se, but rather by focusing on individuals' goals and values instead. That is, one of the core assumptions of the current work is that all (travel) behaviour is goal-directed and that individuals can be broadly distinguished into distinct supra-modal mobility styles, or mode-independent types of travellers, respectively, representing unique combinations of goals and preferences. The latter, in turn, are then negotiated with people's surrounding context or environment, resulting in either a match or mismatch. Subsequently, this research was complemented by an investigation into people's implicit affective associations with different modes of travel so as to reveal the presence (or absence) of commonly held biases towards specific travel modes (Study 5). However, in line with expectations, a predisposition towards certain modes of travel did not emerge.

Based on these studies, general lessons for the promotion of sustainable travel behaviour, beyond the limited context of campus-based universities, are drawn and recommendations for future research are made. At the same time, however, the thesis also acknowledges external constraints on behaviour that tend to be beyond individuals' control. Consequently, the reader should bear in mind that not only behavioural, but also technological and urban design solutions will be required to make current transportation, focused on private motorised transport, more sustainable in the future.

Acknowledgements



Born in Cologne, my journey started in 1989 and has since then brought me to various places in the world. Along the way, I have met many wonderful people and made valuable friends for life in addition to the important people who have always had my back.

In particular, I would like to thank…

My girlfriend and future wife Andressa Andrade Amaral who I met for the first time during the third year of my PhD and who has, since then, accompanied and supported me on my journey. I am eternally grateful for having you in my life and I know that we will overcome all the obstacles in our way. Love you, always. Te amo!

My parents whose unconditional love and support throughout all these years have kept me going, especially in times of struggle and doubt. Nothing compares to the support and encouragement that I have received from you, allowing me to pursue my interests and to become the person that I am today.

My supervisor and mentor Ian, who accepted me to work on this PhD project and who has guided and supported me through the process of becoming an independent researcher. I know that I have made countless mistakes, but those seem small in comparison to the skills and knowledge that I have acquired through your support.

My international friends and housemates. A particular thanks to Amy, Lisa and Kerry as well as Josh and Hannah (Crosby). You have been great housemates and I wish you all the best! Of course, also a big thanks to the 5S and 10W crews! From the very beginnings in 5S to the very end in 10W with Marcus, Tanja, Greg, Hannah, Laurie, Kate, Katy, Bhaggy, Filipa, Elaine, Niall, Fei, Craig, Alina, Meike, Jana, Alaa, Claire, Josie, Richard, Rhiannon, Yiyang, Elisa, Tom, Tommy, Gareth, Lizzy, Susie and Mary amongst others!

The University of Bath staff, in particular Cynthia Maher Spencer and Caroline Ransford for all the organisational support and occasional banter and Ian Fairholm for being a great mentor with regard to teaching. You all made teaching a great experience and whenever I have the opportunity to assume a teaching role as part of my job, I will! A special thanks also to Ed Stevens and Helen Featherstone from the public engagement unit! Through you I have learned the importance of public engagement and some fun ways to get the public more engaged with research! Thanks to all of you!

My first-year Psychology (Controversies) students! You are all great individuals and have done very well in the seminars! I wish you all the best for your further studies and future careers, be it in the UK or elsewhere! You will become great Psychologists!

My Viva examiners, Paul and Lorraine, who not only have read my work in full, but who have also been very critical and fair examiners. Thank you very much for the time and effort you have invested in evaluating my thesis and your invaluable comments!

Those who invested time and effort to participate in my research! Without you there would not have been anything to write about, no papers to publish nor any ideas to test… You are the foundation of everything we do and your participation is a great service to all of us! Keep participating in research and encourage others to do so!

Introduction – Climate change and the role of sustainable travel in the 21st century

Climate change and mitigation efforts – "Thank God men cannot fly, and lay waste the sky as well as the earth." (Henry David Thoreau)

Undoubtedly, climate change poses one of the most daunting existential challenges for mankind, requiring rapid social and political change (Ehrlich & Ehrlich, 2013). Anthropogenic emissions have led to an abundance of so-called GHGs or 'greenhouse gases' (i.e. carbon dioxide, methane, nitrous oxide, hydro- and perfluorocarbon and sulphur hexafluoride) in the atmosphere with levels of the three major GHGs (carbon dioxide (CO_2), methane (CH) and nitrous oxide (N_2O)) having more than doubled or even tripled (142%, 253% and 121%, respectively) compared to pre-industrial times (i.e. before 1750; World Meteorological Organization, 2014), accelerating climate change. According to further recent calculations, CO_2 emission levels have increased at such a high rate that climate change is now inevitable and, worse, potentially irreversible for the next 1,000 years, even after emissions stop (Solomon, Plattner, Knutti & Friedlingstein, 2009). Current atmospheric CO_2 levels have reached about 396-400 ppm (i.e. parts per million or 'the number of molecules of the gas per million molecules of dry air'; co2now.org; WMO, 2014) with recommendations to keep levels below 450 ppm in order to mitigate potentially severe climate change impacts (see Tight, Bristow, Pridmore & May, 2005, for a summary). Consequently, international agreements such as the Kyoto protocol by the United Nations Framework Convention on Climate Change (UNFCC, 1997) have acknowledged the urgent need for more sustainable development.

Under the protocol, with its first commitment period between 2008-2012 (the Doha Amendment, 2012, started the second commitment period from January 2013-December 2020), developed countries agreed to a 5.2% reduction (8% for the EU-15) of the six major greenhouse gases or GHGs below 1990 levels (for carbon dioxide, methane and nitrous oxide) and 1995 levels (for the fluorinated compounds), respectively. So far, the EU-15 fulfilled their commitment, reducing CO_2 emissions levels by 15% compared to 1990 (EEA, 2014). Among the top reducers, the UK has exceeded its Kyoto commitment of a 12.5% emission reduction below 1990 levels, effectively reducing GHGs emissions by about 28% from 1990-2013 (Committee on Climate Change, 2014). However, further cuts are required and the new target, set for the period from 2013 to 2025, is to cut down emissions to half of 1990 levels, which requires a 31% reduction of 2013 emission levels. The recent Paris climate change agreement (UNFCC, 2016) has reinvigorated climate mitigation efforts, aiming to keep global warming below 2°C, and differs significantly from its predecessor, the Kyoto protocol. While the latter was primarily directed at developed countries, the PCCA has also attributed responsibility to developing countries cutting their emissions, aided by financial support from rich countries. However, like the Kyoto protocol, the PCCA lacks a binding mechanism to enforce its targets, instead relying on political pressure (Manolas, 2016). Countries submitted their INDCs (Intended Nationally Determined Contributions), thus being able to adjust their plans to their socio-economic situation, but recent analyses (Rogelj et al., 2016) indicate that "even with accelerated action after 2030, options to keep warming to well below 2 °C from current INDCs are

severely limited, particularly if some key mitigation technologies do not scale up as anticipated (p. 636)

Climate change as a social challenge

Yet, climate change not only poses a daunting existential challenge, it also poses a serious social challenge due to an inexorably growing world population (Bradshaw & Brook, 2014), pending global food and water shortages (Bohle, Downing & Watts, 1994; Vörösmarty, Green, Salisbury & Lammers, 2000) and the inequitable distribution of climate change causes and consequences across nations and future generations (Cazorla & Toman, 2001; McCarthy, 2001). In other words, it may be regarded as a tragedy of the commons where the perpetrators – first and foremost, heavy polluting industrialized countries – do not necessarily suffer the consequences of their own actions, such as an increased mortality from ambient air pollution (Global Health Observatory data; WHO, 2015). An equitable distribution of economic and social costs would warrant, for instance, that the production of cheap consumer goods for people in high-income countries does not result in poor health in low-income countries (Marmot, 2007), whether this be due to poor working conditions or climate change-related outcomes. Meanwhile, small island states that are threatened by global warming – such as Tuvalu in the Pacific Ocean for instance – have become "island laboratories" subject to "wishful sinking" by some Western climate scientists and media who are in constant search of current examples illustrating the severity of global warming (Farbotko, 2010, p. 47). Over the course of the century, the world is likely to be confronted with huge waves of climate refugees who may be forced to leave their country due to extreme droughts, sea level rises or disastrous weather events, requiring new global governance structures to deal with them (Biermann & Boas, 2010). Thus, as argued by Button and Nijkamp (1997), sustainable development – that is, development 'that meets the needs of the present without compromising the ability of future generations to meet their own needs' (World Commission on Environment and Development, 1987) – needs to occur in line with both social and environmental interests. In other words, the challenge lies in safeguarding long-term ecological sustainability, while satisfying basic human needs and promoting equity within and across generations (Holden, 2007).

However, especially in developing countries, the push for more sustainable development from heavily industrialised countries has been met with resistance due to economic interests (Elliot, 2013, p. 43). Indeed, in line with the positive association between per capita GDP and environmental concern (e.g. Franzen & Vogl, 2013), a trade-off approach (more sustainability at the expense of slowed and/or more expensive growth) may be more appropriate for developed nations (Pearce, Barbier & Markandya, 1990, p. 17), although this is not to say that economic growth and climate change mitigation need to be polar ends of a continuum (Klein, 2014). As stressed by past Governor of California, Arnold Schwarzenegger, "we no longer have to get bogged down in the false old choice of what's more important to protect: our environment or our economy" (p. viii in Sperling & Gordon, 2009, see also Schweickart, 2009). As such, it seems obvious that "climate change…is clearly a problem which transcends any one level of government and is heavily influenced by the actions of individuals and organisations as well as formal institutions" (Marsden & Rye, 2010, p. 670).

The role of (sustainable) transport in climate change mitigation

Although most carbon dioxide emissions are a result of energy production, transport – alongside manufacturing and construction – is a significant contributor to climate change. As early as in the year 2000, transport already accounted for a quarter of global CO_2 emissions of which 65% were attributable to road transport (IEA, 2005). In 2011, transport still accounted for an estimated 22% of global emissions according to a recent report by the IEA (2013). Global individual mobility, however, remains a highly valued right, enabling the fulfilment of basic human needs (e.g. access to work, public and private services; Holden, 2007) and global tourism (Hares, Dickinson & Wilkes, 2010), despite the associated consequences which are not limited to the impending long-term global climate change and its repercussions including an increased occurrence of weather extremes (Coumou & Rahmstorf, 2012), ocean acidification (Doney, Fabry, Feely & Kleypas, 2009; Orr et al., 2005), and rising temperatures and sea levels (IPCC, 2014; WMO, 2014). Nowadays, with people having increasingly sedentary lifestyles (Varo et al., 2003) and associated health problems such as obesity and type 2 diabetes (Seidell, 2000) and with dangerous levels of air pollution (WHO Regional Office for Europe, OECD 2015), caused to a significant extent by heavy traffic volumes and congestion in metropolitan areas (Cervero, 1998; Flowerdew, 1993), we are urged to rethink the cost-benefit ratio of our travel mode decisions. Finally, there will also be a need to adapt our transport systems in the light of a rapidly growing world population (Bradshaw & Brook, 2014).

As more and more people own cars and choose to travel even the shortest distances by car (in 2015, 77% of trips between two to five miles were undertaken by car according to National Travel Survey: England 2015; DfT, 2016), the initial advantages of private motorized transport begin to fade vis-á-vis reported negative health outcomes due to traffic-related noise and air pollution (Katsoulis et al., 2014) caused to a non-negligible extent by urban traffic (14% of $PM_{2.5}$ concentrations according to Public Health England, May 2015). In order to mitigate these detrimental effects of road transport on people and the environment, not only technological innovations (e.g. alternative fuels and vehicles), but also land use and urban design (e.g. Banerjee & Hine, 2014) as well as legal measures (e.g. speed limits) and behaviour change (e.g. increased use of active travel modes), will play an important role (Chapman, 2007; Frank, Greenwald, Winkelman, Chapman & Kavage, 2010; Greene & Wegener, 1997; Stanley, Hensher & Loader, 2011). As individuals usually cannot directly influence the former (i.e. technology, urban design and legal measures), the current work focuses primarily on the behavioural aspect of modal choice. The latter often is a lifestyle choice that benefits the individual (e.g. speed and convenience of the car), yet has a negative impact on society (e.g. noise, pollution and congestion). As a logical consequence, a change in travel behaviour also implies a change in lifestyle or, in this case, the willingness to step down from egoistic motives (e.g. convenience, joy of driving or prestige; Steg, 2005) for the larger good. However, rather than fearing the outcomes of impending long-term future climate change, most people's main concerns seem to rest on the immediate disadvantages of giving up on their current lifestyle patterns (Lorenzoni & Pidgeon, 2006).

Climate change discourse increasingly tends to evoke notions of class with some people viewing concern about climate change as nothing more than a middle-class frenzy (Barr, 2011). In addition, huge disparities in emissions arising from personal travel have been revealed as well. With the rich generally having higher levels of motility (i.e. the potential and actual capacity of goods, information or people to be mobile both geographically and socially; Kaufmann, Bergman & Joye, 2004), Brand and Boardmann (2008) estimated that the, usually affluent, top 10% of emitters in the UK cause up to 43% of greenhouse gas emissions (primarily through heavy use of the car and aviation), while the bottom 10% account for a mere 1% of emissions. Behaviour change initiatives and policies may thus need to be tailored to different population segments with more restrictive policies being targeted at those with the greatest level of motility. However, it should also be noted that the expected emissions savings from such initiatives are generally less than from improvements in freight and fuel efficiency or vehicle emissions intensity (Hensher, 2008; Stanley et al., 2011) and the effectiveness of common behaviour change initiatives (or social influence approaches, respectively) has been rather modest (e.g. Abrahamse & Steg, 2013; Ogilvie, Egan, Hamilton & Petticrew, 2004). Thus, the share of alternative transport mode choices (especially active ones) in many EU countries remains low, as is particularly illustrated in the example of cycling in the UK (Aldred, 2012). In sum, it follows that only a collective effort in a supportive environment may result in long-term, systematic change (Lorenzoni, Nicholson-Cole & Whitmarsch, 2007). In fact, as a potential all-in-one approach to the obstacles mentioned above (i.e. sedentary lifestyle, congestion, global warming), a move to a sustainable mobility paradigm appears both necessary and desirable and ways to achieve this have been put forward (Banister, 2008; Gärling, Ettema & Friman, 2013).

Travel behaviour and the influence of external versus internal factors

As mentioned earlier, people's travel behaviour may be seen as being influenced by external factors including technology (Burns, 2013) and urban design (Thorne, Filmer-Sankey & Alexander, 2013) and internal (psychological) factors such as attitudes, norms and values (Gehlert, Dziekan & Gärling, 2013) – each of which plays a major part in the mitigation of climate change through improvements in efficiency and use of various transport options (see also Section 1.3.3.). The present work focuses primarily on the application of psychological constructs and theory and their role in explaining travellers' mode choices and preferences. Below, external factors will thus only be briefly addressed including a rationale for the focus of the present work on individual psychological factors.

Technological evolution is usually driven by improvements in fuel efficiency (Simmons, Shaver, Tyner & Garimella, 2015) and the continuous development of new vehicle technologies, especially hybrid and electric cars (Burns, 2013; Sarlioglu, Morris, Han & Li, 2017). These developments, however, do not tend to challenge the root cause of people's travel behaviour and thus rather serve to maintain current consumption patterns (i.e. an overreliance on private motorized transport). Urban design, in contrast, highlights the importance of external influences on travel behaviour (e.g. street layout or land use) that can be modified to challenge the status quo. Whereas social structures are constantly changing, physical structures often outlive generations through their high permanence and indirectly guide behaviour through enabling or constraining agents' actions and thus can indeed be regarded as causally efficacious for human (travel)

behaviour (Næss, 2015). Recent evidence underlines the importance of the provision of local cycling and walking infrastructure in encouraging active travel (Goodman, Sahlqvist & Ogilvie, 2014). Specific features, such as a high land use mix, high intersection density and transit accessibility, tend to be crucial in determining levels of MVPA (moderate to vigorous physical activity) and walking for transit (Adams et al., 2015). The "post-oil city of tomorrow" (Cervero, 2013, p. 156) will enable convenient travel by active means of transportation and public transport and built environment features, undoubtedly, have a crucial role to play in this respect. However, the latter are usually beyond the scope of individuals' control and thus will not be the focus of the present thesis.

In the end, travel mode decisions are made by individuals whose behaviour is both a driver of change, just as it is a recipient of change. In fact, both, the built environment and technology not only influence behaviour but are also, to some extent, affected by and dependent on changes in behaviour. Individuals' lifestyles and their life situation may play an important role in influencing location decisions and attitudes which, in turn, can affect people's travel mode choices (Scheiner & Holz-Rau, 2007). Similarly, the adoption of new technologies, such as electric vehicles, depends on people's evaluations of their attributes ranging from concerns about instrumental aspects to the evaluation of the hedonic and symbolic consequences of this technology (Schuitema, Anable, Skippon & Kinnear, 2013). In general, psychological theories – such as the Theory of Planned Behaviour (TPB; Ajzen, 1991), Value Belief Norm Theory (VBNT; Stern et al., 1999) or Self-Regulation Theory (SRT; Bamberg, Fujii, Friman & Gärling, 2011) – have increasingly shed light on the influence of internal psychological factors on individual decision making.

With regard to travel behaviour, individuals may engage in instrumental cost-benefit calculations (e.g. cost, service reliability or travel time) and are influenced by both affective (e.g. comfort, convenience and feelings of perceived behavioural control or autonomy) as well as normative considerations (i.e. social norms and values; Steg, 2005). At the same time, individuals may also be subject to the influence of old habits (Walker, Thomas & Verplanken, 2015). Psychological factors, such as attitudes towards particular modes of transport (e.g. Heinen, Maat & Wee, 2011), are often linked to the perceived characteristics of these modes, such as the quality of and access to public transport services (d'Ovidio, Leogrande, Mancarella, Schinzano & Viola, 2014), and thus may influence their use. Targeting psychological factors may thus have great potential to influence people's modal choices in a variety of ways. Certainly, changes in behaviour require individual action and, in the case of travel behaviour, often imply a significant lifestyle change. Nevertheless, the potential of behaviour change initiatives to encourage the use of active and sustainable modes of transportation has been illustrated in previous research (García-Garcés, Ruiz & Habib, 2016; Möser & Bamberg, 2008).

In the context of university travel, changing behaviour may be the most promising way to increase sustainable travel for various reasons. First, students and staff do not have direct control over the physical environment (e.g. availability of cycling facilities, access to public transport services or distance to campus). Second, the costs for adopting novel, more sustainable technologies, such as buying an EV or electric bike, would place a significant economic burden on students and staff, which only few might be able to carry. Third, given the known personal cost, health and environmental benefits of active travel, encouraging active travel would represent a win-win situation for both students and staff and the university, while also being the most cost-effective solution.

Aims and objectives

The following pages provide the context and rationale for the research that has been conducted as part of the current PhD project. The latter has been funded with the specific aim to investigate the potential for healthier and more sustainable travel in a university setting. First, some general background information is provided before the more concrete envisioned contribution of the present work is outlined.

The UK government has identified the higher education sector as key to delivering carbon reduction across the UK in line with the ambitious Climate Change Act targets (University of Bath Carbon Management Plan, 2011). As a result, increased attention has been paid to the promotion of active and sustainable travel in university settings (e.g. Rose, 2008; Shannon et al., 2006; Whalen, Páez & Carrasco, 2013). Indeed, the University of Bath contributes about 22,000 tonnes CO_2 annually to local emissions. On its way to meet the carbon dioxide emissions reduction target of 43% by 2020 (against a 2005 baseline) set by the Higher Education Funding Council for England (HEFCE, 2010), the University of Bath has committed itself to a 19% CO_2 reduction by 2014/2015 (against 2008/09 levels of approximately 23,500 tonnes CO_2) and a long-term reduction of 43% of 2005 emissions levels (circa 25,000 tonnes CO_2) by 2020. Current progress has seen a 7% decrease in emissions despite a growth in campus (Annual Sustainability Report, 2014), although more significant cuts are required in order to meet the 2014/15 target (22,000 versus a targeted 19,000 tonnes CO_2). In this respect, transport plays a crucial role. With large universities attracting thousands of individuals on a daily basis, a strong reliance on (private) motorized transport contributes heavily to emissions, despite sustainable alternatives being available. Encouraging the adoption of sustainable travel modes and reducing the need for travel is thus of particular importance.

Even as a relatively small university, the University of Bath is an excellent example for travel in higher education and travel in general because it represents a worst case scenario for several reasons. First, the University of Bath campus is located in a rather unfavourable location. Rather than being located in the centre of Bath, which is easily accessible from all directions by public transport or active travel, the university is located outside the city centre, maximising the required travel distance to popular student neighbourhoods such as Oldfield Park (ca. 3 miles). Second, the campus lies on a steep hill that stretches out for more than a mile, presenting a major obstacle to overcome, as is nicely captured by a candidate who ran for the 2014 Student Union Officer election: “One of the questions I am asked most frequently at Open Days is ‘If you could change one thing about the Uni, what would it be?’ More often than not the answer is “Get rid of the hill!” In fact, research has shown that a mere increase of one minute in walking time caused by the slope of the local, physical, environment may lower the odds of walking or cycling by about 15% (Rodríguez & Joo, 2004). Similarly, hilliness has been found to be the single most influential physical variable when it comes to predicting the proportion of people who cycle to work (Parkin, Wardman & Page, 2008). Third, to make matters worse for sustainable travel to campus, cycle lanes are only provided for a limited distance uphill and parked cars narrow down the space on the road, forcing passing cars and buses to overtake cyclists closely. Given these strong contextual constraints, the case of the University of Bath is not only representative of other higher education institutions, but also trumps other common travel scenarios, as it includes many barriers to sustainable travel not encountered elsewhere. Nevertheless, a significant number of cyclists and

walkers take on the commute to campus every day, demonstrating that the existing obstacles *can* be overcome.

For the majority of students and staff, however, this challenging environment presents a major barrier, despite sustainable travel for the sake of the environment being only one side of the coin (Rissel, 2009). According to the British Heart Foundation National Centre for Physical Activity and Health (BHFNC, 2014), physical inactivity costs the UK healthcare system close to £1 billion a year. However, through travelling actively and sustainably, people could accrue significant health benefits, such as an overall reduction in all-cause mortality (Kelly et al., 2014), which would additionally result in tremendous savings to the NHS (Jarrett et al., 2012). As shown earlier, however, only about 2% of the population in the UK cycle regularly, while still about 22% of people walk for most of their trips (DfT, 2016). In general, healthy adults between the ages of 18 to 65 are recommended to adhere to a minimum of 30 minutes of moderate-intensity (or 20 minutes of vigorous intensity) physical activity on at least five (three) days of the week (Haskell et al., 2007; WHO, 2010). For walking, this translates into approximately 3000-4000 steps a day, over and above some basic level of activity, resulting in a somewhat contested cut-off point of a total of 10,000 steps in order to be considered active (Le Masurier, Sidman & Corbin, 2003; Tudor-Locke, Hatano, Pangrazi & Kang, 2008). Yet, despite reportedly being active, people often fall short of this recommended level of physical activity (Giles-Corti & Donovan, 2003). In general, active commuters also tend to be more satisfied than both drivers and public transport users (Olson, Gärling, Ettema, Friman & Fujii, 2013; St-Louis, Manaugh, van Lierop & El-Geneidy, 2014; Thomas & Walker, 2015), providing further justification for encouraging mode shifts in this direction.

Travelling to the University of Bath

The University of Bath campus has several access routes for all modes of transportation (see **Figure 1**). Cars mainly enter campus via access points 3 (access to the main East Car Park and smaller South Car Parks) and 6 (access to West Car Park). Buses stop at the south side of campus (access point 5; red dot below the yellow circle) before they continue to drive down Norwood Avenue (3) to drop off and board mainly students, but also staff and visitors, at the arrival square on campus (little red dot to the left of East Car Park). Walkers and cyclists can enter the campus via all access points, although the most frequented access routes are via 5 (about 63% of walkers and 24% of cyclists) and 3 (45% of cyclists) according to the latest University Travel Survey (UTS, 2014/15).

The vast majority of journeys to the University of Bath are either undertaken by bus (55% according to a 2014/15 traffic count carried out by consultancy IMA, http://www.ima-tp.com/) or by car (34% alone or as /with passenger) compared to only 10% of students and staff who walk or cycle. Naturally, there are some significant differences between the travel behaviour of students and staff. For staff members, the main mode of travel reported in the UTS (2014/2015) was the car, either alone (48%) or in the form of car-sharing (16%), together representing a little less than two third of responses (64%). Bus travel was reported by 13% of staff members as their regular travel mode, followed by cycling and walking with 8% each. For students, the main mode of travel is the bus (63%), followed by walking or cycling (22%) and the car (12%). Compared to the earlier 2012/13 University Travel Survey (UTS), there was a slight increase in reported single occupancy car use (1.1% for staff), with an even stronger increase for students (2.7%). At the same time, reported student bus travel decreased by about 2% from 65% to 63%, whereas a 2% increase was observed for students walking to the

University from 11% in 2012/13 to about 13% in 2014/15. No changes in the frequency of cycling were observed for either population.

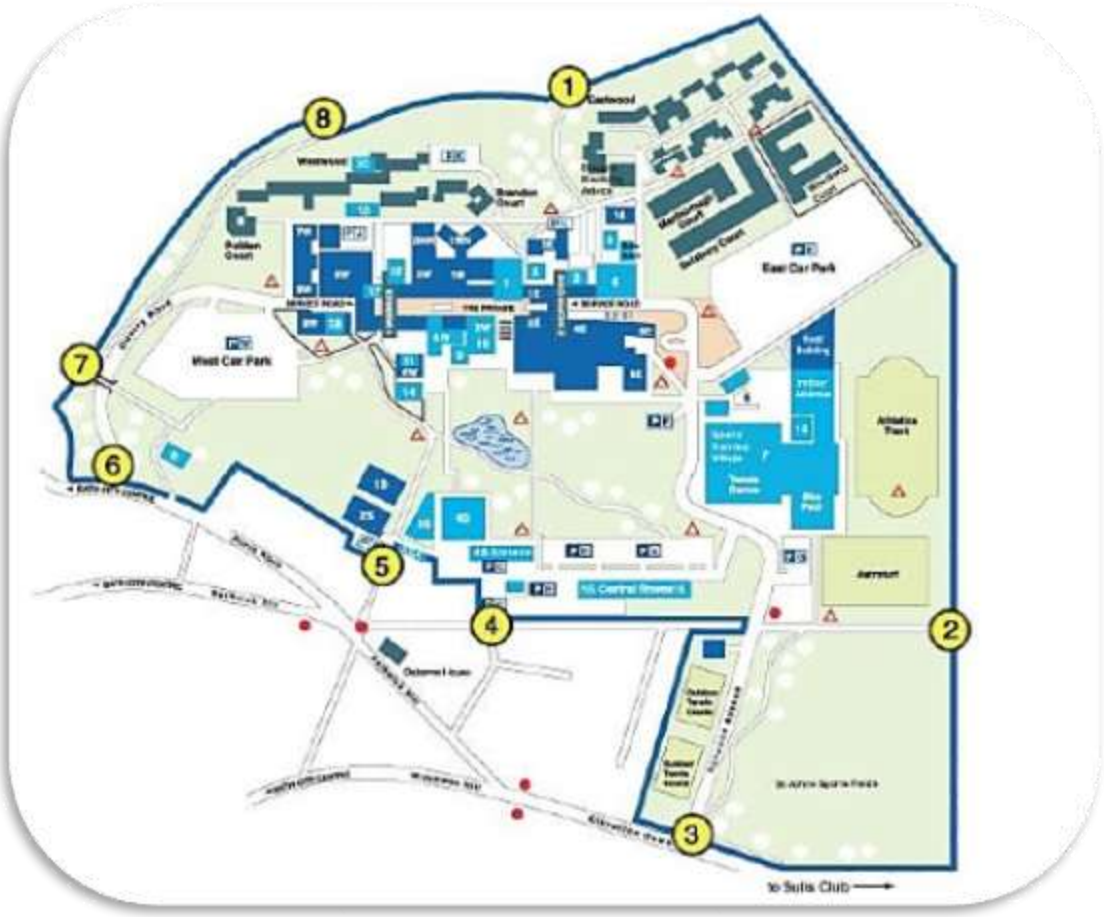


Figure 1. Access points to the University of Bath campus

These data thus draw a clear distinction between students, who primarily use the bus, and staff, who prefer the car. This may, to some extent, be due to greater distances being travelled by staff, as only about 68% of staff members reported living within a fifteen kilometre radius of the University campus compared to 95% of students. Another potential reason may be the affordability and maintenance of a car, which may pose a major barrier to student car use. Given these figures, the relatively low share of emission-free travel modes (approximately 10% of students/staff that are walking or cycling) suggests that encouraging and supporting more sustainable travel mode choices should assume particular importance, especially since not all students and staff members may be satisfied with their current mode choice.

Aims and objectives of the current thesis

The work presented in this thesis aims to encourage healthy and sustainable travel among students and staff in a university setting and can be broadly distinguished into two major parts, one addressing a specific applied problem in the context of the commute to campus by public transport (here: the bus) and the other providing a broader and more abstract perspective on travellers' differing motives and mode switching potential as well as an investigation of implicit associations between particular travel modes and emotions.

After an extended review of the literature on travel mode choice and policy (see Section 1.1. – 1.2.2.), the theoretical framework of the thesis – Goal Framing Theory (GFT, Lindenberg & Steg, 2007) – is introduced (Section 1.3.2.). The latter (GFT) assumes that all behaviour is goal directed and distinguishes between hedonic, gain and normative goals. Goal Framing Theory represents an alternative to rational choice of models of behaviour that are briefly reviewed in the context of travel mode choice in Section 1.3.1. Further psychological factors affecting travel behaviour are considered in Section 1.3.3. If follows a general overview of structural and psychological interventions (Section 1.4.1. & 1.4.2.), that will be returned to in Chapter 4. The literature review concludes with an introduction to travel behaviour segmentation research, which constitutes the building blocks of study chapters 2 and 4, respectively. The subsequent series of studies (Chapters 1, 2 and 3) then offers a new perspective of the often neglected public transport user, using psychological constructs and theory to derive distinct groups of bus users with varying mode switching potential, complemented by a small-scale intervention to encourage (dissatisfied) student bus users to use more active and sustainable means of transport.

The second part of the thesis provides a shift of focus away from bus users, expanding the segmentation approach adopted in Chapter 2 by offering a supra-modal (i.e. mode-independent) segmentation of staff and student travellers to campus based on their individual travel preferences, taking into account various instrumental, affective and normative considerations based on GFT (see Chapter 5). The final study chapter (Chapter 6) then examines people's implicit affective associations with different travel modes, testing people's predisposition towards particular modes of transport. To conclude, the theoretical implications of the study findings are considered, highlighting limitations and directions for future research, in a general discussion chapter (Chapter 7).

Below, a general outline of the thesis is provided.

Part 1 – A new perspective of the public transport user

Increasing public transport patronage has been the goal of many sustainable transport interventions aimed at reducing single-occupancy car use because *per passenger emissions* (albeit not *actual* vehicle emissions) are generally lower for public transport (see Redman, Friman, Gärling & Hartig, 2013, for a review). However, for bus services especially, the per passenger emission advantage only becomes salient when services are running at medium or full capacity (Lowe, Aytekin & Gereffi, 2009). If the vehicle runs empty or with a mere handful of people in it, the emission advantage is lost easily. Consequently, in order to be beneficial for the environment, public transport services require a high patronage, supporting the efforts by interventionists and policy makers to encourage behavioural shifts away from the car to public transport services. However, having become a 'socio-economic necessity' (Steg, 2007) and given the strong psychological barriers against the reduction of car use (Steg, 2005), those attempts have often been in vain (Tertoolen, Van Kreveld & Verstraten, 1998).

In addition, recent evidence suggests that public transport users are among the least satisfied with their travel (Olson et al., 2013; St-Louis et al., 2014; Thomas & Walker, 2015) and are unique in that they lack control over their journey (e.g. Beirão & Cabral, 2007; Thomas, Walker & Musselwhite, 2014), thus raising the question whether public transport is really a desirable alternative in the first place. That is, albeit desirable from an environmental point of view, public transport may not be first choice, especially when journey-based affect and autonomy are concerned (Beirão & Cabral, 2007; Mann & Abraham, 2006). Thus, in line with the overall aim of the current research project of encouraging healthy and sustainable travel in a university setting, the first part of this thesis is devoted to public transport users and how to encourage those who are dissatisfied with the bus use experience to shift to more active and sustainable modes of travel, in particular walking.

First, to get a better idea of the experience and motivation of current bus users, an exploratory study design was used in **Study 1**. Based on the results of the first study, a travel behaviour market segmentation of bus users was conducted to identify distinct groups of bus users, including such groups that might be encouraged to travel more actively and sustainably in the future (**Study 2**). These latter types were subsequently cross-validated with an independent sample by means of an investigation of the effectiveness of different persuasive messages with the goal to promote walking and cycling to campus among current dissatisfied student bus users (**Study 3**).

Part 2 – Supra-modal traveller types and affective associations

The second part of this thesis addresses the support for an overarching traveller type distinction and explores the existence of cognitive biases that might be responsible for preferences in mode choice.

While it has been demonstrated repeatedly that users of particular modes such as the car (Anable, 2005), bus (Beirão & Cabral, 2008; Bösehans & Walker, 2016; Jensen, 1999) or bicycle (Bergstrom & Magnusson, 2003) may differ in their motivations, to date, only very little research (Jacques, Manaugh, & El-Geneidy, 2013; Pronello & Camusso, 2011) has focused on supra-modal traveller types (i.e. preference profiles independent of people's modal choice). At closer examination, a strong overlap among previously suggested traveller types can be discerned, suggesting that supra-modal traveller types may indeed exist. However, so far, a theoretical integration of previous travel market segmentation research appears to be lacking. Consequently, an attempt was made to combine the insights of previous segmentation research with the aid of Goal Framing Theory (Lindenberg & Steg, 2007). Following on from Study 2, another travel behaviour market segmentation was conducted to further explore the existence of universal traveller types (**Study 4**), significantly increasing our understanding of travel behaviour and carrying important implications for policy.

The second study of Part 2 focuses on people's cognitive biases towards particular modes of transport. In making (sustainable) travel mode choices, journey-based affect associated or experienced with particular travel modes has been found to be an important factor in influencing travel mode choice (e.g. Domarchi, Tudela & González, 2008; Gatersleben & Uzzell, 2007; LaJeunesse & Rodríguez, 2012; Mann & Abraham, 2006). However, most of this generated evidence has originated from qualitative or survey-based research, which usually asks respondents to consciously elaborate on their

affective associations. Consequently, an as yet largely unstudied topic of interest is how travel mode decisions may be influenced by our more *immediate* affective associations with different travel modes. This was addressed in a unique laboratory experiment involving a lexical decision task which will be presented in Chapter 6 (**Study 5**).

Consequently, five central research questions arise which will guide the current research process and be addressed in a series of studies:

1) Which factors are most important in directing the choice of PT as travel mode?
    a. **Study 1** Focus groups to explore motives for bus use and the bus use experience
2) Are there subgroups of PT users that might be encouraged to travel more actively?
    a. **Study 2** Travel behaviour market segmentation of current student and staff bus users
3) How can active travel be encouraged among dissatisfied public transport users?
    a. **Study 3** Testing the effect of cognitive dissonance, autonomy and cost-health-environment benefit messages
4) Can traveller types (mobility styles) transcending modes be distinguished?
    a. **Study 4** A supra-modal travel behaviour market segmentation using Goal Framing Theory
5) Do people implicitly associate travel modes with positive and negative emotions?
    a. **Study 5** Testing implicit associations between travel mode primes and positive versus negative emotion words via lexical decision

The wide-ranging, interdisciplinary literature from the past decades has provided some insightful answers to these questions, but this has not (yet) led to the broad scale behaviour change that is required in order to advance sustainability matters. It is now for psychologists and researchers from other disciplines to apply the knowledge that has accumulated and to inform policy in close collaboration with major decision makers. The current work is meant to contribute to this process by encouraging healthy and sustainable travel in a university setting through the development and application of psychological theory and constructs.

Chapter outline, methods and rationale

The present research employed a mixed-methods approach involving both qualitative and quantitative research methods, as well as field and laboratory work. In this way, it was possible to shed light on the issue of sustainable travel from different angles, with each method offering a new perspective. Due to the varied nature of research methods that were used, the particular research method employed in each study is discussed separately in each chapter. Below, the contents of each chapter are outlined with a small summary.

I. **Chapter 1.** The first chapter provides an overview of current transport statistics in England as well as past developments in transport policy and the shifting status of various travel modes over time, which have strongly contributed to current observed travel patterns. At the individual level, the potential influences on people's travel mode choice are identified, starting with a brief overview of rational choice modes before introducing the theoretical framework of the thesis based on Goal Framing Theory (GFT; Lindenberg & Steg, 2007) and related psychological theories and constructs. Finally, different types of interventions to promote sustainable travel as well as the significance of travel behaviour market segmentation research are explored in a concise summary of the literature.

II. **Chapter 2.** The second chapter focuses on bus travel to and from the University of Bath. Despite high levels of dissatisfaction and continuing complaints, the bus remains the main travel mode for students (approx. 63% according to the 2014/15 University Travel Survey), although healthier and even more sustainable alternatives (i.e. walking and cycling) are feasible for most. In general, previous research has focused mainly on car drivers and their motives for car use (e.g. Gardner & Abraham, 2007; Lois & López-Sáez, 2009; Steg, 2005) as well as on the factors determining or increasing car driver's mode switching potential (e.g. Mackett, 2001; Monzon, Vega & Lopez-Lambas, 2011). In comparison, little or no attention has been paid to regular public transport users' motives and their mode switching potential. The second chapter thus attempts to fill this gap by exploring the reasons behind university students' (and staff's) decision to use the bus in a series of focus groups.

III. **Chapter 3.** Building up on the first study, a travel market segmentation of bus users was conducted to identify different types of bus users including such groups that might be motivated to use healthier and more sustainable alternatives in the future. Only few studies have incorporated travel market segmentations of bus users (Beirão & Cabral, 2008; Jensen, 1999), suggesting a need for further exploration. In general, distinguishing different mobility types is important because a) different users may use the same transport mode for different reasons (e.g. cost versus travel time) and b) different user segments may require interventions tailored specifically to their needs. Six different bus user profiles were identified.

IV. **Chapter 4.** In this chapter, a small-scale intervention to promote the University's own Walking Network was held among a group of student bus users, while simultaneously assessing the accuracy of the cluster solution derived in Study 2 (see previous chapter)

Three different messages (autonomy, cognitive dissonance and control) to encourage active travel (here: walking) were employed and tested in a pre-post study design. Although the results did not indicate any message effects on students' travel behaviour, evidence of the validity of the extracted bus user types was obtained. Moreover, valuable lessons were learned to potentially improve the success of future interventions in this area.

V. **Chapter 5.** Whereas Chapter 3 presents a travel market segmentation of current public transport (bus) users, the fifth chapter is concerned with the identification of traveller types transcending modes. When the focus is not on a single travel mode, a less fine-grained distinction of travellers may be desirable. In addition, it may be assumed that the attributes that determine people's travel mode choice differ among individuals and remain relatively stable over time and in different contexts. From the evidence that has accumulated to date, it has become clear that multiple traveller types across modes might be discerned. Yet, to date, an integration of segmentation research has been lacking. Chapter 5 addresses this gap in the literature by offering a travel behaviour market segmentation (based on goals) that ignores modal choice, while integrating the results of previous segmentation research using theory.

VI. **Chapter 6.** The way we travel is not only a matter of instrumental considerations, such as cost, effort and travel time, but also of affective and symbolic considerations (Jensen, 1999; Mann & Abraham, 2006; Steg, 2003, 2005). For many people, the car, for instance, is a symbol of freedom and independence and most people enjoy driving (Jensen, 1999). It is thus no surprise that people often tend to associate the car with positive feelings such as "happy" or "cheerful". However, the affective experience may vary across different travel modes (Gatersleben & Uzzell, 2007; LaJeunesse & Rodríguez, 2012). For instance, public transport users tend to be the unhappiest travellers because they lack control over their journey and are faced with such issues as unreliable or overcrowded service. Consequently, they may associate taking the bus with feeling "down" or "sad". Whereas, in previous literature, these evaluations almost exclusively stemmed from self-report measures, little or no research to date has investigated *immediate affective reactions* to different travel modes. The research presented in Chapter 6 is meant to fill this gap in the literature by investigating whether people implicitly associate different travel modes with specific emotions. This, in turn, may shed light on the process of making travel mode choices, which may, to a significant extent, be guided by implicit affective associations.

VII. **Chapter 7.** Although individual research findings are discussed in the corresponding study chapters, the final thesis chapter summarises the findings and puts them into context with previous literature, explaining their relevance to the field and outlining their anticipated contribution to knowledge. Furthermore, general limitations of the conducted research are discussed and suggestions for future research are made. Finally, some general recommendations are presented to encourage healthy and sustainable travel in a university setting and beyond, based on insights gained from the present work and past literature.

Ontological and epistemological position

Importantly, both qualitative and quantitative research methods are governed by "a patterned set of assumptions concerning reality (ontology), knowledge of that reality (epistemology), and the particular ways of knowing that reality (methodology)" (Sale, Lohfeld & Brazil, 2002, p. 44).

Ontologically, the present work follows the *critical realist* tradition. Realism, in contrast to constructivism, posits the existence of a real world that is independent of our perceptions, theories and constructions (Maxwell, 2012). Scientific theories are approximations of the processes that lead to real-world phenomena and the theoretical concepts they employ are thought to refer to actual features or properties of the real world (Devitt, 2006; Schwandt, 1997). As such, the central tenet of realist thinking is that, through scientific inquiry, we can arrive at an explanation of the physical world that is literally true (Leplin, 1984). As Leplin (1984) explains further, a good scientific theory needs to be at least partially true and its claims must possess the property to be shown as either definitely true or false. Critical realism retains this form of ontological realism (i.e. the existence of a physical reality beyond our individual perception), but, at the same time, questions our ability of generating *objective* knowledge of the world we live in. Although critical realists regard theoretical concepts as referring to features of 'the real world' (i.e. they are describing real-world phenomena), they acknowledge that the generation of this knowledge, and thus our understanding of the world, is inevitably a product of our own perspective. From this critical realist position, we thus cannot arrive at a single understanding of the world that is 'correct' or 'true' (as a 'true' realist would claim we can), as different perspectives (influenced by our values and beliefs) shape how we perceive the world and generate knowledge from it. As a result, the critical realist regards all knowledge as "partial, incomplete and fallible" (Maxwell, 2012, p. 5). However, this is not to say that causal mechanisms in the (social) world cannot be identified.

According to Næss (2015), causality can be attributed to both agents (active) and structures (passive). Travel behaviour, for instance, may be regarded as the result of individual factors (i.e. agents' needs and wants), on the one hand, while at the same time being dependent upon structural conditions, on the other hand. This "context-dependent multi-causality" (Næss, 2015, p. 280) implies that travel behaviour is never the result of a single causal mechanism, but originates from the interplay of agents and structures. In line with this perspective, the present work does not regard agents' choices as the sole driving force of behaviour (possibilism), yet acknowledges the power of contextual factors or the (built) environment respectively, to direct behaviour by making certain occurrences of behaviour more likely than others (probabilism).

Epistemologically (i.e. the ways of knowing reality), the research presented in this thesis should be regarded from a *pragmatist* approach (essentially saying that "Truth is what works" according to Sale, Lohfeld & Brazil, 2002, p. 47) which is in line with the critical realist stance outlined earlier and unites features of both a positivist and an interpretivist perspective. Traditionally, positivism has been regarded as the hallmark of quantitative research, which the current thesis is mainly based on. Positivism aligns with (critical) realism in that it assumes an objective reality that exists independent of human perception. With this perception of reality, empirical knowledge (i.e. verified data from the senses) is seen as the only way of knowing the world (Macionis & Gerber, 2010) and

the researcher and the object under study are regarded as independent entities. Qualitative research, on the other hand, usually subscribes to an interpretivist or constructivist stance. According to this position, there is no single objective reality, but rather multiple realities that depend on the observer's construction of reality. Here, the researcher and the object of interest are interdependent, as reality is created in a mutual exchange between the object and observer. Thus, whereas the focus of quantitative research rests on the unveiling of causal relationships within an objective reality, the focus of qualitative research rests on discovering the process with which multiple truths arise in a socially constructed reality and their meanings within this context.

Despite these apparent antagonist positions, the present work unites both qualitative and quantitative based research methods. There has been an ongoing debate regarding whether research methods that are relying on opposing epistemologies can be combined. According to what has been coined the *incompatibility thesis* (Howe, 1988), qualitative and quantitative methods cannot possibly be combined, since they are based on profoundly different paradigms and methods. Consequently, Howe (1992) suggested that all researchers adopt a positivist epistemological position with some degree of interpretivist influence, although this solution has been dismissed by other researchers (e.g. Sale, Lohfeld & Brazil, 2002). Distancing themselves from the midst of the qualitative-quantitative debate, Johnson and Onwuegbuzie (2004) advocated a solution similar to Howe's (1992) when arguing for a pragmatist approach (see also Morgan, 2007), suggesting that the central tenet of mixed methods research is that researchers employ designs that are suited to answering their research questions. The present work follows this latter proposition, while also endorsing Howe's (1992) intermediate position.

Methodologically, as it constitutes the major part, the paradigm emphasis of this thesis lies in quantitative research; that is, a quant-dominant approach was assumed. However, as outlined earlier, this is not to say that the entire content of this thesis should be regarded from a purely positivist epistemological point of view. The segmentation studies presented in Chapter 3 and 5, in particular, propose the utility of distinguishing traveller types based on supposedly actual differences between people (attitudes, goals and values etc.); however, no claims are made that those types exist in objective reality because we cannot derive any conclusions about objective reality. Second, as has been suggested by Morgan (1998) and others (Sale et al., 2002), quantitative and qualitative research methods may be combined for complementary purposes. For instance, while Study 1 (focus groups) focused on *identifying the factors* underlying students' choice of the bus as a travel mode to campus, Study 2 (cluster analysis) proceeded to develop a *taxonomy* of current bus users using statements taken directly from these focus groups. These two methodologically different studies thus examined different, yet related, phenomena – that is, the underlying motivations of bus use as mode choice, on the one hand, and individual variety in bus users' preferences and behaviour, on the other hand – in a complementary fashion. While the first study (Study 1) could be considered as merely a stepping-stone for the subsequent segmentation study (Study 2), it is worth noting that both studies made significant contributions to knowledge, consistent with a pragmatically oriented approach.

Chapter 1: Understanding travel mode choice: How do people travel and why do they travel the way they do? A review of the literature

1.1. How do people travel? - Travel mode choices in the UK

Before revisiting the literature on travel mode choice, the reader should be aware of how English citizens commonly travel and why certain modes are more popular than others. On average, an individual in England undertook 914 trips in 2015 (a trip is defined as "a one-way course of travel with a single main purpose") and spent 15 days (or about an hour a day) travelling (368 hours in total), covering a distance of about 6649 miles which is 48% more than five decades ago (1972/73), but 7% less compared to 2002 (National Transport Survey: England 2015; DfT, 2016). Overall, half of all trips were undertaken for commuting (incl. business), education (incl. escort) and other escort or personal business (19%/12%/19%), while shopping, visiting friends and other leisure accounted for the remaining half (19%/15%/16%). Sixty-four percent of reported trips in the sample were undertaken by car (see **Figure 2**), either as a driver (42%) or travelling as a car passenger (22%). Together, they accounted for about 80% of the average distance travelled per person per year (in 2012: 5,214 miles of a total of 6,691 miles). Another 22% of trips were spent walking, whereas about 11% of all trips were made by using public transport including local and non-local buses, London Underground, surface rail and taxis. Only about 2% of trips were undertaken by bicycle, despite close to two thirds of trips (66%) being less than five miles in length (DfT, 2016). Although the share of trips covered by active modes (i.e. walking and cycling) is relatively high (24%), these modes (i.e. walking and cycling) only account for about 4% (2013: 236 miles) of the average distance an individual treads annually.

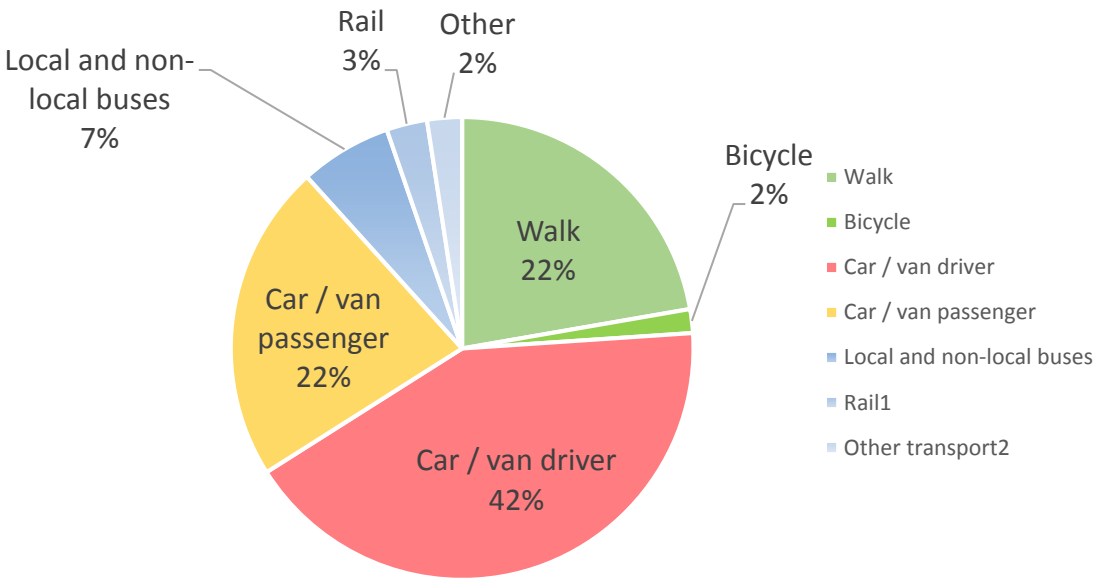


Figure 2. Percentage share of travel modes in England (National Travel Survey; DfT, 2016)

1.1.1. Travel mode changes over time

According to recent data (DfT, 2016), people in England travel less than they used to in the early 2000s. Compared to 2002, they undertake fewer trips (914 trips in 2015 compared to 1051 trips in 2002), travel shorter distances (6649 miles versus 7184 miles average distance travelled per person per year) and spend less time travelling (368 hours versus 386 hours.) However, there have been significant changes regarding how people in England travel on a day-to-day basis. Regarding private transport modes, the most visible change from 1995/1997 to 2015 is a steady decrease in trips made by walking from once 292 down to 200 trips (-32%) per person per year (see **Figure 3**). A decrease of about 12% has also been observed for car trips (15% decrease for car passenger trips), whereas the number of trips by bicycle has decreased by 15% (from 20 to 17 trips).

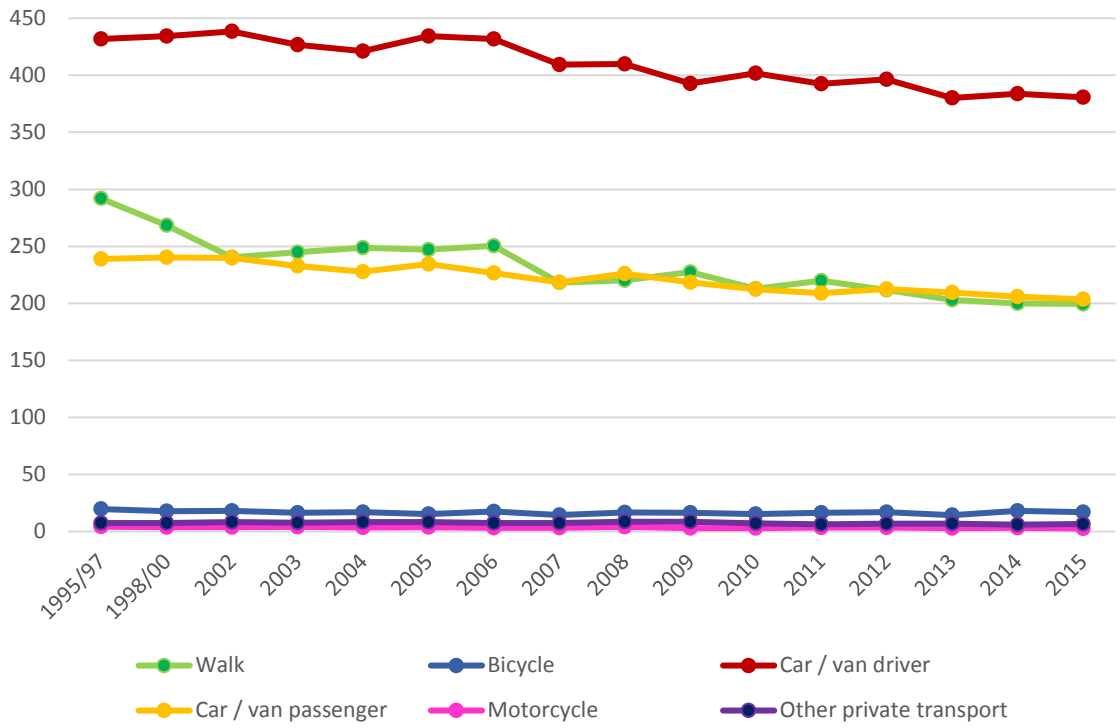


Figure 3. Annual number of trips per person by private transport mode in England from 1995/97 to 2015 (based on DfT, nts0303, 2016)

As can be seen from **Figure 4** below, a noticeable decline (-20%) has occurred for local bus trips in England from 51 trips per person per year in 1995/97 to only about 41 trips in 2015, although no decline has been observed for London area bus use which has increased by 33% from 15 trips in 1995/97 to 20 trips in 2015. Further developments include a significant increase (67%) in surface rail trips (1995/97: 12, 2015: 20) and a corresponding sharp increase in the distance travelled by rail (1995/97: 321 miles, 2012: 553 miles), accounting for about 8% of all distance travelled (2012: 6691). The remaining modes (London Underground, Taxi/ minicab, Non-local bus and other public transport) showed no or only very little variation.

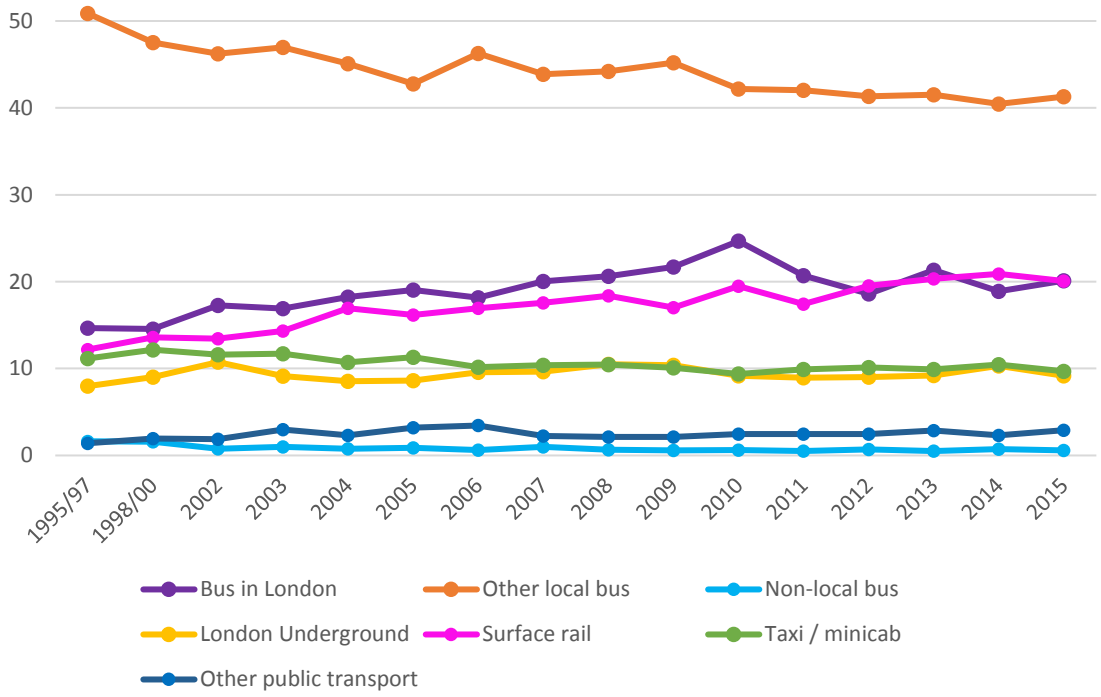


Figure 4. Annual number of trips per person by public transport mode in England from 1995/97 to 2015 (based on DfT, nts0303, 2016)

1.2. Transport policy of (un-)sustainable travel modes

Having shed light on current travel patterns in England, albeit insightful, does not provide an explanation as to how these travel patterns have come about. Before devoting attention to the internal (individual) and external (environment) factors that may result in different mode preferences, it is pivotal to consider how different transport options have been emphasized to varying degrees in (sustainable) transport policy and the consequences this has had on the development and use of these modes in England.

1.2.1. The governance of sustainable transport and the good citizen

In general, transport policy involves the cooperation of state (Type 1) as well as non-state (Type 2) institutions (Bulkeley & Newell, 2015; Marsden & Rye, 2010). Whereas the former represent various departmental government agencies ranging from the smallest, local level over (sub-)regional levels up to the national (e.g. the Committee on Climate Change or CCC) and international level (e.g. the UNFCC), the latter consist mainly of non-governmental agencies such as bus and rail operators, consulting agencies or public-private partnerships. This multi-level governance of transport enables the broad application of sustainable transport interventions and policies, although the influence of Type 1 institutions is increasingly undermined by the appearance of Type 2 institutions, especially strong external industrial lobbies, whose objectives do not always agree with the governmental agenda on climate change (Bulkeley & Newell, 2015). These conflicting interests, combined with a widespread diffusion of responsibility, pose a serious barrier to effective policy implementation. Marsden and Rye (2010) have argued that a "further devolution of powers will not necessarily lead to optimal negotiated solutions but may risk further delays and watering down of commitments" (p. 677). This becomes especially clear at the international level, where a major source of dispute is the spatial allocation of emissions, since emissions may be attributed to the person making the trip, the destination activity, regions or countries en-route or the company providing the travel. This is why, to this day, cross-boundary emissions caused by international aviation or shipping have been omitted from the Kyoto protocol. Clearly, consistency of purpose and actions is thus an essential requirement for the delivery of sustainable transport solutions (Hull, 2008). On a local or regional level, however, the prospects for policy solutions seem brighter. Sporadically, local authorities took action and achieved some positive results – such as the London Congestion Charge which significantly lowered traffic, reduced delays and cut emissions (Transport for London, 2006).

In general, the governance of sustainable transport also needs to consider and accommodate the needs of individuals. Be that as it may, there appears to exist a large gap regarding what the wider public expects from Type 1 and Type 2 institutions, first and foremost the government, in terms of dealing with climate change and vice versa. Whereas, on part of the public, state authorities and multinational corporations are regarded as the culprits of environmental degradation and trust to deal with climate change may be primarily placed into the hands of scientific or environmental organizations (Papoulis, Kaika, Bampatsou & Zervas, 2015), the government (at least in the UK) is seen as shifting on its responsibility to local transport authorities, Type 2 institutions (e.g. public transport operators) and, increasingly, the individual (Hull, 2008). This is especially illustrated in the case of cycling in the UK. Aldred (2012) argues that a lack of state support in the UK has shifted the governance of sustainable transport (i.e.

cycling/walking) into the hands of local authorities and consultants, thereby limiting the potential reach and scope of transport interventions. Rather than regulating (sustainable) traffic on its own then, the state has transformed into what she calls a 'hollow state' creating a farrago "…involving networks which are not purely public, purely private, or purely voluntary, but which mix personnel and characteristics of two or three of these sectors" (p. 96).

In fact, transcending transport issues, there has been a growing emphasis on spurring people to make better consumer choices (Barr, Gilg & Shaw, 2011). Responsible, or sustainable, consumption and consumption reduction have now emerged as the central tenets of various social marketing approaches that aim to increase individual and societal well-being (Peattie & Peattie, 2009). Clearly, voluntary mitigation efforts on the individual level are desirable and may work under favourable contextual (policy) conditions (Semenza et al., 2008). However, this politically powerful and empowering appeal to individual action may be regarded as an intentional shift of responsibility away from those in charge (and thus those who possess the power to initiate large-scale change) to citizens at the basic individual level. From the perspective of decision-makers, facilitating behavioural change towards sustainable transport alternatives may not even be regarded as desirable, as there still prevails the belief that reducing travel demand impedes economic growth (Marsden, Mullen, Bache, Bartle & Flinders, 2014). Consequently, support for behaviour change initiatives may exist primarily on a surface level, with those in charge backing various policy approaches regardless of their actual proven effectiveness (Marsden et al., 2014). Hence, the prevailing 'nudge' approach in sustainability matters. Strong leadership and a high-level commitment from top-down, however, may be the key to success in supporting behaviour change at the individual level and increasing the public acceptability of sustainable transport policies (Banister, 2008).

Surely, this is not to say that behaviour change should be left out of the equation. Smarter travel mode choices and ecological driving bear a significant carbon reduction potential (Chapman, 2007; Hickman & Banister, 2007). Consequently, informing people about what they *can* and *should* do to preserve the environment (e.g. recycling, energy saving or travelling actively), as well as encouraging them to perform any relevant behaviours, remains important for any sustainable policy intervention. Individuals, however, may only act in line with these expectations, when they perceive that society as a whole encourages the shift towards pro-environmental behaviour (Lorenzoni & Pidgeon, 2006). As a matter of fact, most of the work in the current thesis has been carried out from a behaviour change perspective and is intended for transport policy makers, researchers and campaigners to better understand the interaction between individuals' goals and preferences and contextual requirements for sustainable travel. Still, as long as there is no consistent support for major policy changes (e.g. road pricing while extending public transport or cycling networks), at *all* levels of government, this will prevent potential large-scale sustainability developments from happening (Marsden & Rye, 2010).

1.2.2. Travel mode developments

Long before sustainable transport policy assumed the importance it holds today, the following section offers a concise review of how travel modes including the car, bus, cycling and walking (excluding motorcycle and train) and our perceptions of the like have changed over the course of time. Needless to say, the rapid expansion of private motorized transport during the 20th century has radically transformed the way people travel. For a long time, this expansion has proceeded vastly unchallenged, until the threat of climate change became truly apparent.

The rise of the automotive

During the second half of the 20th century, the most sustainable travel modes cycling and walking, have been largely neglected in public discourse and policy making (Tolley, 2008), overshadowed by the rise of and advances in the automotive industry (Dant & Martin, 2001). The domestication of nature by means of technology became a central theme of many car ads and commercials, such as the slogan "Go anywhere…do anything." by Land Rover in 1948 (cited in Aupers et al., 2012), and widely shared agreement that the future belonged to car travel, led to most post-war cities being built with only the needs of car users in mind (Jones, 2008). As a result, car use has become an integral part of our daily lives and culture.

Although children's attitudes towards the car may be shaped by their socio-economic background (Kopnina & Williams, 2012), children were (and still are) born into a society where car travel is normative and desirable. In fact, 'car' not seldom happens to be one of the first words that children learn to pronounce and various toys with transport related themes (especially for boys) reinforce the socialization process into a (car) mobility focused society (Stokes & Hallett, 1992). That is, "mobility focused" may be rather thought of as a synonym for the more general focus on individual freedom, whereby "freedom is not transport but mobility, which keeps open the choice between going and staying, as one's objectives can be achieved either way" (Sager, 2006, p. 480). The car is also an important marker of adulthood, serving as a symbol of independence, and later on, serving as a symbol of group membership according to the motto that "You are what you drive" (e.g. Marsh & Morris, 1988). The public fascination with cars continues to characterise contemporary society as can be seen from the success of action blockbusters such as 'The fast and the furious', 'Transformers' or the animated movie series 'Cars' (see **Figure 5**). In the latter, the main character is Lightning McQueen, a race car, mirroring "our passion for speed, power and uncompromising individuality" (Wallis & Wallis, 2015, p. 16). Despite these developments, car use may actually be on the decline (Metz, 2013) due to factors such as hitting the Marchetti Wall (i.e. all cities share a commonly accepted travel time budget of about one hour; Marchetti, 1994), a slow reversal of urban sprawl and a returning culture of urbanism, as well as improvements in public transport networks (especially rail; Newman, Kenworthy and Glazebrook, 2013) and an ageing population that drives less (Newman & Kenworthy, 2011).

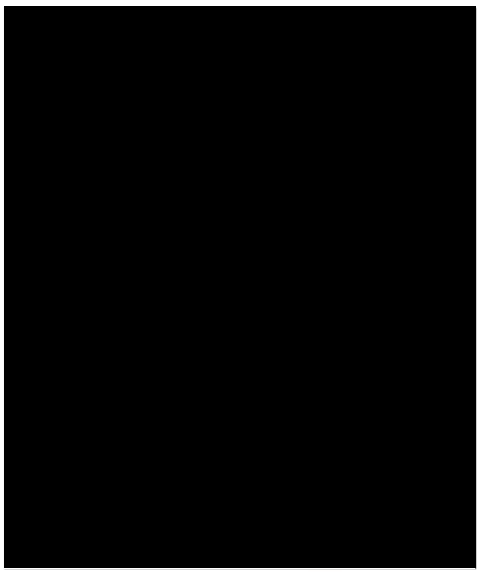


Figure 5. Lightning McQueen from the Pixar movie "Cars" (picture credit: clipartbest.com) and "Bumblebee" from the movie "Transformers" (picture credit: static.bootic.com)

At the same time, changes in the perception of (car) technology in relation to nature have taken place as well (Aupers et al., 2012). Car manufacturers, such as Toyota, increasingly emphasise the importance of living in harmony with the environment and attempt to make the process of car production and the product itself as 'green' as possible. This tendency to seek harmony between people, technology and the environment, may be seen as the result of a general process of Easternization of the Western world (e.g. Campbell, 2007). Despite the increased pressure to live in harmony with nature, thereby mitigating climate change outcomes, there is still a long way to go for car travel to become more sustainable. Current electric vehicles still may equal, or even exceed, fuel-powered vehicles in terms of their life cycle emissions unless powered by renewable energy sources (Poullikkas, 2015). However, the cost of electric vehicle technology is falling rapidly (Nykvist & Nilsson, 2015), suggesting that battery-electric vehicles (BEVs) may spark a green revolution in the private transport sector.

Public transport

In order to address the needs of the poor and the transport disadvantaged, significant efforts have been made in the public transport sector in order to enable widespread individual mobility while redistributing income (Starrs & Perrins, 1989; Vigar, 2013). However, compared to the significant increases in light rail (+479% from 0.056 bn in 1983/84 to 0.268 bn in 2016/17 according to Passenger journeys, vehicle miles and occupancy (LRT01); DfT, 2017) and train trips (+65% from 1 bn in 1950 to 1.65 bn in 2014/15; Rail Trends Factsheet, Great Britain 2014/15; Rail Executive, 2015), bus use has decreased drastically over time. During the second half of the 20th century, journeys on local bus services declined from over 12.73 bn in 1950 down to 5.04 bn in 2015/16 (-60%; Bus statistics; DfT, 2016), to a great part due to the sharp increase in new vehicle registrations during the same time period (Transport Statistics Great Britain 2014; DfT, 2014). Moreover, buses tend to be perceived as overcrowded, old, smelly and unreliable (Beirão & Cabral, 2007; Stokes & Hallett, 1992) and, in extreme cases, may even face public opposition (Weitz, 2008). The bad image of bus services is reflected in advertising, too. In contrast to car commercials, image campaigns and commercials for buses tend to

show “a difference in production quality, subtlety and method of message communication” (Aupers et al., 2012, p. 181), underlining the poor image of bus services. Nevertheless, bus trips represent the lion share of public transport trips and sustainable alternatives, such as hybrid and electric buses (Kühne, 2010; Lajunen, 2014), have the potential to reduce air pollution and congestion (Beaudoin, Farzin & Lawell, 2015). Also, there has been a slight recovery in passenger journeys on local bus services lately (10% increase between 2004/05 – 2015/16; DfT, 2016).

The case of cycling

Some European countries (such as Denmark, Germany or The Netherlands) have proactively resisted the banning of bicycles from the streets and maintaining the status of cycling as an attractive alternative to the car has assumed great importance in these countries (e.g. 35% of the population of Copenhagen cycle to school or work; Danish Ministry of Transport, 2012). Cycling is usually promoted by providing separate cycling infrastructure in large parts, traffic calming of most residential areas, integration with public transport service and traffic education of both cyclists and motorists (Pucher & Buehler, 2008; see also Pucher, Dill & Handy, 2010). Taking The Netherlands as an example, cycling is supported by both a descriptive (i.e. what people typically do) and a corresponding injunctive norm (i.e. what people generally [dis-]approve of; Cialdini, 2007; Cialdini, Reno & Kallgren, 1990) and thus remains a popular transport choice for short to moderate distances. Here, on average, each fourth trip is undertaken by bicycle (Pucher & Dijkstra, 2003) because cyclists are seen as an essential part of the traffic system rather than a disturbance thereof. Conventional use of the bicycle thus both “reflects and reproduces social norms” (Horton, Rosen & Cox, 2007, p. 7).

At the same time, no or little attention has been paid to the needs of cyclists in the UK. In the 1940s, cycling was the most popular mode choice in many European cities until rapid motorization, beginning post-war, led to a massive decline in cycling rates in the population in the decades to follow (Golbuff & Aldred, 2011). In the 1950s, child safety issues shortly brought the discussion about cycling back to life. In some instances, child road casualties were blamed on the victim (see Roberts & Coggan, 1994, for a case study) and the following rise of safety concerns was dealt with by teaching children how to behave as a cyclist on the road. That is, children were taught how to avoid being an obstacle on the road, or in other words, were taught ‘roadmanship’ (Aldred, 2012, 2015). This implicit assumption of posing an obstacle as a cyclist may not only have resulted in a broken sense of harmony between cyclists and road traffic, but may also have engendered a fear of cycling and contributed to the view of cycling as a leisure pursuit rather than a viable means of transport (Horton, 2007).

By the 1970s, cycling levels had reached an all-time low (Aldred, 2012). Continued concerns about safety and a growing concern about the impact of road traffic on quality of life and the environment led to a movement to reinstate cycling as a social practice (Golbuff & Aldred, 2011), but it was too late. As Horton (2007) writes, roads have stopped “feeling like a place to cycle” and “it begins to feel as though cycling does not belong there” (p. 144). As a consequence, rather than focusing on the more utilitarian aspects of cycling, most public discourse has framed cycling more and more as a popular kind of sports activity, a healthy and environmental lifestyle choice for the ‘responsible

individual' (Aldred, 2012). Aldred and Jungnickel (2014) further add that "even where cycling has become relatively normalised in the UK, it is still marginalised" (p. 86).

Although cycling in general has come to be regarded in a positive light (Daley & Rissel, 2011), cyclists are still viewed as a minority of 'Incompatible lawbreakers' or 'Lycra wearing groups or people wearing fluorescent clothing that is somehow alien to the mainstream' (Rissel, Bonfiglioli, Emilsen & Smith, 2010, p. 7). These negative connotations of cyclists may discourage people from cycling on a regular basis in order to avoid being associated with this group. As suggested by Aldred (2012), "For the majority…cycling is a 'good thing' as saving polar bears is a 'good thing': something abstract and far away that hardly touches everyday life, with those individuals who do decide to engage in it seen as rather odd at best" (p. 99).

Walking

Albeit limited to shorter distances, walking benefits from the vast availability of infrastructure such as sidewalks and crossings and, compared to cycling, does not require any costly equipment while offering the same degree of flexibility. Increasing traffic volumes and speed, however, have led to a drastic decline in active travel modes (i.e. walking and cycling) since the 1960/70s (Jacobsen, Racioppi & Rutter, 2009) with great variations between nations (Pucher & Dijkstra, 2003). Thus, it is no surprise that walking has become a popular target for active travel initiatives intended to increase levels of physical activity among the population (e.g. Dubuy et al., 2013; or see Ogilvie et al., 2007, for a systematic review). Frequently, only the benefits of walking as a health-enhancing physical activity (HEPA) are emphasised (e.g. Audrey, Procter & Cooper, 2014; Oja, Vuori & Paronen, 1998), although walking may offer psychological benefits (such as increased positive affect) as well (Johansson, Hartig & Staats, 2011; LaJeunesse & Rodríguez, 2012).

1.3. Why do people travel the way they do?

After a brief overview of travel mode developments over time and the governance of sustainable transport, which jointly can be seen as responsible to a great extent for today's travel patterns, the following section focuses on the theoretical framework of the thesis. Individual factors that may affect travel mode choice have a long research history that continues until the present day. As early as five decades ago, primary investigations of people's travel mode choices indicated that instrumental aspects such as convenience, cost, comfort and travel time belong to the major driving factors underlying people's mode choice (Quarmby, 1967; Stopher, 1968). The majority of these approaches construed travel mode choice as a reasoned utilitarian process (Pratt, 1970) that largely influenced psychological theories of behaviour until the 21st century. The subsequent section provides a concise overview of the application of such models to travel mode choice in a thesis-relevant setting, based on the work by Bamberg and Schmidt (2003).

1.3.1. Rational choice models and habit

Exploring the predictive power of traditional psychological theories – including the Theory of Interpersonal Behaviour (TIB; Triandis, 1977, 1979), the Norm Activation Model (NAM; Schwartz, 1977; Schwartz & Howard, 1981) and the Theory of Planned Behaviour (TPB; Ajzen, 1985, 1991) – on university students' car use behaviour, Bamberg and Schmidt (2003) discovered that the TPB behaviour constructs of attitudes (based on

behavioural beliefs; that is, an evaluation of the consequences of available alternatives), subjective norms (derived from normative beliefs; i.e. the likely approval or disapproval of one's actions by significant others) and perceived behavioural control (PBC or control beliefs; that is, confidence in one's ability to perform the behaviour in question) all significantly predicted the intention to drive which, in turn, predicted actual car use behaviour (see also Abrahamse, Steg, Gifford & Vlek, 2009). Role beliefs (i.e. beliefs about the appropriateness of the behaviour for one's social role), an additional factor taken from the TIB, also predicted the intention to drive. The only further factor directly predicting students' car use was found to be habit, leading the authors to conclude that "car use is a habitual choice process that, rooted in once made conscious considerations about pros and cons, usually involves routine-shaped automatic associations between stimulus situations and habitually chosen options" (pp. 279/ 280). TPB constructs have also been shown to be applicable with regard to students' bus use (Bamberg, Ajzen & Schmidt, 2003; Heath & Gifford, 2002), which will be the focus of Chapters 1 to 3.

For example, applying the TPB, Bamberg, Ajzen and Schmidt (2003) found that attitudes (i.e. behavioural beliefs), subjective norms (i.e. normative beliefs), and perceived behavioural control (PBC; i.e. control beliefs) all influenced students' intention to take the bus to campus, which in turn predicted actual bus use. Earlier, in a similar study, Heath and Gifford (2002) attempted to predict university student's bus use within the scope of a universal bus pass (U-pass) program at a Canadian university. The U-pass program offered students a great reduction in bus transportation fees and was intended to reduce student car use. In addition to the fundamental building blocks of the TPB, the authors added three NAM variables related to car use (i.e. car-use moral norm, car-use problem awareness, and car-use felt responsibility), as well as a measure of the perceived descriptive norm (what most people do in a given situation), environmental values and an intention by PBC interaction term. Before and after the introduction of the U-pass program, the strongest predictors of actual bus use were the intention to take the bus, with the largest contribution to explained variance, followed by the descriptive norm, PBC and the intention by PBC interaction. The remaining predictors, including the basic TPB constructs of attitude and subjective norm, did not contribute significantly to the prediction of bus use, thus partly contradicting subsequent findings by Bamberg and colleagues (2003). In other words, students used the bus when they intended to do so, when other students/friends were using the bus as well and when they perceived high behavioural control. More recent research, based on extensions of the original TPB, also converges on these findings. Based on a study conducted with a large sample (N = 827) of commuters to work, Donald, Cooper and Conchie (2014) found car use to be driven by intentions and habit (albeit not PBC), whereas the use of public transport appeared to be solely driven by intention.

In general, there is now some consensus that travel behaviour involves a strong habitual component (Domarchi, Tudela & González, 2008; Forward, 1998; Klöckner & Matthies, 2004; Thøgersen, 2006; Thomas & Walker, 2015; Verplanken, Aarts, Van Knippenberg & Van Knippenberg, 1994). A habit may be defined as a behaviour pattern that is triggered automatically when specific cues are encountered in an *unchanging* environment. The behaviour occurs frequently enough to be enacted without much (or any) cognitive effort and usually leads to the desired outcome. Past research has demonstrated repeatedly that habits moderate the intention-behaviour link in stable

travel mode contexts, with the link disappearing when habit strength is high (Gardner, 2009; Verplanken, Aarts, Van Knippenberg & Moonen, 1998). As a result, once formed, a (bad) travel habit may only be difficult to change, as previous research has shown that a strong habit may prevent people from forming the behavioural intentions necessary for a change in travel behaviour (Taniguchi & Fujii, 2007). That is, given that behaviour change is considered at all, since – as research by Verplanken, Aarts and Van Knippenberg (1997) has demonstrated – less attention is paid to information about behavioural alternatives when habit strength is high. This, however, may alter when habits are disrupted, as suggested by the habit discontinuity hypothesis (Verplanken, Walker, Davis & Jurasek, 2008). Testing the latter in a field experiment, Verplanken and Roy (2016) found there to be a short window of opportunity (< 3 months) to influence environmental behaviours more effectively through an intervention when participants had recently relocated. Yet there is also a potential for relapse into old routines, as habits may be hard to extinguish. Even in the event of a drastic change in the environment – such as the move to a new city or an office relocation – old habits have been shown not to vanish immediately, yet rather to fade away gradually as new habits are established (Walker, Thomas & Verplanken, 2015).

1.3.2. Theoretical framework of the current thesis

Whereas the aforementioned theoretical accounts construe mode choice as a once reasoned process that became habituated, it should be noted that the way we travel may be influenced by a variety of additional factors. Although findings from traditional psychological models, such as the TPB or NAM, confirm the important role of various psychological constructs (such as attitudes, personal norms and perceived behavioural control) in decision-making, they may underestimate the powerful influence of people's goals and how both, (social) psychological and utility factors, may act together to jointly affect behaviour (Jaśkiewicz & Besta, 2014; Mann & Abraham, 2006).

Broadly, travel behaviour can be regarded as being influenced by instrumental, affective and normative motives. Obviously, travel mode choice is strongly influenced by **instrumental motives** including the perceived costs and benefits of each mode, especially in terms of what has been labelled the 'three Cs' (i.e. costs in time and money, comfort and convenience), which frequently may outweigh health or environmental (normative) considerations (Chatterton et al., 2009). First, for any given trip, the travel mode that achieves the best cost/benefit ratio may be chosen (although this does not always have to be the case as discussed later). For instance, for a short trip to the supermarket around the corner, walking or cycling will be most profitable. However, when visiting a good friend who lives in another city, we may be willing to incur costs in terms of money (e.g. bus or train ticket, fuel) in order to shorten travel time substantially. Second, being practical or convenient implies that the planned trip should not be too complex, as having to switch travel modes for a single trip several times (e.g. bus ⇔ train ⇔ walk), is usually something most people like to avoid. This, in turn, stresses the importance of residential density, public transport access and street connectivity (Frank et al., 2010). Third, comfort may play a pivotal role, although the latter might be better seen as an affective motive. Whereas the car is generally perceived to offer a high degree of personal comfort, public transport is frequently regarded as lacking comfort (Beirão & Cabral, 2007) and may thus be perceived as a less attractive transport alternative.

In addition to these rational instrumental factors, such as cost, convenience and travel time, travel mode choice may be strongly influenced by **affective motives**, such as the comfort (see above) or enjoyment experienced during travel (Gatersleben & Uzzell, 2007; LaJeunesse & Rodríguez, 2012; Lois & López-Sáez, 2009; Mann & Abraham, 2006). For car drivers, these may particularly relate to the fun or comfort experienced while driving, which certainly differs between individuals (e.g. Steg, 2005). The importance of affective motives has also been confirmed by research conducted by Lois and Lopéz-Sáez (2009). Employing a structural equation modelling approach, they found that instrumental motivations for car use (e.g. speed, availability and comfort) and symbolic motivations for car use (above all, self-expressive and categorical functions) predicted affective motivations, such as attachment to the car or experienced enjoyment when driving. Affective motivations, in turn, predicted a significant amount of variance of frequency of car use for a variety of trips – that is, shopping, visiting a leisure area, visiting friends or relatives and going to work or to a study centre – although trips to work/study centre were not significantly related to affective motivations. The latter is also illustrated in research on journey-based affect during commuting experiences. LaJeunesse and Rodríguez (2012) found that both walkers and cyclists were significantly better attuned to their commuting experience than car drivers and bus users. More specifically, walkers and cyclists felt more competent, less stressed and less constrained by time concerns than drivers or bus users, pointing to the potential benefits of non-motorized travel.

Travel behaviour may also be affected by **normative motives**, which reflect a concern with the consequences of one's own behaviour for others or the environment. According to the Norm Activation Model (NAM; Schwartz, 1997; Schwartz & Howard, 1981), for altruistic (or pro-environmental) behaviour to be performed, people need to be aware of the consequences of their behaviour for others or the environment, and need to feel morally responsible for these consequences. Otherwise, personal norms (i.e. a felt moral obligation) to act will not become activated. In addition, for activated personal norms to translate into behaviour, people need to perceive behavioural control (i.e. absence of barriers and high behavioural costs). In a study of Canadian office workers commuting by car, Abrahamse et al. (2009) found only personal norms to be predictive of people's intentions to reduce car use. Closely related to personal norms, people's (pro-) environmental self-identity may be a significant determinant of behaviour (Van der Werff, Steg & Keizer, 2013; Whitmarsh & O'Neill, 2010). For instance, those with a more pro-environmental self-identity have been found to evaluate the instrumental, affective and symbolic attributes of electric vehicles (EVs) more positively than those for whom a green image is not a central part of their identity (Schuitema et al., 2013).

Needless to say, people's identity, personal norms and values may be very closely intertwined (Dietz, 2015). This is also illustrated in travel behaviour market segmentation research which aims to distinguish different types of travellers based on their attitudes and travel behaviour. For instance, in contrast to the environmentally concerned *Aspiring Environmentalists*, *Complacent Car Addicts* are indifferent to the environmental impact of car use (Anable, 2005). Although people might not see themselves as *Complacent Car Addicts*, whether they identify as a car driver, cyclist, public transport user or walker may be important. How strongly people identify as a motorist, worker or parent, for instance, may affect travel mode choice over and above other internal, instrumental or situational factors (Murtagh, Gatersleben & Uzzell, 2012).

More often than not, people's varying motives and sustainable travel mode choice are in conflict. Car users, for instance, have been shown to be well aware of the potential affective (e.g. excitement or relaxation), environmental and health benefits of active travel, but they may still prefer the car due to its actual or perceived convenience and flexibility (Anable & Gatersleben, 2005), thus exhibiting 'car stickiness' (Innocenti, Lattarulo & Pazienza, 2013). Similarly, if the price of public transportation is perceived as being too expensive, people's beliefs about the negative environmental impact of car use may decrease (Collins & Chambers, 2005). Yet, admittedly, there may be no single travel mode that can fulfil all of people's motives simultaneously. As a result, for most people, the conflict between personal desires and normative considerations (e.g. environment or effects on non-car users) are resolved in favour of unsustainable travel modes, primarily the car, which may come closest to fulfilling their individual preferences (comfort, speed, the amount of joy experienced while driving, independence and status etc.).

A popular theory summarising the interaction and potential conflict between people's instrumental, affective and normative motives is Goal Framing Theory (GFT), which represents the chosen theoretical framework underlying the research that has been conducted as part of this thesis. The central tenet of GFT is that all behaviour is goal-directed, as is further elaborated below.

Goal Framing Theory

Providing an integrative framework for explaining pro-environmental behaviour, GFT (Lindenberg & Steg, 2007; Steg, Lindenberg & Keizer, 2016) suggests that people's information processing and actual behaviour are guided by three overarching goals: hedonic goals which reflect the desire 'to feel better right now', gain goals which refer to the management of one's resources, as well as normative goals which include information on how to 'act appropriately' (see **Figure 6**). The three goal frames thus mirror affective (hedonic), instrumental (gain) and normative (normative) motives. At any given moment in time, a different goal or combination of goals may be activated or 'focal' building the 'goal frame'. This goal frame subsequently determines which information is attended to, how behavioural options are perceived and finally which action will (eventually) be taken. However, as multiple goals can be activated simultaneously, conflict between these goals may arise (Steg, Bolderdijk, Keizer & Perlaviciute, 2014).

Figure 6. The three goal frames guiding behaviour (Lindenberg & Steg, 2007)

As a default, the hedonic goal frame is assumed to be dominant, as people tend to be very sensitive to the hedonic consequences of their actions (Steg, Perlaviciute, Van der Werff & Lurvink, 2014). That is, they try to avoid situations which may involve extra effort and tend to choose the most convenient alternative of behaviour (e.g. taking the elevator instead of the stairs) by weighing available options on their likely utility (gain) aspects and their anticipated affective (hedonic) consequences (Mann & Abraham, 2006). This has an especially detrimental effect on (pro-) environmental behaviour which is often costly in terms of time or effort. For instance, in deciding whether to take the bike or bus to University, Lisa may decide to take the bus because cycling uphill takes a lot of effort and it is also raining outside and she does not like to get wet. Although Lisa is well aware of the cost, health and environmental benefits of active travel, in this particular situation, the hedonic goal of reducing effort (cycling uphill) and discomfort (getting wet) is focal, building the goal frame and ultimately leading to Lisa's decision to take the bus. It thus comes as no surprise that, in most cases, gain and hedonic goals will need to support the normative goal (what is the right thing to do?) in order for pro-environmental actions to be performed (De Groot & Steg, 2009). As another example, consider bottle recycling.

In many European countries, people are rewarded for recycling deposit bottles (normative) with a small monetary incentive (gain). In addition to receiving a refund, returning deposit bottles tends to be convenient (hedonic) because they can easily be disposed of when doing the next shopping tour. However, shifting people's focus to gain and hedonic goals may also lead them to neglect the normative aspect of the behaviour (here: recycling for the sake of the environment) and focus only on the individual benefits (refund) of carrying out the behaviour (Steg, 2015). Moreover, for sustainable behaviours that incur high behavioural costs, such as travel mode choice, gain and hedonic goals (e.g. cost, comfort or travel time) frequently outweigh normative goals (Steg, Perlaviciute et al., 2014). Reducing the conflict between goals or strengthening the *values* that reinforce the normative goal frame (i.e. biospheric values) may thus be necessary to encourage sustainable behaviour (Steg et al., 2016).

Turning back to Lisa's decision whether to take the bike or bus to campus, imagine that Lisa was also very environmentally conscious and rather preferred to save her money rather than spending it on a bus ticket. In this case, the combined strength of the gain (saving money) and normative (avoiding motorized transport) goal may outweigh the hedonic goal (less effort, not getting wet) and lead her to cycle despite the effort and unpleasant rain. Thus, goals may conflict, yet also reinforce each other (like the normative and gain goal in the current example). Which goal or combination of goals will be focal or dominant in any one given situation will thus, amongst other factors (e.g. availability of alternatives), depend on the strength of people's values (Steg et al., 2014). Understanding an individual's behaviour thus not only requires knowledge about that person's activated goals in a particular situation, but also his or her endorsement of specific value types.

Goals versus values and the powerful influence of situational factors

In line with Schwartz's (1992) original definition, Steg, Van den Berg and De Groot (2013) describe "values, such as freedom, equality and protecting the environment, [as] desirable trans-situational goals that vary in importance and serve as guiding principles in the life of a person or other social entities" (p. 142).

According to Schwartz's value theory (Schwartz, 1992, 1994), values can be broadly distinguished based on two dimensions. The first dimension distinguishes between values related to people's openness to change (stimulation and self-direction) versus conservatism (conformity, tradition and security), whereas the second dimension contrasts self-enhancement values (including hedonism, power and achievement) and self-transcendence values (including universalism and benevolence). The latter dimension, contrasting egoistic and hedonic (self-enhancement) with altruistic and biospheric (self-transcendence) values, respectively, has been shown to have great potential to explain pro-environmental beliefs and behaviour (Steg et al., 2014). Self-transcendence values (biospheric values in particular) have been shown to be related to measures of pro-environmental attitudes and behaviour (De Groot & Steg, 2008, 2010; Nilsson, Von Borgstede & Biel, 2004; Schultz & Zelezny, 1998, 1999; Steg & De Groot, 2012). In their review of the literature, Steg et al. (2014) suggest that values influence behaviour by affecting the importance and evaluation of consequences of actions as well as through the activation of personal norms and people's environmental self-identity. Crucially, the authors suggest that individuals will choose a course of action based on how it will affect the values that they hold dear. Consequently, individuals tend to choose courses of action that are congruent with their values. In line with this, people with strong biospheric values have been found to be more likely to express pro-environmental behaviour intentions and to consider the environmental consequences of their actions, while the opposite was observed for those with weak biospheric values or strong egoistic values, respectively (Bolderdijk, Gorsira, Keizer & Steg, 2014; De Groot & Steg, 2010; Loukopoulos, Jakobsson, Gärling, Schneider & Fujii, 2004).

Environmental values (Dietz, 2015) may be especially important for transport choice, since sustainable travel behaviour (e.g. reducing car use) inevitably requires the restriction of one's personal interests (e.g. the comfort and independence offered by one's car), thus sacrificing the immediate and tangible benefits of car travel for uncertain future benefits (De Groot & Steg, 2008; Nordlund & Garvill, 2003). A recent meta-analysis (Hurst, Dittmar, Bond & Kasser, 2013) confirms that people who strongly endorse self-enhancing (materialistic) values are the least likely to behave in sustainable ways, and to assume responsibility for environmental matters, although climate change knowledge may attenuate the detrimental effects of ideology on climate change beliefs (Guy, Kashima, Walker & O'Neill, 2014). Ironically, however, the most environmentally aware travellers, who tend to stem from higher income classes and who, due to their higher than average mobility, are responsible for a major share of distances travelled and thus emissions, may be the least willing to change their travel behaviour – a transport taboo that is rarely addressed in depth (Gössling & Cohen, 2014). Especially with regard to aviation, which has a much severer impact on the environment than car travel (Borken-Kleefeld, Fuglestvedt & Berntsen, 2013), ignorance, denial, necessity and indulgence or fatalism are common responses to the dilemma of air travel and its relation to climate change, although guilt may also play a role (Bösehans, 2013; Kroesen, 2013).

It is important to note that goals and values are related, yet distinct, constructs. Each goal or goal frame corresponds to a particular value type. That is, gain goals are related to egoistic values (i.e. managing or improving one's resources), hedonic goals to hedonic values (i.e. increasing personal comfort and well-being), and normative goals to either altruistic and/or biospheric values (i.e. helping others or the environment). Goals,

however, differ from values in that they are assumed to be situationally dependent and are thought to reflect people's prioritization of held values in a particular situation (Steg et al., 2014). Due to their stability over time, it is expected that values affect the chronic strength of goals so that, across situations, individuals will tend to prefer particular goals (Steg et al., 2014, 2016). A person with a strong biospheric value orientation, for example, would be expected to act in line with a normative goal frame most of the time. That is, he or she would be expected to evaluate the (environmental) consequences of behavioural options and their perceived likelihood, making an informed decision based on this information. The aforementioned example of aviation, however, illustrates the powerful influence that situational factors may have on performing value-congruent actions so that, despite people's stable value orientations, their actions may not always follow suit with their personal convictions. Situational factors such as high behavioural costs, signs that others violate social norms and/or having to prioritise several goals simultaneously may lead people to abandon a pro-environmental course of action (Abrahamse & Steg, 2013; Bamberg & Schmidt, 2003; Steg & Vlek, 2009).

1.3.3. Other internal and external factors that may affect mode choice

Due to the complexity of travel behaviour, no single theory can possibly account for all the factors that are relevant to any one given individual at a certain point of time. Serving as a reminder of the incompleteness of any theoretical approach to account for people's travel patterns, the following section is intended to provide a brief summary of further non-negligible *internal* (*psychological*) and *external* (*natural or built environment*) factors underlying people's travel behaviour that have been identified in past literature.

The failure of most (public) policy interventions to decrease the use of *unsustainable* travel modes (primarily private car use) significantly (e.g. Gärling & Schuitema, 2007; see also Graham-Rowe, Skippon, Gardner & Abraham, 2011, for a review of available evidence) – while at the same time aiming to increase the use of *sustainable* transport modes (e.g. Monzon, Vega & Lopez-Lambas, 2011) – has led to a renewed research interest in exploring the psychological motives underlying people's *unsustainable* travel mode choices (e.g. Anable, 2005; Donald, Cooper & Conchie, 2014; Ellaway, Macintyre, Hiscock & Kearns, 2003; Gardner & Abraham, 2007; Jensen, 1999; Schneider, 2013; Steg, 2005). Part of this research has focused on university settings in particular (Rose, 2008; Shannon et al., 2006). It should also be noted that, beyond these individual factors, the natural and built environment may play a critical role in people's travel mode choices (Næss, 2015). The latter often makes certain travel alternatives more attractive than others (e.g. through the presence of well-maintained cycle networks, good public transport access and availability or short travel distances).

External factors – The natural and built environment

On a very basic level, the simple decision of living in a rural versus urban environment, which is often influenced by considerations in terms of family planning or job security, can strongly influence travel behaviour (Banerjee & Hine, 2014; De Vos, Derudder, Van Acker & Witlox, 2012). People living in rural settings, for instance, may be particularly unlikely to seek for alternatives to the car since the latter may be associated with significantly higher costs in terms of convenience, effort and safety (Chatterton, Coulter, Musselwhite, Lyons & Clegg, 2009). But even urban environments may greatly differ in their potential for active and sustainable travel. Reviewing findings from the transportation, urban design, and planning literatures, Saelens, Sallis, and Frank (2003) found that high-walkable neighbourhoods were associated with up to 30 minutes of additional physical activity per week due to walking trips compared to low-walkable neighbourhoods. In particular, frequent intersections, wide sidewalks and parks, or other attractions, may positively affect the utility of walking, whereas hilly topology may negatively affect utility (Guo, 2009). Similar findings have been obtained in the case of cyclists for whom built environment characteristics such as turn frequency, distance, slope, intersection control (e.g. signals or stop signs) and traffic volume have been found to affect route choice (Broach, Dill & Gliebe, 2012).

Although, in theory, people may exert some control over external factors that affect their mobility (e.g. where they choose to live or work, which school their children attend), frequently those factors are not under their control. When experiencing residential dissonance for instance – that is, a mismatch between preferred and actual neighbourhood – people may be prevented from travelling with their preferred means of transportation (De Vos et al., 2012). Additional factors such as the availability of cycle paths, the frequency and reliability of public transport services or road works, may elude people's control. Random factors, such as the weather, which may affect both motorised and non-motorised mode choice (Anta et al., 2016; Böcker, Dijst & Faber, 2016; Liu, Susilo & Karlström, 2015; Saneinejad, Roorda & Kennedy, 2012), may also a play role. As a result of adverse weather conditions, some trips might be cancelled, postponed or shifted to other modes (Koetse & Rietveld, 2009). In general, active mode users are more vulnerable to changing weather conditions, but may also have a richer experience of the spatial environment (i.e. higher place evaluations; Böcker, Dijst, Faber & Helbich, 2015).

In contrast, internal or so-called *person factors* – such as habits, values, the acquisition of information about or attitudes toward certain transport modes (Gehlert,

Dziekan & Gärling, 2013) – may be subject to change through individual action. Whether external factors (i.e. situational constraints) can be overcome by individuals thus also depends on how people manage their person or internal factors.

Internal factors – From autonomy to personal norms

Except for socio-demographic factors (discussed below), the only (relatively) recent attention devoted to internal psychological factors influencing travel behaviour, has not yet received the same attention as widely applied rational choice models, such as the TPB (Ajzen, 1985, 1991). As a result, the forthcoming enumeration of internal factors should be regarded as mostly theory independent which, however, shall not undermine their importance.

Socio-demographic factors

People's life situation has a very profound influence on their travel behaviour that may even exceed the role of individual lifestyles (Scheiner & Holz-Rau, 2007). Various socio-demographic factors, such as age, income or marital status, may affect people's life situation which, in turn, influences people's social roles and contacts. The latter will have a strong impact on people's travel behaviour. Regarding marital status, a married couple with two children may be expected to have vastly distinct mobility needs when compared to a college student or a retired man or woman. Young families have been shown to be far more reliant on personal motorized transport (e.g. car) than elderly people or people without children, whereas for the latter the availability of public transport and the proximity of retail stores is relatively more important to accommodate their life situation (Scheiner & Holz-Rau, 2007).

It should also be mentioned that individual mobility is strongly influenced by income. This is particularly illustrated in the example of car use. Compared to the lowest income group, people in the highest income group in the UK covered a distance with their cars that was, on average, more than three times greater (1411 versus 5097 miles per person per year; according to the NTS 2015; DfT, 2016). Similarly, people in the highest income group showed the highest use of rail services with 1370 miles, which was about five to six times greater than the average of lower income groups (232 miles). Differences were smaller for other transport modes and clearly reversed for bus use, where the lowest income group appeared up front with 459 miles compared to only 216 miles for the highest income group (less than half), underlining the image of public transport as a means of travel for those with low status in society.

Finally, a major factor impacting mobility and travel mode choice is the age of the individual (Haustein, 2012). By 2051, more than a quarter of the population in the UK will be 60+ (about 27% according to 2012-based projections; Office for National Statistics, 2013), likely having a fundamental impact on current mobility patterns. There are a host of unanswered questions regarding future mobility of the elderly including the reliance on individualised versus collective transport (e.g. car versus journey-sharing or public transport), engagement in active travel (e.g. assistive technology could significantly boost levels of active travel in old age), trip purpose (e.g. older people may be required to stay in the workforce longer in the future) and the substitution of journeys through technology (e.g. tele-presence facilities such as Skype; Shergold, Lyons & Hubers, 2015). Thus, it has become apparent that transportation strategies increasingly need to consider

and meet the needs of the elderly and those with disabilities (Kim & Ulfarsson, 2004; Schmöcker, Quddus, Noland & Bell, 2008) which could be met through self-driving cars in the future (Azmat, Schuhmayer & Kummer, 2016).

Autonomy, independence and freedom

In Sager's (2006) words, "freedom is not transport but mobility, which keeps open the choice between going and staying" (p. 480). Autonomy plays a key role in travel mode choice (Thomas, Walker & Musselwhite, 2014), even if it may lead to the "encroachment on others' private spheres" (Sager, 2006, p. 470). Certainly, the car confers a great sense of independence and freedom (Rubens, Gosling & Moch, 2011) and it may add significantly to one's self-construal or identity (Stradling, 2002). Elaborating on the attractions of the car, Stradling (2002) proposes that the car may confer a strong sense of identity to young and/or poor people in particular because they both look for ways to express themselves and to experience control in their lives. A similar argument was made by Jensen (1999), who suggests that self-determination may play a key role in travel mode choice. As Jensen suggests, "humans in modern society have so little influence on the "major" issues, so that one will do everything to maintain integrity or independence – even if it is only possible in the trivial issues" (p.31). Likewise, in a series of interviews with car drivers, Mann and Abraham (2006) identified car ownership as a significant marker of adulthood or financial status and as an important source of autonomy due to its easy accessibility and reliability compared to public transport.

A car is not 'just a car' – Symbolic motives

Although instrumental, symbolic and affective motives apply to all travel mode choices, at least in theory, they have been investigated primarily with regard to car use. In line with the theory of the meaning of material possessions (Dittmar, 1992, 2004), in addition to fulfilling its *instrumental* aspects (i.e. being a means of transportation, practicality), a car fulfils certain affective and, at least for some people, also symbolic outcomes (Mann & Abraham, 2006; Steg, 2005; Steg, Vlek & Slotegraaf, 2001; see also Anable & Gatersleben, 2005, on the role of instrumental and affective motivations on car use frequency). With regard to the *symbolic* functions of a car, self-expressive and categorical functions (Dittmar, 1992) may be distinguished. *Self-expressive functions* allow people to make a statement about themselves and the values they endorse. For instance, buying a Toyota Prius may symbolize one's pro-environmental attitude, whereas driving an Aston Martin may symbolize one's preference for luxury items and the fact that one can afford them. The latter inevitably serves a *categorical function* in that it indicates that someone who is able to afford a luxury car will likely belong to a high status group (e.g. CEO or VIP). In sum, symbolic or status and identity concerns primarily deal with the question "What does the way I travel say about me?" (Gatersleben, 2007; Steg, 2005).

The three R's

As identified in the work of Pooley et al. (2013), another three important factors that may affect travel mode choice are: (perceived) risk, relatives and reputation. With regard to risk, the major concerns relate to road and child safety. For example, in regions where cycling is not a common travel mode choice (e.g. due to a lack of corresponding facilities), motorists will not be used to dealing with many cyclists on the road, increasing

the potential for accidents. This may subsequently prevent those who have considered switching modes from doing so, while those who still decide to cycle desperately call for improvements in cycling infrastructure. Since children are especially vulnerable in traffic, it is understandable that many parents are reluctant to let their children walk or cycle to school or other activities on their own. Thus, relatives may play a major role in decision-making regarding travel mode choice. After all, rather than co-ordinating a cycle trip with children to school, it is much easier to fasten their seat-belts and just drive them there. But not only children may obscure travel plans. The elderly or disabled may also demand a different choice of travel mode. Finally, the alternative travel mode may suffer a bad reputation (even if it happens to be sustainable!). In the case of cycling or small electric vehicles, for example, people may often feel ridiculed or marginalized when this travel mode is not the norm (e.g. at work), ultimately leading them to give up on their preferred choice or not to switch in the first place.

1.4. Promoting healthy and sustainable travel

In sum, it is now widely recognised that "individual mobility is determined by an interaction of driving factors that are both internal to a person and external. A hierarchy of decisions are made by travellers where decisions at a higher level determine the scope of actions at lower levels" (Gehlert, Dziekan & Gärling, 2013, pp. 19/20). Given these various potential influences on people's daily travel behaviour, promoting sustainable travel, or sustainable behaviour in general, is certainly easier said than done. Nowadays, there is a multitude of existing approaches to this end, some of which (e.g. public commitment or modelling) have been shown to be more effective than others (e.g. feedback or normative information), although the effectiveness of any approach may depend on the context in which it is used (see Abrahamse and Steg, 2013, for a recent meta-analysis). The subsequent section outlines the most common approaches taken to influence people's travel behaviour.

Broadly, interventions can be grouped into two separate clusters – that is, structural or psychological (Graham-Rowe, Skippon, Gardner & Abraham, 2011). Ideally, interventions involve a combination of both approaches (Steg & Vlek, 2009).

1.4.1. Structural interventions or 'hard measures'

Structural interventions focus on discouraging the use of unsustainable travel modes (especially the car) through changes in context. These might involve alterations in the physical environment (e.g. bus priority lanes, segregated cycling facilities and speed bumps; Borger & Proost, 2013; Parkin, Wardman & Page, 2008; Sakamoto, Abhayantha & Kubota, 2007), but may also include novel technologies (e.g. electric vehicles or increased fuel efficiency; Hensher, 2008; Sarlioglu et al., 2017), improved service provision (e.g. increased appeal, frequency and reliability of public transport services; Redman et al., 2013) or changes to the legislative environment (e.g. through a carbon tax, congestion charges or other driving restriction policies; Borger & Proost, 2013; Börjesson, Eliasson, Hugosson & Brundell-Freij, 2012; Hensher, 2008; Liu, Hong & Liu, 2016; Peirson & Vickerman, 2008). As such, structural interventions may be implemented on a small scale (e.g. traffic calming of residential neighbourhoods) or broader scale (e.g. urban design) and may vary in their degree of coerciveness (i.e. the extent to which they enforce behaviour change).

As an example, take the introduction of separate cycle paths in a medium-sized city. While this moderately coercive intervention may be welcomed by some (i.e. cyclists), or seen with a degree of indifference by those unaffected (e.g. walkers), it is likely, at least initially, to evoke strong resistance among drivers who may experience some disadvantages as a result of the intervention (e.g. decreased road space, slowing down of traffic). This may especially be the case when there is no or only little understanding regarding the reasons for the implementation of the measures (Gärling, Gärling & Loukopoulos, 2002). Still, in the long run, even drivers may benefit from such an intervention (e.g. when some drivers decide to switch to cycling because of the new cycle paths, reducing overall traffic volume).

However, a problem with some or even most structural interventions such as speed limits or other traffic calming measures is that, as Gärling and Schuitema (2007) add, such "coercive measures may be evaded since they are limited in time and spatial scale" (p. 144). Car use, in particular, has proven extremely resistant to change. One of the reasons for this strong resistance may stem from the sense of freedom and independence that many people gain by owning a car. As mentioned in the beginning, for most people a car is not just a car. It symbolizes a fundamental aspect of their existence which is self-determination (Deci & Ryan, 2000; Ryan & Deci, 2000). Instead of being told, people always have been able to choose *where* they want to go and *how*. In our contemporary world, where people have little influence over political decisions that potentially affect them, people want to retain control in the few areas of life that *are* under their control, "even if it is only possible in the [rather] trivial issues" (Jensen, 1999, p. 31), such as the decision as to whether to own a car or not. It follows that structural interventions, such as speed limits or congestion charges, may be more acceptable when they do not restrict car driver's freedom, compensate for possible negative effects and have a positive and visible impact (e.g. reduced congestion, air pollution and noise; Gärling & Schuitema, 2007). Yet, it may prove difficult to achieve a reduction in car use without some form of restriction. Consequently, Johansson, Heldt and Johansson (2006) suggest that, to decrease levels of car use, the latter needs to become more expensive and less convenient and/or public transport needs to offer a similar level of flexibility as the car (which may be a practical impossibility). It thus seems that structural interventions on their own are unlikely to result in lasting behaviour change or, at least, not without strong opposition.

It thus comes as no surprise that most behaviour change interventions do not solely rely on structural measures. Rather, there is another type of approach that views travel mode choice as malleable through psychological intervention. What this means in practice is outlined below.

1.4.2. Psychological interventions or 'soft measures'

The primary aim of psychological interventions is to promote the regular use of sustainable travel modes (especially cycling and walking) by applying insights gained from psychological research. For instance, instead of attempting to decrease the attractiveness of car travel by imposing structural barriers on drivers (e.g. congestion charges or limiting available parking space), psychological interventions or "soft measures" target people's cognitions (e.g. attitudes, beliefs, values) and/or behaviour (e.g. habits) without directly enforcing change.

Indeed, even very simple measures such as the formation of concrete plans of action or implementation intentions (e.g. “Starting today I will leave home at 7:45am and take bus X at station Y each morning at 8am”) may prompt behaviour change. An illustration is provided by a review of Travel Feedback Programs (TFPs) in Japan by Fujii and Taniguchi (2006). In the studies considered by the authors, TFPs reduced car use and emissions by almost 20% accompanied by an increase in the use of public transport by a staggering 50%. It is noteworthy that the most effective TFPs asked participants to come up with a behavioural plan, suggesting the important role of active involvement in the process on part of the participant. Conducting a meta-analysis of soft policy measures aimed at reducing car use, Möser and Bamberg (2008) found that, taken together, there was a significant reduction in car use and a corresponding increase in the non-car population by 7%. Similarly, Graham-Rowe et al. (2011) suggest that Personalised Travel Planning Interventions (PTPIs) have the potential to reduce the use of unsustainable means of transport. More recent evidence also supports the effectiveness of personal Travel Behaviour Change Programs (TBCPs; García-Garcés, Ruiz & Habib, 2016).

As such, soft measures may be more acceptable to the target audience, yet at the same time may be less effective in achieving behaviour change because change is on a voluntary basis. In a study aimed at reducing private car use, Tertoolen, van Kreveld and Verstraten (1998) provided participants with information and feedback regarding the environmental and financial consequences of their car use and, at the same time, provided information on public transport as an alternative. Moreover, some participants committed themselves to drive less. However, none of the measures had any effect on subsequent car use. Yet, not only were the measures ineffective, but they also tended to evoke psychological reactance (Brehm, 1966) and (cognitive) dissonance-reducing effects (Festinger, 1957). That is, since the car/driving conveys a sense of freedom for many people (Jensen, 1999), car drivers will be motivated to re-establish this freedom once it becomes threatened and will change their attitudes (e.g. downplay the negative environmental consequences of car use or not relating those to their own behaviour) as they continue to drive. Consequently, with regard to car travel, it may be essential to change the ways in which people think about their car.

Acknowledging that the car does have many symbolic and affective functions (Steg, 2005), it is important for people to recognize that there are also other ways in which these needs may be fulfilled. For instance, people may also derive a sense of self-esteem from, and be put into a positive mood by, physical activity from alternative travel modes, such as walking or cycling, and not only from the possession of a car (Pretty et al., 2007). Further encouragement for a mode shift may also come from local initiatives such as “The Big Commuting Challenge” (https://thebigcommute.getmeactive.org.uk) where people can log individual journeys or participate as workplace teams and compete for small rewards, such as cinema tickets, rail or bus passes. Such combinations of intrinsic (competition) and extrinsic motivation (rewards) may help people to try out new alternatives and, ideally, to maintain the desirable behaviour.

One type of psychological interventions, social influence approaches, deserve particular mention because they make use of socially available information.

Social influence

Based in the psychological domain, social influence approaches attempt to influence (environmental) behaviour primarily via normative information (Cialdini, 2001, 2003). Normative information may be particularly effective when the descriptive norm (i.e. what is typically done) suggests that most people engage in the desirable behaviour (e.g. recycling; Schultz, 1999; reusing towels in a hotel; Goldstein, Cialdini & Griskevicius, 2008; or saving energy; Schultz, Nolan, Cialdini, Goldstein & Griskevicius, 2007). A recent meta-analysis conducted by Abrahamse and Steg (2013) suggests that social influence approaches that involve face-to-face interaction may be particularly effective in encouraging pro-environmental behaviours. More specifically, so-called block leader approaches (i.e. volunteers from the same social network who forward information to others), modelling (performing the recommended behaviour so that others can imitate it), and public commitment (committing oneself to behaviour change in a public setting) have all been found to result in significant behaviour change. As the authors argue, other approaches such as the provision of group or socially comparative feedback and the use of social norms in information and feedback may only be moderately effectively, although results may differ depending on the target group.

As indicated earlier, interventions may be most effective when they are tailored to the specific situation of each individual. In practice, however, this is hardly feasible. Yet, individuals also tend to form groups that share certain characteristics and/or values and it is to these groups that interventions might be tailored most effectively.

1.4.3. Identifying travel behaviour segments

As a general rule, we like to think of people and objects in categories because treating each new individual or object that we encounter as a single, separate entity, would be both tedious and time-consuming. This sort of stereotyping in (social) judgment has thus usually been regarded as "a simplification strategy employed by the social perceiver to facilitate her interactions with a complex social environment" (Mackie & Hamilton, 1993, p. 15). When it comes to people, we tend to draw distinctions based on (socio-)demographic characteristics such as age, income/wealth or professions. For instance, we distinguish between young people and old people, the poor and the wealthy, a scientist and a banker. In most cases, these categories are stereotyped to possess particular traits and/or to engage in particular behaviours. Old people, for example, are assumed to move and react more slowly than young people. A banker or politician may be regarded as untrustworthy and wealthy, while the opposite may be true of a primary school teacher or retailer. What is vital about these group stereotypes, which usually contain a kernel of truth, is not their accuracy, but the way they facilitate social interaction and planning. A company selling luxury goods would not try to market their products to low-income groups. Segmenting the population into different groups of people has thus become a popular tool for marketers and policy makers, and has, by now, extended its reach to the realm of (pro-)environmental behaviour (DEFRA, 2008).

Travel behaviour is no exception. Although being aware of the factors which may affect individual mobility is essential, different people will be affected by different combinations of internal and external factors and consequently may choose different travel options. By their nature, different travel modes may fulfil different goals – for instance, a car may provide independence and private space while public transport may be a less comfortable but more sustainable choice; Beirão & Cabral, 2007) – just as

different individuals may hold different goals (e.g. prestige versus protecting the environment). This individual variety in motives in conjunction with variations in local context complicates the promotion of sustainable travel, since "different groups need to be served in different ways to optimise the chance of realising changes in behaviour" (Anable, 2005, p.75), thus rendering a "one-size-fits-all" approach impossible (see also Jensen, 1999). As a result, transportation research has helped to identify distinct clusters of transport users by applying a multitude of travel market segmentation schemes (e.g. Anable, 2005; Diana & Mokhtarian, 2009; Kaufmann, 2000; Prillwitz & Barr, 2011; Pronello & Camusso, 2011) with the most basic distinction being made between transport users into captive and choice users (e.g. Beimborn, Greenwald & Jin, 2003). That is, a broad distinction can be made between those travellers bound to a specific travel mode out of necessity, such as due to a lack of alternatives or lack of resources (hence captive users), and those being able to travel using their desired mode (i.e. choice users). Travel behaviour market segmentations were applied, and thus will be discussed in more depth, in Chapters 3 and 5.

1.5. Conclusion

The present chapter has provided an overview of how people in the UK currently travel, how the status of different travel modes has changed over time and how transport policy has shaped today's travel patterns. Moreover, the chapter has explored potential external and individual factors that may affect travel mode choice, types of interventions that have been applied to promote sustainable travel and the process of travel behaviour market segmentation to tailor interventions to appropriate audiences. There are at least three general lessons that the reader should take away from this review of the literature.

First, sustainable travel behaviour, maybe even more so than other pro-environmental behaviours – for instance, recycling or energy saving, which usually occur in the familiar and controllable realm of the home rather than outside the home – is complex. The potential motives behind people's travel mode choices and preference for the car have been explored in some detail. Still, the variety of personal and external factors that may jointly affect behaviour is overwhelming (Gifford & Nilsson, 2014), rendering any one-size-fits-all strategy optimistic at best. Second, despite our improved understanding of the factors affecting travel mode choice, attempts to influence the latter have not achieved the large scale shifts in behaviour required to truly mitigate its negative impacts. That is, although the importance attributed to car-based mobility may be undergoing change (Hopkins, 2016), today still more than 60% of day-to-day trips in the UK, including a substantial number of short trips, are made by car as a driver or passenger (DfT, 2016). Furthermore, current progress mainly occurs on a technological level (Sarlioglu et al., 2017) rather than behavioural basis, as attempts to attract drivers out of their cars have only been moderately successful (Möser & Bamberg, 2008). Meanwhile, on a societal scale, the glorification of the car continues, as the media tend to emphasise the symbolic and affective aspects of cars (Steg, 2005), although environmental aspects (e.g. harmony with the environment) have gained in importance (Aupers et al., 2012). Third, there are still significant gaps in our understanding of people's travel behaviour which the present work fills by putting forward a novel perspective of the public transport user, adding a novel theoretical basis to segmentation research and studying peoples' perceptions of the urban environment.

Chapter 2: Understanding the public transport (bus) user - A qualitative approach

Introduction – Why focus on public transport users?

"I'd rather go by bus." (Prince Charles)

Chapter 1 has explored how internal and external factors may influence our travel behaviour, especially in relation to car use. Overall, research with the aim to encourage healthy and sustainable travel that has been carried out in previous decades has concentrated mainly on car drivers' motives for car use (Anable, 2005; Anable & Gatersleben, 2005; Gardner & Abraham, 2007; Lois & Lopéz-Sáez, 2009; Steg, 2005) and on how to discourage driving (Gärling & Schuitema, 2007; Graham-Rowe, Skippon, Gardner & Abraham, 2011) while encouraging car drivers to switch to alternative travel modes such as public transportation, cycling or walking (Bergstrom & Magnusson, 2003; Jones, 2008; Mackett, 2001; Monzon, Vega, & Lopez-Lambas, 2011; Pooley et al., 2013; Steg, 2003). Although this preoccupation with car drivers may be justified in the light of the environmental impact of single-occupancy car use and an increasing number of households with at least one car available (14% increase from 2001 to 2011; Office for National Statistics, 2011), this should not mean that public transport mode users are to be neglected. After all, despite public transport being more sustainable than car use in terms of emissions (Lowe, Aytekin & Gereffi, 2009), there still exist greener alternatives (i.e. walking or cycling) that benefit individuals in various ways. Since bus journeys tend to be short, a shift to these alternative travel modes should thus be encouraged, if feasible (Shaw & Gallent, 1999).

(Free) Public transport is frequently seen as *the* solution to car dependence (Cools, Fabbro & Bellemans, 2016; De Witte, Macharis & Mairesse, 2008). Whether public transport is a truly desirable alternative for most travellers, however, has seldom been asked. Bus users have repeatedly been shown to have more negative appraisals of their mode than other mode users (St-Louis, Manaugh, Van Lierop & El-Geneidy, 2014; Thomas & Walker, 2015), often due to stress and boredom caused by waiting times and delays (Gatersleben & Uzzell, 2007). The experience of bus travel has also been shown to be qualitatively distinct from other transport modes, although not necessarily in a positive way. For instance, whereas active travel modes such as walking (not arousing) and cycling (arousing), are usually perceived as pleasant, using the bus is perceived as neither arousing nor pleasant (Gatersleben & Uzzell, 2007) or, in the worst case, unpleasant (Thomas & Walker, 2015). This may be because bus travel requires a different combination of affective, cognitive and physical effort than active travel modes or driving (see Stradling, 2002). For instance, physical effort when using the bus may be associated with walking to the bus stop and having to wait for the bus while either standing or sitting down. Cognitive effort may involve looking for information relevant to one's journey, such as routes, schedules and fares, or monitoring progress of one's journey (e.g. where to get off). Finally, affective effort may arise when worrying about the timeliness or safety of the journey. Bus travel is also dependent on external (i.e. situational) influences beyond the user's control (e.g. cost, availability and quality of bus services). Although desirable from an environmental point of view, promoting shifts to public transport may thus not be particularly desirable from an individual perspective. Rather, like car users, bus users could derive significant personal benefits from a switch to active travel such as better mood and health, in addition to a reduction of any negative environmental impact.

2.1. Study 1 – "It is better to travel well than to arrive." (Buddha): A focus group study of student and staff bus users

While the introductory paragraphs have already hinted at the qualitatively distinct nature of bus travel, the present chapter continues to explore the individual experience of bus travel in comparison to other travel modes and focuses on the factors affecting bus use motivation as suggested by past research on public transportation (see also section 1.3.1. Rational choice models and habit). This short review is then complemented by a case study of University of Bath undergraduate and postgraduate students' motives for choosing the bus and their experiences with bus travel in a university setting, as raised in a series of exploratory focus group discussions. The insights gained from this exploratory study were subsequently used to distinguish an independent sample of bus users into distinct groups with varying mode switching potential (Study 2).

Prior to any attempts at encouraging current bus users to shift towards more active and sustainable modes of travel, it is vital to first get a sense of the nature of bus travel and the factors that make people choose (or not choose) and stay (or not stay) on the bus in the first place. According to popular bus companies, such as the First Group, their services are inexpensive, comfortable and environmentally friendly compared to the private car (see **Figure 7** below). Nevertheless, despite the hassle of "long queues, finding parking spaces and rising petrol costs", currently approximately two thirds of staff members (64%) commute to campus by car regularly either alone or with passengers (UTS 2014/15), mirroring national figures (64% of trips by car; DfT, 2016). At the same time, an equal proportion of students uses the bus (ca. 63%). While bus use may be a necessity for part of this group due to insufficient funds to buy a car or absence of a driver's license, it is difficult to imagine that those are the sole motives for using the bus, especially when active travel is a potential alternative. Similarly, although staff tend to live further away from campus (68% within a 15km radius compared to 95% of students; UTS 2014/15), distance cannot be the sole factor justifying car use. Thus, what is it about the nature of bus travel that makes people choose or not choose the bus, respectively?

Figure 7. Excerpt from the FirstGroup homepage describing the advantages of bus use (http://www.firstbus.co.uk/take-the-bus.html; accessed on May 14, 2015)

In line with the theoretical framework of the thesis, choosing the bus as one's main mode of travel for commuting may be driven by gain goals such as minimising cost, travel time and/or distance to be travelled. However, often there is more to travel mode choice than simple cost-benefit calculations. For instance, in a qualitative study exploring people's attitudes towards public transport and car use in the metropolitan area of Porto (Portugal), Beirão and Cabral (2007) found that, among the rather practical aspects such as cost, travel time and accessibility (e.g. proximity of bus stops), hedonic goals such as the ability to relax, read or talk to other people on the bus are mentioned frequently. Also, many public transport users perceived bus travel as being less stressful than driving (hedonic) and said they enjoy the freedom from any driving responsibilities (see Mann & Abraham, 2006). Although mentioned rarely, the relative environmental friendliness of buses was recognized as an advantage of bus travel as well, reflecting a consideration of normative goals. Among the most prominent negative aspects associated with bus travel were overcrowding, a lack of control or flexibility and long walking or waiting times, indicating a potential for conflict between gain and hedonic versus normative goals.

With public transit (PT) in general, a factor that may be of particular importance appears to be the predictability of one's trip. For instance, Evans, Wener and Phillips (2002) found that rail line commuters who perceived their commute as less predictable, were more likely to experience stress as indicated both by self-report on a standardized commuting stress scale and psycho-physiological measures (elevated salivary cortisol levels). Conversely, in a study where participants were informed that trip time variability was greater for the car, the preference for car use decreased (López-Sáez, Lois & Morales, 2016). Negative experiences such as delays or overcrowding may also play an important role in choosing PT. Those may be especially memorable when using PT for the first time. For example, Schmitt, Currie and Delbosc (2013) found that respondents of a university access survey (N = 285) remembered their first public transit trip as significantly more negative than their overall evaluation of public transit. Especially problems related to the ease of navigation (finding one's way around), ticketing and navigation of transfer were pronounced. Nevertheless, more than half of respondents (58%) continued to use public transport afterwards on a regular basis, suggesting they may have overcome the initially negative experiences with the previously unfamiliar travel by transit.

As previous research has shown (Anable, 2005; Jensen, 1999), it may be assumed that there is some variation in motives for using the bus, ranging from using the bus out of necessity to cost-benefit calculations or environmental concern. In order to explore these motives within the context of a university setting, the aim of the following study was to explore students' motives for using the bus by means of a qualitative research approach (here: a series of focus group discussions). Qualitative research has gained popularity in transportation research (e.g. Beirão & Cabral, 2007; Gardner & Abraham, 2007; Jensen, 1999; Mann & Abraham, 2006; Thomas, Walker & Musselwhite, 2014) as it enables the exploration and analysis of individuals' experiences and accounts of everyday phenomena which can be moulded into theories and constructs aimed at describing and explaining social-psychological issues and behaviour (Barbour, 2007). Focus groups, in particular, are frequently conducted within the exploratory phase of a research project and are often part of mixed methods approaches (Barbour, 2007), as in the current research project. The advantage of this qualitative study design rests in its unique ability to elicit people's individual perceptions and explanations of their behaviour and their (emotional) experiences with and views about the behaviour in question (here: why they have chosen the bus as their main transport mode). Moreover, interaction between the focus group members enabled the identification of commonly held, but also divergent, views regarding bus use for the commute to campus.

2.1.1. Method

Participants

Potential focus group participants were approached by the researcher directly on campus or at the bus terminal located on campus and were invited to take part in one of the focus group discussions. The study was also advertised repeatedly online on the University noticeboard and with flyers attached to pin boards on various campus locations. First-year Psychology students were able to sign-up for the study using the university's research participation pool and received two credits for participation. Remaining participants took part in the group discussions voluntarily. Focus groups only went ahead when a minimum of three participants were present. Refreshments and snacks were provided in each session. The final sample of bus users consisted almost exclusively of university students (undergraduate, N = 8, and postgraduate, N = 7) and only two members of staff. Consequently, no firm conclusions could be drawn about the experiences of staff commuting to campus, whose bus use experience might differ from those of students. In total, five focus group discussions (11 female, 6 male) were held, lasting 31.3 minutes on average (see **Table 1** for the demographics of each group). The study received full ethical approval from the Psychology Ethics Committee of the University of Bath (reference number 14-028).

Group	Group size	Age range	Gender	Duration (min.)
Focus group 1	4	21-30	1 Male, 3 Female	30:44
Focus group 2	3	27-XX*	1 Male, 2 Female	43:36
Focus group 3	3	19-28	3 Female	23:29
Focus group 4	4	19-20	3 Male, 1 Female	20:00
Focus group 5	3	25-26	1 Male, 2 Female	39:37

*Table 1. Demographic information and duration of each focus group *One participant did not disclose age information*

Materials

A participant information sheet outlining the course of the focus group discussion, as well as an informed consent form were handed out to each participant before the start of the focus group discussion. At the end of the discussion, participants were provided with a debriefing sheet explaining the purpose and larger context of the study. The focus group discussions were recorded (audio only) using a Zoom H1 Handy Recorder and were transcribed manually on a computer.

An interview protocol was designed to tap onto different aspects of the bus use experience and was used to guide focus group sessions if discussion came to a halt or had lost focus. In the beginning, participants were asked to introduce themselves and also to describe their typical bus journey to and/or from the university campus (Question 1). This was done to encourage them to talk about their bus use experience and their motives for using the bus in a non-directive fashion. Question 2 was designed to encourage further discussion about the positive and negative instrumental (e.g. cost, time and reliability) and affective aspects (e.g. comfort, effort and relaxation) of bus use identified in the

literature (Beirão & Cabral, 2007; Rubens, Gosling & Moch, 2011; Stradling, 2002). Questions 3 and 4 explored participants' awareness and use of alternative modes of transport focusing on participants' own behaviour (Question 3) and giving advice to others (Question 4). The latter question was intended to give participants the opportunity to distance themselves from their own travel behaviour and thus to give advice from a more objective point of view. Finally, focus group participants were asked to think about potential improvements to the bus services in Question 5 and to give a concise overall evaluation of their bus use experience in three words (Question 6).

1) *General bus use*
   Could you please describe your typical bus journey?
2) *Affective experiences*
   What are the positive and what are the negative aspects of your typical bus trip?
3) *Practical aspects*
   If you could, for some reason, not take the bus to university, how would you come to university instead?
4) *Advice for newcomers*
   What advice would you give new students at the University of Bath on how to travel to campus?
5) *Improvement of bus services*
   What measures could bus companies take to improve your journey experience?
6) *Overall evaluation*
   If you had to describe your overall experience with the local bus services in three words, what would those be?

Procedure

When all participants had arrived and given their consent to participate, the researcher introduced himself and shortly outlined the purpose and course of the focus group discussion. Before starting the discussion, participants were asked to come up with a false name serving as pseudonym for their real name, so as to ensure the anonymity of participants' responses. After that, the researcher turned on the recording device and the actual focus group discussion began. First, participants were asked to openly describe their usual bus journey to campus. Unless discussion had already resulted from this initial open phase, the questions from the interview protocol were used to generate discussion. The wording of the questions differed slightly from participant to participant in response to their own answers and experiences. Each question was allowed a maximum of ten minutes for discussion. Following a nondirective approach (Stewart, Shamdasani & Rook, 2007), focus group participants were encouraged to share their experiences and to challenge each other's views on the topic, with as little interference by the researcher as possible. Overall, focus groups lasted between 20 and 45 minutes. After the group discussion, students were given the debriefing sheet and thanked for their participation. The researcher stayed available in the room for questions.

Analysis

There is a vast array of qualitative data analysis techniques available to Social Science researchers, ranging from those approaches that subscribe to a particular theoretical standpoint, such as **Conversation Analysis** (CA; Clayman & Gill, 2004) or **Grounded Theory** (GT; Corbin & Strauss, 1990; Glaser & Strauss, 1967), to approaches that are rather theory independent, such as **Thematic Analysis** (TA; Braun & Clarke, 2006). The former usually make specific assumptions about the nature of conversation

and follow strict guidelines for analysis, although variations of any given method may exist. Further qualitative analysis techniques including **Discourse Analysis** (Potter, 1997), which emphasizes the use of language to produce certain kinds of effect (e.g. when trying to convince others of our account of a certain event), and **Narrative Analysis** (Riessman, 1993), which attempts to elicit a coherent narrative of participants with a particular focus on temporal continuity in their lives, are available. Like CA or GT, these methods make specific assumptions about the process of data collection, the nature of collected data, epistemology and the coding process, but also offer unique insights into the subject.

Various qualitative approaches have been applied in transportation research including **Grounded Theory** (GT; Glaser & Strauss, 1967) which, as the name implies, is concerned with the specification of a substantive (specific context, low level of abstraction) or formal (no specific context, high level of abstraction) theory that is 'grounded' in qualitative data (Bryman, 2012). For an example of the application of GT to travel behaviour, see Gardner and Abraham (2007) or Thomas, Walker and Musselwhite (2014). As a similar approach to GT, **Interpretative Phenomenological Analysis** or **IPA** (e.g. Smith, Jarman, & Osborn, 1999; Smith & Osborn, 2003) is also concerned with the identification of themes in the data (i.e. ideas, thoughts or feelings that are mentioned repeatedly by participants and thus may be of particular importance to them), although the primary goal does not involve theory development. IPA assumes that "through careful and explicit interpretative methodology, it becomes possible to access an individual's cognitive inner world" (Biggerstaff & Thompson, 2008, p. 215). In other words, the researcher attempts to understand how subjects make sense of specific life events ranging from taking a swim in the sea to the loss of a loved one (Smith, Flowers & Larkin, 2009). As such, IPA is often employed in healthcare settings (Biggerstaff &Thompson, 2008), although like GT, it has been used in the context of travel mode choice (e.g. Mann & Abraham, 2006) as well. For the present study, TA has been chosen for data analysis.

Thematic Analysis

An influential paper by Braun and Clarke (2006) has lifted the status of **Thematic Analysis** (TA) from a vaguely defined to a proper scientific approach to qualitative data analysis. Although TA does not offer an entirely new approach, it differs from other approaches in its theoretical rationale and its applicability. Like GT (Glaser & Strauss, 1967) or IPA (Smith & Osborn, 2003), TA (Braun & Clarke, 2006) is concerned with the identification of patterns in the data. However, unlike GT or other approaches, TA is not bound by any theoretical rationale, making it a more flexible approach. More specifically, TA can position itself at any point along the continuum of essentialism (i.e. experiences and meanings comprise people's reality) versus constructionism (i.e. experiences and meanings are created in social discourse; Bryman, 2012). In line with the critical realist ontological position adopted throughout the thesis, a midpoint 'contextualist' theoretical position was thus assumed which recognizes reality as being subjective to the individual's experience (here: the individual's experience with bus travel to campus) and responsive to social influences (e.g. publicly held views of bus services) and thus questions our ability to gain objective knowledge of reality from these accounts. After all, the common bus use experience is inherently subjective, despite objectively measurable indicators such as the level of crowdedness or the adherence to time schedules. So, while participants' accounts may reflect some of this objective reality, they still only scratch on the surface of reality as participants do not possess full awareness of all the influences on their stated attitudes.

Taking an inductive (data-driven) approach, the goal of the focus groups was to provide a rich description of students' (and staff's) experience of and motives for bus travel to and from the University of Bath. The analysis of data occurred in line with the

authors six-step guide to TA (Braun & Clarke, 2006; also Nowell, Norris, White & Moules, 2017). That is, first, focus group discussions were transcribed and familiarization with the data was achieved through a thorough re-reading of the transcripts. In the second phase, participants' statements were given initial codes or labels by the researcher, paying equal attention to each data item. Rather than using a published framework, initial codes were generated using a data-driven, bottom-up approach. The coding process itself consisted of scrutinizing the text line by line for any noticeable patterns, repetitions, indigenous typologies or categories (i.e. local or colloquial terms), metaphors and analogies, as well as similarities and differences between codes throughout the text (see Ryan & Bernard, 2003). As suggested by Ryan and Bernard (2003), specific attention was also paid to the occurrence of transitions (i.e. shifts in content), linguistic connectors (e.g. "because" or "rather than"), and omissions or missing data (e.g. themes that have been identified in previous research, yet were not mentioned in the current study).

In the third phase, underlying themes (i.e. specific aspects related to the topic under investigation that are mentioned repeatedly and/or by different participants) were identified by combining matching codes, using a semantic approach (i.e. no attributions were made as to the underlying or hidden dimensions of meaning beyond participants' verbal statements). Hereby, it quickly became clear that emerging themes would overlap with past literature on common attitudes towards public transportation (e.g. Beirão & Cabral, 2007). The fourth step involved reviewing the themes extracted in Phase 3, while making a distinction between major and sub-themes. A frequency count of the observed occurrence of each (sub-)theme across focus groups was added to determine the relative commonality of each theme in the data. As there was huge variation between groups regarding which themes were focal in discussion, the frequency of occurrence of themes across all focus groups was preferred as commonality measure rather than identifying the number of people who referred to each theme (also due to the low overall sample size). When all themes and sub-themes appeared to be saturated, themes were defined and given labels (Step 5). A 'thematic map' (i.e. a depiction of all the themes and sub-themes derived from coding) was created and themes in the map were refined and eventually renamed to more accurately reflect their content. In the last step (Step 6), the final analysis and writing up of the results were carried out, using quotes for illustration.

2.1.2. Results

In general, there was wide agreement on the most salient features of the local bus services in Bath as well as the journey experience itself. The three major themes, as suggested by their high degree of recurrence across focus groups, appeared to focus on the instrumental, affective and cognitive aspects of using the bus (*N* = 248; **Figure 8**), alternative travel modes (*N* = 218; **Figure 9**) and participants' perceptions of bus drivers and companies (*N* = 76; **Figure 10**). Themes surrounding instrumental and affective aspects often went hand in hand, with instrumental aspects (e.g. unreliability) often giving rise to specific (primarily negative) affective consequences (e.g. frustration), mirroring the concept of "affect-utility integration" as coined by Mann and Abraham (2006). Instrumental aspects were comprised of several sub-themes including travel time, frequency, location, space and cost. Cognitive aspects (e.g. information seeking or day planning activities), albeit distinctive, only surfaced seldom. Alternatives to using the bus – that is, walking, cycling, driving or taking a taxi/car-sharing – comprised the second major theme and were frequently commented on in response to Questions 3 and 4 (see Materials in Section 2.1.1.). Finally, perceptions of the behaviour of bus drivers and service providers emerged as an additional theme, as is illustrated below.

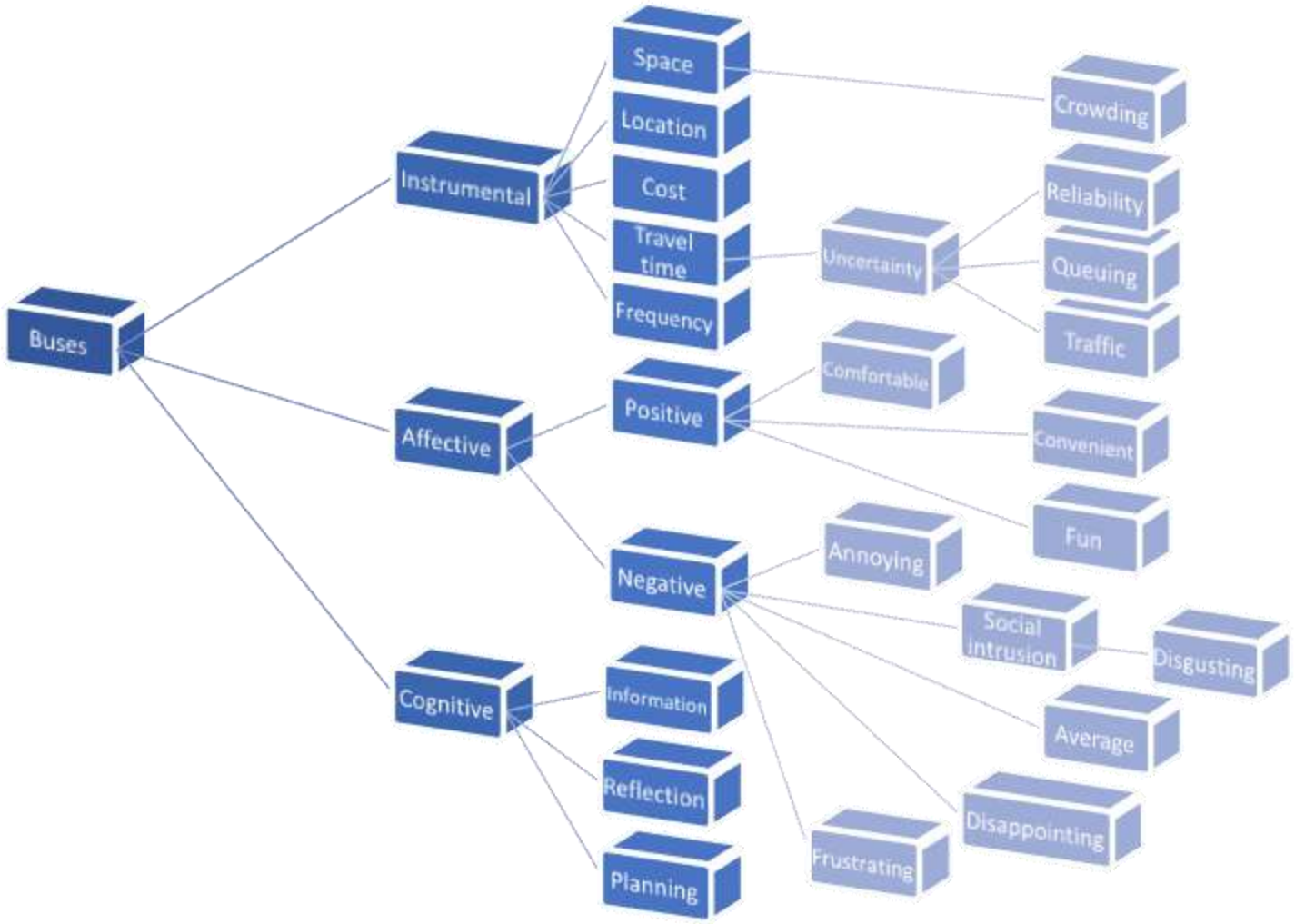


Figure 8. Thematic map summarizing core themes of bus travel as mentioned in the focus group discussions

Instrumental aspects (Theme occurrence: 170 times)

Instrumental aspects were most frequently mentioned in relation to travel time (especially reliability), the frequency and cost of service, location (i.e. the difference between trying to get on the bus at bus stops located at earlier versus later points of the bus route), and space issues (crowding). Themes including travel time and space were especially likely to be mentioned in relation to peak hours. Often, dissatisfaction with instrumental aspects, gave rise to a host of negative emotions. Each theme (including sub-themes) is considered in turn below.

Travel time (Theme occurrence: 88 times)

In general, (door-to-door) travel time was perceived as too long, compared to the ideal bus journey experience. Agatha (f, FG 2, Q501-506) compared the duration of the bus journey to a long text that no one bothers to read and that could easily be summed up in one sentence:

So, the actual…you know…it's actually not a long…it's not a long journey, but it takes you too long. You know, it's like an e-mail that you read and then you are really, really happy if someone says "Too long did not read" and sums it up in one sentence. That's what it feels. The journey itself is this one sentence, but you have to read 20, 30 pages in order to get to the point. If that makes any sense.

On occasion, it would even be possible to outrun the bus during peak hours. As stated by Pancho (28m, FG 1, Q34-37) regarding his experience with travel time:

[…] whenever I'm late in the morning and turns out you take more time to take the bus then you would have just…to normally when you run up. Because I live in the city centre, so it takes me like 20 minutes, honest. Sometimes a little bit less if I got a good sleep."

Travel time also involved a great deal of uncertainty and was seen to be influenced by various factors, notably the reliability of bus services as well as waiting times caused by queuing or traffic. These issues were considered to be particularly pronounced during peak hours throughout term time.

Reliability. Generally, the local bus services to and from the University of Bath were not perceived to be reliable. Christina (27f, FG 2, Q78/79), for instance, asserted that the bus service tends to be "late or earlier, but it's never on time". This, in turn, would pose a major obstacle to the predictability of travel and arrival times. As an example, Mary reported having given up on trying to catch buses at certain times "because it just makes me really angry when they're not there" (26f, FG5, Q551/552). A similar point was made by Anna (27f, FG 1, Q86-90):

I don't know if any of them are more regular than others. It just seems like they're not that well 'spaced out'. It's not like they keep to a timetable. So, sometimes you'll have two come at once and then you wait ages for the next one. So, if you just happen to get there at the wrong time, you just missed the [name of a local bus company] one. You might have to wait for ages for the next one.

Queuing. Participants talked about how, with many students queuing, buses would fill up quickly, leaving those for whom no space was left on the bus waiting for the next bus (or even buses) to take them to university. Sam (m, FG4, Q151-153) mentioned how the duration of the bus journey may become unpredictable as "you're not sure how long the queue is going to be and how long you'll be waiting". Mary (26f, FG5, Q220-222)

was especially upset with waiting in the queue to the point of walking back home instead of taking the bus:

It takes forever. Like just getting off of campus…like, you know, at this intersection there…you just queue there for like half an hour…it makes me so angry. That's why I walk back.

Often queuing itself evoked strong negative reactions among participants, because they felt it made the bus journey less comfortable. Jess (30f, FG1, Q19-20), for instance, described the situation of long waiting times in the queue and the prospect of not getting a seat and having to stand for the entire bus journey as "really horrendous". It appeared to them that there was no avoiding the queues either, as described by Samantha (27f), FG3, Q202-204) who tried to get the bus at an earlier bus stop:

I pick it up in front of [uhm] the bus station because that's closer to Oldfield Park. So, that's when it first kind of picks up and there's less people on it. But even then the queue is like all the way down, you know.

Traffic. Another, uncontrollable, obstacle to timely arrival was seen in traffic. Pancho (28m, FG1, Q215-217) described how getting stuck in traffic could further delay the bus ride:

Sometimes it's traffic, even if the bus is on time. There's just traffic down at the hill or on that little street which is…and then…the one that crosses the bridge. Sometimes it gets so busy, you're just stuck there and…

Frequency (Theme occurrence: 48 times)

Consensus also emerged regarding the frequency of service. In particular, bus companies were seen as incapable of coping with the heavy demand at peak hours. Jo (21f, FG1, Q303-306), for instance, remarked that

…at peak hours that's when…there should be more buses because, so between let's say nine and eleven, that's when most…the majority of students will get on and yet there only seems to be a few buses that will take students up to the university.

In order to cope with the high student numbers, Christina (27f, FG2, Q75-78) described how "they [the bus drivers] try to fit lots of people in one bus". The lesser frequency of service at weekends was also regarded as an area for improvement, as "it seems like, at the weekends, you have to wait like 20 minutes for the…or if not longer, if it [the bus]'s not really on time (Laura, f, FG4, Q56-59).

Yet, again, not all participants agreed. A number of participants saw the bus services as frequent enough. Laura (f, FG4, Q216) thought that "Generally, in the morning, they do seem to have a good number of buses". Likewise, Brian (26m, FG5, Q44/45) also found the buses to be "quite frequent" and said that he "actually find[s] them okay". However, having the bus turn up did not necessarily guarantee that one would be able to board it, as illustrated in a comment by Agatha (f, FG2, Q45-47):

Because it's funny for me, it's a bus every five minutes approximately. But, still, I can't get on and stand there for 40 to…40 minutes to one hour. This is ridiculous. [laughter] People getting annoyed behind me in the queue.

Location (Theme occurrence: 8 times)

Furthermore, in trying to get on the bus, the location turned out to be important. As Agatha (f, FG2, Q31-37) explained her situation:

…getting on the bus doesn't just depend on the point of time of the day or the weekday as such. It also depends on where you are trying to get on the bus. So, from trying to do this at the Abbey, say, it doesn't almost matter at what time of day I'm standing there or what weekday. I see five to six, maybe seven, buses, be it 18 or U18 or 18B go past. Whereas if I go to the bus station [one stop before the Abbey], I get in pretty quickly. So, I usually just take the five to seven extra minutes walking and then go from the bus station, if I can.

Thus, it would be easier for people to get on the bus at earlier stops along the bus route, putting those who want to get on the bus at a later stop at a disadvantage. As another example, Tracy (22f, FG3, Q181-183) talked about the difficulty of keeping to time schedules, having no "guarantee that your bus is gonna to stop to pick you up". This often led to frustration due to perceived unfairness.

Christina (27f, FG2, Q403-405) and Mary (26f, FG5, Q398-400) also talked about their (negative) experience of trying to get on the bus in different locations. Mary's case, specifically, illustrates how a simple change in location can significantly change one's chances of boarding.

…and you have to wait at the abbey, you have to wait at Bathwick Hill [the last stop before the university; located at the bottom of the hill] and it's the same…And the people at Bathwick Hill have to wait more than 40 minutes because it's…I have waited more than ten buses…So, it's very annoying and quite frustrating.

Yeah, I mean…at one point, I just made the effort to go the train station, but that was like a 25 minute walk from my home…so, it was quite annoying, but yeah. But lucky, I got…now I got a stop before the train station, so I'm alright. But, it does seem very unfair.

Space (Theme occurrence: 10 times)

Another frequently mentioned issue concerned the capacity of buses. Crowding at peak hours was perceived as one of the main problems and significantly contributed to the overall rather negative experience of bus travel. Jo (21f, FG1, Q10-12) expressed the capacity issue in the morning as an "absolute nightmare" and told the group that sometimes she would have to take a taxi, simply because the buses were so "damn packed" with students. Negative feelings were mainly associated with the intrusion of intimate space by others. While discussing being on the bus with other students, Nelly (25f, FG5, Q278) described her disgust referring to how it feels "like you're breathing in their breath". Agatha (f, FG2, Q269-272) and Mary (26f, FG5, Q275-277) shared similar experiences involving the intrusion of personal space:

…people are touching your front and your back side at the same time because sometimes it is really crowded like this. Even if you put your bag down, someone is always…or for example…someone is always brushing your back and trying to rush through.

Oh my god…they are running these really small buses at the moment. Like two days in a row, I've been stuck in this tiny, tiny, tiny bus with the same amount of people as normally. Oh, it's disgusting. [You] got like people like all over you…

Cost (Theme occurrence: 16 times)

Bus services (especially single tickets) were seen as being too expensive by some focus group participants. Anna (27f, FG1, Q72/74) voiced how she "hate[s] paying £1.50 for a single" and that "it just feels like such a rip-off". Similarly, Jo (21f, FG1, Q53/54) found the ticket price exaggerated since "it [the bus trip] is just up the hill". However, most participants were actually satisfied with the prices, especially due to the availability of return tickets and multi-journey passes (i.e. bus tickets granting up to 20 journeys at a reduced fare). Anna (f, FG3, Q82/83) said she was "quite satisfied with the buses" and that "the prices are okay, the return tickets as well". Jimmy (m, FG4, Q85) also found the prices to be "acceptable" or "reasonable". One participant (Falsy, m, FG2, Q128) also mentioned the possibility of public transport being "cheaper than the other [means of] transport". Multiple-journey tickets were clearly in favour as stated by Mary (26f, FG5, Q128/129) and Jess (30f, FG1, Q59-62):

It's only like 80p for a single from my place if you get a twenty…twenty journey ticket.

I think it's a good thing that they offer the multi-journey passes because if I'm travelling by train every day and need to get the bus at the other end, obviously, it adds costs to my commute. But I've bought like fifteen-journey passes whatever and it…it significantly reduces the cost of each journey.

Affective aspects (Theme occurrence: 66 times)

Affective reactions to the bus services became particularly apparent when focus group members were asked to describe their experiences with the local bus services in three words.

Anna (27f, FG1, Q355/356) and Christina (27f, FG2, Q495/497/499) expressed their disfavour with the buses by using words such as frustrating, annoying or disappointing.

My first two would be frustrating and disappointing. Not sure about the third one. Probably just…annoying.

Cold […] I've been so cold waiting. […] And frustration as well. I'm afraid…frustration is one of my big words.

However, there was also a general sense of annoyance, dislike and mediocrity regarding the bus services, as Jess (30f, FG1, Q366-368) expressed with her three chosen words.

I'd go expensive, annoying and average. And by average I mean an average experience. I don't find it terrible, but I don't find it great either. But also average in that I lived in another city for eight years and it's no different…it's the same wherever you go.

Nelly (25f, FG5, Q635-637, 639) burst out with a much stronger negative reaction:

I have nothing positive to say about the bus service, but they exist. That's the most positive thing I can say about the bus service…that there is one. Not that it's any good. […] I hate buses. I hate it…I hate public transport anyway.

Most of the time, negative reactions were evoked by poor service provision, such as unreliable and/or infrequent service causing long waiting times, queues and overcrowded buses. Jimmy (m, FG4, Q148-149) described the experience of walking to the bus stop only to "see the buses pass through" as "very painful" and how he would

"get mad of it". Referring to the crowding issue, Brian (26m, FG5, Q627-629) added that often "you just don't know how many people are gonna fill the bus up. Is it gonna be less people, is it gonna be none, is it gonna so much that you, like, can't breathe. Is it gonna be a journey from hell or is [it] gonna be a pleasant journey back". Finally, Agatha (f, FG2, Q113-116) talked about how the bus journey "doesn't make [her] feel good in terms of people" because, although she likes to engage in "people watching", she "rarely get[s] to talk" with other students on the bus.

However, not all the reactions were purely negative. Some aspects, especially comfort and convenience, were seen as positive or even regarded as fun. In a short exchange between Anna and Jo in FG1 (Q48-50), for instance, Jo initially agreed with Anna that she couldn't think of any positive aspects of the bus services, but subsequently admitted the convenience of taking the bus.

Anna: *I can't think of any good aspects. [laughs]*
Jo: *I know. Well, it is convenient. It's there if you need it and sometimes in…like later on in the day, it's fine. It gets you from A to B.*

Pancho (28m, FG1, Q203-206, 240-243), too, talked about the comfort of taking the bus and having the opportunity to engage in various activities while sitting or standing on the bus.

Because it is…it is…comfortable, to be honest. You can get on the bus and you can just read, or do anything whatever you want, just text or listen to music and it's comfortable to get on the bus and just get up to Uni. I won't deny it. It is. [laughter]…Well, if you got a seat, you just play around, I guess…like also with the phone…just see the news or some messages or whatever…music…[uhm] and even when you're standing up, you still…you still…find it quite fun, entertaining to stabilize yourself.

Cognitive aspects (Theme occurrence: 12 times)

Apart from listening to music or playing with one's smartphone, time spent on the bus was regarded as an opportunity to structure the day ahead or simply to "let [one's] mind wander", as illustrated in the following exchange between Tracy (22f, FG3, Q233/235) and Samantha (27f, FG3, Q236):

Researcher: *When you're…when you're on the bus, what kind of things do you do? How do you spend your time? Is it just…I don't know…boring or…*
Tracy: *Focused…*
Samantha: *Sitting on the bus…you can steal the bus [laugh] I don't know…*
Anna: *[Uhm] I play with my phone…or listen to music.*
Samantha: *Yeah, I mean, I just play with my phone or just…*
Tracy: *Let my mind wander.*
Samantha: *Yeah, exactly.*
Tracy: *Think about what I'm meant to be doing.*
Samantha: *Yeah, that's exactly what I do, yeah…or check my e-mail. [Inaudible]*

Problems with information gathering became apparent for infrequent bus users and were especially related to knowledge about the availability of multiple-journey tickets. Both Jess (30f, FG1, Q77-81) and Nelly (25f, FG5, Q132) did not learn about the existence of the latter until they accidentally came across this information.

Again, that's another negative. When I started working here, I tried to find the information by the bus companies to work out what my commute would be, if I took the job, things like that. And I didn't know about any of these bus passes until I hear people on the bus saying that I've got…some sort of…you know…fifteen journey pass. And then I asked the bus driver to get one.

I just found out about that [multiple-journey tickets]…and I'm like two and a half years living here.

Solutions to the peak hour problem (Theme occurrence: 14 times)

Several options in order to circumvent or solve the peak hour problem were mentioned, some of which included actions that could be performed by the participants themselves and others that could be implemented by the bus companies or university. Regarding the former, Mary's (26f, FG5, Q324-327) advice, for instance, was to "get twenty-journey tickets for each bus company" so that "You don't have to wait for a specific bus". While this may be one option to avoid the hassle with the buses at peak times, Anna (27f, FG1, Q25-27) preferred "trying to get on the bus before eight o'clock in the morning just to try and avoid some of the rush".

Agatha (f, FG2, Q192-197) described another way of adjusting to the peak hour problem that she learned from her students:

I have students and I was wondering why they were staying late after the tutorial and they were like "Well, I can't get home fast anyways. I'd have to queue, so I can as well spend the time and talk to you for another 15 minutes or 20, [uhm] because I…I would stand in the queue any way. So, I'm just gonna spend my time doing something nice…or helpful, in terms of studying".

Yet another alternative was not taking the bus at all. Pancho (28m, FG1, Q214/215) was convinced that sometimes "it's quicker to either walk up or run up, or walk down, than it is than when you get on the bus". Similarly, Falsy (m, FG2, Q132/133, 135), on occasion, would avoid taking the bus when under time pressure, even if that would incur a high financial cost. As he states, "…when I'm really out of time…I sometimes take [uhm] a taxi from my home to here. […] the times are the same, but the money, you know…that's much".

Apart from these self-initiated actions, alternative solutions to the peak hour problem that could be implemented by the bus companies (or university) were mentioned as well. Regarding the bus companies, for instance, the introduction of different on- versus off-peak prices was suggested, so that "everybody will change their, you know, working way" (Falsy, m, FG2, Q357-359). Another suggestion was the introduction of new bus routes with extra buses for certain locations, such as "one empty bus for the Abby people, one empty bus for Bathwick hill, one empty bus for the bus station, another empty bus for Oldfield Park" (Christina, 27f, FG2, Q397-401), to avoid having buses fill up at previous bus stops and disadvantaging those boarding at later stops along the bus route. A feedback mechanism allowing customers to "report when a bus hasn't come for ages" was proposed by Laura, although she admitted this "doesn't necessarily mean the bus will come any faster" (FG4, Q218-221). Finally, Agatha (f, FG2, Q386-393, 395/396) and Mary (26f, FG5, Q506/507) regarded the scheduling of classes and lectures as an opportunity for the university to take action.

[…] there is a crunching time for certain lectures taking place…within the core times each day. So, the nine o'clock one, ten o'clock one. I do think it is a lot of effort to co-ordinate that in the first place… within the Uni. So, I'm suggesting this carefully, being aware of all the problems that are connected to it and maybe the non-feasibility. But, if you could try to figure out a way to have a look at the student-strong lectures or courses and then try to come up with a way to tilt that maybe…to kind of work out a balance…that not the majority of Bath Uni students would have to go to campus at the same time. But trying to even that out. […] hypothetically, it could be a good idea to look into this.

Perhaps if they started a little bit later than nine, then you wouldn't catch the traffic of people who actually come in [at] nine.

Alternative travel modes and multi-modality/journey-splitting (218 times)

Answers to the questions "If you could, for some reason, not take the bus to university, how would you come to university instead?" and "What advice would you give new students at the University of Bath on how to travel to campus?" often stimulated discussion of alternative travel modes – that is, walking, cycling, driving by car or getting a taxi. The core themes and sub-themes revolving around these alternatives are outlined below (see also **Figure 9**).

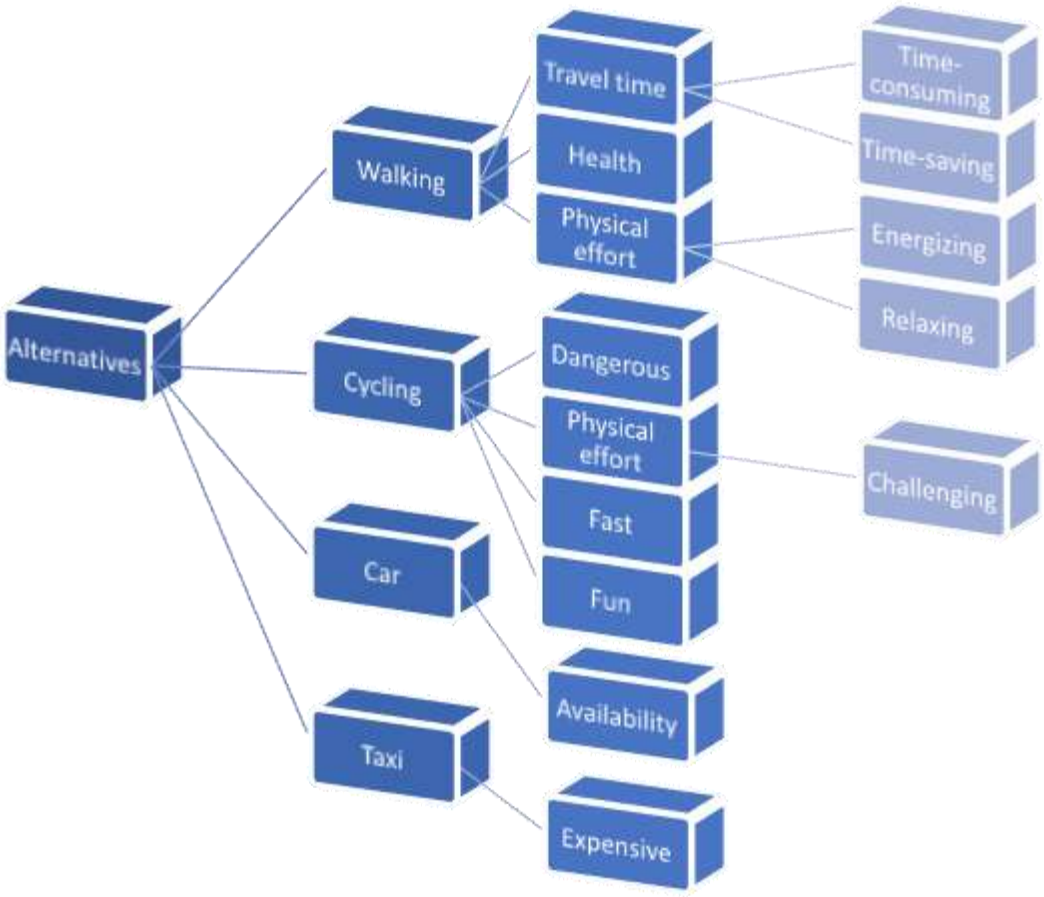


Figure 9. Thematic map summarizing core themes of alternative travel modes as mentioned in the focus group discussions

Walking (Theme occurrence: 160 times)

Walking was mentioned as the most popular alternative or complementary mode to the bus services. As an example, Pancho (28m, FG1, Q31) told the group "I prefer honestly to run up". Anna (27f, FG1, Q124-126) and Agatha (f, FG2, Q176/177) also reported walking occasionally (or frequently in the case of Agatha) for at least one way of their journey.

…if there was no bus service I would walk up. And that'd probably take me about 45 minutes…to walk from where I live in the city centre. So, it's doable. I do it every now and then.

I usually take the bus to Uni, but I walk home…if that makes a difference.

Walking was seen as "a good way for relaxing and keep[ing] healthy" (Falsy, m, FG2, Q210-211), yet, at the same time, was also seen as potentially energizing (helping to combat morning tiredness) and time-saving, as Pancho (28m, FG1, Q196-201) remembered from his experience with walking to campus:

You've already done exercise, you got up and you're ready to start the day. I would strongly advise them to do that. I don't know, you just get more awake to your lectures, whatever it is that you need to do. When you walk back, you just kind of, it allows you to relax and leave everything like back here at Uni. And by the time you get home, you're like really relaxed...just like home and enjoy. Plus the fresh air helps, just to calm down.

However, the constraints of walking (e.g. carrying clothes or equipment, physical effort and travel time) were recognized as well. Jo (21f, FG1, Q50-52) was especially concerned about the physical effort required to walk *up* the hill and paid her respect to the people walking up:

To walk up that hill, I don't know how you run. I really…I take my hat off, too. It's hard. So, you know, walking down the hill, now that's fine.

In an exchange between Mary and Nelly (FG5, Q310-316), consensus emerged that walking up the hill is "doable". However, both disliked how walking up the hill would make one "feel sweaty and disgusting" before even having started the working day and that one needs time to recover from the walk.

Nelly: *And also, the hill is not too bad, actually, to walk up. Cause I walked up to mine.*
Mary: *Yeah, it's doable.*
Nelly: *It's doable. It's just you don't feel very nice at the end of it.*
Mary: *No, exactly. Like you feel sweaty and disgusting and you still need to start your working day.*
Nelly: *You need to have like a good 15 minutes to be like a normal person.*

Even Pancho (28m, FG1, Q31-34), who reported walking regularly, admitted "The days I don't do it [walk to university] is when we have a very important meeting or a company is visiting and you have to dress smart and you don't wanna put in your bag all the like [uh] shoes and extra clothes that you have to bring along". Samantha (27f, FG3, Q34/35) didn't deny the possibility of walking, but explained that she didn't walk because "it would take me a while". A similar point was made by Jess (30f, FG1, Q117-120) who needs to cover the way from the train station to campus. In response to the question what she would do if there was no bus service available, she replied that she would rather drive the entire journey instead of combining a trip by train with walking to campus.

If there was no bus…I…I think because…where I live I already walk up in order to get to the train station, then I got 15 minutes on the train, to add an extra 40 minutes to the walk. I just wouldn't be able to do it. It would be too long every day. So, I drive.

Cycling (Theme occurrence: 42 times)

While there was some agreement on the possibility of walking, cycling was hardly considered as an alternative to using the bus with the physical effort of cycling up the hill to university being mentioned as the major obstacle. Anna and Jess both denied cycling on these grounds and both talked about the additional *external* constraints such as not being allowed to leave the bicycle in communal areas or getting the bicycle on the train (FG 1, Q 136-147).

Anna: *I think I wouldn't cycle, partly because I think it would be too much hard work to cycle up the hill. But also [uhm] because I live in [uhm] like a building that's been [inaudible] to flats. You're not allowed to keep bikes in communal areas and I live on the top floor. So, I would have to carry my bike up like 5 [inaudible] stairs…So, this can't really help like…not really an option.*

Jess: *Yeah, same for me. Cycling up that hill. Just…I don't know…if I tried, let alone every day. But as well for me, there is the issue of getting the bike on the train because, obviously, I come by train. There's space to take bikes on the train, but I think they only let a few bikes on. I've actually seen people trying to get on, with the bike, and not being allowed. So, that would be an issue for me…yeah… [pause] And also I don't know if there'd be anywhere you can shower or change. If you bike and got really sweaty, is it? I mean, I don't know, I'm not aware of that, but…*

Participants agreed that road safety concerns may also prevent people from choosing the bicycle as their main transport mode for the commute to university. Mary, being used to cycling in her home country, shared how she missed cycling, but was quickly reminded by Nelly, who preferred to travel to campus in her "big metal car", about the risks of cycling in Bath and the non-suitability of cycling as anything other than a leisure pursuit (FG 5, Q 243-250):

Mary: *I really miss cycling.*

Nelly: *Yeah, but…have you seen how fast they go down? Like I saw a cyclist set up a road thing that was flashing. They were fucking nailing it…it was without reckon…they were nailing it down there. It was terrifying. And it…I just saying, you know, I can…I can go downhill and feel okay because I'm in this big metal car. You've got buckle protection. If you can't, you're gonna kill yourself?*

Mary: *Yeah, it's not extremely safe, is it?*

Nelly: *No…you can do nice bikes round the canal though.*

Similarly, Jo (21f, FG1, Q155-157) felt that cycling would make her feel unsafe:

I go spinning, but that's as far as it goes. And plus with spinning, you can stop. Whereas if you are going up that hill, it's like 'aaah'. [laughter] Do you know? If there's cars behind you, it's just like 'Oh my god, I'm gonna die!' [laughter]

Nevertheless, for some cycling may remain an option because of its instrumental (e.g. speed) and affective (fun, enjoyment) qualities. Pancho (28m, FG1, Q129-134), who used to cycle before his bike was broken, admitted that cycling up the hill can be "quite challenging", but also that "It's fun taking it down" and practical, since it's "so fast " and "you get home in 5 minutes, something like that". Reminiscing about his cycling

memories, Pancho said he "would consider it [cycling] again", if he had his bicycle back. Tracy (22f, FG3, Q126-128), despite not cycling herself, told the group that she knew "lots of people who live in Oldfield Park and [they] cycle because the queues for the buses are so long". Like Pancho, Tracy recognized the striking advantage that cyclists may have compared to public transport "because they can be on campus before buses even got to the stop".

Other motorized transport (Theme occurrence: 16 times)

Some participants also mentioned the car, car-pooling or taking a taxi as options. In contrast to walking or cycling, driving (alone or with passengers) was always perceived as an alternative to getting the bus. Jess (30f, FG1, Q116) claimed that she "would have no choice but to drive" if there was no bus service to campus. Similarly, Tracy (22f, FG3, Q132-134) admitted that walking back (not up) may be an alternative "if you just live [like] a mile down the road". However, she also thought that "If you got a car, drive!". To Nelly (25f, FG5, Q134-137), the cost of parking was a reason *for* driving and *against* taking the bus, while she did not consider the costs of driving more broadly:

But for me like…I don't know…I can drive on to campus cheaper than I can even I get a single. So, it'll cost me one pound ten…to park. And if I were just to get a single, it's gonna cost me 1.50…at least. So, to me…it's…I…I see driving as the better option.

If there was no bus service, having a car available, Agatha (f, FG2, Q148/151) said she would "try to set up a park and ride or kind of a community car thingy" with some of her colleagues that live close by, thus making the best use of her car's capacity. Finally, Falsy (m, FG2, Q132-135) reported taking a taxi "when I'm really out of time", despite the high cost.

Perceptions of bus drivers and their companies (Theme occurrence: 76 times)

In discussing the performance of the bus services, a few aspects regarding the behaviour of drivers and the bus companies emerged as well (see **Figure 10**).

The behaviour of bus drivers (Theme occurrence: 45 times)

The behaviour of the bus drivers turned out to be both a source of positive and negative affect. In general, however, most drivers were seen as "quite nice" (Christina, 27f, FG2, Q74/75) and negative reactions were primarily associated with bus drivers' not stopping or letting students wait, as is illustrated in the following excerpt (FG4, Q172-179, 197-201):

Laura: *I understand they got to take their break sometimes, but I don't understand why, sometimes, they stop just before you're going to Oldfield…around the corner. And also, here, they sometimes like sit with door closed and they could let you on, and then…*

Sam: *And sometimes, when we were just running towards the bus and then they just close the door and they…but they wouldn't let you in. It's just like…they're about to go and then you finally arrive at the bus stop, just right outside the door, but they don't let you in…just…just go away.*

Jimmy: *Sometimes they need to improve the driver's attitude. Like, I remember one time, the driver is not in a good mood, and I just tell him my friend's coming. Like he's*

running to the bus stop, so he arrive[s] like in 20 seconds…something, but the driver just…closed the door and…yeah…and drive[s] away.

A similar experience was reported by Nelly (25f, FG5, Q85-90), who was annoyed with bus drivers letting students wait to board, especially during the coldest time of year:

I've seen people [bus drivers] do like...they were using their phones and stuff like that…and…it really annoyed me when, in the winter, they wouldn't let you on. So, you're standing there in the fucking cold and they won't let you on for whatever reason and you just stand there, outside in the cold, in the freezing cold and they wouldn't let you on to the buses. And they're just sitting there, reading the newspaper.

Only few participants reported incidences of other "bad" behaviour, such as Jess's (30f, FG1, Q283-289) experience with a bus driver who let queue jumpers board before others:

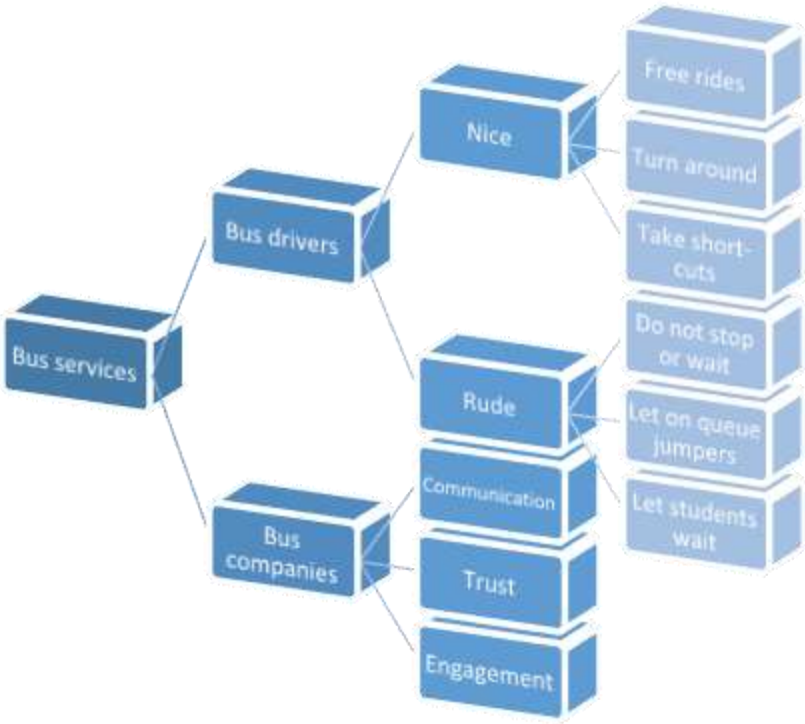


Figure 10. Thematic map summarizing core themes of bus drivers and their companies

I [have] been queuing to get the bus from work to the train station and I been queuing on campus for like half an hour for a bus to turn up. […] And then just as people are starting to go on, these people at the back, jumping the queue…getting on…and I tell the bus driver "Don't let them on, they just jumped from the back of the queue" while others…people in the front…had been waiting for half an hour and he still let them on. So, I had a bit of an argument with the bus driver.

Positive reactions were often associated with bus drivers occasionally letting students get on the bus free of charge, as reported by Jimmy (m, FG4, Q160/161), or taking short-cuts when the bus was full (Laura, f, FG4, Q 191-193; see below). Again, further particular instances of positive behaviours were mentioned (Christina, 27f, FG2, Q406-410).

[Uh] They have been quite friendly and…yeah…just…we talked about…sometimes they say "Just jump into the bus" and they don't cost you anything, yeah.

And then, 'cause I know in town sometimes they like…go against…it's no right turn as well and sometimes they do turn right, but that's quite good 'cause then it gets you to Uni quicker, if the bus is full.

[…] the Bugler one…the yellow one…and sometimes the Uni connect…they turn. If I'm waiting at Bathwick Hill…they…if they're coming empty…like going down empty…they turn in the roundabout and they kind of collect everyone that has been waiting there for hours…well, not hours but…long time because all the other buses from the previous bus stops were full…

The bus companies (Theme occurrence: 31 times)

Regarding the bus companies, some participants perceived a lack of communication between the companies and their customers, paired with a lack of trust in the companies' efforts to improve the current services. Agatha (f, FG2, Q318/319, 321-324) described how there was "a leaky pipeline in terms of communication" between the bus companies and their customers:

[…] because I've never seen how they actually access or evaluate the problem. I've never been asked. […] I didn't even get a questionnaire or anything. Might have been that it was before I started here, 'cause I've not been here for a while. But [uhm], you know, there seems to be a leaky pipeline in terms of communication, if you can put it like this. At least if feels like it.

Falsy (m) accused the bus companies of responding to a complaint about a bus that did not turn up with clearly false information (FG2, Q54-57, 60) and that the bus companies have no real interest in improving their services (FG 2, Q 332-334):

The main problem is…I just mentioned…that sometimes it [the bus] is delayed for half an hour and sometimes it just disappears for the whole hour…I don't know where it goes. And when we were trying to argue that to [company name] and they said that "No, every bus is on schedule!" […] But everybody knows that it [the service] doesn't [run normally]. […] They just want to make money because it doesn't give them any benefit from [uhm] improving. 'We're just taking money and [uh]…we're just doing some transport thing and that's it. I don't really care about what you guys are thinking.'

In contrast, some participants – including Tracy (22f, FG3, Q76-80), Agatha (f, FG2, Q342/343 and Samantha (27f, FG3, Q253-255) – acknowledged the bus companies' awareness of persisting issues with the current service and their efforts aimed at improving services:

[…] it is a shame that there are still so many complaints. But, I think, the companies are very cautious with the fact that…they know it's a problem. And they are trying to deal with it because you do see like press releases coming out about how they have made note of the fact that there's a problem. I think that's quite a good thing. That they acknowledge there is a problem and they are trying to solve it.

I'm just wondering what else this…the…the bus companies could do. Because, you know, as I've said, I see buses go by every five minutes. What more can you do?

The thing is, they just get a beating every year. Do you know what I mean? So…and when I came here in my first year, it was…it was pretty bad. And now, it's just like…it's getting better. So, we shouldn't complain.

2.1.3. Discussion

With the goal of exploring perceptions of and experiences with using the bus services to the University of Bath campus, five focus group studies with primarily student volunteers were held. The primary aim of these focus groups was to elicit the reasons behind students' choice of the bus as their main mode of travel to and from the University of Bath campus and to lay the foundation for Study 2 aimed at identifying particular subgroups of bus users with varying mode switching potential. To this end, students were encouraged to discuss their motives for bus use and the various positive and/or negative aspects they experienced with that mode. A qualitative approach for this study was taken to avoid bias through giving respondents pre-defined questions. By openly discussing their bus use experiences in a focus group, participants were able to focus only on those aspects of bus travel that mattered to them personally. Focus group transcripts were analysed using thematic analysis and the first major theme indicated a broad distinction into affective, cognitive and instrumental aspects, with affective reactions frequently being triggered by the bus company's performance on instrumental aspects, such as cost and reliability. Two further major themes focused on alternative modes of travel, especially walking, and perceptions of bus drivers and companies. Themes are revisited below and discussed with reference to existing literature.

Instrumental aspects. According to Stradling (2002), unreliable public transport places a heavy demand on 'cost considerations (saving money), instrumental journey needs (saving time), and psychological needs (saving effort)' (p. 27). Indeed, in the current study, a very similar pattern of findings emerged. First and foremost, the frequency and unreliability of the bus services, as well as the resulting (long) waiting times and time uncertainty, were identified as major issues by the focus group participants. The local bus companies were perceived as being unable to deal effectively with the high student demand at peak hours (primarily due to a perceived lack of buses) and bus timetables were perceived as being largely inaccurate. These results mirror the findings of earlier studies stressing the importance of perceived travel time variability and reliability as determinants of transport mode choice and satisfaction (e.g. see Beirão & Cabral, 2007; López-Sáez, Lois & Morales, 2016; Redman, Friman, Gärling & Hartig, 2013). In addition, the location of the bus stop at which participants would try to get on the bus emerged as a decisive factor in the present study. However, it was not the proximity of the bus stop itself (i.e. access; e.g. Redman et al., 2013), but rather the point along the bus route at which the bus stop was located (earlier vs. later), that was considered as important. That is, participants reported that they were particularly annoyed and frustrated by the long waiting times caused by buses filling up at earlier bus stops and resulting queues at their own bus stop. Indeed, as previous research has shown, pre-process waiting (i.e. before boarding the bus) may be a source of negative affect (Friman, 2010) and lead to negative evaluations of the bus as transport mode (Stradling, Noble, Carreno, Jeffrey, & Marshall, 2004). In terms of monetary cost, the pricing of bus tickets was seen as adequate (e.g. bus passes, multi-journey passes), although single rides were dismissed as too expensive.

Affective aspects. Affective reactions to the bus services were frequently or mostly related to utility aspects of the services, such as the frequency and reliability of service (i.e. 'affect-utility integration' as suggested by Mann & Abraham, 2006). For instance, unreliability causing long waiting times led to frustration and disappointment with the services. Overall, however, apart from the annoying instrumental aspects associated with the bus services (i.e. frequency, reliability, etc.), most focus groups participants evaluated the bus journey itself as a rather average experience. As one participant summarized, "I don't find it terrible, but I don't find it great either." This

points to the relative affective neutrality (with a somewhat negative connotation) of bus travel that has been shown in previous research (e.g. Gatersleben & Uzzell, 2007; Stradling, Carreno, Rye & Noble, 2007; Thomas & Walker, 2015). Based on Russell's circumplex model of affect (Russell, 1980; see Yik, Russell & Steiger, 2011, for an updated version), which characterises dimensions of core affect according to level of arousal (activated/deactivated) and pleasantness (pleasant/unpleasant), bus travel may primarily be perceived as unpleasant and not arousing (i.e. boring or depressing; Gatersleben & Uzzell, 2007) or as unpleasant and arousing (i.e. intrusive arousal; Stradling et al, 2007). However, participants acknowledged that travelling by bus may also fulfil certain instrumental (saving time) and psychological (saving effort) needs, as suggested by Stradling (2002). More specifically, the bus was regarded as a comfortable and convenient means of transport 'to save your time and energy', greatly reducing travel time compared to walking (at least for more distant locations) and allowing for a range of activities, including browsing the internet or social networks, listening to music, people watching, reading or texting.

Cognitive aspects. Time spent on the bus does not have to be wasted time. As some participants mentioned, it can provide an opportunity for reflection and organizing one's day. As for any other activities that are performed on the bus, this advantage of bus travel may likely stem from the freedom of any driving responsibilities (Beirão & Cabral, 2007; Jensen, 1999). Actual cognitive effort involved in finding information about the bus services were only reported by two participants. In particular, these participants (both described themselves as infrequent bus users) were unaware of bus companies' offers such as multiple-journey tickets which, according to them, should be advertised better.

Alternative travel modes. Walking, cycling, car-sharing and driving were all mentioned as potential alternatives to the bus, with walking being the most prominent answer. Generally, the physical effort of walking or cycling up the hill to university was seen as a major barrier to mode switching, although the potential benefits of both modes were acknowledged. Both means of transport were seen as a good way to avoid the hassle of using the bus (e.g. due to unreliability or queuing), although differences between the two modes were perceived as well. That is, in the case of cycling, focus group participants emphasised benefits related to physical exercise and speed (e.g. Gatersleben & Appleton, 2007), while with walking the benefits were seen in its potential for health (Pooley et al., 2011) and relaxation (Gatersleben & Uzzell, 2007). However, cycling was also seen as too dangerous (in line with public discourse on cycling; e.g. Rissel et al., 2010) and walking as too time-consuming, making these modes less attractive as an alternative. Consequently, many participants appeared to "choose" the bus out of necessity rather than due to an innate passion for using that mode (Jensen, 1999).

Bus drivers and companies. As part of the bus travel experience, bus drivers' behaviour could have both a positive or negative impact. Positive behaviours were associated with bus drivers being friendly and ignoring rules – for instance, letting students on the bus free of charge; taking a shorter route when the bus is full or turning around to pick students up from the bottom of the hill and driving them to university. Negative behaviours were associated with bus drivers being unfriendly, taking breaks during service times, braking sharply, letting queue jumpers on the bus or not waiting for students running to the bus stop. An equally mixed picture emerged for the bus companies. On the one hand, the bus companies were seen as untrustworthy, mainly due to the discrepancy between their actual and promised service reliability. Also, one participant viewed the bus companies as solely driven by financial concerns and not interested in improving services. Another participant pointed to general communication problems with persisting issues with the services not being communicated adequately to

the bus companies. These findings suggest that bus companies might benefit from a closer involvement with their customers, notably the malcontented ones. On the other hand, a few participants acknowledged the bus companies' awareness of service weaknesses (e.g. service provision at peak times) and their efforts at improving services (e.g. an increased number of buses).

Missing aspects. No pressing concerns were mentioned with regard to self-image or the environment (e.g. Rubens, Gosling & Moch, 2011; Stradling, Carreno, Rye & Noble, 2007). Due to the small sample size and unequal share of staff vs student participants, however, it is difficult to generalize these findings to the entire population of student and staff bus users. With regard to self-image, students may be less concerned than (academic) staff because of their generally low socio-economic status (SES). As other students tend to come from similar backgrounds and also rely on the bus (UTS 2014/15), there may be little need for social comparisons (Festinger, 1954) at this stage of their lives. Similarly, environmental concerns were only mentioned by one participant and generally absent from focus groups discussions. This may not necessarily reflect a lack of concern, however, as buses may be generally perceived as sustainable (Haraldsson, Folkesson, Saxe & Alvfors, 2006). Moreover, It may well be that people who have such concerns are already using a sustainable travel mode (i.e. walking or cycling) to begin with and thus do not belong to the population of bus users in the first place. Finally, in none of the discussions habit emerged as a theme. This may be because not all participants were habitual bus users or because, at least for the regular bus users, bus travel may have become so habitual that they simply ignored this aspect.

Strengths and weaknesses

One obvious limitation of the current findings is that they are based on a small sample size. Three of the focus groups included merely three participants and although several focus groups were conducted, in total only 17 participants took part in the discussions. Nevertheless, the findings across groups were highly consistent and there is some consensus that even small focus groups may produce useful qualitative data (see Gill, Stewart, Treasure & Chadwick, 2008; Lupton, 1996; Peek & Fothergill, 2009). Another caveat relates to the potential underreporting of social and symbolic influences on behaviour compared to practical considerations (Steg et al., 2001). Participants may have been unaware of any normative influences on their bus use behaviour (as bus use is the norm for students) and may have been reluctant to discuss symbolic aspects due to social desirability concerns (e.g. not expressing a preference for the car). Participants may also have recalled experiences in a biased way. There are also some concerns about the generalizability of findings to other settings or locations. The environment of the City of Bath may be rather distinctive with its steep hill stretching out to campus and a profound lack of cycling infrastructure, creating barriers for alternative, active travel modes (walking and cycling) that may not be present or as extreme in other locations. Consequently, there may be more bus users out of necessity in Bath compared to other contexts. Finally, in the present study, mostly students taking the bus to university were considered, thus limiting the generalizability of the findings to staff members, bus users in general or other public transit users (e.g. train). Yet the overlap of the themes that were identified, suggested significant overlap with earlier research (Beirão & Cabral, 2007).

Another limitation concerns the subjectivity of the themes drawn from the data. Although care was taken to consider multiple viewpoints, it is possible that another researcher coding the same transcripts would have arrived at (somewhat) different themes. In a similar vein, as with qualitative research in general, it may be difficult to replicate the current findings due to the specific nature of the individuals being studied.

Different focus group participants might have mentioned different concerns with bus travel and, consequently, different or additional themes might have been extracted from the data. Even the same individuals might have mentioned different concerns at different points in time due to changes in the immediate context or surroundings. That is, although the physical environment may remain relatively stable (e.g. it is fairly unlikely that Bathwick hill will disappear all of a sudden), changes in context may occur (e.g. improved bus services, changes in environmental awareness or improved cycling and walking facilities) that could alter individuals' perceptions and (travel) behaviour in the long term.

Implications

The insights gained from the focus group sessions are valuable for at least two reasons. First, the focus groups discussions confirmed a basic underlying relationship between the positive and negative, instrumental and affective, aspects of bus travel (i.e. affect-utility integration; Mann & Abraham, 2006). Common negative instrumental aspects of bus use (e.g. long waiting times or queuing, crowded buses, and delays due to either bus drivers' behaviour or traffic; Beirão & Cabral, 2007), in particular, often resulted in a host of negative affective reactions (anger, frustration etc.). However, in spite of frustration and annoyance about these aspects, students continued using the bus on a regular basis, even when walking (or cycling) would have been feasible. This suggests a lack of perceived behavioural control (Ajzen, 1991) among students who partly ascribed responsibility for change to the bus companies rather than altering their own behaviour. Any potential cognitive dissonance (Festinger, 1957) among participants, which might be expected when behaviour (taking the bus) and beliefs (bus travel is annoying/frustrating) conflict, suggests that bus use may also have been strongly habitualised. In line with this, there was no evidence of behaviour change regarding bus travel, yet rather some degree of rationalization of participants' bus use (*Well, it is convenient…It gets you from A to B)*.

It should be noted, though, that some participants showed a high degree of multi-modality or journey-splitting in their travel behaviour. That is, a few students reported walking frequently for at least one way of their journey (usually from the university campus to their home), which is desirable from both an environmental and health-focused perspective. In general, however, it is likely that the positive utility of using the bus may have been outweighing the negative affective experience. Indeed, not all aspects of bus travel were perceived negatively. The major advantages of bus travel were seen in its convenience and comfort (see also Redman et al., 2013) when compared to alternative travel modes, such as walking or cycling. In addition, time for activities such as chatting, listening to music or reading on the bus, appeared to make the bus journey more endurable (at least while sitting down).

Second, being aware of the link between instrumental aspects and affective outcomes, the issues raised in the focus group sessions may also be of considerable interest to operating bus companies whose interest lies in further improving the quality of their services. Important areas for improvement, as identified by the participants, are the frequency (especially in the weekends) as well as reliability (keeping to timetables) of the service, representing two aspects of public transport that are crucial to customer satisfaction (Beirão & Cabral, 2007; Redman, Friman, Gärling & Hartig, 2013). In addition, pleasant bus shelters (Pizzato, Guimarães & Ten Caten, 2012) and displays of real-time travel information (Dziekan & Kottenhoff, 2007) could reduce perceived waiting times significantly, thus increasing satisfaction with the service (in fact, the latter have now been added in some locations). Further improvements, such as a closer involvement with customers (customer feedback), reduced prices for single tickets and new bus routes, may help to increase satisfaction with the bus journey.

Future research

Although a vast array of research has been conducted on how to attract drivers out of their cars (e.g. Gärling & Schuitema, 2007; Mackett, 2001; Monzon, Vega & Lopez-Lambas, 2011; Tertoolen, van Kreveld and Verstraten, 1998) and on how to promote or improve public transport (e.g. Friman, 2010; Pizzato, Guimarães & Ten Caten, 2012; Redman et al., 2013; Stradling, 2002), little or no research has been conducted on how to attract unhappy bus users out of buses. Obviously, private car use has a much higher impact on the environment and congestion than bus use (Lowe, Aytekin & Gereffi, 2009). This should not mean, however, that bus users should be neglected, especially when truly sustainable and active alternatives like walking or cycling are feasible. The current study thus calls to attention that, as with car users, there may also be a considerable number of 'malcontented bus users' (borrowing from Anable's 2005 terminology) or public transport users of necessity (Jensen, 1999). However, little is known about why those who are dissatisfied with public transport stick with this mode when alternative choices are feasible. Certainly, aspects such as disability, distance to be travelled and, by implication, travel time, are limiting factors when it comes to the choice of walking or cycling. However, beyond these factors, when walking or cycling *is* feasible, it is unclear which factor or combination of factors prevents dissatisfied users from switching modes.

Habit, despite its absence from the focus group discussions, may be a likely explanation, as it may prevent the acquisition of information about available alternatives (e.g. looking for a walking or cycling route; Verplanken, Aarts & Van Knippenberg, 1997). In addition, concerns with self-image or identity and safety might put off many malcontented users from attempting a mode switch, despite knowledge about the positive environmental and health benefits of walking and cycling. Future research should further explore these factors and how they prevent dissatisfied transport users from alternating travel modes in more detail.

2.1.4. Conclusion

The results of the present study have highlighted several issues with the local bus services, ranging from disgruntlement about crowded buses at peak times to frustration and annoyance about unreliable or infrequent service. Although individual variation in bus use behaviour and satisfaction became apparent, for most the bus journey appeared to be an average experience at best. Importantly, compared to cycling or walking up to campus, the bus was regarded as a convenient alternative, even if, with the former, the daily hassles of using the bus might be avoided. In spite of some focus group participants expressing the desire to travel more actively and sustainably, this desire was easily overshadowed by the various barriers perceived to hinder the uptake of regular walking or cycling to campus, such as the hilly environment, physical exhaustion (e.g. sweating) or safety concerns (e.g. cycling on the road). Some of these (perceived) barriers may be dealt with by changing perceptions (e.g. first-hand experience of walking or cycling up the hill), others by changing the physical environment (e.g. off-road or segregated cycle paths). In addition, the differing attitudes regarding the local bus services suggest that behaviour change interventions may need to be targeted at specific individuals. At this point, however, it is not obvious as to who those individuals might be. Identifying different types of bus users with varying mode switching potential, using suitable statements made in the focus groups discussions, was thus the objective of Study 2, which is presented in the following chapter.

Chapter 3: “Daily Drags” and “Wannabe Walkers” – A travel behaviour market segmentation analysis of public transport users

Introduction – A new perspective of the public transport user

The results of the previous study (Study 1) have shed light on how bus travel may be experienced in a university setting. Consensus emerged regarding some of the unpleasant instrumental aspects of taking the bus, such as overcrowded buses and unreliable services, yet also regarding positive aspects such as convenience or the ability to engage in activities, such as reading or chatting, when on the bus. Having identified the factors that may contribute to the daily bus use experience, the aim of the current study was to use this information to identify coherent subgroups of bus users who might easily be tempted to walk or cycle instead. That is, as suggested in Study 1, despite buses being more sustainable than cars in terms of per capita emissions (Lowe, Aytekin & Gereffi, 2009), and despite bus users getting more exercise than drivers (Besser & Dannenberg, 2005), there still exist more sustainable and healthier (Audrey, Procter & Cooper, 2014; Oja, Vuori & Paronen, 1998) alternatives – walking and bicycling – onto which a subset of journeys could legitimately be transferred. This is not only the case in Bath where, as will be shown, bus journeys tend to be short, but also applies to the rest of the UK where bus journeys are less than 4 miles (6.4km) on average (Statista, 2015). Consequently, after years of efforts to attract people from cars to public transport (Jain, Aggarwal, Kumar, Singhal & Sharma, 2014; Redman et al., 2013; Rosli et al., 2012), there are a couple of reasons that reconsidering the motives for bus use might be timely.

First, given the aforementioned issues with population health, mass transit use cannot be the only end-goal for population travel-change interventions, and for some trips, we might more appropriately view bus use as an intermediate goal between car use and active travel. In fact, it has been estimated that increasing levels of active travel in urban England and Wales could reduce the prevalence of common diseases, such as diabetes or heart disease, to such an extent that it might reduce costs to the NHS by up to £17 billion (based on 2010 prices) within 20 years (Jarrett et al., 2012). It was therefore always going to be necessary, sooner or later, to consider how a transition from public transport to active travel can be made for a certain subset of journeys. Second, from the perspective of the individual traveller, there might be good reasons to switch to more active forms of travel, especially taking into account that people may easily be dissatisfied with the public transport options in their area (Thomas, Walker & Musselwhite, 2014). As the focus group discussions have revealed, public transport service provision to the University of Bath campus tends to suffer from inadequate reliability and frequency, poor bus driver behaviour and overcrowding issues. It is thus not surprising that, apart from the obvious environmental and health benefits of active travel, more recent evidence has further supported claims that active commuters tend to be more satisfied than both drivers and especially public transport users (Olson et al., 2013; St-Louis et al., 2014; Thomas & Walker, 2015), providing further justification for encouraging mode shifts in this direction. However, before corresponding steps can be taken, a suitable target group needs to be identified. To this end, an attitudinal travel behaviour market segmentation was deemed as an appropriate tool for the identification of distinct subgroups of users and was applied with an independent sample of staff and student bus users.

3.1. Study 2 – “Everybody's journey is individual.” (James A. Baldwin) - Identifying distinct mobility types of bus users

(For the published version of this study please see Bösehans & Walker, 2016)

Earlier travel market segmentation schemes have mostly focused on drivers versus public transport users (Anable, 2005; Cools, Moons, Janssens & Wets, 2009; Jensen, 1999; Kaufmann, 2000), cyclists (Bergstrom & Magnusson, 2003; Dill & McNeil, 2013; Gatersleben & Haddad; 2010; Li, Wang, Yang & Ragland, 2013) or have taken a broader, more inclusive, approach incorporating several or no specific travel modes (Diana & Mokhtarian, 2009; Jacques, Manaugh & El-Geneidy, 2013; Pronello & Camusso, 2011). However, in terms of travel market segmentations to date, little empirical work has been carried out with an exclusive focus on the public transport user. And even in cases where such research has been carried out – see, for instance, Krizek & El-Geneidy’s, 2007, research on transit users or Tarigan, Susilo & Joewono’s, 2014, research on paratransit users in Indonesia – the focus has usually been on identifying service factors that may increase the attractiveness of public transport to current (non-)users (see also Pronello & Rappazzo, 2010) or identifying gender differences (Beirão & Cabral, 2008). Attitudinal travel market segmentations that distinguish public transport (bus) users not solely based on their valuation of service attributes, but also on their affective and overall journey experience, seem to be lacking. Similarly, there appears to exist a gap in the literature on how to encourage alternatives to the use of public transportation for short trips (especially those under 3km), especially when regular users are dissatisfied with the services provided (i.e. captive or malcontented users or ‘public transport users of necessity’; Jensen 1999) and when healthier and more sustainable alternatives may be preferable. There are at least two possible explanations for this omission.

First, from an environmental perspective, public transport (bus, light rail, train etc.) is commonly regarded as a fairly sustainable transport choice, although this is not necessarily the case. In fact, the reduced emissions advantage of a single deck bus, for instance, only becomes apparent with increasing patronage since, at base level (i.e. no passengers), a bus may emit up to four to ten times more emissions when compared to a medium-sized car (Lowe, Aytekin & Gereffi, 2009; Potter, 2003). In university settings, this may especially pose a problem during off-peak and non-term periods, when patronage tends to be low. Nevertheless, in contrast to the car, buses are seen as a cheap and environmentally friendly travel mode (e.g. Rubens, Gosling & Moch, 2011) and hence bus users may not be perceived to require as much attention as car drivers in terms of mode switching potential, even if walking or cycling would be feasible and desirable. As a result, identifying peoples’ motives for using the bus beyond the simplified distinction of captive versus choice user (e.g. consider Anable’s, 2005, ‘Car-less Crusaders’ versus ‘Reluctant Riders’) may have been regarded as unnecessary, although exceptions do exist (e.g. Jensen’s, 1999, Public transport users of the heart, convenience or necessity).

Second, from an economic perspective, just as the potential to attract drivers out of their cars runs against the economic interest of car manufacturers, so does the potential to attract people out of buses run against the economic interest of bus companies whose interest lies in attracting as well as retaining a solid customer base. It should be noted, however, that encouraging walking or cycling instead of using public transport does not necessarily have to run counter the interests of service providers because relieving some of the strain on the public transport system might actually improve (perceived) service quality (e.g. due to less crowded buses at peak times), which in turn might attract current non-riders.

With these environmental and economic aspects of public transport in mind, it is easy to see why the focus in the public transportation sector has been on improving service quality by determining the factors that are related to customer satisfaction (Beirão & Cabral, 2007, 2009; Friman, 2010; Krizek & El-Geneidy, 2007; Redman et al., 2013; Stradling, 2002) rather than on finding ways to get people off the bus for short trips. The current segmentation study is thus meant to fill a gap in the literature by focusing exclusively on bus users' motives, not with the goal to increase bus ridership, but with the goal to determine the factors that may motivate current users to change their travel behaviour into more active and sustainable ways (e.g. by increasing their multimodality or through a permanent change in travel mode).

What to expect based on segmentation research to date

At the most basic level, a distinction between captive and choice users or 'adapters' may be drawn (e.g. Tarigan et al., 2014). Whereas captive public transport (PT) users tend to be dissatisfied with service provision and are bound to their current travel mode because they have no feasible alternative available to them (for instance, an older person who does not possess the resources to purchase a car or lacks the ability to drive), choice users, on the other hand, do have different alternatives available to them and simply choose the one that best fits their current needs (for instance, a choice user may take the bus when it is the most convenient alternative for him or her). Although certainly accurate, the captive-choice user distinction fails to differentiate between the different psychological motivations that people may have for using public transport, some of which may be conscious, such as environmental concern, or unconscious in nature, such as social norms. However, based on travel market segmentation research that actually has included such motivations (e.g. Anable, 2005; Jacques et al., 2013; Jensen, 1999), it can be expected that bus users will fall into one of at least four different mobility classes (see **Table 2** below):

PT users of the heart or 'Car-less Crusaders'	Enjoy using the bus Environmental concerns
PT users of convenience	Especially value low effort and comfort
Utilitarianists	Prioritize *cost and time efficiency*
PT users of necessity or 'Reluctant Riders'	Represent captive mode users

Table 2. Types of public transport users based on past research

This theoretical approach offers an intuitive answer to the mobility types that may prevail among students and staff commuting to the University of Bath and among bus users more generally. This is not to say, however, that the distinctions offered by Jensen (1999) and others (Anable, 2005; Jacques, Manaugh & El-Geneidy, 2013) are exhaustive. For that reason, the current study takes an exploratory approach that may or may not converge with this previous work. In the focus group sessions (Study 1), some key aspects with the potential to distinguish bus users have already been mentioned (mainly related to the affective reactions to bad service and certain aspects of the bus journey) and those will be implemented in the current segmentation study. Many insights from earlier segmentation schemes will also be useful in this respect, although a more unifying framework, such as Goal framing theory (Lindenberg & Steg, 2007) may be needed (more on this in Chapter 5).

3.1.1. Method

Participants

Students and staff members of the University of Bath were invited to complete an online survey about their views on and experiences with using the bus services to and/or from campus. As an incentive to take part, potential respondents were informed about the possibility to enter a price draw for a £50 Amazon voucher after completing the survey. The survey was accessible for approximately four weeks (14th of May until 15th of June 2014) and advertised through various means. In collaboration with the university's student union (Bath SU), the survey was shared on social networks (Facebook and Twitter). In addition, repeated ads were put on the university's noticeboard and, for the last week of data collection (i.e. 9th to 15th of June), the questionnaire was added to the "Participate in projects page" (a freely accessible information page which lists ongoing research projects at the Department of Psychology and calls for research participation). On four days (29th/30th of May and 2nd/3rd of June) participants were also recruited face-to-face by the researcher on campus. That is, participants were asked whether they would like to take part in an online survey about the local bus services and were asked to provide their university mail address if they agreed to participate. As a requirement, participants were asked to take part in the survey only if they were familiar with the local bus services defined as currently using the services at least once a week or having used them consistently in the past. Ethical approval for the study was granted by the Psychology Ethics Committee of the University of Bath (reference number 14-097).

Materials

The online survey was created using Qualtrics software (2014) and consisted of five parts.

1.) **Participant information** page including participation requirements (i.e. using the local bus services to or from University at least once a week or having used the services consistently in the past) and informed consent.
2.) **Basic demographic information** including respondents' age, gender, student status (i.e. undergraduate, postgraduate, or staff of the university) and place of residence. For the latter, participants were asked to choose from 17 numbered areas on a map showing the area of Bath or to type in another location if they did not live in Bath). For each location the average walking distance to campus was computed using Google Maps.
3.) The third part consisted of four questions regarding **participants' travel behaviour**. Participants were asked to select their main mode of travel to and/or back from the university from a list of alternatives (i.e. bicycle, bus, car, car passenger, motorcycle, walking or train), to indicate their frequency of bus use in a typical week (each one-way journey counting as one) as well as their preferred bus company (First, Wessex, Bugler or Other/Combination of services) and overall satisfaction with the service provision (1 – Very dissatisfied to 7 – Very satisfied).
4.) The fourth and main part of the questionnaire comprised a series of **50 statements on bus travel** to the university rated on a 5-point Likert scale (1 - Strongly disagree to 5 – Strongly agree). Two thirds of these statements were original verbatim focus group statements taken from Study 1 to provide continuity between Studies 1 and 2, as Study 2 directly builds upon the ideas that emerged in the exploratory focus group discussions. Another reason for preferring verbatim statements was to confront participants with concepts framed as relatable real-

life experiences (e.g. “It’s really horrendous. You can end up queuing for a long time and don’t get a seat”) rather than using standard survey terminology (e.g. “Queuing is a major problem”). The remainder of items were added by the researcher based on previous literature (e.g. Beirão & Cabral, 2007; Gardner & Abraham, 2007; Jensen, 1999). It should be noted that a limited number of statements (N = 8) were not directly related to bus travel and sometimes included information on the local context of the city of Bath, such as “I do think Bath has a pollution problem”, but could easily be tailored to other contexts (see appendix A1 for the full list of statements including Means/SDs).

5.) The final part of the questionnaire included a **debriefing** page explaining the purpose of the study and providing participants the option to enter the price draw by following a link to a separate survey where they could provide their e-mail address (this was done to assure participants of the anonymity of their responses).

Analysis – Exploratory factor analysis (data pre-processing)

A principal component factor analysis with varimax rotation (Kaiser, 1958) was carried out in SPSS (Version 22) in order to reduce the number of variables (i.e. the 50 statements) into a manageable number of independent factors. In principal component analysis, linear combinations of the original variables are derived that explain as much of the observed variation (i.e. the pattern of possible correlations among the variables) as possible (Stevens, 2009; Williams, Brown & Onsman, 2010). The first linear combination of variables or first principal component ($y_1 = a_{11}x_1 + a_{12}x_2 + \ldots + a_{1p}x_p$), respectively, accounts for the largest amount of variance and equals the largest eigenvalue in the sample covariance matrix. After the first factor has been identified, a second linear combination of variables is found that best explains the variance left unaccounted for by the first factor. This process continues until all the variables load on one or several factor(s). Subsequently, varimax rotation was employed in order to facilitate the interpretation of the factors. Varimax rotation results in factor solutions with variables optimally loading highly on just one of the factors and low on all others (Abdi, 2003; Kaiser, 1958). Although the overall amount of variance explained remains unaltered, the variance explained by each individual component is subject to change. Once a number of (rotated) factors has been decided, factor loadings (i.e. the correlation between each variable and its superordinate factor) may be interpreted (what do the variable loadings have in common?) and tested for significance.

Sample size. There has been some debate on the sample size requirements for factor analytic procedures with recommendations ranging from a minimum desirable N of 100 cases (Gorsuch, 1983), to 250 (Cattell, 1978) or 500 and more (Comrey & Lee, 1992). According to MacCallum, Widaman, Zhang & Hong (1999), a sample size in the range of 100 to 200 observations may be deemed adequate with communalities in the range of .5. The current sample (N = 250) fulfilled this requirement with communalities in the expected range.

Choosing a number of factors. It should be noted that there is no clear-cut rule for deciding how many components to retain (Stevens, 2009). According to Kaiser (1960), it is sensible to retain only the components with an eigenvalue larger than 1. This is the standard procedure in SPSS. A drawback of this approach, however, is that factors may be retained which only explain a rather small amount of variance and may thus be of limited practical significance. Another popular method is the Scree test (Cattell, 1966) which depicts the eigenvalues graphically.

Since the first few factors usually explain the largest amount of variance, a sharp decline in the magnitude of eigenvalues (i.e. variance explained) usually occurs early in the plot. The recommendation of this approach is to retain all the factors before the drop-off in magnitude. In contrast to Kaiser's (1960) approach, this method tends to retain only the most important factors, but eventually does not retain factors that may be of practical relevance although they explain merely a small amount of variance. There is also a formal test to determine the number of factors to be retained (Lawley, 1943; Tucker & Lewis, 1973) which may, however, be too liberal as sample size increases. Finally, as many factors may be retained as are necessary to achieve a certain desired amount of explained variance (usually at least 70%). In the present study, the number of factors to be retained was decided based on the factor loadings. According to Guadagnoli and Velicer (1988), a reliable factor consists of four or more loadings with an average value > .60 (regardless of N) or 10 or more loadings > .40 (N > 150). Thus, variables with a factor loading < .40 were not considered for interpretation.

Cluster analysis

The purpose of cluster analysis is to divide a sample of respondents into a previously (un-)known number of homogenous subgroups (i.e. clusters) based on a specific number of variables or factors, respectively (Norušis, 2011). This is achieved by maximising the distance (variance) between groups while, at the same time, minimising the distance (variance) within groups. The resulting cluster solution is thus "assumed to reflect the similarity of individuals within the subgroups and the dissimilarity between them" (Dolnicar, 2002, p. 4). Similar to labelling the factors in principal component analysis based on the variable loadings, labelling the segments or groups in cluster analysis involves examining the mean factor scores for each of the extracted clusters. Content validity of the generated cluster solution can be evaluated by comparing clusters on additional information (such as demographic data), if available.

Cluster analysis has been applied in various disciplines such as Health Psychology (e.g. Clatworthy, Buick, Hankings, Weinman & Horne, 2005) or marketing research (e.g. Dolnicar, 2002; Punj & Stewart, 1983) and has also become a popular approach for use in travel market segmentation studies (e.g. Anable, 2005; Beirão & Cabral, 2008; Diana & Mokhtarian, 2009; Jacques et al., 2013; Krizek & El-Geneidy, 2007; Tarigan, Susilo & Joewono, 2014). However, critique against this approach has been levelled as well. More specifically, cluster analysis has been criticized for "its ´descriptive´, ´atheoritcal´ and ´noninferential´ nature" (Hair, Anderson, Tatham & Black, 1998), since performing a cluster analysis will always result in a cluster solution, regardless of whether actual groupings do or do not exist in the wider population and because of its lack of generalizability due to poorly defined boundary values for the variables distinguishing the groups (Diana & Pronello, 2010). Also, unless one has a solid rationale to justify the number of clusters to be extracted, the classification risks becoming increasingly artificial since progressively dissimilar clusters must be combined.

A less popular approach to data clustering, Correspondence analysis (CA; see Greenacre, 2007, for an introduction), is available as well and has been demonstrated to be applicable to clinical data (Ciampi, González Marcos & Castejón Limas, 2005). Not relying on any particular theoretical distribution, correspondence analysis can also handle categorical variables, allows clusters to be constructed from any combination of factors (rather than relying on all of them) and avoids force-fitting (i.e. observations that do not match any cluster will not automatically enter any cluster; Diana & Pronello, 2010). However, in its most basic form being a bi-plot technique, CA is more appropriate for

concrete rather than continuous data (Hill, 1974) and, in the absence of categorical data used for the clustering process, as in the current sample, the initial advantages of this computationally more laborious method become marginal. In the exploratory context of the present study, cluster analysis thus emerged as a satisfactory choice.

In a nutshell, the process of identifying structures through the use of cluster analysis can be divided into six consecutive steps that are illustrated below (see **Table 3**):

Stage 1 – Clarifying the objective	Taxonomy description	✓
	Data simplification	☒
	Hypothesis generation or testing	☒
	Relationship identification	☒
Stage 2 – Handing research design issues	Adequate sample size	✓
	Dealing with outliers	✓
	Selecting clustering variables	✓
	Choosing a similarity measure	✓
	Standardizing data	✓
Stage 3 – Verifying assumptions	Clusters are the same size/do not overlap	☒/✓
	Numeric and normally distributed data	✓
	Representative sample	✓
	Variable correlations	☒
	No missing data	✓
Stage 4 - Deriving clusters and assessing overall fit	Hierarchical clustering	✓
	Partitional clustering	✓
	Density-based clustering	☒
Stage 5 – Interpretation	Identifying differences between clusters	✓
Stage 6 – Validation and profiling	Examine whether non-random structure actually exists in the data	✓
	Compare to already established results and evaluate plausibility without reference to external information	✓
	Compare results of two sets of different cluster analyses	✓
	Determine the 'correct' number of clusters	✓

Table 3. The six stages of the clustering process applied to the current study

Below a more detailed explanation of available clustering procedures, along with the procedure chosen for the current study, is provided. Broadly, clustering methods can be divided into hierarchical (agglomerative) methods on the one hand and non-hierarchical (iterative) methods on the other hand.

Hierarchical clustering methods

Hierarchical clustering methods (Johnson, 1967) start the clustering process at the individual level and join observations into clusters based on similarity. In the process, a hierarchy of clusters will emerge ranging from the most specific (i.e. each individual case) to the broadest distinction between observations. This hierarchical structure is usually presented numerically in the form of an agglomerative schedule which shows all cluster solutions ranging from one cluster to as many clusters as there are cases in the data set. A visual presentation of this data is given in the form of a dendrogram (a tree-branch figure). Based on this information, the researcher has to decide which cluster solution (i.e. the number of clusters to be retained) is the most accurate representation of his or her findings.

Choosing a distance measure. In order to compute the distance between separate clusters, a distance measure needs to be chosen. Broadly, distance measures can be distinguished into those that measure distance based on similarity characteristics and those that measure actual geometric distances between objects in a two-, three- or n-dimensional space, which may be assessed with a 'ruler' (i.e. Euclidean distance; Burns & Burns, 2008). The latter are usually limited to the application on continuous data. For dissimilar cases, distance measures will be large, while similarity measures will be small. Using a *squared* Euclidean distance measure in cluster analysis is common because it puts an increasingly higher weight on objects as the distance between them increases (i.e. it maximises the distance between groups). After having chosen a distance measure, a clustering algorithm needs to be selected.

Choosing an appropriate clustering algorithm. Four common hierarchical methods for combining clusters are single linkage, complete linkage, average linkage and Ward's method (see Punj & Stewart, 1983, for a review). The *single linkage* (or nearest neighbour) method combines clusters so that the distance between two clusters is always the distance between the closest pair of cases that can be formed from the two clusters. In contrast, the *complete linkage* (or furthest neighbour) method defines distance between clusters based on the two cases that are furthest apart from each other. Differing from the two previous methods, the *average linkage method*, uses information about *all* pairs of distances and comes in two variants (average linkage between versus within groups). While the former solely considers distances between groups (i.e. between pairs of cases from different clusters), the latter merges clusters "so that the average distance between all cases in the resulting cluster is as small as possible" (Norušis, 2011, p. 373). Finally, *Ward's method* (Ward, 1963), similar to the average linkage method, minimises the average distance within clusters (i.e. minimises within-cluster variance), yet at the same time optimises the objective statistic tr W (i.e. pooled within-clusters sum of squares and cross-products matrix). In the first step, the method computes the average (mean) of all variables for each cluster. Next, the total sum of squared deviations (i.e. the distance of each case to its cluster mean) is computed and clusters are generated by gradually merging observations that result in "the smallest possible increase in the error sum of squares" (Burns & Burns, 2008, p. 557). Ward's method is known to have a tendency to merge clusters with only few cases and often produces clusters with a similar number of observations (both desirable given the small size of the current sample), although it may be sensitive to outliers (Milligan 1980). In the context of marketing research, Ward's minimum variance and the simple average linkage method have been found to be most effective (Punj & Stewart, 1983).

Alternative (iterative) partitioning methods

In contrast to the above mentioned hierarchical methods, iterative clustering methods, such as k-means or hill-climbing methods, do not merge observations into increasingly broader clusters, but start with a predetermined (or randomly chosen) number of clusters to which cases are reassigned. The hill-climbing method, for instance, reassigns observations until an *optimal* assignment of cases to clusters is achieved based on some statistical criterion which includes, but is not limited to, the optimisation of tr W (Punj & Stewart, 1983).

A somewhat less flexible approach is offered by the k-means method which was used in the current study. As Kanungo et al. (2002) explain, "In k-means clustering, we are given a set of n data points in d-dimensional space Rd and an integer k and the problem is to determine a set of k [reference] points in Rd, called centres, so as to minimize the mean squared distance from each data point to its nearest centre" (p. 881). That is, like Ward's method, k-means cluster analysis reduces tr W (within-cluster sum of squares). Initial cluster centroids may be fixed or chosen at random and may alter multiple times throughout the partitioning process. At first, all observations are assigned into one of the *k* to be extracted clusters. Subsequently, for each observation *x* in cluster *i*, it is tested whether the centroid z_i is the closest reference point for that observation. If so, the algorithm proceeds to the next data point. If, however, observation *x* is closer to another reference point, for instance the cluster centroid z_j *of cluster j*, then this observation will be reassigned to that cluster and all cluster centroids are recomputed before a new iteration begins (Faber, 1994). The iteration process continues until all observations have been assigned to the cluster with the nearest centroid.

As the k-means clustering method requires a predetermined number of clusters, Ward's method was conducted first as an aid for the decision of how many clusters to extract with the k-means procedure ("Quick cluster" in SPSS). In order to maximise the variance (distance) between groups, squared Euclidean distance was chosen as the distance measure due its greater emphasis placed on entities that are further apart. Content validity of the cluster solution was assessed by comparing clusters on the additional information that was collected (i.e. demographic data and travel related items).

3.1.2. Results

Sample characteristics

Demographics. In total, 291 respondents started the survey of whom, however, only 256 completed the survey (88%). In particular, thirty-three surveys expired because respondents did not submit their answers after one week of having accessed the survey and two respondents did not consent to participate. Of the 256 respondents who did complete the survey (150 female, 104 male, and two respondents who did not indicate their gender), eight provided largely incomplete data (six respondents did not fill in the statements section and two filled in only the first half of the statement section) and a further 22 respondents missed at least one statement. In both instances, responses were omitted from the main analysis (valid N listwise = 226). The age of respondents (*N* = 226) ranged from 18 to 65 (*M* = 26.18, *SD* = 9.2) and about one third of respondents reported living in the highly student populated area Oldfield Park (*N* = 72 or 32%), followed by locations outside of Bath (*N* = 28 or 12.4%), the city centre (*N* = 27 or 12%), and Bathwick (*N* = 16 or 7%). Among respondents who indicated their student/ occupation status (N = 254), the majority followed an undergraduate degree (N = 118 or 47%), followed by university staff members (N = 78 or 31%) and postgraduates (N = 57 or 22%).

Travel related questions. Sixty-eight percent of respondents (*N* = 174) reported using the bus as their main mode of travel to the university, followed by walking (*N* = 27 or 11%), car (*N* = 20 or 8%), train (*N* = 17 or 7%), and bicycle (*N* = 13 or 5%). Only two respondents regularly travelled to university as a car passenger and only one respondent used a motorcycle for the commute to university (1%). The reported number of trips in a typical week ranged from 0 to 24 (*M* = 7.92, *SD* = 4.67), thus representing both high- and low-frequency users. An almost even split between users of the two major bus companies was obtained with 96 respondents preferring the First bus company (38%) and 92 preferring the Wessex company services (36%). Only two respondents selected Bugler as their preferred company (1%) and the remaining 64 respondents (*25%*) reported either having no preferred bus company or using a combination of services, respectively.

Satisfaction. Average satisfaction ratings showed a rather neutral stance on the bus services (*M* = 4.22, *SD* = 1.56) and were somewhat skewed to the left as more than half of respondents (54%) reported being either “somewhat satisfied” or “satisfied” with the services. An independent samples t-test confirmed that female respondents (*N* = 150) were generally more favourable towards the bus services than males (*N* = 104) with mean ratings of *M* = 4.45 (*SD* = 1.46) and *M* = 3.88 (*SD* = 1.60), respectively (t_{252} = -2.98, $p < .01$). In addition, a One-way ANOVA (*N* = 254) indicated that there were significant differences between the bus companies ($F_{3,250}$ = 3.53, p = .015), although the homogeneity of variances assumption for this test was not met (Levene’s test: 1.15, *df1* =2, *df2* = 243, p = .036). This was due to the two respondents indicating Bugler as their preferred bus company, showing no variance in satisfaction ratings (*M* = 5, *SD* = 0). Upon omitting these two observations, the homogeneity of variances assumption was met (Levene’s test: p = .32) and the significance of the ANOVA increased ($F_{2,243}$ = 4.95, $p < .01$). Post hoc comparisons using the Bonferroni procedure revealed that First bus users (*M* = 4.59, *SD* = 1.51) were on average more satisfied than Wessex bus users (*M* = 3.90, *SD* = 1.63) with M_{diff} = .69 (95% CI: .14, 1.23; $p < .01$) and also tended to be more satisfied than those using a combinations of services (M = 4.05, SD = 1.44), although not significantly so (M_{diff} = .54 (95% CI: -.76, .46; p = .10). Satisfaction ratings did not vary significantly between student status/ occupation levels ($F_{2,244}$ = 2.30, p = .10, Levene’s test: .50, *df1* =2, *df2* = 244, $p > .60$), although inspection of the means suggested that undergraduate students tended to be more satisfied (*M* = 4.41, *SD* = 1.51) than both, university staff members (*M* = 4.11, *SD* = 1.57) and postgraduate students (*M* = 3.89, *SD* = 1.62).

Statement means. Between 246 and 250 responses were recorded for each of the 50 questionnaire statements. Of the 50 survey items, “It would be convenient to be able to get on any service with one's bus pass” received the strongest endorsement (*M* = 4.57, *SD* = .74), while "I don't have any problems with delays" received the weakest endorsement (*M* = 1.79, *SD* = .84; see **Table A1** in the appendix for the full list of statements used).

Factor analysis

A principal components analysis was performed in SPSS on the 50 statements about bus travel and alternative modes. The Kaiser-Meyer-Olkin (KMO) measure of sampling adequacy (Kaiser, 1970), which 'yields an assessment of whether the variables belong together psychometrically and thus whether the correlation matrix is appropriate for factor analysis' (Dziuban & Shirkey, 1974, p. 359), was in the middling range (.75), thus justifying the use of factor analysis for the current sample (KMO is computed by comparing the magnitude of the partial correlations to the original zero-order correlations of variables and as KMO approaches 1, variables are increasingly likely to share common factors and hence the partial correlations become smaller). Likewise, Bartlett's test of sphericity (Bartlett, 1950), which tests the assumption that the sample correlation matrix stems 'from a multivariate normal population in which the variables of interest are independent' (Dziuban & Shirkey, 1974, p. 358), was significant ($X^2 = 3726$, $df = 1225$, $p < .001$), although the probability of rejection of the hypothesis increases with sample size. To facilitate the interpretation of factors, varimax rotation (i.e. orthogonal rotation that assumes factors to be independent) rather than oblimin rotation (i.e. oblique rotation that assumes factors are correlated) was computed. That is, despite the relaxed assumption of independence in oblique rotations allowing new axes to take any position in the factor space (i.e. no fixed angles), the degree of correlation allowed between factors is only small, as two highly correlated factors are better interpreted as only one factor (Basilevsky, 1994). The advantage of assuming independence between factors (varimax rotation) is that variables tend to load highly only on one factor. Due to the large number of survey statements ($N = 50$), choosing varimax rotation was thus considered desirable to minimise the number of variables with high loadings on all or several factors, thus reducing the conceptual overlap between rotated factors.

In total, 16 factors with eigenvalues equal to or greater than 1.00 were extracted and these factors, together, accounted for approximately 65% of explained variance. A summary of the rotated factor solution is provided in **Table 4**. Inspection of the rotated factor solution suggested the presence of four reliable factors according to the criteria defined by Guadagnoli and Velicer (1988). That is, each of the factors included at least four variables with an average loading of at least .60. Also, only the first four factors showed acceptable levels of reliability (.70 or higher). Only one statement ("The quality of the buses is good.") did not load on any of the factors. The first factor can be interpreted as a measure of dissatisfaction with the bus services, primarily related to reliability. Items loading high on this factor included, inter alia, "The buses are not reliable on their schedules. I think it [the bus] is not…it's later or earlier, but never on time." or "It's really horrendous. You can end up queuing for a long time and don't get a seat". The second factor appeared to be associated with reasons for taking the bus or having a positive attitude regarding the bus services in general. For instance, "Being on the bus allows me to relax." or "It's comfortable to get the bus". Statements associated with a positive attitude regarding alternative travel modes, especially walking, loaded positively on the third factor (e.g. "Sometimes you take more time to take the bus than when you run up." or "If there was no bus service, I would walk up to Uni."). Finally, the fourth factor appeared to capture habitual bus use and convenience aspects (e.g. "I almost always take the bus to university. It's a habit." or "Taking the bus is the easiest way to save your time and energy.").

Factor	Example attitude statement (variable loading most highly on the factor)	Number of variables loading on factor	Cronbach's alpha	% of Variance
Unreliability	"The buses are not reliable on their schedules. I think it [the bus] is not…it's later or earlier, but never on time." (.72)	9	.83	8.7
Pro-bus	"Being on the bus allows me to relax." (.77)	7	.76	6.1
Pro-walking	"I don't know, [when you walk] you just get more awake to your lectures, whatever it is that you need to do. When you walk back, you just kind of…it allows you to relax and leave everything like back here at Uni. And by the time you get home, you're like…just home and enjoy." (.78)	6	.70	5.5
Convenience/habit	"I almost always take the bus to university. It's a habit." (.74)	5	.70	5.4
Anti-bus	"For me, using the bus is really an average experience. I don't find it terrible, but I don't find it great either. It gets you from A to B." (- .68)	3	.62	4.4
Crowding	"Buses are hot and sweaty". (.74)	3	.58	4.0
Social	"I often chat with friends or colleagues on the bus." (.81)	3	.59	3.9
Location/access	"Being able to get on the bus doesn't just depend on the point of time of the day or the weekday as such. It also depends on where you are trying to get on the bus." (.65)	2	.40	3.7
Bus drivers/info	"Most of the bus drivers are quite nice." (.66)	2	.45	3.3
Physical effort	"You have to be really fit in order to cycle up that hill." (.84)	2	.51	3.1
Descriptive norm	"The main reason I take bus is because everyone else does." (.72)	1	-	3.1
Smartphone/music	"I usually listen to music on the bus." (.71)	2	.39	3.0
Reading	"I prefer to read when I'm on the bus."	3	.22	3.0
Pollution	"I do think Bath has a pollution problem."	2	.26	3.0
Driving	"Getting the bus makes me feel good in terms of the environment." (-.59)	3	.35	2.8
Standing	"If I don't get a seat and I'm standing, then I don't do anything." (.74)	1	-	2.5

Table 4. Summary of the rotated factor solution

Cluster analysis

Using only the first four factors extracted from the principal component analysis, survey respondents were grouped together according to their factor scores by means of Ward's method (see Analysis) with *squared* Euclidean distance being chosen as the similarity measure (in order to maximise the distance between groups; Burns & Burns, 2008). The agglomeration schedule, which gives the within-cluster sum of squares (coefficient) as cases/clusters are combined, is shown in **Table 5**.

For instance, at stage 7, cases 89 and 159 are combined and the within-cluster sum of squares at this step is .184 (remember that cases are combined in a way that results in the smallest possible increase in the sum of squares). The two 0s indicate that neither variable has been clustered at an earlier stage. At stage 10, a further case (case 22) is added to the cluster (the 7 indicates that case 89 has already been clustered at stage 7). The last column shows that the next stage involving this cluster (22, 89, and 159) is stage 104 at which it is merged with another cluster (cases 156 and 186). Cases continue to be clustered until the two most dissimilar clusters are derived (stage 225).

	Cluster Combined			Stage Cluster First Appears		
Stage	Cluster 1	Cluster 2	Coefficients	Cluster 1	Cluster 2	Next Stage
1	62	219	.005	0	0	116
2	107	179	.010	0	0	99
3	40	105	.032	0	0	29
4	26	61	.064	0	0	70
5	10	53	.101	0	0	112
6	221	234	.142	0	0	101
7	89	159	.184	0	0	10
8	128	187	.232	0	0	48
9	25	136	.282	0	0	36
10	22	89	.333	0	7	104
…	…	…	…	…	…	…
220	2	47	486.697	207	209	223
221	4	16	541.974	214	212	224
222	1	3	602.441	219	217	225
223	2	5	671.462	220	218	224
224	2	4	769.384	223	221	225
225	1	2	900.000	222	224	0

Table 5. Shortened agglomeration schedule obtained with Ward's (1963) method

For ease of interpretation, a rearranged version of the agglomeration schedule is shown in **Table 6**. A look at the coefficients in this schedule suggested a three cluster solution (Clusters 1, 2 and 4), as preceding agglomerations of dissimilar clusters produced relatively smaller step changes (a large step change indicates that two rather dissimilar groups have been clustered). For instance, the within-cluster sum of squares increase by about 130 as clusters 1 and 2 are combined, which is about 33 more than the step change obtained by merging clusters 2 and 4 at stage 224 (i.e. clusters 2 and 4 are relatively more similar than clusters 1 and 2). The step change obtained by merging clusters 2 and 4, in turn, is greater by about 29 compared to the agglomeration of clusters 2 and 5, which were combined one step earlier.

Number of clusters	*Agglomeration last step*	*Coefficients this step*	*Change*
2	900.000	769.384	130.616
3	769.384	671.462	97.922
4	671.462	602.441	69.021
5	602.441	541.974	60.467
6	541.974	486.697	55.277

Table 6. Rearranged agglomeration schedule

Assuming that public transport users can be grouped beyond a simplistic captive versus choice mode user distinction and based on earlier segmentation studies (e.g. Beirão & Cabral, 2008; Jacques, Manaugh & El-Geneidy, 2013; Jensen, 1999), a cluster solution consisting of at least three groupings seemed adequate. However, closer inspection of the dendrogram produced by Ward's (1963) method (see **Figure 11**), suggested that the three initial clusters could be further split into six clusters, while maintaining a sufficient degree of distinctiveness.

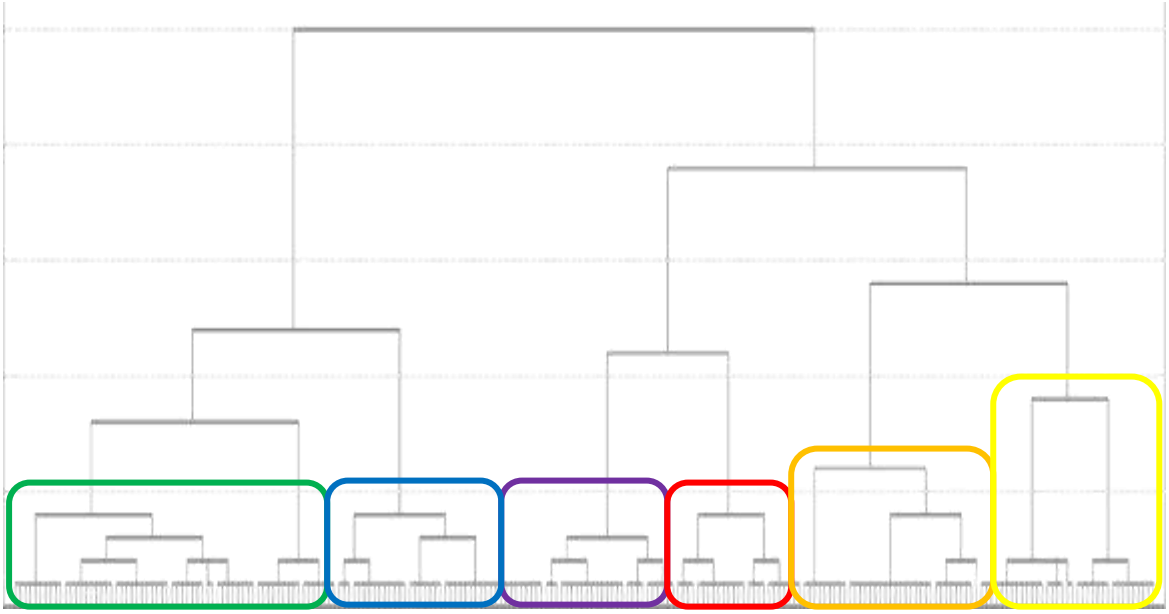


Figure 11. Dendrogram produced by Ward's (1963) method (rectangles added)

Consequently, in the next step, four, five, six and seven clusters were chosen for extraction with the k-means (Quick cluster in SPSS) clustering procedure of which the six cluster solution appeared to offer the best compromise between differentiation and interpretability of resulting clusters.

Table 7 and **Figure 12** show the cluster centres for each cluster based on the four components extracted from the factor analysis based on which clusters were identified. Demographic information and descriptive statistics (trip frequency and satisfaction) for each cluster are given in **Table 8** and **Figure 13**.

Factor/Cluster	*1*	*2*	*3*	*4*	*5*	*6*
N	23	42	31	54	25	51
Unreliability	.68	.43	-1.34	- .51	- .09	.72
Pro-bus	.86	-.91	- .70	1.04	- .45	- .08
Pro-walking	.77	.89	.30	.05	-1.31	-.68
Convenience/habit	-1.07	- .23	.46	.36	-1.32	.65

Table 7. Final cluster centres for the six cluster solution (< -.5 – low, -.5 - .5 – medium, and > .5 – high)

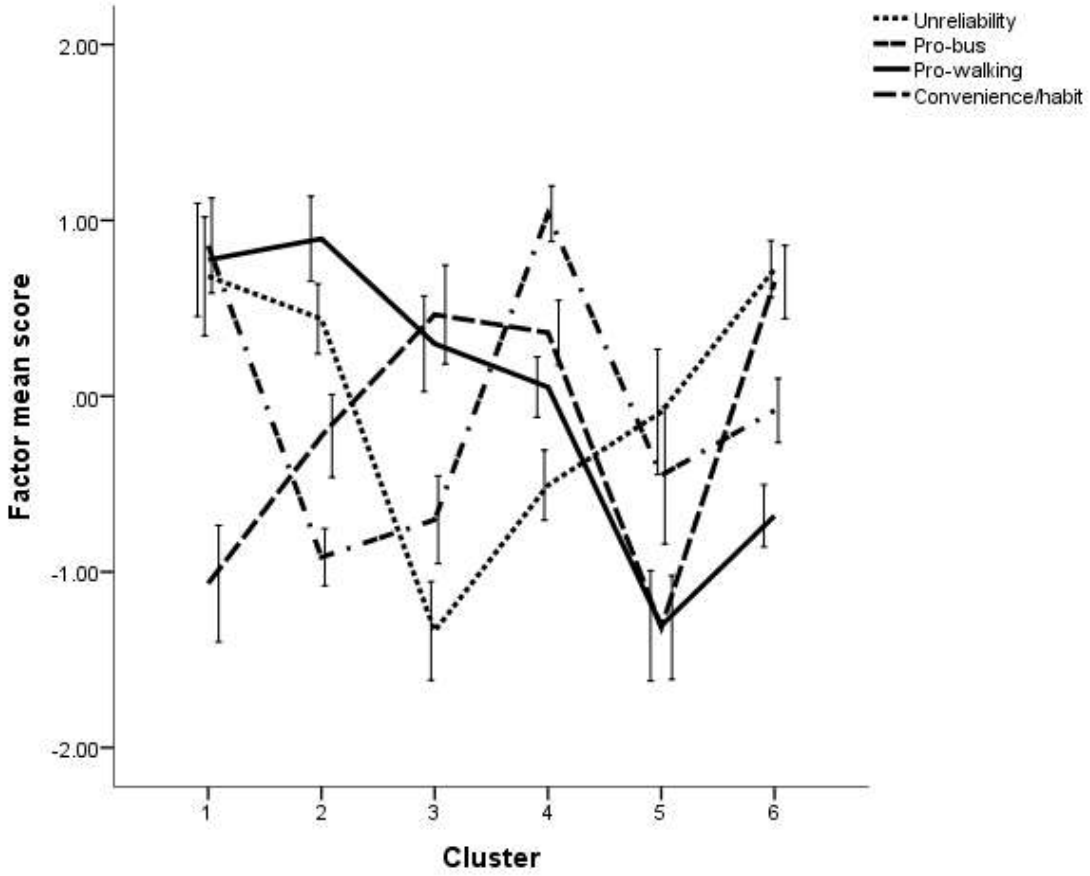


Figure 12. Mean factor scores by cluster membership

Demographics	*Cluster 1*	*Cluster 2*	*Cluster 3*	*Cluster 4*	*Cluster 5*	*Cluster 6*
Total N	*N = 23*	*N = 42*	*N = 31*	*N = 54*	*N = 25*	*N = 51*
Male	**57%**	36%	26%	30%	**60%**	47%
Female	43%	**64%**	**74%**	**70%**	40%	**53%**
Mean age	28.4	26.4	24	25	**30**	25.7
Student/occupation						
Undergraduate	**39%**	**45%**	**61%**	**52%**	36%	**51%**
Postgraduate	30.5%	19%	13%	28%	20%	18%
University staff	30.5%	36%	26%	20%	**44%**	29%
Main mode						
Bus	26%	**67%**	**77%**	**74%**	**52%**	**88%**
Bicycle/motorcycle	22%	2%	3%	4%	-	-
Car/car passenger	9%/-	5%/-	3%/3%	7%/-	36%/4%	2%/-
Train	4%	7%	3%	7%	4%	10%
Walk	**39%**	19%	10%	7%	4%	-
Location (network distance)						
Areas within 2 miles (3.2km)						
Bathwick (1.4m, 2.2km)	26%	5%	3%	6%	4%	6%
City centre (1.7m, 2.7km)	4%	19%	10%	15%	8%	10%
Areas between 2 to 4 miles (3.2 - 6.4km)						
(Lower) Oldfield Park/ Moorland Rd (2.8m, 4.5km)	13%	26%	39%	**35%**	20%	**43%**
Other locations within Bath (1.3 - 3.8m, 2.1 - 6.1km)	**48%**	**38%**	**45%**	31%	**40%**	29%
Other locations outside Bath (5.2 - 39m, 8.4 - 62.8km)	9%	12%	3%	13%	28%	12%
Preferred bus company						
Company 1	**39%**	36%	**48%**	**50%**	32%	25%
Company 2	30.5%	**38%**	39%	30%	32%	**50%**
Combination/Comp 3	30.5%/-	24%/2%	13%/-	20%/-	**36%/-**	25%/-
Mean trip frequency	4.8	6.9	8.7	8.2	6	**10.7**
Mean satisfaction	4.3	3.8	**5.1**	**5.1**	3.4	3.5

*Table 8. Cluster demographics (Note. *average walking distance to campus in miles)*

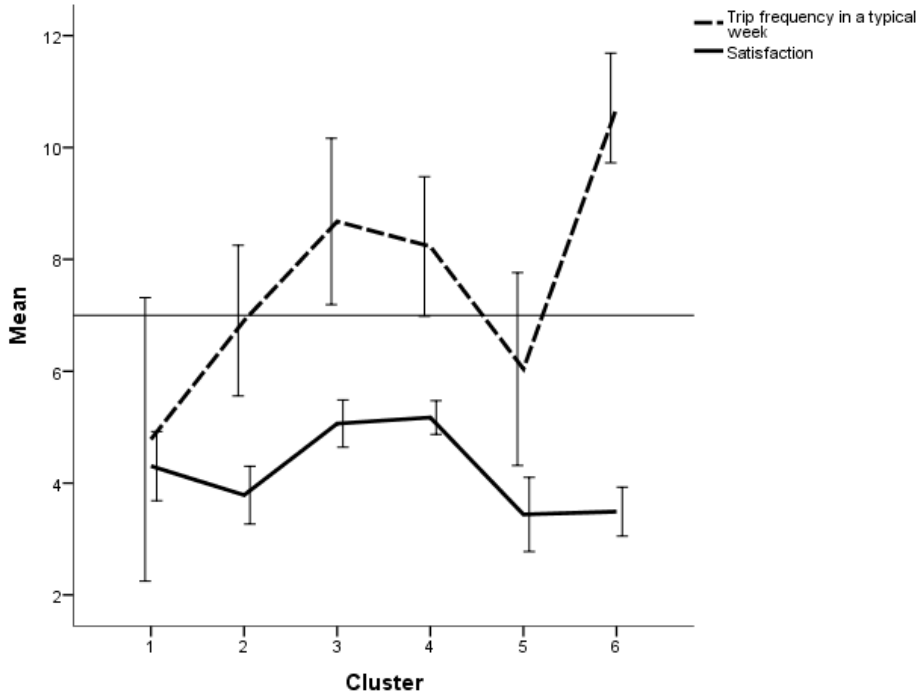


Figure 13. Mean trip frequency and satisfaction ratings for each cluster

Cluster descriptions

Cluster 1 – *Mode Mixers.* Survey respondents in the first and, at the same time, smallest cluster (*N* = 23), were deeply dissatisfied with the unreliability of the buses and expressed a very favourable attitude regarding alternative travel modes (i.e. walking). In line with this, they reported the lowest bus trip frequency in a typical week (*M* = 4.78). However, despite being dissatisfied with the reliability of the bus service, mode mixers held a surprisingly positive attitude regarding the experience of being on the bus. Unsurprisingly, about 61% of the respondents in this cluster reported either walking (*N* = 9) or cycling (*N* = 5) to campus as their main mode of travel.

Cluster 2 – *Wanna-be Walkers.* Like members of the first cluster, respondents in this female dominated cluster (64%) showed some degree of dissatisfaction with the reliability of service and a strong preference for alternative travel modes. However, unlike members of the first cluster, they did not like the experience of being on the bus at all, while simultaneously relying the bus more often (*M* = 6.90). As the label implies, these bus users would like to forsake the bus in favour of walking but feel constrained in their choice, preventing change.

Cluster 3 – *All fine on the Weston front.* The third and youngest cluster (M = 23.97) was also dominated by female respondents (74%) and largely represented undergraduate students (61%). Contrary to the first two clusters, members of this cluster did not perceive any difficulties with the reliability of bus services, although they did not like the experience of being on the bus. They also showed a markedly higher trip frequency in a typical week (*M* = 8.68) than the two previous clusters, while being somewhat satisfied with the service in general (*M* = 5.06). Despite holding a slightly positive attitude regarding walking, members of this cluster do not appear to have a strong desire for a change in travel mode.

Cluster 4 – *First Fans.* Dominated by undergraduate students (52%) and female respondents (70%), about one third (35%) of individuals in this cluster reported living in the highly student-populated area Oldfield Park. Showing similar trip frequency and

satisfaction ratings compared to the third cluster (*M* = 8.23 and *M* = 5.11, respectively), respondents grouped in the fourth cluster did not perceive a need for change in travel mode. In particular, members of this cluster were content with the reliability of service (albeit to a lesser extent than members of the third cluster) and, among all groups, held the most favourable attitude concerning bus travel. Regarding the latter, it should also be noted that half of the bus users in this cluster preferred the First bus company which received overall higher satisfaction ratings from both under- and postgraduate students.

Cluster 5 – *Car Curtailed.* As one of the only two male-dominated clusters (60%), and as the second-smallest cluster (*N* = 25), the fifth cluster featured a relatively high occurrence of university staff (44%) and car drivers (36%). This cluster also had the highest mean age (*M* = 30.00). Showing a moderate trip frequency (*M* = 6.04) and the lowest satisfaction rating (*M* = 3.44), members of this cluster neither held a positive attitude regarding the bus nor walking. In fact, they reported the by far most unfavourable attitude regarding walking as a potential alternative mode of travel. Clearly, individuals in this cluster favour private motorized transport and rely on the buses only if they have to. The affordability of a car may pose an obstacle for the non-car owners in this cluster.

Cluster 6 – *Daily Drags.* About half of the bus users in the last cluster preferred the Wessex bus company (49%) which, as shown before, generally received lower satisfaction ratings than the rival First Bus Company. Largely representing undergraduate students (51%), the majority of respondents in this cluster lived in the highly student-populated area of Oldfield Park (43%) and were most dissatisfied with the reliability of the bus service. Members of this cluster showed by far the highest trip frequency in a typical week (*M* = 10.71) and were equally dissatisfied as members of the fifth ('Car curtailed') cluster (*M* = 3.49). Still, most individuals in this cluster were not very favourable towards walking as an alternative to using the bus.

3.1.3. Discussion

The objective of the current study was to segment a sample of student and staff bus users from the University of Bath into distinct mobility types. For this purpose, an online questionnaire consisting of a few travel-related questions and 50 attitude statements on bus travel and alternatives was created. Based on four components (Unreliability, Pro-bus, Pro-Walking, and Convenience/habit) extracted from the 50 attitude statements, two clustering algorithms (Ward's method followed by k-means) were employed in order to group respondents based on their factor scores. The results suggested a six cluster solution with clusters overlapping with those found in previous research (e.g. Anable, 2005; Jacques et al., 2013; Jensen, 1999), yet also with clusters that may be specific to the context of the University of Bath. The following clusters were distinguished:

Respondents in the first two clusters ('Mode mixers' and 'Wanna-be Walkers'; N = 65 or 28.8% of the sample) were (strongly) dissatisfied with the reliability of bus services and expressed a very favourable attitude regarding walking instead of using the bus. However, whereas the Mode mixers were already using alternative modes of travel (i.e. walking or cycling), the Wanna-be Walkers still used the bus on a regular basis, although they did not enjoy the experience of being on the bus.

The 'All fine on the Weston front' bus users and 'First fans' (N = 85 or 37.6%) were both at least somewhat satisfied with the bus services. The former did not experience any major problems in terms of reliability and appeared to choose the bus primarily because of practical considerations. Although they do not enjoy the ride much, they stick to the

bus because it's the most convenient choice for them. In contrast, the First fans actually like the experience of being on the bus, while being content with the reliability of service.

Finally, the 'Car curtailed' and 'Daily drag' clusters (N = 76 or 33.6%) represent respondents who are not very pleased with the bus services. The former, as the name implies, prefer private motorized transport and rely on the buses only if they have to. Non-car owning bus users in this cluster eventually bear with the buses until car ownership becomes affordable. The Daily drag cluster represents a group of a very location-specific, non-car owning group of undergraduate students who use the bus on a daily basis. Due to high demand at peak hours, they experience many problems with the frequency and reliability of service. Yet, since they *perceive* no alternatives as being available, they continue using the bus.

Overall, the extracted clusters mirror the results of earlier travel market segmentations. For instance, Jensen's (1999) *Public transport users of convenience* (or 'Utilitarianists' as labelled by Jacques, Manaugh and El-Geneidy, 2013) were also found in the present sample ('All fine on the Weston front'). These habitual bus users, despite being somewhat dissatisfied with buses in general (e.g. due to crowding), had no intention of switching modes because of their otherwise positive experience with the reliability of service. This finding aligns with previous research which has found practical considerations (here: ease of access and travel time), rather than comfort, as driving the choice of public transport for some users (Rubens, Gosling & Moch, 2011). Similarly, *Passionate public transport users* (Jensen, 1999) or Transit Enthusiasts (Beirão & Cabral, 2008; alternatively, the 'Dedication' segment in Jacques et al., 2013) were reflected in the 'First fan' cluster. On average, these users scored highest on the Pro-bus factor which included items such as "Being on the bus allows me to relax" or "It's comfortable to get the bus". Being able to relax, rest or read has been shown to be a potential advantage of using public transport compared to the private car (Beirão & Cabral, 2007), although it is not clear whether these users actively look for these properties when choosing a travel mode or whether it is more of a pleasant side-effect.

Public transport users of necessity (Jensen, 1999) were represented in the 'Daily drag' cluster. Deeply dissatisfied with the unreliability of bus services, these captive users felt a lack of control and flexibility which is generally associated with the use of public transportation (Beirão & Cabral, 2007; Thomas, Walker & Musselwhite, 2014). The somewhat dissatisfied Wanna-be Walkers, who have a desire to rely on the bus less or to abandon the bus entirely, might also be described as 'Malcontented bus users' analogous to Anable's (2005) 'Malcontented drivers'. In contrast, bus users in the *Car-curtailed* cluster, comparable to Beirão and Cabral's (2008) Obstinate drivers, only use the bus rarely and only if they have to. They prefer the freedom, independence and prestige that the car offers (Anable, 2005; Beirão & Cabral, 2007; Jensen, 1999; Steg, 2005; Thomas, Walker & Musselwhite, 2014). Consequently, they may represent a group of 'Complacent car addicts' or 'Die hard drivers' (Anable, 2005) rather than a cluster of regular bus users. Likewise, *Mode Mixers* only rely on the bus some of the time since they are already using alternative modes of travel, such as walking or cycling. Although the current study did not allow a further exploration of these users' motives, it can be assumed that journey-based affect is relatively high for these modes, as has been illustrated in past research (LaJeunesse & Rodríguez, 2012). Investigating the daily commuting habits of university students, Páez and Whalen (2010), for instance, found that students travelling actively not only reported being more satisfied than their peers ("Getting there is half the fun"), but even showed a preference towards longer rather than shorter trips.

Limitations

Although a fairly representative distinction of students and staff members using the bus *to and from the University of Bath* has been achieved, new or different clusters might emerge in other settings. That is, because a small part of the 50 statements on bus travel and alternatives, which provided the foundation for the main analysis, contained information on the local context (e.g. about the hill leading to university), the findings might not be applicable to other settings. In order to determine the external validity of the clusters, the unique features of the environment (topography, street architecture etc.) and of the local bus services (i.e. cost, frequency, reliability, quality of buses etc.) in other cities need to be considered, eventually resulting in slight nuances to the current cluster solution. Thus, unless replicated in an independent study with a preferably larger sample size (N > 500), the confidence in the current cluster solution is undermined. In addition, there is a drawback of data pre-processing by performing factor analysis prior to the clustering procedure, as part of the distance information inherent in the original relationships (i.e. dependence) between the variables, which should be reflected in the clustering solution, becomes lost (Dolnicar, 2002). On the other hand, interpreting a cluster solution based on the 50 questionnaire statements would have hardly been feasible, thus rendering some data pre-processing necessary. Furthermore, the current study only included students and staff members of the University of Bath whose bus use experiences may differ from the experiences of other people who are not commuting to the university. In addition, responses were only collected near the end of term time. Since there may be fluctuations in bus use throughout the academic year (e.g. less students may travel to campus during the revision period), this could have had an impact on the results. Overall, however, the strong overlap with earlier segmentation studies suggests that fairly valid and reliable clusters have been identified.

Implications

The identification of different types of bus users has two important implications. First, in terms of healthy and sustainable travel, the segmentation has led to the identification of groups which may be particularly amenable to interventions promoting and encouraging more active travel (e.g. the Wannabe Walkers or Daily Drags). Since most bus users fail to amass recommended levels of daily physical activity (i.e. equal to or more than 30 minutes of moderate-intensity physical activity; Besser & Dannenberg, 2005), reinforcing perceived behavioural control (PBC) in these groups may help them to bridge the gap between their current state (relying on the bus) and the desired/desirable behaviour (walking or cycling). Attention should be paid to the Daily Drags, however, as they were not very positive about walking as a potential alternative to using the bus and might be more prone to engage in unsustainable behaviours (i.e. driving) as a result of stressing PBC. Second, the cluster information can be used by the local bus companies to address the concerns of the most dissatisfied users (e.g. Car Curtailed or Daily Drags) and, by doing so, to increase customer satisfaction and attract new customers. In this respect, creating a positive waiting experience (e.g. by providing adequate sheltering and real-time arrival displays; Dziekan & Kottenhoff, 2007; Friman, 2010) and having a fleet of good quality, clean vehicles, may be important additions to the provision of frequent, quick and reliable service (Beirão & Cabral, 2007). In another study conducted in a university setting (Collins & Chambers, 2005), as many as 70% of car-commuters indicated that they would consider public transport as an alternative, if it performed as well as the car. However, in the context of the University of Bath, this seems rather unlikely due to high peak demand and a vast availability of on-site parking for staff.

Future research

Future studies should further test the universality of the proposed cluster solution and explore the most effective ways to encourage public transport users to increase their multi-modality or to travel more actively and sustainably, respectively. In this respect, stressing the advantages of active travel versus public transport (e.g. no queuing or waiting times, predictability of travel time, as well as health and environmental benefits) will be crucial. Attention should be paid, however, to the framing of messages, since people are most likely very aware of the environmental and health benefits of active travel. Consequently, messages about control (i.e. independence and predictability) may be more appropriate. Also, in order to avoid reactance (especially from car users), multi-modality should be communicated as the goal rather than a mode switch altogether.

3.1.4. Conclusion

Choosing public transport is more than a matter of choice versus captivity. The current travel behaviour market segmentation study has shown that not only may experiences differ from one individual to the next, but also that we may engage in the same behaviour (here: bus use) for different reasons or motives, respectively. The present study has offered insight into these differing motivations and experiences by distinguishing novel kinds of bus user groups and highlighting commonalities to segments found in previous research (i.e. Public transport users of necessity, convenience and the heart). Although public transport is an already fairly sustainable means of transport, dissatisfied regular users should be encouraged to travel more actively and sustainably, if possible. Some of these groups, such as the *Wannabe Walkers* or *Daily Drags* (together representing 41% of the current sample), may be targeted by tailored campaigns and interventions in the future, providing an opportunity for improvements in both population health and environmental quality. Of course, as a mode shift may not be feasible or desirable for every user, continuing to improve the quality of public transport remains an important task for current service providers. In the following chapter, the current cluster solution was cross-validated with an independent sample of bus users, within the scope of a small-scale intervention aimed at encouraging walking to campus (Study 3). At the same time, this study will conclude the series of studies focused on public transport users.

Chapter 4 – The art of persuasion: Promoting sustainable travel through psychological interventions

Introduction – Changing attitudes or behaviour?

"Tell me and I forget. Teach me and I remember. Involve me and I learn." (Benjamin Franklin)

Given the findings of Studies 1 & 2, addressing dissatisfied and inactive bus users' needs could be achieved by either a) promoting a change in attitudes towards the local bus services by creating an ideal bus journey experience that is both pleasant and deactivated (Stradling, Carreno, Rye & Noble, 2007) or by b) actually changing behaviour by not (or at least not exclusively) using the bus. Whereas the first approach may be costly (e.g. increasing the number and/or quality of buses) and may depend on the good will of the local bus companies and authorities, the second approach appears to be both cost-effective *and* feasible. As an environmentally friendly and cost-effective solution, promoting sustainable travel seems like a worthwhile pursuit. Based on the assumption that students would be more receptive to information on alternatives to the bus during their transition to off-campus accommodation, the following study evaluates the effectiveness of a behaviour change intervention that was administered shortly after students had relocated from on-campus accommodation to off-campus sites.

4.1. Study 3 – "Everyone thinks of changing the world, but no one thinks of changing himself." (Leo Tolstoy) – Encouraging active travel to campus using autonomy, cognitive dissonance and value based messages

The present study combines the earlier work of Studies 1 and 2. In Study 1, current students' bus use experiences were investigated, showing some perceptions of improvement of the bus services over time, yet also frustration about continuing problems (mostly related to unreliability and capacity constraints), especially during term time. In Study 2, this information was used to identify different types of bus users based on their attitudes regarding bus use and alternatives. Informed by these earlier studies, Study 3 presents the administration of an information-based intervention aimed at second-year students to a) raise awareness of alternatives to bus use, to b) influence their bus use behaviour, and to c) cross-validate the segment solution proposed in Study 2 with an independent sample.

As argued in Study 2 (Bösehans & Walker, 2016), although public transport is generally more sustainable than single-occupancy car use (Lowe, Aytekin & Gereffi, 2009), even bus users may be encouraged to travel more actively and sustainably, especially in the light of ongoing complaints about the services, as at the University of Bath. Active travel is associated with positive health outcomes such as reductions in cardiovascular risk (Hamer & Chida, 2008) or lower levels of obesity and diabetes (Pucher, Buehler, Bassett & Dannenberg, 2010). Less demand for the bus services during peak hours would also have the potential to reduce some of the negative aspects, such as queuing and crowded buses which, in turn, may attract users of other travel modes (especially drivers) who may have avoided the bus service previously for exactly those reasons. Thus, a small-scale intervention, based on the **PATH** model (**P**roblem, **A**nalysis, **T**est, **H**elp phase; Buunk

& Van Vugt 2008; see **Figure 14**) was designed to promote walking to the University in particular.

Figure 14. The PATH model by Buunk and van Vugt (2008)

According to this model, there are four steps involved from encountering a real-world problem to the development and application/evaluation of an appropriate counter-measure. The first step is the identification of the problem at hand and the target behaviour, attitudes or cognitions that the to-be-developed intervention is supposed to change. According to Buunk and Van Vugt (2008), there are several questions that need to be answered in order to arrive at a comprehensive problem definition ("*What is the problem? Why is it a problem? For whom is it a problem? What are the possible causes of the problem? What are the key aspects of the problem?" and "Who should be targeted by the intervention?"* – see also **Figure 15**). Following these guidelines, a problem definition for the current issue is offered below.

***P**roblem definition*

Many users are deeply dissatisfied with the bus services to and from the campus of the University of Bath (based on the UTS 2014/15) because of unpredictable departure and arrival times due to unreliable service (see also Study 1 & 2). Furthermore, capacity constraints may lead to queuing, long waiting times and crowding on the bus. Students have no control over these negative instrumental aspects and thus no control over their journey. Although alternatives such as walking or cycling are available, most students continue to rely on the bus despite their expressed dissatisfaction (*What is the problem?).* First of all, this poses a problem for the students themselves (*For whom is it a problem?*) because they are stuck in an unpleasant routine of using the bus while travelling more actively and sustainably could enable them to regain control over their journey and to improve their well-being and physical activity levels. In addition, as long as buses do not use sustainable technology (e.g. hybrid or electric buses; Kühne, 2010; Lajunen, 2014), the emissions they cause are just as, or even more, detrimental to the environment as those emitted from cars (*Why is it a problem?*). This may be especially so when they are running uphill with many passengers, but also when buses complete their route empty because of low demand (Lowe, Aytekin & Gereffi, 2009), as is often the case during semester break. A shift in mentality at the university towards more active travel might lead to a reduction in emissions as more people decide to travel more actively and sustainably. Here, second-year students will be targeted in particular (*Who is the target group?*) because once they move from campus to off-campus locations, they are in a period of transition and have yet to establish a new travel pattern. Frustration with the bus services may be especially salient during the first few weeks of using the bus, potentially making students more receptive to information on alternative travel modes before they establish a habitual travel pattern. Clearly, this is an applied problem (*What are the key aspects of the problem?)*, as the aim of the intervention is to find a way to motivate dissatisfied student bus users to switch to active travel modes. The intervention necessarily involves a social psychological component as the messages that will be

addressed to students were designed to target different psychological dimensions (cognitive dissonance versus autonomy versus values).

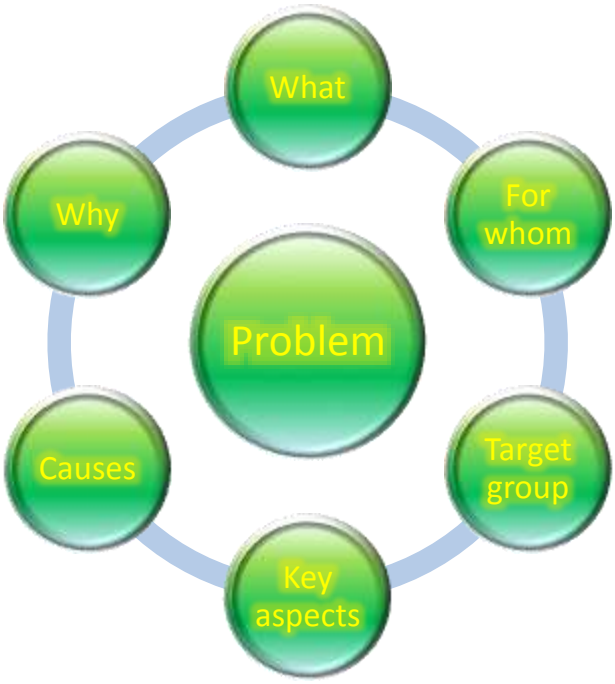


Figure 15. Problem definition according to the PATH model (Buunk & van Vugt, 2008)

Analysis

Before conducting the actual intervention, a concrete outcome variable needs to be specified. This variable should be relevant to the problem at hand, it should be measurable and it should be specific enough in order to tackle only those aspects of the problem that need to be changed and not those that don't. This also requires that possible explanations for the problem are generated (divergent phase), which are subsequently reduced to the most plausible explanations (convergent phase).

Specifying the outcome variable

In the present study, the objective was to encourage a shift to active travel among current second-year student bus users. Thus, here, "self-reported frequency of trips made by walking and cycling to and/or from campus before and after the intervention" and "use of the Walking network (yes/no)" were chosen as the outcome variables.

Possible explanations for the problem

The previous two chapters have suggested that a significant share of student and staff bus users may simply endure the bus journey to campus without great pleasure, but with frequent frustration and disappointment (see Study 1). Yet any cognitive dissonance (i.e. an incongruence between thoughts and behaviour; Festinger, 1957) that some local bus users may experience, does not appear to be sufficiently strong to instigate a mode switch or consistent bi-modality (e.g. bus and walking or cycling). The reason for this lack of initiative, especially among *Daily Drags* and *Wannabe Walkers* (Study 2), is not entirely clear, however. From a cognitive dissonance perspective, there may be at least two possible explanations.

First, apart from actual constraints such as a disability or travel distance, student and staff bus users might hold a more positive or neutral attitude towards the bus services than the rather negative attitude they tend to express openly. Indeed, the openly expressed negative attitudes might be the result of a primacy effect, where students particularly recall the initially negative instances they might have had with the bus services, when those were still unfamiliar (Schmitt, Currie & Delbosc, 2013). These attitudes might, however, not always reflect the actual sentiment towards the bus services. In the first focus group (Study 1), for instance, Jo took a rather neutral, utilitarianist perspective on the bus services by asserting that, despite all the issues surrounding the services, "It [the bus] gets you from A to B". This might indicate that the cognitive dissonance (if there was any in the first place) may have been resolved in favour of a more positive attitude towards the local bus services by admitting that the services are flawed, but also acknowledging that they fulfil certain instrumental needs (Stradling, 2002). Thus, students may not perceive a need to change their travel behaviour.

Second, internal factors such as habit or external factors such as a lack of information (e.g. walking and cycling routes) and a challenging environment may prevent (student) bus users from resolving their cognitive dissonance through behaviour change. Although, in the age of easily accessible information technology such as Google Maps, information acquisition is unlikely to pose a problem, incentives to look for and access this information may be lacking. The location of the university campus on top of Bathwick Hill is certainly a major deterrent of walking and cycling, as hilliness may pose a significant barrier to active travel (Guo, 2009; Parking, Wardman & Page, 2008). Thus, another possible explanation for students continuing to use the bus, despite being dissatisfied with the service, is that it involves less effort than walking or cycling, while being protected against the weather. Also, for longer distances, taking the bus may be quicker than walking, although not necessarily quicker than cycling. In addition, taking the bus is comfortable and offers the potential for relaxation or chatting (Beirão & Cabral, 2007), the latter being equally true of cycling or walking, however. Having purchased a bus-pass (£179 for the first semester or £249 for the whole academic year; see Bath Uni Bus 2017, www.firstgroup.com), commitment to use the bus in order to avoid losing money ('sunk costs'; Arkes & Blumer, 1985) may arise, too. In other words, students may escalate their commitment to use the bus, allowing them to maintain the illusion that they have made the right choice (Whyte, 1986).

Finally, habit may have a significant influence on students' travel mode choice. It has been demonstrated that highly habitual travellers attend less to information about alternatives (Verplanken, Aarts & Knippenberg, 1997) and that the window of opportunity for change, given a change in context, may be as small as three months or less (Verplanken & Roy, 2016). Given that most students spend their first year of university in on-campus accommodation, and only relocate after their first year of studies, considering the formation of new habits thus seems crucial.

***T**est*

In the test phase, a process model, which links the explanations to the target behaviour, is developed (and tested). On the left-hand side of **Figure 16**, the aspects of walking or cycling that prevent the uptake of more active travel are presented, with red arrows showing the negative link to the target behaviour. On the right-hand side, the positive aspects of walking or cycling as a travel mode are listed, which could encourage the uptake of these modes (green arrows).

Note that, here, affect refers to both the (eventually) negative experience of being on the bus which may motivate people to switch to active travel, as well as the inherent affective benefits of walking (or cycling) as an activity in itself.

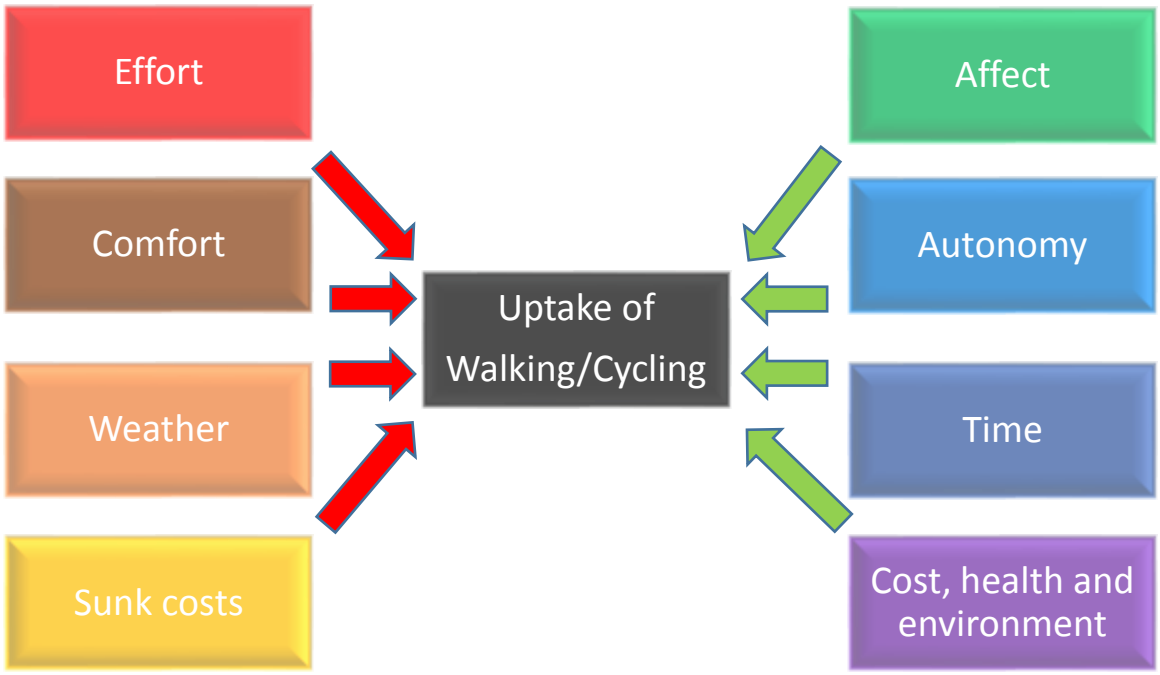


Figure 16. Hypothetical process model of potential positive and negative aspects preventing or encouraging the uptake of walking or cycling

Due to individual differences and different contexts, it may be difficult to quantify these relationships numerically. However, there is some evidence that both walking and cycling may increase positive affect, while decreasing negative affect (Gatersleben & Uzzell, 2007; Johansson, Hartig & Staats, 2011; LaJeunesse & Rodríguez, 2012; Martin, Goryakin & Suhrcke, 2014; Pretty et al., 2007). Public transport users, in contrast, often hold more negative attitudes towards their transport mode than users of active modes (Olson et al., 2013; St-Louis et al., 2014; Thomas & Walker, 2015), which may be traced back to the deactivated and unpleasant nature of the travel (or, put simply, boredom; Gatersleben & Uzzell, 2007), stress associated with unpredictable journeys (Evans, Wener & Phillips, 2002) or in-process waiting times (Friman, 2010), and a general lack of autonomy (Beirão & Cabral, 2007; Thomas, Walker & Musselwhite, 2014). Needless to say, walking and cycling involve obvious cost, health and environmental benefits (Lee & Buchner, 2008), while offering a high degree of autonomy. However, it is also clear that these modes may involve more (physical) effort, may be less comfortable and may, at least in the case of walking longer distances, take more time than using the bus.

However, data from the 2014/15 University Travel Survey show that active travellers tend to have shorter journey times on average (Cycling: *M* = 30 minutes; Walking: *M* = 35 minutes), compared to bus users (*M* = 44 minutes), suggesting that time-saving concerns might be better met using these modes of travel. Of course, in part, the shorter travel times for walking and cycling may reflect shorter distances being travelled. However, the time-saving potential of these modes should not be dismissed, especially since time is used in a productive fashion. Finally, weather conditions (Böcker, Dijst & Faber, 2016) and sunk costs (Arkes & Blumer, 1985) are assumed to have a negative impact on the uptake of walking or cycling. Regarding weather conditions, factors such as cold, strong wind and showers may deter people from walking and cycling especially (Saneinejad, Roorda & Kennedy, 2012) and add to the already demanding physical environment conditions. Sunk costs, too, may hinder the uptake of walking or cycling, as the financial resources invested into a bus pass would lose their value, if the latter is not used sufficiently.

H*elp*

The final stage of the PATH model focuses on the development of an intervention aimed at changing the problematic behaviour. After having identified the nature of the problem and formulating a process model, steps can be taken to develop a suitable intervention. In terms of sustainable travel, the common approach has been to encourage a decrease of unsustainable travel modes (especially the car and aviation) through a corresponding increase in 'green' travel modes (such as walking, cycling or public transit). However, not only may there be significant barriers to behaviour change – such as habits (Klöckner & Matthies, 2004), a lack of knowledge (e.g. Lorenzoni, Nicholson-Cole & Whitmarsh, 2007), and physical, affective or cognitive effort (Stradling, 2011) – there may also be multiple ways of tackling a given problem (e.g. choosing between an educational/ non-coercive and structural/coercive approach, or a combination of both).

Choosing the factors to be targeted in the intervention

The process model in **Figure 16** has already outlined a list of factors which may be targeted in the intervention. In the following *balance table* (see **Table 9**), the modifiability of each variable (i.e. whether the variable can be manipulated well or not) and potential influence of each factor on the target variable (i.e. resulting change in the outcome variable) is estimated based on a qualitative assessment of previous literature.

Variable from the process model	*Modifiability*	*Effect size*
Weather	-	+
Cost, health and environment	0	+/0
Comfort	0	+
Effort	0	++
Travel time	0	++
Sunk costs of switching modes	+	+
Affective consequences	+	+
Perceived autonomy	++	++

*Table 9. Balance table outlining the modifiability and potential effect of each of the variables from the process model; *++ = highly modifiable/large effect, + = medium modifiable/moderate effect, 0 = low modifiable/small effect, - = not modifiable/no effect, and +/0 = depends on another variable*

First of fall, the weather cannot be influenced, although favourable weather conditions could increase the uptake of walking or cycling in the long run (Saneinejad, Roorda & Kennedy, 2012). The cost, health and environmental benefits of walking or cycling are inherent in the activity itself and cannot be easily changed. That is, both modes are emission-free in their use and provide health benefits that may, however, differ on an individual basis and thus are dependent on other variables (e.g. differing baseline levels of physical fitness). Both modes also incur no significant external costs compared to the car (e.g. insurance and tax) or public transport (e.g. buying a return ticket or bus pass), although it could be argued that, at least in the case of cycling, some costs for the acquisition of a bicycle and its maintenance are due. Supportive initiatives, such as the University's loan scheme for electric bicycles, suggest that at least the cost of cycling may be somewhat modifiable, although the uptake of such schemes may yet again depend on other variables (e.g. distance from home).

Although not impossible, it may be difficult to modify the comfort and effort associated with walking or cycling or to reduce the commute time required using these modes. As suggested by participants in Study 1, both walking and cycling up the hill to campus require a significant amount of effort (e.g. "*To walk up that hill, I don't know how you run. I really…I take my hat off, too. It's hard.")* and may be uncomfortable (e.g. "*Like you feel sweaty and disgusting and you still need to start your working day."*). A better network of walking or cycling facilities could facilitate their use (Pucher, Dill & Handy, 2010), yet these do not remove the existing physical barriers (i.e. the steep incline of the hill). Likewise, travel time only possesses low modifiability as it depends, amongst factors, on individual factors (e.g. personal walking or cycling speed). New technologies (e.g. exoskeletons or electric bicycles) have the potential to make walking or cycling faster, less effortful and more comfortable, especially for the elderly. With regard to walking, however, such technology is still in its early infancy and usually intended for medical purposes only (Wolff, Parker, Borisoff, Mortenson & Mattie, 2014). Reducing effort, travel time and, to a somewhat lesser extent, improving comfort, might have significant effects on the uptake of walking or cycling for transport, as journey time and effort minimisation are among travellers' key concerns (Gardner & Abraham, 2007). Due to their low modifiability, however, targeting theses aspects may not be very effective.

Finally, the affective consequences and the perceived costs of switching to active travel (sunk costs) may be at least moderately modifiable. Previous research has indicated that switching from car to active travel may increase psychological well-being (Martin, Goryakin & Suhrcke, 2014), while similar improvements may be expected for switching from public transport to active travel, as users of the former tend to be the least happy travellers (Olson et al., 2013; St-Louis et al., 2014; Thomas & Walker, 2015). Sunk costs may primarily represent a perceived psychological barrier to behaviour change rather than an actual barrier. Thus, these aspects may be expected to have a small to medium effect on the uptake of active commuting. Finally, perceived autonomy may play an important role. Perceived autonomy may be highly modifiable as people can easily switch from essentially zero autonomy, when using the bus, to 100% autonomy, when walking or cycling. This may have a large effect, given the central role of autonomy in people's life that has emerged from previous literature (Jensen, 1999; Mann & Abraham, 2006; Thomas, Walker & Musselwhite, 2014).

Choosing a target group

In general, there may be rather limited use in tackling those individuals who are not willing to change, or who are very unlikely to change, their current main mode of transport (Anable, 2005). Some people may be reluctant to change their travel mode due to practical considerations (e.g. travel distance, no access to public transport, physical inability), whereas other transport users may refuse to change based on personal conviction (e.g. passionate car lovers/addicts). The latter group may be especially hard to convince of alternating travel modes. As an example, in a series of in-depth interviews aimed at exploring car and public transport users' attitudes towards public transport and private car, respectively, a young woman replied "I think nothing!" when asked about the potential factors that would make her abandon her car (Beirão & Cabral, 2007). Instead, previous research (e.g. Beirão & Cabral, 2007; Ogilvie, Egan, Hamilton & Petticrew, 2004) has claimed repeatedly that interventions should be targeted at those individuals who are already motivated to change their current travel mode, for instance, because they are not satisfied with their current travel mode choice (e.g. think of Anable's, 2005, 'Malcontented Motorists' or the "Wannabe Walkers" identified in Study 2).

It may also be promising to target those individuals who experience a transition in their lives (e.g. a new workplace) or whose routine commute is affected by external circumstances (e.g. roadworks), because they may be more receptive to information on new or existing transport alternatives (Bamberg, 2006; Prillwitz, Harms, & Lanzendorf, 2006, 2007). That is, according to the habit discontinuation hypothesis (Verplanken, Walker, Davis & Jurasek, 2008), a new opportunity for behaviour change arises when a habit becomes disrupted through a context change (which can be incidental, such as a road block, or deliberate, such as the introduction of a congestion charge or relocation). Triggered by the context change, old behaviour may be revised by analysing past behaviour and allowing one's beliefs and values (e.g. environmental concern) to shape a new pattern of behaviour (e.g. switching from car to public transport after relocation). As the change that occurs when students move from campus to off-campus accommodation represents just such a transition, it may be a good opportunity to target interventions during that time period. However, it may take up to four weeks or more for a new habit to become established, while, at the same time, there may be a temporary risk of relapse to the old (undesirable) behaviour (Walker, Thomas & Verplanken, 2015).

For the present study, *second-year students* were selected as an appropriate target group for three reasons. First, at the University of Bath, students spend their first year of studies living on campus. Therefore, new undergraduate students do not need to travel to campus and are thus not an appropriate target for an intervention. Second, final-year undergraduate students or staff members may have a strongly habitual travel pattern which may be difficult to change, especially when considering the emotional and physical constraints associated with such a change (e.g. attachment to the car, travel distance). Third, after their first year of studies, the soon-to-be second-year students are required to leave their on-campus accommodation and must move to other places in Bath, which means they need to start travelling to university and establish a new travel pattern. The normative environment usually leads second-year students to start using the bus, since this is what the descriptive norm suggests. However, at this point, students may still be receptive to information on travel alternatives since, as mentioned in the beginning of the chapter, people may be more receptive to new information during

periods of transition (Verplanken, Walker, Davis & Jurasek, 2008). At the time of the study, most students had just moved residence and might not have fully established a new travel routine yet, since it may take weeks before a new habit replaces an old one (Walker, Thomas & Verplanken, 2014).

Choosing the right channel

In order to reach the target group, an appropriate means of communication has to be chosen. Ranging from channels with a small effect on the individual level, such as stickers, prompts or web-based information (e.g. emails or websites), to channels with a potentially large effect (e.g. a community-based intervention programme), there is a variety of outputs to choose from. Here, it was decided to reach the audience through the use of informational flyers containing persuasive messages, which were distributed at the end of a lecture, along with a short questionnaire for data collection. The latter had the additional purpose of cross-validating the bus user segments extracted in Study 2.

Similar to leaflets, flyers are primarily a source of information. Although their effect on behaviour may be rather small, they can aid recipients in acquiring new knowledge and produce psychological change (Buunk & Van Vugt, 2008). Apart from being inexpensive to produce, flyers are easy to administer and, in contrast to web-based information, are more durable. That is, while flyers may pose a practical inconvenience, they are a physical reminder that can be kept for later use and that does not require any action on part of the recipient (e.g. not having to actively browse for relevant information on the web). Receiving a flyer also involves face-to-face interaction (here: with the researcher), thus providing the opportunity to ask for more information or clarification and to share personal experiences. Here, it is examined which of three messages, related to either the negative experience of being on a crowded bus or the benefits of active travel (i.e. autonomy versus cost, environmental and health benefits), is the most effective in encouraging students to travel more actively.

Choosing a method

The method chosen in the current study represents an informational approach, while using different persuasive messages to encourage the uptake of either walking or cycling to campus. Informational strategies are based on the assumption that recipients possess a lack of knowledge and/or motivation (here: about using alternatives to the bus for travelling to campus). As freshers spend their first year of studies on campus and never had to commute to university on a regular basis (excluding trips to local shops, bars or clubs in the city centre), they may not be informed about the best walking and cycling routes to campus. Hence, each of the flyers provided information on the Walking Network, signposting popular walking routes to campus (most of them also suitable for cycling), thus aiming to increase recipients' knowledge of behavioural alternatives (Steg & Vlek, 2009). In addition, rather than merely providing information, the flyers in this study also contained one of three persuasive messages designed to promote behaviour change (i.e. walking or cycling to campus) by either highlighting students' contradictory behaviour (using the bus despite being dissatisfied) or by highlighting some of the benefits of the available behavioural alternatives – that is, either stressing the autonomy or the cost, health and environmental benefits of walking or cycling, respectively. Each of these messages and their theoretical basis is elaborated below.

The former approach necessarily involves a notion of cognitive dissonance (i.e. an incongruence between one's own beliefs and behaviour; Festinger, 1957). Given that, according to GFT (Section 1.3.2.), people tend to be most strongly motivated by hedonic goals (i.e. with the aim "to feel better right now"), the rather unpleasant nature of bus travel (Section 2.1.2.) may trigger cognitive inconsistency. According to Gawronski (2012), cognitive inconsistency "is an unambiguous cue for errors [in one's system of beliefs] that require appropriate revisions" (p. 655). Such a negative feedback control mechanism is also central to self-regulation theories of behaviour (Bandura, 1991; Carver & Scheier, 1981), which suggest that human self-motivation is dependent on discrepancy production and reduction. That is, if a discrepancy between one's own performance and a set goal or internal standard is perceived, this should motivate action to remove the incongruity. Thus, if feeling better during their commute is an important goal, then evoking or strengthening cognitive dissonance among current dissatisfied student bus users should lead them to reduce any perceived discrepancy by either a) rationalizing their behaviour through a change in attitudes (e.g. "Maybe taking the bus is not that bad after all") or b) actually changing their behaviour (e.g. "Riding the bus *is* terrible. I'll rather start walking from now on"). Dissonance-based interventions have been shown to be effective for both health behaviours (for a systematic review, see Freijy and Kothe, 2013) and environmental behaviours (e.g. Dickerson, Thibodeau, Aronson & Miller, 1992).

In addition to the obvious cost, health and environmental benefits (standard message), autonomy is a key benefit of walking and cycling. People share an innate desire to exercise control over their own behaviour and over events that have an impact on their lives. According to self-regulation approaches, people's self-efficacy beliefs "influence the choices they make, their aspirations, how much effort they mobilize in a given endeavour, how long they persevere in the face of difficulties and setbacks, whether their thought patterns are self-hindering or self-aiding, [and] the amount of stress they experience in coping with taxing environmental demands" (Bandura, 1991, p. 257). In general, personal autonomy is highly valued by travellers (Thomas, Walker & Musselwhite, 2014) and most are reluctant to give up on their independence (Jensen, 1999; Mann & Abraham, 2006). A lack of control and flexibility, however, is one of the major disadvantages of bus use or public transport (Beirão & Cabral, 2007) and low self-efficacy beliefs may prevent change. Stressing how people may regain control through active travel may thus be of particular importance. Consequently, a second, autonomy-based, persuasive message was created to encourage behaviour change by appealing to students' self-efficacy (autonomy) beliefs.

Developing a strategy

The strategy refers to the concrete content used with the method. In this case, the persuasive appeals presented on the flyers (see Figure 17) stressed either the negative experience of being on public transport by depicting a crowded bus (provoking cognitive dissonance), the independence gained by travelling actively symbolized through the silhouette of a man standing on a mountain in front of the sunset (i.e. stressing freedom and autonomy) or the potential cost, health and environmental benefits of walking and cycling supported by corresponding symbols (standard message). In addition, each flyer contained a written message tailored to the content of the image. The knowledge part, printed on the back of each flyer, provided information on the Walking Network which is a signposted set of four walking routes to the University of Bath (see **Figure 17**).

Hypotheses

Hypothesis 1: The cognitive dissonance and autonomy messages should have a larger, if any, impact on self-reported levels of active travel and on use of the Walking Network at Time 2 than the standard message (cost, health and environment) with the autonomy message eliciting the largest effect.

Hypothesis 2: All message types should have greater effects on self-reported levels of active travel and on use of the Walking Network at Time 2 for bus user segments with the greatest potential for change (i.e. Wannabe Walkers and Daily Drags; see Study 2).

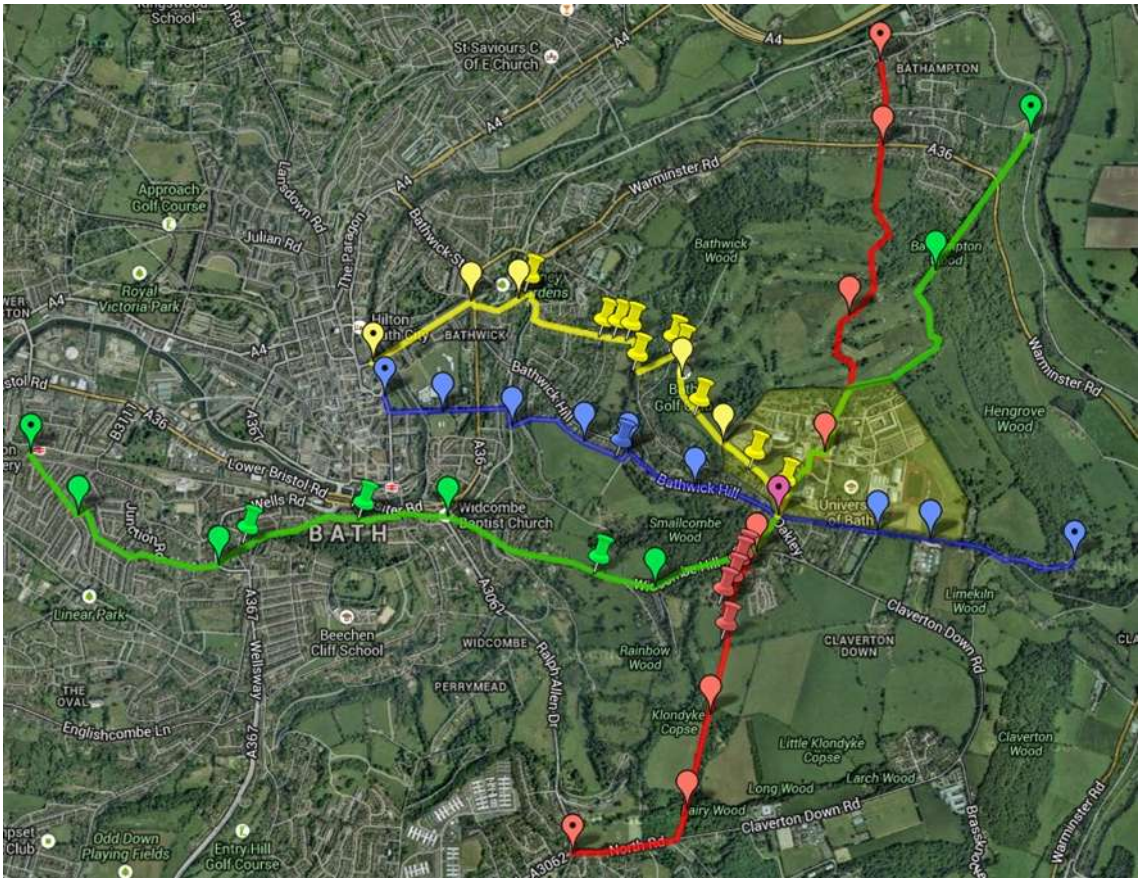


Figure 17. The Walking Network showing walking routes from key student areas in Bath to the University of Bath campus (http://bath.ac.uk/transport/walking)

4.1.1. Method

Participants

Sixty-eight second-year students (60 female, 8 male) participated in the study, which was given full ethical approval by the Psychology Ethics Committee of the University of Bath (reference number 14-216). Forty-five students completed both the initial survey at Time 1 and the follow-up survey at Time 2. Students ranged from 19 to 21 years (M = 19.53, SD = .66) in age and half of them lived in the highly student-populated area Oldfield Park (N = 34 or 50%), followed by City Centre (N = 21 or 31%) and other locations in- or outside of Bath (N = 13 or 19%). Being required to leave their campus accommodation for their second year of studies, 94% students reported living less than three months in their current accommodation. Only one respondent had stayed in the same place for more than a year.

Materials

Pen and paper questionnaires. The **Time 1** questionnaire (administered on November 4, 2014, see appendix A2) consisted of four parts including i) demographic information (age, gender, location), ii) current travel behaviour (main travel mode plus frequency of bus use and waking/cycling), iii) ratings of seven aspects of the local bus services (cost, frequency, reliability, space and quality of the buses, behaviour of bus drivers and information provision regarding routes and fares) and iv) a self-classification task. The latter was based on the six bus user segments extracted in Study 2. Respondents were also asked how long they had been living in their current accommodation and whether they intended to walk or cycle to and/or from campus more in the future. The former was meant to establish the likelihood that the respondent had experienced any habit discontinuity recently and whether he or she was in the process of acquiring a new travel routine. Finally, respondents were able to sign up for a guided walking group to show them the best route(s) to Oldfield Park and the City Centre, respectively. The **Time 2** survey (administered on November 25, 2014, see appendix A3) asked respondents i) whether they could remember the content of the flyer they had been given at Time 1, ii) how often they had walked or cycled to campus between Time 1 and Time 2 (3 weeks), and iii) whether they had made any use of the Walking Network during that time.

Flyers. As outlined above (Developing a strategy), one of three double-sided flyers – each containing a different message (i.e. cognitive dissonance, autonomy or standard) – was handed out along with each questionnaire (see **Figure 18**). Participants were instructed to take the flyer home along with the information sheet. Flyers were pre-tested regarding content and motivation potential with a short survey administered to an independent sample of students (N = 65). Three items each questioned the reader to what extent each flyer evoked notions of autonomy and freedom, cognitive dissonance (i.e. a conflict of attitude and behaviour) or being active, saving money and caring about the environment. A fourth question asked respondents how much the given flyer would motivate them to walk or cycle more in the future. All answers were given on a scale ranging from 0 – Not at all, to 4 – Somewhat and 7 – Strongly. The results suggested that each flyer portrayed its message adequately, with the mean representing the intended content of each particular flyer always scoring significantly higher than the two remaining means (all $p < .001$; see **Table 10**). However, the findings also indicated that the flyers were only considered moderately motivating.

Flyer	Autonomy	Cognitive Dissonance	Cost, health and environment	Motivation potential
Autonomy	**5[a] (1.51)**	3.34[b] (1.56)	4.05[b] (2.04)	3.89 (1.47)
Cognitive Dissonance	2.6[b] (1.59)	**4.83[a] (1.70)**	2.8[b] (1.60)	4.08 (1.58)
Cost, health and environment	3.17[b] (1.66)	2.67[b] (1.53)	**5.41[a] (1.70)**	3.75 (1.80)

Table 10. Means and SDs for the manipulation check and motivation potential of flyers; [a,b] Means with a different superscript letter differed significantly from each other at $p < .001$

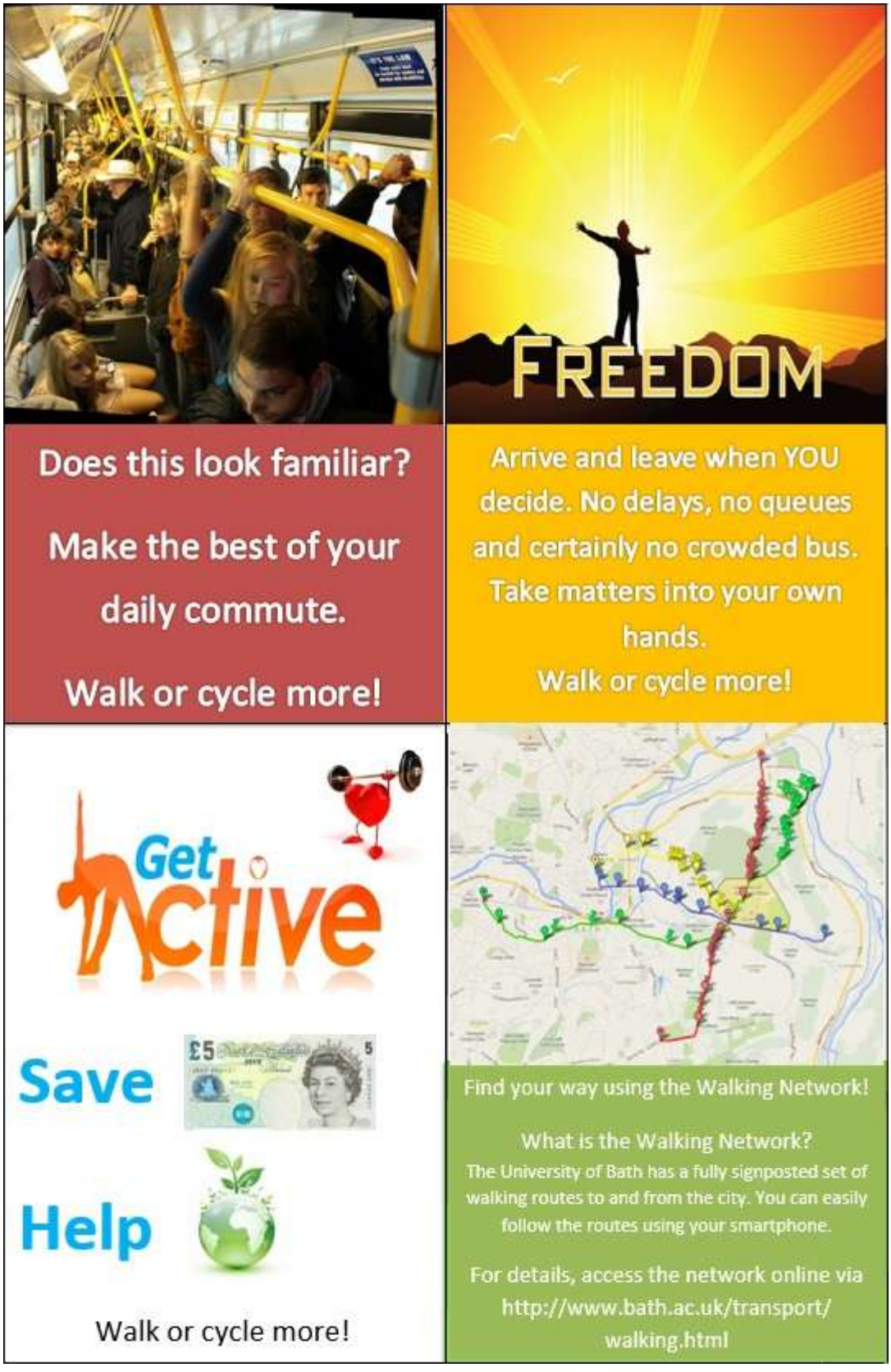


Figure 18. Message flyers front view (top and bottom left) and flipside (bottom right)

Procedure

Near the end of the Psychology lecture, the lecturer introduced the researcher who invited students to take part in the study, stressing that participation was entirely voluntarily and would not affect their course grade in any way. The researcher then explained the purpose of the study to students and handed out the information sheets, consent form as well as the questionnaires and flyers. The latter were sorted into piles beforehand, randomly assigning participants to one of the three experimental conditions using a random number generator. Flyers and questionnaires were handed out in pairs and distributed randomly across the room (each questionnaire was marked by an individual code in order to indicate the flyer condition). Respondents were given sufficient time to fill in the questionnaire and asked to return it to the investigator when they were finished. The researcher then collected the questionnaires for data entry and analysis. Hereby, it was also recorded whether participants had taken the flyers or not, as indicated by the number of flyers that were still attached to returned questionnaires. The same procedure was followed at Time 2. In order to match responses at Time 1 and Time 2, respondents were asked to provide a combination of their initials followed by their birth date (e.g. "JR512" for John Rambo born on May 12).

4.1.2. Analysis and Results

In total, 45 of the 68 students (66%) who filled in the survey at Time 1 also filled in the follow-up survey three weeks later (Time 2). To determine whether any changes in students' travel behaviour occurred, chi-square tests for independence were computed. The chi-square is a goodness of fit measure, as it tests whether an observed distribution fits with the expected distribution if the variables are independent. In other words, the test indicates whether knowing the level of one variable helps to predict the level of another variable (i.e. alternative hypothesis, H_a: the variables are related) or whether the observed distribution is merely due to chance (i.e. null hypothesis, $H_{0:}$ the variables are independent). For a chi-square test to be computed, three assumptions need to be met. All possible samples from the population must be equally likely to occur (i.e. simple random sampling), variables must be categorical and expected cell frequencies (i.e. row x column total / total) should be greater than 5.

Overall, among those who provided information about their active travel behaviour (i.e. walking and/or cycling) at Time 1 and 2 (N = 32 out of 45 or 71%), there was no significant deviation from chance in the distribution of trips made to/from campus by walking or cycling (χ^2 = 4.52, p = .10). However, a third of respondents (8 out of 24) who indicated not having walked or cycled to/from campus at Time 1, did so at Time 2. The observed difference in frequency between those who remained inactive and those who increased their active travel behaviour from Time 1 to Time 2 was significant as indicated by the different subscripts in **Table 11**. Due to the small sample size, statistical power was very low (.25) to detect potential large effects (.5) and insufficient (.07) to detect small effect sizes (.2). Observed and expected cell frequencies are shown in **Table 11**. As expected cell frequencies were less than five in many cases, and thus violating test assumptions, the original table was reduced to a 2x2 format by merging the 1-5 and 5-10 frequency categories and Fisher's exact test (nonparametric) was computed (**Table 12**). This test confirmed the results of the earlier chi-square test (0.1, p > .05), indicating no significant relationship between the variables.

Count		Trips made by walking or cycling at Time 2		Total
		0	1-5	
Trips made by walking or cycling at Time 1	0	16_a (13.5)	8_b (10.5)	24
	1-5	2_a (3.94)	5_a (3.06)	7
	5-10	0_a (.56)	1_a (.44)	1
Total		18	14	32

Table 11. Trips made by walking or cycling at Time 1 & 2 (expected frequency)

Count		Active trips at Time 2		Total
		0	1-10	
Active trips at Time 1	0	16_a (13.5)	8_b (10.5)	24
	1-10	2_a (4.5)	6_a (3.5)	8
Total		18	14	32

Table 12. Active trips at Time 1 & 2 (expected frequency 2x2)

Due to more students reporting bus trips at Time 1 and Time 2 than active travel (N = 45), power was somewhat higher (.31) to detect large effects, yet still very low and insufficient (.075) overall to detect small effects (.2). Regarding bus use, a chi-square test indicated some significant differences between Time 1 and Time 2 (χ^2 = 18.16, p < .01). In particular, 22% of respondents (10/45) increased their bus use from Time 1 to Time 2 (1 from 0 to 1-5 trips, 3 from 1-5 to 5-10 trips and 6 from 5-10 to >10 trips), while another 20% reduced their bus use (5 from 5-10 trips to 1-5 trips and 4 from >10 to 5-10 trips), as can be seen from **Table 13**. Yet, again, the table was reduced to a 2x2 format by merging the two smallest (0 and 1-5) and the two biggest frequency categories (5-10 and >10) and Fisher's exact test statistic was computed to overcome the limitation of small expected cell frequencies (**Table 14**). Like the chi-square test, the latter was also significant (.022, p < .05), suggesting a significant positive relationship between bus use at Time 1 and Time 2 (i.e. dependent variables), showing that the vast majority of students maintained their travel behaviour over time.

Count		Trips made by bus at Time 2			Total
		1-5	5-10	>10	
Trips made by bus at Time 1	0	1_a (0.2)	0_a (.47)	0_a (.33)	1
	1-5	3_a (1.2)	3_a (2.8)	0_b (2)	6
	5-10	5_a (5)	14_a (11.7)	6_a (8.3)	25
	>10	0_a (2.6)	4_a (6.07)	9_b (4.3)	13
Total		9	21	15	45

Table 13. Trips made by bus at Time 1 & 2 (expected frequency)

Count		Trips made by bus at Time 2		
		0-5	>5	Total
Trips made by bus at Time 1	0-5	4_a (1.4)	3_a (5.6)	7
	>5	5_a (7.6)	33_a (30.4)	38
Total		9	36	45

Table 14. Bus trips at Time 1 & 2 (expected frequency 2x2)

Flyer condition

Overall, 12 out of 45 students (36.3%) were able to remember the flyer content at Time 2 (three weeks after the first questionnaire at Time 1). Across flyer conditions, respondents were equally likely to remember the content of the flyer ($\chi^2 = .05$, $p > .97$). Similarly, there was no effect of flyer condition on usage of the Walking Network ($\chi^2 = 4.02$, $p > .40$) with 36 of 45 respondents (80%) indicating that they hadn't made use of or looked up the network, a further 8 respondents (17.7%) who didn't know what the Walking Network was and one person (2.3%) who actually looked up the network (see **Table 15**). In general, respondents who took the flyer home, were more likely to remember the content than respondents who left the flyer in the room or returned it with the survey ($\chi^2 = 4.60$, $p = .03$; see **Table 16**).

Count		Memory of content		Walking Network Usage			Total
		No	Yes	No	Yes	What is the Walking Network?	
Flyer condition	Affective	12_a (11.7)	4_a (4.3)	11_a (12.8)	1_a (.35)	4_a (2.8)	16
	Autonomy	11_a (11)	4_a (4)	14_a (12)	0_a (.33)	1_a (2.67)	15
	Control	10_a (10.3)	4_a (3.7)	11_a (11.2)	0_a (.31)	3_a (2.49)	14
Total		33	12	36	1	8	45

Table 15. Cross-tabulation of flyer condition by Walking Network Usage (expected freq)

Count		Memory of flyer content		Total
		No	Yes	
Flyer taken or not	No	14_a (11)	1_b (4)	15
	Yes	19_a (22)	11_b (8)	30
Total		33	12	45

Table 16. Memory of flyer content depending on whether the flyer was taken or not

In line with the previous results, there was no support for either of the two hypotheses. As can be seen from **Tables 17 through 19**, there was some variation in reported frequencies of travelling to campus by bus or walking/cycling, yet there were no striking deviations that might be traced back to any of the three flyer conditions. Due to splitting the groups by flyer condition, power levels decreased to .17 - .18 for large and .065 for small effects. For the cognitive dissonance message (**Table 17**), no significant differences in frequency of bus use or walking/cycling to campus were observed ($\chi^2 = 9.24$, $p = .16$ and $\chi^2 = .48$, $p > .49$, respectively). For the autonomy message (**Table 18**), a marginally significant result was obtained for bus trips ($\chi^2 = 8.49$, $p = .075$), according to which 33.3% (5 out of 15) of students reported increased bus use at Time 2. No significant difference was observed for trips made by walking or cycling ($\chi^2 = 3.59$, $p = .17$). Finally, a marginally significant result emerged for bus trips in the standard message condition ($\chi^2 = 8.04$, $p = .09$; **Table 19**) with respondents reporting 5-10 trips at Time 1 reporting either more (i.e. >10 trips; N = 2) or less (1-5 trips; N = 2) trips at Time 2. Again, no significant results were observed for walking/cycling trips to campus ($\chi^2 = .20$, $p > .65$).

Count (Affective message)			Trips made by bus, walking or cycling at Time 2				Total
			0	1-5	5-10	>10	
Trips made by bus, walking or cycling at Time 1	0	Walked/cycled	6_a	2_a	-	-	8
		Bus	-	1_a	0_a	0_a	1
	1-5	Walked/cycled	1_a	1_a	-	-	2
		Bus	-	1_a	1_a	0_a	2
	5-10	Walked/cycled	-	-	-	-	-
		Bus	-	1_a	5_a	1_a	7
	>10	Walked/cycled	-	-	-	-	-
		Bus	-	0_a	3_b	3_b	6
Total		Walked/cycled	7	3	-	-	10
		Bus	-	3	9	4	16

Table 17. Cross-tabulation of trips made by walking/cycling at Time 1 and at Time 2 (cognitive dissonance message condition)

Count (Autonomy message)			Trips made by bus, walking or cycling at Time 2				Total
			0	1-5	5-10	>10	
Trips made by bus, walking or cycling at Time 1	0	Walked/cycled	4_a	3_a	-	-	7
		Bus	-	-	-	-	-
	1-5	Walked/cycled	0_a	3_a	-	-	3
		Bus	-	0_a	2_a	0_a	2
	5-10	Walked/cycled	0_a	1_a	-	-	1
		Bus	-	2_a	4_a	3_a	9
	>10	Walked/cycled	-	-	-	-	-
		Bus	-	0_b	0_b	4_a	6
Total		Walked/cycled	4	7	-	-	11
		Bus	-	2	6	7	15

Table 18. Cross-tabulation of trips made by walking/cycling at Time 1 and at Time 2 (autonomy message condition)

Count (Control message)			Trips made by bus, walking or cycling at Time 2				Total
			0	1-5	5-10	>10	
Trips made by bus, walking or cycling at Time 1	0	Walked/cycled	6_a	3_a	-	-	9
		Bus	-	-	-	-	-
	1-5	Walked/cycled	1_a	1_a	-	-	2
		Bus	-	2_a	0_a	0_a	2
	5-10	Walked/cycled	-	-	-	-	1
		Bus	-	2_a	5_a	2_a	9
	>10	Walked/cycled	-	-	-	-	-
		Bus	-	0_a	1_a	2_a	3
Total		Walked/cycled	7	4	-	-	11
		Bus	-	4	6	4	14

Table 19. Cross-tabulation of trips made by walking or cycling at Time 1 and at Time 2 (standard message condition)

Cross-validation of bus user segments

In general, all segments were female dominated due to the high overall percentage of female students in the sample. Notably, more than half of students selected the "All fine on the Weston front" segment to describe themselves, reflecting Convenience users. **Table 20** shows the demographic and travel-related variables for each bus user segment. The most common bus use frequency in a typical week was a moderate 5-10 trips (N = 34 or 50%), followed by high-frequency users (i.e. >10 trips; N = 17 or 25%) and irregular users (i.e. <5 trips; N = 17 or 25%). For walking and cycling, almost half of respondents reported no regular trips to or from campus at all (N = 32 or 47%), while 13 (19%) reported infrequent (1-5) trips and six students (9%; all Mode Mixers) reported a moderate (1-5 trips; N = 3 or 4.5%) or high number (>10 trips; N = 3 or 4.5%) of trips by bicycle or foot, respectively. As might be expected, Mode Mixers and Car curtailed users do not usually own a bus pass and their main modes tend to be walking or cycling (Mode Mixers) or driving by car or motorcycle (Car curtailed).

A multivariate analysis suggested a marginally significant effect of students' bus user type choices on ratings of bus service aspects (Wilk's $\lambda = .46$; $F_{35,238} = 1.38$, $p = .09$), which were subsequently tested further using LSD post-hoc comparisons (see **Table 21**). Significant differences between segments emerged for ratings of the frequency of service ($F_5 = 2.15$, $p = .07$), the space on ($F_5 = 2.81$, $p = .02$) and the quality of buses ($F_5 = 3.98$, $p < .01$), as well as the behaviour of bus drivers ($F_5 = 2.20$, $p = .07$).

Segment/ Variables	Mode Mixer	Wannabe Walker	All fine on the Weston front	First fan	Car curtailed	Daily drag
Age (Mean/SE)	19.63 (.26)	19.50 (.27)	19.49 (.11)	19.60 (.25)	19.00 (.00)	20.00 (.22)
Gender (F/M)	6/2	8/0	33/2	4/1	4/1	5/2
Location CC/OP/OT*	4/2/2	3/4/1	10/19/6	0/4/1	2/1/2	2/4/1
Main mode Bus/BC/Car/ MC/W**	2/1/0/ 0/5	8/0/0/ 0/0	34/0/0/ 0/0	5/0/0/ 0/0	1/0/3/ 1/0	7/0/0/ 0/0
Trips by bus 0/1-5/5-10/>10	1/7/0/0	0/2/5/1	0/1/23/11	0/1/1/3	3/1/1/0	0/1/4/2
Trips by bicycle/foot 0/1-5/5-10/>10	0/2/3/3	3/2/0/0	19/6/0/0	4/0/0/0	4/1/0/0	2/2/0/0
Bus pass (Y/N)	2/6	6/2	35/0	5/0	0/5	6/1
Intention to walk or cycle more (Y/N)	2/6	2/6	10/25	0/5	2/3	2/5
Desire to attend walking group (Y/N)	1/7	2/6	7/28	1/4	1/4	0/7

*Table 20. Demographic variables and travel behaviour of each bus user type (Note: time lived in current accommodation has been omitted since 94% of respondents reported having lived less than three months in their current place); *CC = City Centre, OP = Oldfield Park, OT = Other; **BC = Bicycle, MC = Motorcycle, W = Walking*

Segment/ Bus service aspect	Mode Mixer	Wannabe Walker	All fine on the Weston front	First fan	Car curtailed	Daily drag
Cost	4.00[a] (1.41)	3.75[a] (1.17)	4.66[a] (1.11)	4.80[a] (1.30)	3.80[a] (1.64)	3.71[a] (1.29)
Frequency	4.38[acd] (1.51)	2.88[b] (1.46)	3.97[abcd] (1.40)	5.20[ac] (.45)	3.80[abcd] (1.79)	3.14[abd] (1.86)
Reliability	4.00[a] (1.85)	2.88[a] (1.81)	3.54[a] (1.48)	4.20[a] (.84)	4.40[a] (1.52)	2.71[a] (2.06)
Space	3.63[a] (1.85)	2.13[b] (1.25)	3.14[ac] (1.22)	3.00[abc] (.71)	2.40[abc] (1.14)	1.71[b] (.95)
Quality	4.63[a] (1.41)	2.88[b] (1.64)	4.80[a] (.87)	4.60[a] (.55)	3.80[ab] (1.64)	4.00[ab] (1.63)
Behaviour	5.13[ad] (.64)	3.88[b] (2.03)	4.94[cd] (.97)	5.00[abcd] (.71)	4.00[abcd] (1.23)	3.86[ab] (1.95)
Information	4.38[a] (1.19)	3.88[a] (2.17)	4.34[a] (1.16)	4.80[a] (.84)	3.60[a] (1.14)	3.71[a] (1.89)

Table 21. Satisfaction with bus service aspects by bus user segment (1 - Very dissatisfied, 7 - Very satisfied; highest/lowest rating marked in green/red). Means with different superscript letters differed significantly at α = .05 according to LSD post-hoc comparisons.

Below, each bus user segment will be considered in turn.

Mode Mixers. Mode Mixers represented the group with the lowest proportion of bus users with a bus pass (25%) and the highest proportion of students with equal to or more than 5 trips per week by foot or bicycle (100%). In spite of being slightly dissatisfied with space on the bus, they were significantly more satisfied with the space than both Wannabe Walkers and Daily Drags. At the same time, they were also significantly more satisfied with the behaviour of bus drivers, the quality of buses and the frequency of service than the Wannabe Walkers. Overall though, Mode Mixers were fairly neutral regarding most service aspects (i.e. cost, frequency, reliability and information about routes and fares).

Wannabe Walkers. Notably, bus users in this segment were most dissatisfied with the frequency and quality of buses and fairly dissatisfied with the space on the bus. Furthermore, Wannabe Walkers were about equally neutral with regards to cost, information provision and the behaviour of drivers. Most users of this segment owned a bus pass (75%), yet only two respondents (25%) reported a desire to walk or cycle more in the future.

All fine on the Weston front. Somewhat dissatisfied with the reliability of service and space on the bus, members of the by far largest of all segments (N = 35 or 51% of the whole sample) indicated being relatively (somewhat) satisfied with the cost and quality of buses as well as the behaviour of bus drivers. Moreover, they were neither dissatisfied nor satisfied with information provision and the frequency of service. Heavily relying on the bus (N = 34 or 97% with >5 trips/week), every student in this segment owned a bus pass and more than half (N = 19 or 54% of the segment) reported never walking or cycling to/from campus. Nevertheless, almost a third of respondents (N = 10 or 29%) showed

some intention to walk or cycle to campus more in the future and every fifth respondent indicated the desire to participate in a walking group (N = 7 or 20%).

First Fans. Only somewhat dissatisfied with the space on buses, First Fans generally tended to be somewhat satisfied with all service aspects, except reliability on which they scored rather neutral. Like the All fine on the Weston front bus users, First Fans used the bus extensively (3 out of 5 with more than 10 trips/week) and never walked or cycled to/from campus. Each First Fan owned a bus pass and did not indicate any intention of alternating modes in the future.

Car Curtailed. With three car users and one motorcyclist, this segment was dominated by students primarily relying on private motorized transport. This was complemented by the fact that this was the only segment with no bus pass owners in it. Like the Wannabe Walkers and Daily Drags, these occasional bus users were dissatisfied with the limited space on buses. As might be expected of (future) car owners, they were slightly dissatisfied with information on routes and fares, while remaining fairly neutral on the remaining aspects. Surprisingly, Car curtailed users rated reliability of the services higher than all the other segments (albeit not significantly so) which might be attributable to their lack of experience with the bus services.

Daily Drags. Daily Drags were deeply dissatisfied with the space on buses (lowest score of all segments) and even more dissatisfied with the reliability of service than the Wannabe Walkers. In addition, they were somewhat malcontented with the frequency of service and just barely neutral about the remaining aspects (cost, quality of buses, driver behaviour and information). With all but one of the Daily Drags owning a bus pass, only two respondents each reported walking or cycling to/from campus occasionally (1-5 trips/week) and intending to walk or cycle more in the future.

4.1.3. Discussion

The objective of the present intervention was to encourage walking to campus among a group of second-year Psychology student bus users who had only recently relocated, forcing them to develop a new travel routine. It was hypothesized that providing (dissatisfied) student bus users with a flyer displaying either an autonomy, affective or control message coupled with information about access to the Walking Network, would be effective in raising awareness of alternatives to public transport and encouraging more active travel to campus.

Flyer intervention

Regarding the different message types, it was hypothesized that the message stressing the autonomy of active travel would be most effective, followed by an affective message stressing the negative experience of bus travel and a standard message, stressing the cost, health and environmental benefits of walking or cycling to campus. The results, however, suggested that none of the messages provided was effective in producing behaviour change. Although 80% (36 out of 45) of respondents were able to recall the Walking Network, only one person reported using it (2.3%). There were no differences between flyer conditions either, indicating that none of the messages had any effect beyond increasing awareness of the Walking Network. Among the likely explanations for the null-findings is a misperception of travel time of the available

alternatives (i.e. walking or cycling), the sunk costs of owning a bus pass, but also a general unwillingness to switch modes.

Overall, a high proportion of students in the current study reported using the bus either out of convenience (All fine on the Weston front, 51%) or because they enjoyed bus travel (First Fans, 7%), whereas others indicated that they did not use the bus regularly because they were already using different modes, such as walking, cycling, a car or motorcycle (i.e. Mode Mixers and Car Curtailed, 19%). Convenience users (All fine on the Weston front), in particular, may be prone to overestimate the travel time required by alternatives to the bus. Just as car drivers may overestimate the travel time using public transport (Van Exel & Rietveld, 2010), the same may apply to public transport users' perceptions of active travel. In addition, potential time savings, such as freedom from the need to exercise, by moving from sedentary bus use to active travel, might be hardly considered (Aldred, 2015).

Even if there was a potential gain in travel time incurred by walking, the traditional framing of travel time as time that is "unproductive, wasted time in-between 'real' activities and which should be minimised" highlights a general problem with how travel and travel time are perceived (Lyons & Urry, 2005, p. 257). Rather than being time lost, active travel may be an inherently valuable experience that benefits from high levels of autonomy (Thomas, Walker & Musselwhite, 2014), promotes positive affect, such as excitement or relaxation (Gatersleben & Uzzell, 2007), and increases mindfulness and time affluence leading to a better attunement with one's commute (LaJeunesse & Rodríguez, 2012). While the dissatisfied Wannabe Walkers may be aware of these benefits, other groups, such as the Daily Drags, may not. Emphasising or, better yet, getting students to experience these qualities of active travel, might thus be crucial. This may be difficult to achieve, however, as another likely explanation for the null-findings is the high rate of bus pass owners (79% or 54 out of 68) among participants. Owning a bus pass indicates that a commitment to use the bus has been made, which would result in 'sunk costs' when using a mode other than the bus. In addition, there was only a low proportion of Wannabe Walkers and Daily Drags in the study sample (together only 22% or 15 out of 68), who might be the most willing to change their bus use because they are not satisfied with the way they travel at the moment. Nevertheless, 26% of respondents indicated some desire to walk or cycle more in the future, suggesting that there might be scope for behaviour change.

Cross-validation of segments

In addition to testing the effectiveness of the three types of messages, the current study also tested the proposed classification of bus users which was derived in Study 2 and aims to be globally representative. Although participants were forced to make a choice between the six descriptions provided, the findings clearly indicated that the six groups of bus users can be distinguished effectively. Despite there being a high prevalence of Convenience (All fine on the Weston Front) users – which is plausible given the amount of time and effort required for active travel compared to using the bus – all categories were used by respondents. Participants also had the opportunity to comment on their choice, yet no comments were made.

Mode Mixers and *Car Curtailed* bus users hold a fairly neutral opinion regarding the bus services and rely on them less than the other groups, which is also reflected in the low share of students with a bus pass in these segments (15%). Instead, the former frequently alternate between (sustainable) travel modes (e.g. bus, walking and cycling), whereas the latter prefer private motorized transport (i.e. car or motorcycle). Car curtailed users were also dissatisfied with the space on buses, supporting their preference for private motorized transport.

In contrast, those in the *All fine on the Weston front* segment, and *First Fans*, heavily rely on the bus, usually own a bus pass (combined 39/40 or 97.5%) and are relatively satisfied with the buses (except for space on the bus). None of the *First Fans* showed any intention to walk or cycle more in the future, underlining the *First Fans*' attachment to the bus. *All fine on the Weston front* users, on the other hand, expressed some desire to walk or cycle to/from campus more in the future (29%), indicating that they may not be as attached to the bus as the First Fans, but rather use it out of convenience. A fifth of respondents also showed some interest in taking part in the walking group, illustrating that mode shift might be encouraged.

Finally, *Wannabe Walkers* and *Daily Drags* were the most dissatisfied with the bus services, with all but one (Quality of the buses for the *Daily Drags*) of their satisfaction ratings falling below the midpoint of the scale. Eighty percent (12 out of 15) of student bus users in these segments owned a bus pass and only about a quarter (4 out of 15) expressed some intention to walk or cycle more in the future. A major impediment to the uptake of more active travel among these types of bus users may be the sunk costs of not using their already owned bus pass. This, in turn, may open the possibility to support the uptake of active travel once their current bus pass expires, given that their dissatisfaction with the service remains unresolved.

Limitations

One of the supposed strengths of the current study design was the chosen timing of the intervention. By intervening only a few weeks after second-year students had just moved residence (i.e. from on-campus to off-campus locations), it was hypothesized that students would be more receptive to information on alternatives to bus travel during this period of transition. However, as the results suggested, the window of opportunity for a change in travel routine may already have been shut.

As proposed in earlier research, the window of opportunity for a change in travel habits after relocation may be as small as four weeks (Walker, Thomas & Verplanken, 2015), although more recent evidence suggests that the window may last up to three months (Verplanken & Roy, 2016). Close to 80% of students possessed a bus pass at Time 1 of the study which was already 4 weeks after the beginning of the semester. It should be noted that local bus companies start advertising bus passes to students well before the beginning of the semester and this is usually supported by the Student's Union (SU). The results suggest that most students had already established their travel routine by the time of the study and thus may have been less receptive to new travel information. Specifically, it has been shown that strong habit travellers' choice processes tend to be less elaborate than those of weak habit travellers (Verplanken, Aarts & van Knippenberg, 1997) because they may act within a habitual mind-set that prevents them from considering other possible courses of action (Verplanken & Aarts, 1999).

Probably, the outcome of the intervention would have been more positive if it had taken place shortly *before* students moved residence and bought a bus pass, rather than after.

Another limitation concerns the chosen method itself. Although flyers constitute a very common approach that is often used in the real world by employers and healthcare providers, the persuasiveness of the messages designed for the current study has been clearly insufficient to motivate students to walk or cycle to campus instead of using the bus. Due to the inadequate timing and low power of the present study (see below), however, no firm conclusions can be drawn about the effectiveness of particular message types including autonomy- or cognitive dissonance-based vs standard messages. Steg and Vlek (2009) suggest that "informational strategies in themselves are especially effective when pro-environmental behaviour is relatively convenient and not very costly (in terms of money, time, effort and/or social disapproval), and when individuals do not face severe external constraints on behaviour" (p. 313). As, due to the locality of the University of Bath campus, walking or cycling to campus may be perceived as both inconvenient and costly (effortful) alternatives, this might explain why behaviour uptake was equal to zero. Additionally, previous research has illustrated that intention on its own may be insufficient as a predictor of behaviour (Davies, Foxall & Pallister, 2002; Prestwich, Perugini & Hurling, 2008), especially if habit strength is high (e.g. De Bruijn et al., 2007), thus providing a likely explanation why even the *Wannabe Walkers* (12%), who would like to travel actively, did not do so, as they were accustomed to using the bus. It should also be noted that 74% of sampled students did not show any intention to walk or cycle more in the future in the first place (see **Table 20**), thus indicating significant barriers to change.

Further methodological weaknesses included the low levels of statistical power due to small sample size. To detect potential large effects (.5) at an $\alpha = .05$ significance level with .80 power, a sample size of at least N = 161 would have been required. This would have been more than the entire second-year Psychology class at that time (N = 106). It follows that, for future interventions, the inclusion of additional (non-Psychology) second-year students would be desirable. Another issue is the lack of a pre-intervention baseline measure which, due to time constraints (i.e. intervening before habit formation), could not be implemented, as well as a lack of tailoring of specific messages to particular target groups. Ideally, the intervention would have been tailored to bus user segments with the greatest potential to change their behaviour (e.g. the Wannabe Walkers). This, in turn, would have required a much larger sample of students which, again, could not be realized within the available time frame. Also, at this point, the bus user segments had not been cross-validated with an independent sample, thus rendering their use for the intervention study premature. Finally, there were some concerns with the study materials due to overlapping response categories in two of the questionnaire items including the frequency of bus use (1-5 and 5-10 trips per week; should have been 6-10 trips per week) and time spent living in the current accommodation, where response categories were not mutually exclusive (e.g. "less than 4 weeks" also being "less than three months"). The possibility that some participants did not use the response categories correctly may be small, yet cannot be excluded. A continuous frequency measure and mutually exclusive response categories should be employed in future research.

Implications

The findings of the present study have three major implications for theory and practice.

- First, the results provide evidence that persuasive, dissonance- or autonomy-based, messages by themselves may be insufficient to motivate behaviour change, as can be said of commonly used messages stressing the cost, health and environmental benefits of active travel. With convenience emerging as a key motivator for most students, a cultural shift in the perception of travel time towards a more positive, gain-focused, rather than a negative, loss-focused, framing, may be required. Yet, as long as commuting time to campus/work is continued to be perceived as a loss rather than an inherently valuable experience in itself, such as when walking/cycling up the hill, little hope of initiating behaviour change beyond motivated subgroups (such as the *Wannabe Walkers*) may be given.
- Second, the findings support the value of distinguishing different traveller types (here: bus users), some of which (*Wannabe Walkers* & *Daily Drags*) may be encouraged to travel more actively and sustainably in the future. The results thus strengthen the findings obtained in Study 2 showing that not only strong parallels exist to car use motives (convenience), but also that the motives to use the bus differ among its users. In general, higher institutions and workplaces may be advised to carefully consider the variety of travel preferences that their commuting staff and visitors hold, because it may be in this variety where the answer for successful (tailored) behaviour change initiatives can be found.
- Finally, the current results alert to the importance of administering interventions at the right point in time. Recent research suggests that there may be a brief window (< 3 months) of opportunity for behaviour change measures following relocation (Verplanken & Roy, 2016). The results of the present study indicate that this window may be significantly shorter, especially in the context of travel mode choice, and that, as a consequence, interventions might need to be initiated well before current habits are disrupted.

Future research

As the current study has not found dissonance-based, autonomy or cost, health and environmental appraisals to be effective in influencing travel behaviour, future behaviour change interventions should employ additional or different approaches for encouraging a shift to active travel, such as (public) commitment, goal-setting or block leader approaches (Abrahamse & Steg, 2013; Dwyer, Leeming, Cobern, Porter & Jackson, 1980). If possible, these approaches should be tailored to specific subgroups of drivers or public transport users, to increase their effectiveness and thus maximise their outcome. In addition, future interventions should be targeted at participants immediately after or, better yet, before relocation – in this case, before students move and commit themselves to a bus pass – as the window of opportunity may already be open before the anticipated change in context (Verplanken & Roy, 2016).

Regarding the measures employed, a useful addition could be the use of pedometers to monitor the physical activity levels of participants. Although walking to public transit may help people reach recommended levels of physical activity (Besser & Dannenberg, 2005), it might be particularly interesting to study which groups of public transport users achieve the commonly cited 10,000 steps a day threshold (Dubuy et al., 2013). For this purpose, participants could be asked to record their daily accumulated steps in a travel diary, which could then then be compared between different types of bus

users and users of alternative modes of travel. Furthermore, this should be accompanied by measures of the affective appraisal of the commute (Gatersleben & Uzzell, 2007; Thomas & Walker, 2015), as well as measures of mindfulness and time affluence (LaJeunesse & Rodríguez, 2012)

4.1.4. Conclusion

The third consecutive and, at the same time, final study on bus users has complemented and confirmed the results of Study 1 and Study 2. Consistent with the findings of Study 1, the present study has revealed significant differences in the perception of service provision by the local bus companies. Congruent with expectations based on the results of the second study, the six previously extracted bus user segments were successfully cross-validated, as collected data closely matched participants' chosen bus user types in the self-classification task. Segments, however, still need to be validated with a general population sample. With regard to walking to campus, no behaviour change could be encouraged in this particular sample although, overall, the current results suggest that about a quarter of current bus users may be encouraged to travel more actively and sustainably. That is, 26.5% (or 18/68) of respondents indicated the desire to walk or cycle to campus more in the future, thereby potentially relieving the strain on current service providers at peak times during the semester and increasing the attractiveness of public transport as an alternative to the car for student and staff car drivers. It has become apparent that encouraging such a shift will require not only well-timed and persuasive messages, but also the involvement and commitment of the whole university and local city council, since broader structural and cultural changes may be required to shape the environment to actually enable such a shift.

In line with the overarching aim of the thesis to encourage healthy and sustainable travel in a university setting, the subsequent study chapter will broaden the focus to include other mode users. Although bus users' motives and needs, as well as their mode switching potential, have been subject to much neglect in previous literature, bus users are but one group of travellers and only represent the majority among student travellers. It is thus pivotal to also consider other mode users and their mode switching potential, especially since bus users are not the major culprit of transport emissions, which may be traced back to the large proportion of car users, primarily among staff. Understanding the motives of the latter, but also those of walkers and cyclists, should thus assume equal importance. Furthermore, it is important to note that users of different modes – be it public transport, car or active travel – may actually share common goals and values. That is, just like the same behaviour can take place for different reasons, different behaviours can take place for the same reason. Building on the segmentation approach taken in Study 2, Study 4 (presented in the next chapter) thus suggests that, independent of mode choice, common traveller types can be distinguished based on their attitudes and values. These traveller types, in turn, each represent a unique combination of goals and values that restrain their mode switching potential to those alternatives that come closest to fulfilling their goals. Under the theoretical framework of *Goal Framing Theory* (Lindenberg & Steg, 2007), introduced in Section 1.3.2., Chapter 5 thus offers a review of travel behaviour segmentation research to date while, at the same time, offering a new perspective of mobility styles or traveller types, respectively.

Chapter 5 – Do supra-modal traveller types exist?

(Please note that some parts of the following chapter may overlap with a paper version of the study that may reappear in a later publication)

Introduction – Travel market segmentation research to date

The previous series of studies on current bus users (Studies 1, 2 and 3) has illustrated the importance of recognizing the diversity among travellers' motives. Assuming that a one-size-fits-all transport strategy alone will produce shifts in the travel behaviour of the population at large would be misguided, as there may be different population segments that share specific attitudes, worldviews and preferences (Anable, 2005). For example, public transport services may be regarded as dirty and unreliable by some or as an opportunity for pleasant encounters and to relax by others (Beirão & Cabral, 2007). As a consequence, policy makers and scientists alike have acknowledged the need to unveil the differing motivations underlying travellers' modal practices and have done so by conducting travel market behaviour segmentations (Jensen, 1999; Kaufmann, 2000); see also segmentproject.eu for a recent application).

Various travel market segmentations, where transport users of a particular mode (e.g. car) or a combination of modes are distinguished based on attitudinal, demographic and/or travel-related information (**Figure 19a**), have now been employed with general population samples (e.g. Diana & Mokhtarian, 2009; Pronello & Camusso, 2011), but also with more specific target groups such as day-trip travellers (Anable, 2005), elderly people (Haustein, 2012) or tourists (Dolnicar, 2002). Most of this segmentation research has either focused on cyclists (Bergstrom & Magnusson, 2003; Dill & McNeil, 2013; Zhibin, Wang, Yang & Ragland, 2013), or car and (potential) public transport users (Anable, 2005; Beirão & Cabral, 2008; Cools et al., 2009; Jensen, 1999). This has shed light on the individual motivations of particular mode users, yet has not addressed the more central question of whether different *supra-modal* traveller types can be distinguished more broadly. If the latter were to be the case, this would have significant implications for policy interventions that are tailored to specific audiences based on their mode choice – first and foremost, car users. This is because the underlying assumption being made is that, rather than solely being driven by particular attitudes towards mode X, people may hold basic underlying preferences (e.g. cost- and/or time-efficiency, convenience, comfort or ecological footprint) regarding their individual mobility which a) depending on context, can be fulfilled by various transport options and b) they thus may carry over to *any* transport mode they are using. Consequently, the objective of the current study was to test whether a mode-independent segmentation study that segments travellers solely based on their preferences, habit, satisfaction and values, *irrespective* of their mode choice or travel behaviour per se (**Figure 19b**), would converge or diverge from the integrated findings of past research.

Initial attempts at such a distinction have been carried out by Jacques, Manaugh and El-Geneidy (2013), who distinguished travellers based on their trip practicality and satisfaction, and Pronello and Camusso (2011) who strived "to define homogeneous travellers' groups based only on attitudinal variables, regardless of the behaviour in terms of mode and trip purpose" (p. 1297). But there is another caveat with present segmentation research that deserves attention.

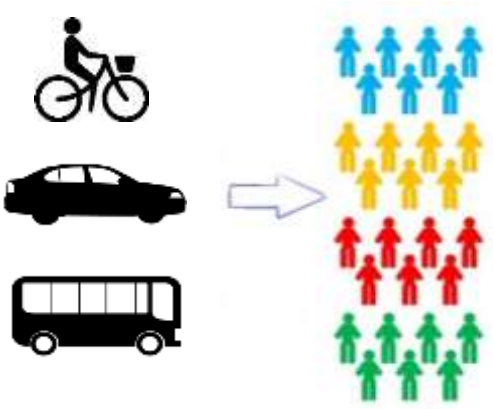


Figure 19a. Past segmentation research

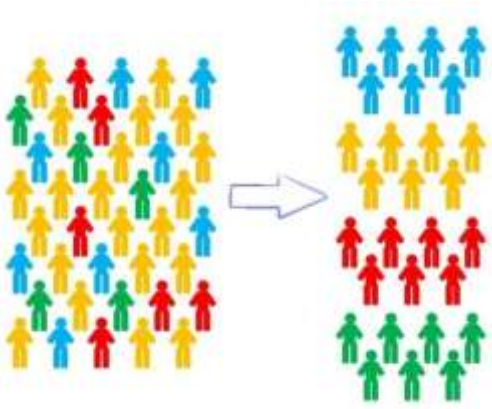


Figure 19b. The present research

The search for an integrative approach

An as yet unresolved issue regarding the segmentation research to date is that, to a large extent, this research has occurred independently without a thorough integration of findings. This lack of integration, in turn, may be traced back to a lack of theoretical foundation of most previous segmentation work. Commonly originating from a largely atheoretical social marketing approach (Corner & Randall, 2011), it is hardly surprising that most segmentations to date have not been guided by theory (see Anable, 2005, for an exception). Consequently, any further travel market segmentations may contribute only moderately to the existing body of literature. It follows that a theory-guided integration of the findings from past travel behaviour market segmentation research is long overdue. After all, on the one hand, mobility types such as Anable's (2005) *Complacent Car Addicts*, Jensen's (1999) *Passionate Car Drivers* or Jacques, et al.'s *Dedication* cluster (2013; Chapter 1) share important features, such as attachment and satisfaction; yet, on the other hand, they also add unique parts to the identification of clusters of transport users, that is, normative concerns (*Aspiring Environmentalists*; Anable, 2005) and practicality (Jacques et al., 2013), respectively. A theory that can reflect travellers' affective, instrumental and normative motives (Gardner & Abraham, 2007; Lois & López-Sáez, 2009; Mann & Abraham, 2006; Steg, 2005), independent of their personal mode choice (Pronello & Camusso, 2011) may thus be needed, and there might be no better theory than Goal Framing Theory (GFT), which has been introduced in Chapter 1 (see Section 1.3.2.), to fulfil these requirements.

Combining what we know - How GFT might relate to earlier segmentation work

Goal framing theory's focus on affect (hedonic goal), resource management (gain goal) and socially acceptable behaviour (normative goal) suggests it bears high potential to feed into travel behaviour market segmentation analyses since, ultimately, all travel is goal-directed, if only for the intrinsic satisfaction of movement.

The three goal frames may provide a parsimonious way to summarize the various attitudinal variables that have been used in previous segmentation research. Hedonic goals, for instance, may be reflected in the *journey-based affect* that people anticipate from their travel mode choice (Anable, 2005; Mann & Abraham, 2006), whereas goals that are related to the management or improvement of one's resources may be reflected in the practicality (e.g. cost, time and effort) of people's current travel behaviour (Jacques et al., 2013). Finally, attitudes towards the environment or the benefits of sustainable

travel (Anable, 2005; Barr & Prillwitz, 2012) may be expected to translate into normative goals (i.e. doing the right thing). The huge potential of GFT can also be observed when applied retrospectively to existing segmentations. **Table 22** provides an overview of different travel behaviour market segments that have been identified in previous research and aligns them with GFT to highlight commonalities between individual segments. As most segmentation studies used a different combination of variables or method to derive clusters, only those factors common to the various approaches are considered. Here, hedonic goals are represented primarily through attachment to the car or public transport modes, which has been a popular way to distinguish between *Carless Crusaders* (i.e. those primarily using alternative modes of travel; Anable, 2005) and the variously labelled *Complacent / Die Hard / Obstinate* or *Passionate Drivers* (i.e. those with a strong attachment to the car; Anable, 2005; Beirão and Cabral, 2008; Jensen, 1999). Gain goals consider distinctions based on instrumental motives such as cost, time and effort, whereas normative goals reflect concerns about others or the environment. Two factors from Jensen's (1999) work that did not feature in other mentioned segmentation studies (i.e. freedom/independence and habit) are included as well, due to their high salience in previous literature (e.g. Klöckner & Matthies, 2004; Mann & Abraham, 2006; Thomas & Walker, 2015; Thomas, Walker & Musselwhite, 2014), as is the TPB factor *Perceived Behavioural Control* (PBC) used by Anable (2005) which may also be expected to be an important aspect in distinguishing transport users.

As an example of the congruence between GFT and common travel behaviour market segments, consider Anable's (2005) *Aspiring Environmentalists* versus *Die Hard Drivers*. Whereas the latter appear strongly guided by hedonic goals (i.e. great pleasure in driving paired with a high attachment to the car), the former may primarily adhere to normative goals (i.e. a mix of high environmental concern and relatively low attachment to the car). This non-coincidental overlap illustrates that combining segments and theory in this way, a more adaptive and theory-based travel behaviour market segmentation scheme may be developed.

5.1. Study 4 – "All animals are equal, but some animals are more equal than others." (George Orwell) – Distinguishing supra-modal travel behaviour market segments

To determine whether GFT is indeed a useful framework to arrive at an overarching traveller type classification, data from a large-scale quantitative survey was used to segment a sample of current staff and student commuters to the University of Bath via cluster analysis. First, respondents were asked to rate the importance of four values (i.e. altruistic, biospheric, egoistic and hedonic), reflective of the three goal frames for which currently no scale exists, as guiding principles in their lives. This was followed by the importance of seven travel-related factors – including comfort, convenience, cost, travel time, effort, environment and independence – to their own travel preferences. Respondents then answered questions about their habit and satisfaction related to their current main mode of travel. This information was then used to identify unique traveller type segments. Respondents were also asked to choose one of seven traveller type descriptions, adopted from previous segmentation research, which they felt described them best. In this way, some cross-validation of findings was enabled. The initial survey was pilot-tested on a University Open Day (not reported) and repeated with a larger sample obtained from a bi-annual University Travel Survey (UTS, 2014/15).

Goal frames/PBC/ Freedom/ Habit **Travel segments**	Hedonic goals Attachment (Car/PT)	 Satisfaction (Car/PT)	Gain goals Practicality (i.e. cost, time and effort)	Normative goals Environmental concern	Control beliefs Perceived behavioural control	Freedom Independence	Habit Habit strength
Aspiring Environmentalists (adopted from Anable, 2005) are motivated to reduce their use of unsustainable travel modes such as the car or long-haul flights driven mainly by environmental concerns (high normative). However, they are still dependent on these modes, usually for reasons of practicality (gain), such as using the car for shopping tours or leisure trips.							
Aspiring Environmentalists[1,7]	**-**	**o**	**+**	**+**	**o**	**+**	**-**
Mode mixers (PT)[3]	**-**	**o**	**+**	**?**	**+**	**+**	**-**
Leisure time car drivers[5]	**-**	**o**	**+**	**+**	**o**	**+**	**-**
Committed Environmentalists are dedicated travellers who travel sustainably (mostly by walking or cycling) for the sake of the environment. They are strongly committed to their mode, even in the face of adversities such as bad weather, and try to avoid unsustainable modes of transportation whenever possible (exceptions might include taking a flight overseas or moving house).							
Committed Environmentalists[7]	**- (Car)**	**+**	**o**	**+**	**+**	**o**	**+**
Car-less Crusaders[1]	**- (Car)**	**- (Car)**	**o**	**+**	**+**	**o**	**+**
Civic ecologists[6]	**- (Car)**	**+ (PT)**	**o**	**+**	**+**	**o**	**+**
Green Cruisers[2]	**- (Car)**	**+ (PT)**	**o**	**+**	**+**	**o**	**+**
Convenience (Jacques, Manaugh & El-Geneidy, 2013) users stick to their current travel mode because it provides the least complicated and least effortful choice (high hedonic) while, at the same time, performing well in gain aspects such as cost and travel time. They have no intention of switching modes in the near future, unless an even more convenient option arises.							
Convenience[3]	**+**	**+**	**+**	**?**	**?**	**?**	**?**
Convenience at any cost	**+**	**+**	**+**	**-**	**o**	**+**	**-**
PT users of convenience[5]	**o**	**o**	**+**	**o**	**o**	**o**	**+**
Everyday car drivers[5]	**+**	**o**	**+**	**o**	**o**	**+**	**+**
Time servers[7]	**-**	**o**	**+**	**-**	**o**	**-**	**+**

Goal frames/PBC/ Freedom/ Habit **Travel segments**	Hedonic goals Attachment	 Satisfaction	Gain goals Practicality	Normative goals Environment	Control beliefs PCB	Freedom Independence	Habit Habit strength
Dedication (Jacques et al., 2013). Dedicated users have a strong emotional attachment to their current travel mode (high hedonic) and would never think of travelling any other way. They are highly habitual users and, in the case of private (motorized) transport, cherish the freedom and independence offered by their mode. They neither care about the practicality of their travel mode (low gain) nor about any environmental consequences (low normative).							
Dedication[3]	**+**	**+**	**-**	**?**	**?**	**?**	**?**
Travel pleasure addicts[8]	**+**	**+**	**-**	**o**	**o**	**+**	**+**
Cyclists/PT users of heart[5]	**+**	**+**	**-**	**+**	**+**	**+**	**+**
First fans (PT)[3]	**+**	**+**	**-**	**?**	**+**	**+**	**+**
Transit Enthusiasts[2]	**+**	**+**	**-**	**o**	**+**	**+**	**+**
Car curtailed (PT/Car)[3]	**+ (Car)**	**- (PT)**	**-**	**?**	**o**	**+**	**- (PT)**
Complacent Car Addicts[1,7]	**+**	**o**	**-**	**-**	**o**	**+**	**+**
Die Hard Drivers[1]	**+**	**+**	**-**	**-**	**-**	**+**	**+**
Exclusive motorists[6]	**+**	**+**	**-**	**-**	**-**	**+**	**+**
Passionate car drivers[5]	**+**	**+**	**-**	**-**	**-**	**+**	**+**
Obstinate Drivers[2]	**+ (Car)**	**- (PT)**	**-**	**-**	**-**	**+**	**- (PT)**
Perceived Captivity. Like the true captives, perceived captives are dissatisfied with their current travel mode (low hedonic) and would prefer to travel with another mode or to increase their multi-modality. Yet, although they possess the means for such a change, current gains are perceived to outweigh potential losses associated with a mode switch. Barriers that prevent a mode switch may range from concerns regarding safety (e.g. cycling on the road) to a lack of appropriate facilities (e.g. no separate cycle paths) or reduced comfort (e.g. due to increased physical effort).							
Malcontented Motorists[1]	**o**	**-**	**o**	**+**	**-**	**o**	**+**
Paying ecologists[8] (Car)	**+**	**-**	**+**	**+**	**-**	**+**	**+**
Anxious Status Seekers[2]	**o (Car)**	**+ (PT)**	**o**	**+**	**o**	**+**	**+**
Wannabe walkers (PT)[3]	**o**	**o**	**o**	**+**	**-**	**o**	**o**

Goal frames/PBC/ Freedom/ Habit **Travel segments**	Hedonic goals Attachment	 Satisfaction	Gain goals Practicality	Normative goals Environment	Control beliefs PCB	Freedom Independence	Habit Habit
True captivity (adopted from Jacques et al., 2013). People in this cluster represent captive mode users. They did not choose their current travel mode, yet are bound to it for some reason. Potential reasons might include a lack of (perceived) alternatives, disability or low income. They have no control about gain factors (e.g. cost and travel time) and are usually not satisfied with their transport mode (low hedonic). Captive mode users may or may not have environmental concerns, but they would all like to switch as soon as possible.							
True Captivity[3]	-	-	-	?	?	?	?
Cyclists/PT users of necessity[5]	-	-	o	Variable	-	o	+
Motorists constrained into using PT[6,7]	-	-	o	-	-	-	+
Daily drags (PT)[3]	-	-	-	-	-	-	+
Carless/Reluctant Riders[1,2] (PT)	-	-	-	-	-	-	+
Time addicts/Utilitarianism (Jacques et al., 2013; Pronello & Camusso, 2011). Utilitarianists only care about the performance of their chosen travel mode, that is, for example, efficiency in terms of cost or travel time (high gain). Whatever option performs best on the selected criterion is chosen, regardless of the pleasantness of the ride or environmental friendliness.							
Utilitarianism[3]	-	-	+	?	?	?	?
All fine on the Weston front (PT)[3]	o	o	+	o	o	o	+
Frugal Travellers[2] (PT)	o	-	o	-	o	o	o
Time addicts[8]	+ (Car)	o	+	-	o	+	o
Open to all possibilities[6]	o	o	+	-	+	+	o

Table 22. Travel behaviour segments (Anable, 2005[1]; Beirão and Cabral, 2008[2]; Bösehans & Walker, 2016[3]; Jacques et al., 2013[4]; Jensen, 1999[5]; Kaufmann, 2000[6]; Prillwitz & Barr, 2011[7]; Pronello & Camusso, 2011[8]) classified using Goal Framing Theory (Lindenberg & Steg, 2007) plus additional factors: perceived behavioural control (PBC), freedom and habit. Signs stand for (-) low, (o) medium, (+) high and (?) not measured.

5.1.1. Method

Participants

Since 2008/09, a large University Travel Survey (UTS) is conducted bi-annually at the University of Bath in order to assess travel patterns of students and staff to and from the university campus, to record progress on sustainability targets and to improve travel-related facilities. All students and staff of the university received an e-mail invitation to the UTS from the Vice-Chancellor via e-mail. As compensation, all participants were eligible to enter a prize draw for one of three £50 Amazon vouchers, which was held after closure of the survey. The last UTS (2012/13) generated 2,937 responses, providing a fairly representative sample of staff and student commuters at the University of Bath. Apart from assessing general travel patterns, the last survey also included an optional Psychology section including questions on constructs such as habit or values. The current UTS (2014/15), which was open to all students and staff at the University of Bath from the 4th to the 30th of November 2014, generated 2,932 responses (1328 male, 1458 female, 146 missing) with 1667 respondents completing the optional psychological part (747 male, 907 female, 13 not disclosed). Of those, a further 418 respondents were excluded due to either missing data or unusual response patterns, leaving 1249 responses to enter the main analysis. The mean age overall was 41.5 (SD = 11.1) for staff and 22.0 (SD = 5.8) for students and two third of respondents (67.3%) reported living within 15 kilometres of the University campus. An additional 14.3% of respondents (mostly undergraduate students) reported living in campus accommodation. The average commute time was 34.2 minutes (*SD* = 23.3).

Materials & Procedure

Respondents were asked to complete the following list of scales and items:

i. **Satisfaction** – Participants' general level of satisfaction with their current main mode of travel (on a scale ranging from 1 – Very dissatisfied to 7 – Very satisfied)

ii. **Habit** – Habit, here defined as the automaticity of using one's main mode of travel, was measured using a shortened version of the Habit Index (Verplanken & Orbell, 2003) consisting of four items rated on a 7-point Likert scale (1 – Completely disagree to 7 – Completely agree). The four items included "Travelling by [chosen main mode of travel] is something…" 1) I start doing before I realise it, 2) I do without thinking, 3) I do automatically and 4) I do without having to consciously remember.

The present study included ratings of habit which has only rarely been measured in the context of travel behaviour market segmentation research (see Krizek & El-Geneidy, 2007, for one exception). Considering that travel mode choice often involves a strong habitual component (Domarchi, Tudela & González, 2008; Donald, Cooper & Conchie, 2014; Klöckner & Matthies, 2004; Verplanken, Aarts & van Knippenberg, 1997; Walker, Thomas & Verplanken, 2015), including habit as an additional factor has the potential to improve taxonomies of different traveller types. In their recent work, Thomas and Walker (2015) illustrated that satisfaction and habit may vary significantly between mode users and thus may also be suitable to discriminate between traveller types.

iii. **Main mode** – Participants' routine mode choice to campus

If you had to describe your journey to the university in a single way, what would that be? (Although it can be difficult to break down some journeys to a single mode, please choose the option that you feel is the largest part of your journey)

Options available to select included bicycle, bus, car (as a passenger), car (by yourself), car (driving with passengers), motorcycle/scooter, train, walk and other (please specify)

iv. **Mode switch** – Desire to switch the current form of transport (current and desired mode)

Note that, in line with our supra-modal approach, the desire to switch modes was not included in the clustering procedure (the same applies to participants' main mode of travel), but solely used for the interpretation of clusters.

v. **Travel aspects** – Ranking the importance of seven travel-related factors to their usual trip

The factors represented commonly recognized travel aspects including the 'three Cs' (comfort, convenience and cost in terms of money and travel time; Chatterton et al., 2009), as well as effort (Stradling, 2002), environment (Anable, 2005) and independence (Jensen, 1999). In line with Goal Framing Theory (Lindenberg & Steg, 2007), the choice of travel related factors attempted to include *gain* goals referring to the management of one's resources (i.e. cost, convenience and travel time), *normative* goals referring to the right course of action (environment), as well as *hedonic* goals referring to the desire to feel better right now (comfort and effort). A control aspect (independence) was added in line with previous research stressing the importance of autonomy (Jensen, 1999; Mann & Abraham, 2006; Thomas, Walker & Musselwhite, 2014). Rather than rating the importance of each individual aspect, participants ranked the aspects by assigning rank #1 to the most important aspect, rank #2 to the second most important aspect, and so on. This was done so that participants had to prioritize aspects, resulting in a more distinct cluster solution. For the clustering algorithm each travel aspect was treated as a continuous variable by turning ranks into scores (Rank #1 equal to 7, Rank #2 equal to 6 and so on).

vi. **Goals (Values)** – As goals cannot be measured directly (because they are situationally dependent), they were approximated through measuring values. Values serve as guiding principles in people's lives (Rokeach, 1973) and are assumed to affect the relative strength of the three overarching goal frames distinguished by GFT. That is, "because values are fairly stable, they render some goals chronically stronger than others" (Steg, Lindenberg & Keizer, 2016, p. 185). Which goal frame tends to be dominant for any one given individual, across situations, may thus best be determined by measuring people's values instead (see also Section 1.3.2.). Respondents completed ratings of altruistic, biospheric, egoistic and hedonic values on a 16-item instrument adopted from Steg et al. (2014; see also De Groot & Steg, 2008), assessing these values (four items per value) on a 9-point rating scale ranging from -1 (coded 1) – Opposed to my values to 7 (coded 9) – Of supreme importance.

Analysis

Multinomial logistic regression analyses were carried out to assess which factors predicted mode choice for both students and staff (independent of cluster membership). For the analyses, main modes were collapsed into Active travel (walking and cycling), Car (alone or as/with passengers) and Public Transport (bus and train).

As in Study 2, respondents were then grouped into segments using hierarchical cluster analysis (staff and students separately), using their rankings of the seven travel-related aspects as well as their value, habit and satisfaction ratings, to gauge the number of clusters to extract with the iterative k-means clustering procedure. However, rather than using Ward's method (1963) for an initial cluster solution, the centroid method (Sokal & Michener, 1958) was used. Within this method, the distance between two clusters is defined as the (squared) Euclidean distance between their centroids or means. Thus, unlike Ward's method, which calculates and attempts to minimise the sum of squared deviations from points to centroids (i.e. a vector containing one number for each variable, where each number is the mean of a variable for the observations in that cluster; minitab.com), the centroid method maximizes the between-sets sum of squares by dividing the N data points into sets whose centroids (cluster averages) are at maximum distances apart (Gower, 1967). The centroid method computes initial centroids for each cluster and average similarity is based on these centroids (Punj & Stewart, 1983). Subsequently, data points are added successively to each set and "at any stage each set is represented by the centroid of the points currently assigned to it" (Gower, 1967, p. 632). An advantage of the centroid method vis-á-vis Ward's method is its relative robustness against outliers, while also refraining from combining clusters with only a small number of observations (Milligan, 1980), which might be a desirable property given the large size of the present sample. A drawback of the method is the possibility of the existence of points nearer to neighbouring centroids rather than their own. This limitation, however, is not present in the iterative portioning method (k-means), which was used next to extract a fixed number of clusters.

The k-means procedure (Faber, 1994; MacQueen, 1967), in contrast to its hierarchical counterparts, uses a *top-down approach*, starting with a predetermined number of clusters to extract. At first, each case is assigned to any one of the k to-be-extracted clusters with a randomly generated cluster centroid (i.e. a reference point in an n-dimensional space based on random values of the input variables). Each individual case is subsequently tested for its proximity or "closeness" to the assigned cluster centroid. If it turns out that the case fits closer with another centroid (i.e. cluster), it will be reassigned to the corresponding cluster and all cluster centroids will be calculated anew (i.e. a new iteration process begins). The iteration process continues until all cases have been assigned to the cluster with the nearest centroid, thus overcoming a core limitation of the hierarchical centroid method, which only focuses on the cluster averages (for a more detailed discussion of the clustering procedure, please revisit Chapter 3). Resulting clusters were then compared against demographic and travel-related information, as well as self-classifications.

5.1.2. Results

Preliminary results and assumptions

Multinomial logistic regression (MLR) analyses

Staff (N = 545) and student (N = 704) populations differed greatly in their main mode of transport, with car being the standard option for staff (63%) and bus (58.5%) for students (excluding students living on campus). MLR analyses were carried out to explore the factors affecting travel mode choice and to identify any potential differences between students' and staffs' motives, before conducting the cluster analyses. In each case, the most frequent mode of travel was chosen as the reference group; that is, the car for staff (see **Table 23**) and the bus for students (**Table 24**).

Overall, for staff, the odds of travelling actively increased with greater concern for the environment, but decreased with a higher importance attributed to comfort, convenience and travel time (see **Table 23**), reflecting journey time concerns (Gardner & Abraham, 2007). Confirming the results of recent literature (Olsson et al., 2013; St-Louis et al., 2014; Thomas & Walker, 2015), active commuting was also significantly associated with higher satisfaction. Using public transport rather than the car, on the other hand, was also significantly predicted by environmental concern, in addition to a greater concern about cost and effort, albeit at the cost of lower journey satisfaction.

Category	Active travel				Public transport			
Variable	B	SE	OR	CI	B	SE	OR	CI
Intercept	**-1.98*** **	.21			**-1.49*** **	.16		
Avg Hedonic	.03	.16	1.03	.76; 1.41	.04	.16	1.04	.76; 1.44
Avg Egoistic	-.25	.17	.78	.56; 1.09	.21	.17	1.24	.89; 1.72
Avg Altruistic	-.10	.18	.91	.64; 1.29	-.16	.18	.85	.60; 1.21
Avg Biospheric	-.26	.20	.77	.52; 1.14	.01	.19	1.01	.69; 1.47
Comfort	**-.35***	.16	.70	.52; .96	-.00	.16	1.00	.74; 1.37
Convenience	**-.31†**	.16	.73	.53; 1.01	.20	.16	1.22	.88; 1.68
Cost	.04	.15	1.04	.77; 1.40	**.45** **	.16	1.57	1.13; 2.16
Travel time	**-.84*** **	.15	.43	.32; .58	.04	.17	1.04	.75; 1.45
Effort	-.01	.16	.99	.72; 1.35	**.55*** **	.16	1.73	1.28; 2.35
Environment	**.72*** **	.18	2.04	1.44; 2.91	**.81*** **	.18	2.25	1.59; 3.19
Independence	0	.	.	. .	0	.	.	. .
Habit Avg	-.15	.15	.86	.64; 1.15	-.07	.14	.93	.71; 1.23
Satisfaction Avg	**.73*** **	.19	2.07	1.42; 3.03	**-.83*** **	.13	.44	.34; .57

Table 23. Parameter estimates predicting mode choice for staff using cluster variables. Note that the reference category for the equation is Travel by car (alone or as/with passengers).
*† p < .10 * p < .05 ** p < .01 *** p < .001*

For students, the strong positive association of active travel and satisfaction was also found, although the odds of travelling actively rather than taking the bus (PT) decreased with concerns about cost, convenience, comfort, travel time and effort as well as altruistic values (see **Table 24**). That is, the same motives preventing staff from travelling actively emerged for students (i.e. comfort, convenience and travel time), in addition to monetary costs and effort minimisation (Gardner & Abraham, 2007). A similar picture emerged for student car use which was negatively predicted by cost, convenience, travel time and effort yet, somewhat surprisingly, was predicted positively by biospheric values and was positively associated with satisfaction (albeit to a lesser extent than active commuting). As for staff, however, the environment factor increased the odds of being a public transport user rather than a car driver, yet again at the cost of lower journey satisfaction.

Category	Active travel				Car			
Variable	B	SE	OR	CI	B	SE	OR	CI
Intercept	**-.91*** **	.15			**-1.28*** **	.16		
Avg Hedonic	.02	.16	1.02	.74; 1.39	-.26	.17	.77	.55; 1.08
Avg Egoistic	-.16	.16	.86	.63; 1.16	.02	.16	1.02	.74; 1.39
Avg Altruistic	**-.45** **	.16	.64	.47; .87	-.09	.18	.92	.64; 1.31
Avg Biospheric	-.03	.18	.97	.68; 1.38	**.51***	.20	1.66	1.11; 2.47
Comfort	**-.42** **	.15	.66	.50; .88	-.03	.16	.97	.71; 1.32
Convenience	**-.71*** **	.15	.49	.37; .66	**-.38***	.18	.69	.49; .97
Cost	**-.48** **	.16	.62	.45; .85	**-.73*** **	.17	.48	.34; .68
Travel time	**-.79*** **	.16	.45	.33; .62	**-.79*** **	.17	.46	.33; .63
Effort	**-1.04*** **	.16	.35	.26; .49	**-.77*** **	.17	.46	.33; .65
Environment	-.16	.18	.85	.60; 1.22	**-.91*** **	.22	.40	.27; .62
Independence	0	.	.	. .	0	.	.	. .
Habit Avg	**-.28†**	.14	.76	.57; 1.00	.11	.15	1.12	.83; 1.51
Satisfaction Avg	**1.14*** **	.18	3.13	2.21; 4.43	**.56** **	.17	1.76	1.26; 2.45

*Table 24. Parameter estimates predicting mode choice for students using cluster variables. Note that the reference category for the equation is Travel by public transport (bus/train). † p < .10 * p < .05 ** p < .01 *** p < .001*

Assumption testing

Before entering the analysis, all input variables were examined for deviations from normality and for homogeneity of variances. The homogeneity of variances assumption is particularly important as variables with a larger dispersion will exert a stronger impact on the outcome of the clustering procedure (Lazar, 2012). **Table 25** provides the means and standard deviations/variances as well as reliability measures (Cronbach's alpha) for each of the variables used in the clustering process. By rule of thumb, there was no concern about the homogeneity of variances assumption, as the ratio of the smallest (yellow) to largest (red) variance did not exceed 3. Overall, respondents tended to agree that their travel behaviour was automatic or habitual and most reported being at least somewhat satisfied with their current form of travel.

Egoistic values received significantly less endorsement on average when compared to the other three kinds of values (-1.77 < M_{diff} < -2.39, -34.74 < t < 50.85, all p < .001), yet were, nevertheless, seen as important. Altruistic values, on the other hand, received the strongest endorsement and were also rated significantly higher than both biospheric and hedonic values (M_{diff} = .56, t = 15.68 & M_{diff} = .62, t = 13.56, both p < .001), which did not differ significantly from each other (t = 1.44, *ns*). Regarding travel aspects, cost, convenience, and travel time dominated the outcomes, whereas a moderate importance was attributed to comfort, effort and independence. The environment was considered the least important travel aspect.

Variable	N	Min	Max	Mean	SD	Variance
Habit average (α = .89)	1249	1	7	3.25	1.60	2.55
Satisfaction with main mode	1249	1	7	4.79	1.65	2.72
Average hedonic value orientation (α = .74)	1249	1	9	6.52	1.37	1.88
Average egoistic value orientation (α = .72)	1249	1	9	4.75	1.25	1.56
Average altruistic value orientation (α = .75)	1249	1	9	7.14	1.21	1.47
Average biospheric value orientation (α = .90)	1249	1	9	6.58	1.50	2.24
Travel aspect - Comfort	1249	1	7	3.31	1.62	2.63
Travel aspect - Convenience	1249	1	7	5.57	1.42	2.02
Travel aspect - Cost	1249	1	7	4.77	1.75	3.06
Travel aspect - Travel time	1249	1	7	5.32	1.53	2.34
Travel aspect - Effort	1249	1	7	3.16	1.57	2.48
Travel aspect - Environment	1249	1	7	2.72	1.67	2.80
Travel aspect - Independence	1249	1	7	3.15	2.08	4.33

Table 25. Means and variances of the clustering variables

Normality. Most of the distributions of the clustering variables were somewhat skewed, yet no significant deviations from normality were observed. **Figure 20** illustrates the results for habit and satisfaction ratings. Habit ratings were distributed fairly normal except for a substantial proportion of participants who (completely) agreed that their travelling by main mode is something they do automatically, without having to consciously remember, without thinking and before realising that they're doing it (see the two large peaks at the lower end of the distribution). Satisfaction ratings, on the other hand, showed a left-skew with most respondents being satisfied with their main mode of travel.

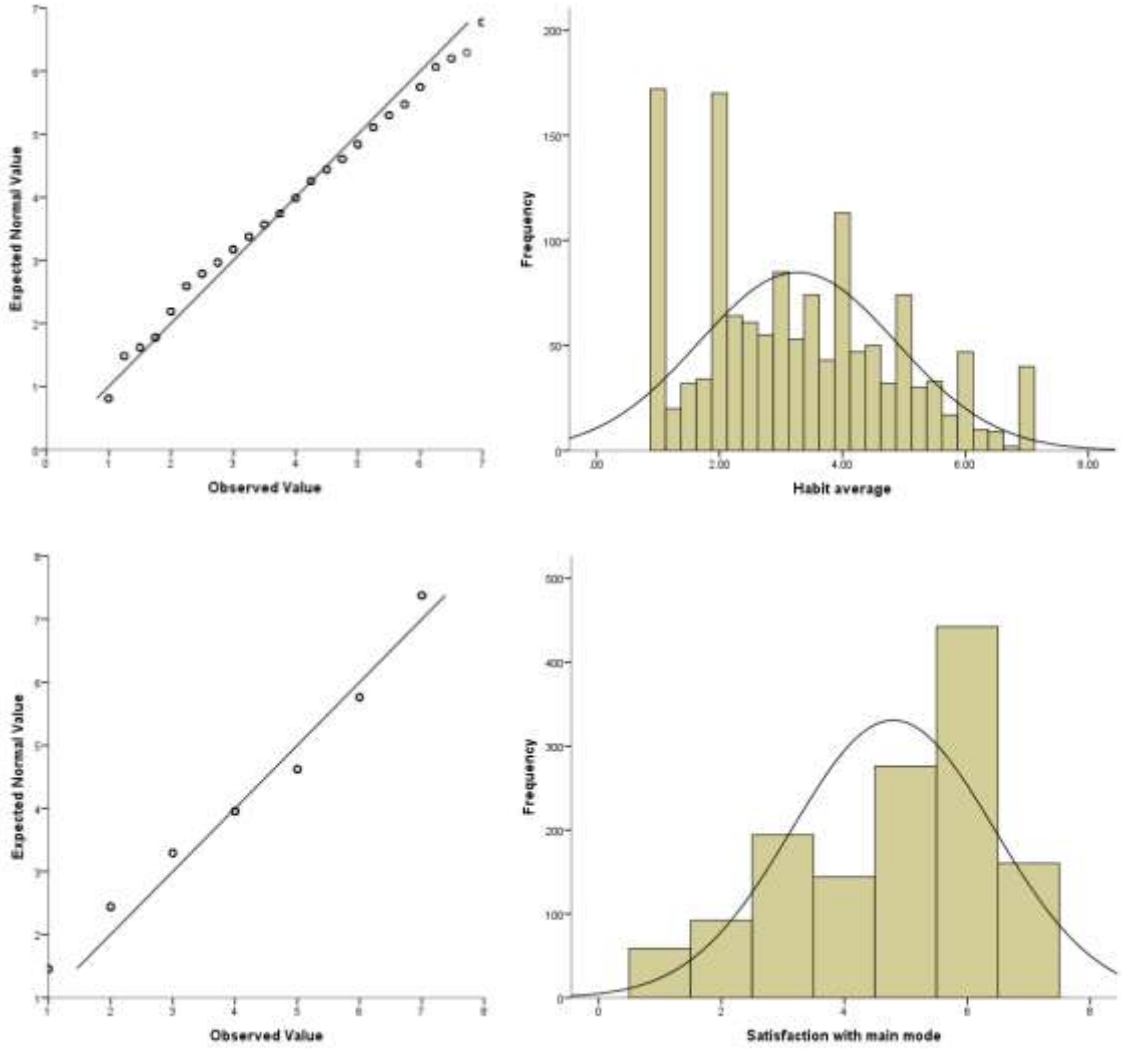
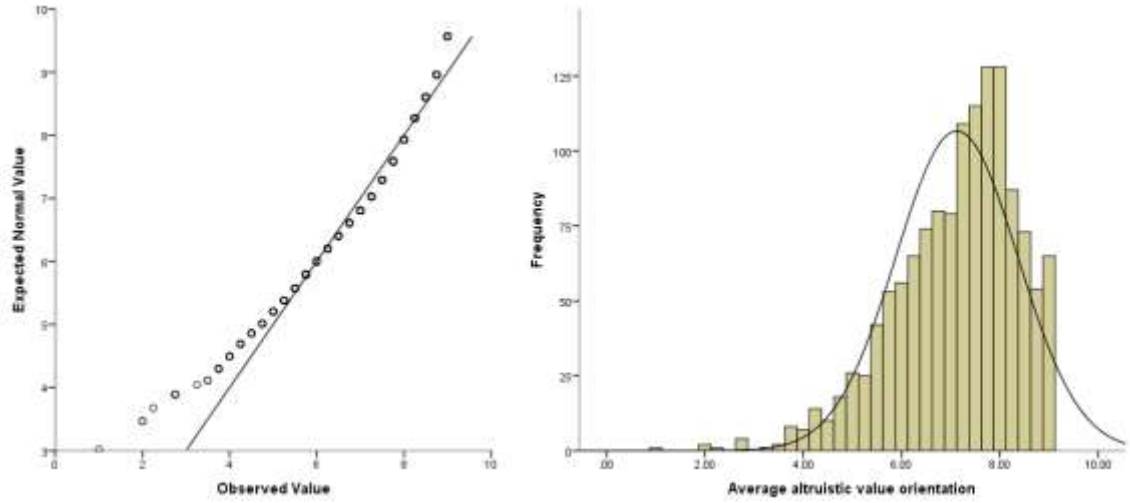


Figure 20. Q-Q plots and histograms for habit and satisfaction ratings

For values, the most significant observation was a strong left-skew for the altruistic value orientation. The distributions for biospheric and hedonic values were similarly skewed to the left, albeit to a lesser degree. Finally, egoistic values were distributed close to normal. **Figure 21** shows the Q-Q plots and histograms for each value orientation.



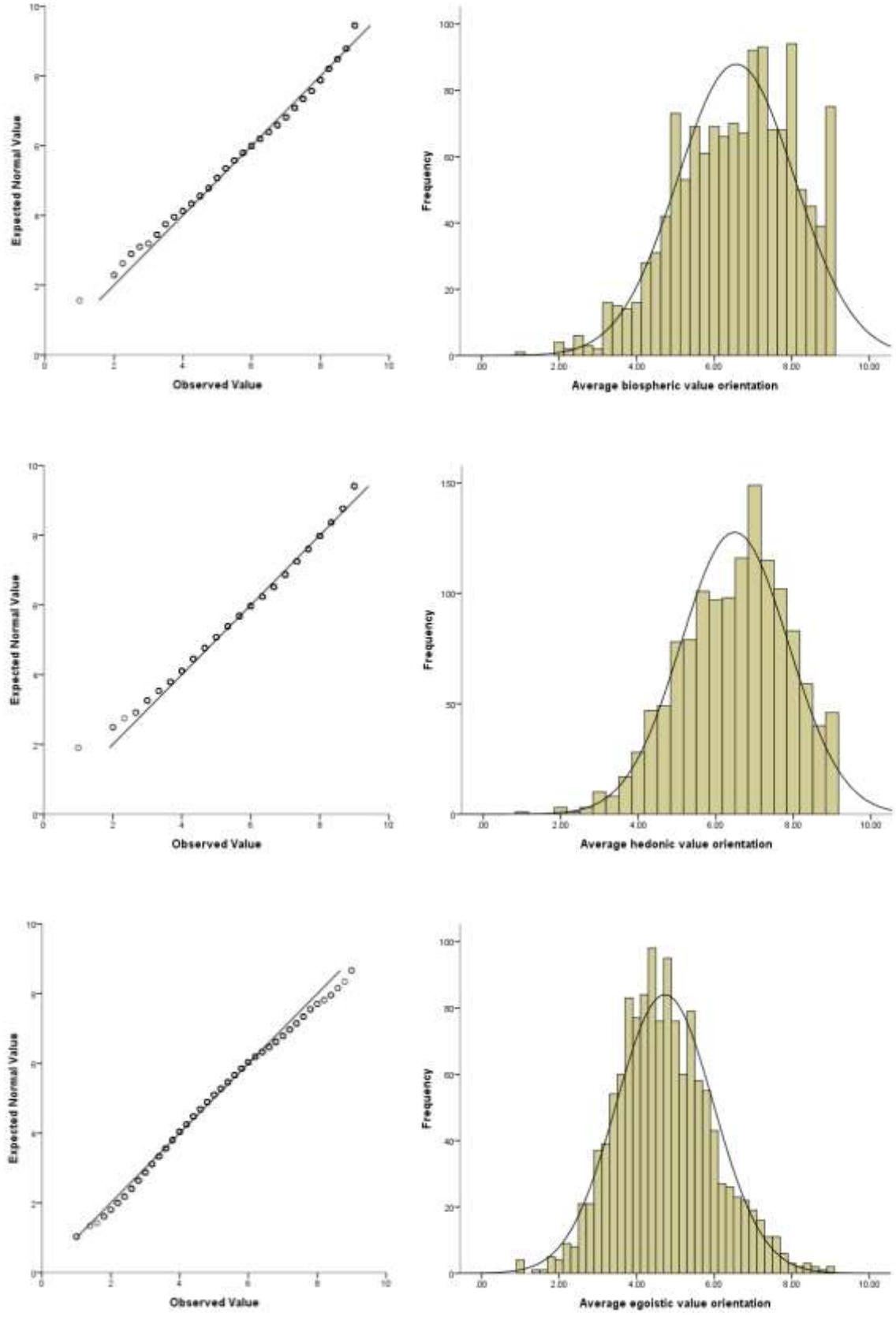


Figure 21. Normal Q-Q plots and histograms for average hedonic (top), egoistic (second from top), altruistic (third from top) and biospheric value orientations (bottom)

Cluster analysis

The results of the preliminary clustering process using the centroid method suggested that both, staff and student respondents, could be distinguished into three segments each (see agglomeration schedules in **Table 26** below). Consequently, three clusters each were extracted with the iterative k-means procedure.

Number of clusters	*Agglomeration last step*	*Coefficients this step*	*Change*
Staff			
2	30.39	42.05	11.66
3	27.24	30.39	3.15
4	26.73	27.24	.51
5	26.38	26.73	.35
6	24.23	26.38	2.15
Student			
2	29.50	34.10	4.60
3	24.91	29.50	4.59
4	24.30	24.91	.61
5	24.30	24.30	0
6	22.66	24.30	1.64

Table 26. Agglomeration schedule for staff and student clusters based on centroid method

Consequently, three clusters each were extracted with the iterative k-means procedure. **Tables 27 and 28** show the (unstandardized) mean scores of habit, satisfaction and value ratings, as well as travel-related aspects for each of the six clusters. For ease of interpretation, a summary of the standardized mean scores is presented graphically for each cluster in **Figure 22** (Staff) and **Figure 23** (Students).

For staff, Cluster 3 differed notably from the other clusters in that members of the cluster showed a significantly higher commute time (car drivers in particular), as well as significantly higher habit and lower satisfaction ratings (see **Table 27**). Post-hoc comparisons revealed that the average commute time was significantly higher for Cluster 3 compared to both Cluster 1 (M_{diff} = 7, *95% CI*: 1.59, 12.42, $p < .01$) and Cluster 2 (M_{diff} = 7.64, *95% CI*: 2.69, 12.59, $p < .01$).

Factor/Cluster	1	2	3	Total
Male	66	94	87	247
Female	87	126	83	296
N Total	153	222	170	545
Age	40.55[a] (10.83)	42.78[a] (11.03)	40.63[a] (11.36)	41.49 (11.11)
Avg Commute time	37.05[a] (17.44)	36.41[a] (20.73)	44.05[b] (21.84)	38.97 (20.48)
Avg Ct by Active	36.18[a] (16.31)	34.89[a] (13.52)	34.58[a] (16.32)	35.52 (15.23)
Avg Ct by Car	33.12[a] (12.79)	34.42[a] (19.70)	40.45[a] (19.32)	35.99 (18.52)
Avg Ct by PT	52.10[b] (25.82)	61.86[b] (28.45)	54.45[b] (24.57)	55.08 (25.41)
Hedonic values	6.58[a] (1.28)	6.07[b] (1.29)	5.96[b] (1.39)	6.18 (1.34)
Egoistic values	4.70[a] (1.18)	4.29[b] (1.06)	4.14[b] (1.12)	4.36 (1.13)
Altruistic values	7.85[a] (.84)	6.73[b] (1.24)	7.28[c] (1.07)	7.21 (1.18)
Biospheric values	7.88[a] (.91)	5.99[b] (1.30)	6.57[c] (1.32)	6.70 (1.44)
Habit	2.94[a] (1.63)	2.59[a] (1.37)	4.25[b] (1.48)	3.21 (1.64)
Satisfaction	5.67[a] (1.31)	5.64[a] (1.28)	3.48[b] (1.63)	4.97 (1.73)
Comfort	3.16[a] (1.76)	3.68[b] (1.59)	3.16[a] (1.49)	3.38 (1.63)
Convenience	5.45[a] (1.58)	6.26[b] (.97)	5.10[a] (1.45)	5.67 (1.41)
Cost	4.71[a] (1.71)	3.36[b] (1.56)	5.08[a] (1.50)	4.27 (1.77)
Travel time	4.28[a] (1.76)	5.32[b] (1.44)	6.24[c] (.85)	5.31 (1.58)
Effort	2.33[a] (1.47)	3.12[b] (1.53)	3.00[b] (1.62)	2.86 (1.58)
Environment	4.40[a] (1.75)	1.78[b] (1.00)	2.84[c] (1.54)	2.85 (1.77)
Independence	3.67[a] (2.19)	4.48[b] (1.87)	2.58[c] (1.83)	3.66 (2.11)

Table 27. Descriptive statistics for staff clusters (Mean values with a different subscript letter a, b or c, differ significantly at p < .01)

For students, a significant difference in commute time emerged between Cluster 1 and 2 and Cluster 3 (see **Table 28** below), the latter having a significantly shorter commute time than both Cluster 1 (M_{diff} = -10.35, *95% CI*: -15.35, -5.34, $p < .001$) and Cluster 2 (M_{diff} = -7.42, *95% CI*: -12.64, -2.20, $p < .01$). Interestingly, members of Cluster 3 also regarded their travel behaviour as less habitual than either Cluster 1 (M_{diff} = -.57, *95% CI*: -.93, -.22, $p < .001$) or Cluster 2 (M_{diff} = -.99, *95% CI*: -1.36, -.62, $p < .001$) and were more satisfied than either Cluster 1 (M_{diff} = 1.17, *95% CI*: .82, 1.52, $p < .001$) or Cluster 2 (M_{diff} = 1.32, *95% CI*: .96, 1.68, $p < .001$).

Factor/Cluster	1	2	3	Total
Male	142	105	78	325
Female	149	140	85	374
Travelling to campus	213	173	133	519
Living on campus	81	73	31	185
N Total	294	246	164	704
Age	21.12[a] (4.22)	22.17[a,b] (6.23)	23.29[b] (7.31)	21.96 (5.89)
Avg Commute time	44.93[a] (20.99)	42.00[a] (24.40)	34.59[b] (19.94)	41.31 (19.27)
Avg Ct by Active	34.53[a] (12.28)	33.61[a] (14.50)	33.01[a] (15.61)	33.51 (14.54)
Avg Ct by Car	46.13[a] (39.42)	39.06[a,b] (23.59)	28.19[(b)] (16.92)	37.97 (29.99)
Avg Ct by PT	47.01[a] (16.24)	44.38[a] (16.98)	44.39[a] (12.54)	45.67 (16.21)
Hedonic values	6.63[a] (1.36)	7.10[b] (1.26)	6.56[a] (1.31)	6.78 (1.34)
Egoistic values	4.99[a] (1.21)	5.35[b] (1.28)	4.69[c] (1.19)	5.04 (1.26)
Altruistic values	6.40[a] (1.23)	7.82[b] (.87)	7.16[c] (1.06)	7.07 (1.24)
Biospheric values	5.41[a] (1.32)	7.63[b] (.95)	6.69[c] (1.25)	6.49 (1.53)
Habit	3.28[a] (1.47)	3.70[b] (1.62)	2.70[c] (1.45)	3.29 (1.56)
Satisfaction	4.44[a] (1.52)	4.28[a] (1.60)	5.60[b] (1.20)	4.65 (1.57)
Comfort	3.77[a] (1.46)	3.12[b] (1.62)	2.52[c] (1.57)	3.25 (1.62)
Convenience	5.96[a] (1.10)	5.04[b] (1.47)	5.35[b] (1.62)	5.50 (1.42)
Cost	5.15[a] (1.58)	5.55[b] (1.40)	4.56[c] (1.88)	5.15 (1.64)
Travel time	5.22[a] (1.46)	5.90[b] (1.20)	4.68[c] (1.62)	5.33 (1.49)
Effort	4.19[a] (1.34)	2.94[b] (1.40)	2.66[b] (1.39)	3.39 (1.53)
Environment	1.74[a] (.82)	3.59[b] (1.61)	2.76[c] (1.70)	2.63 (1.59)
Independence	1.98[a] (1.29)	1.85[a] (1.23)	5.46[b] (1.34)	2.75 (1.97)

Table 28. Descriptive statistics for student clusters (Mean values with a different subscript letter a, b or c, differ significantly at p < .01)

The following sections breaks down clusters by main mode of travel and also considers which mode respondents desired, if they were contemplating a mode switch in the near future. Moreover, respondents' self-classifications and support for various sustainable travel initiatives are examined with regard to cluster membership. Finally, an interpretation including a brief description of each cluster, summarizing its key features, is provided.

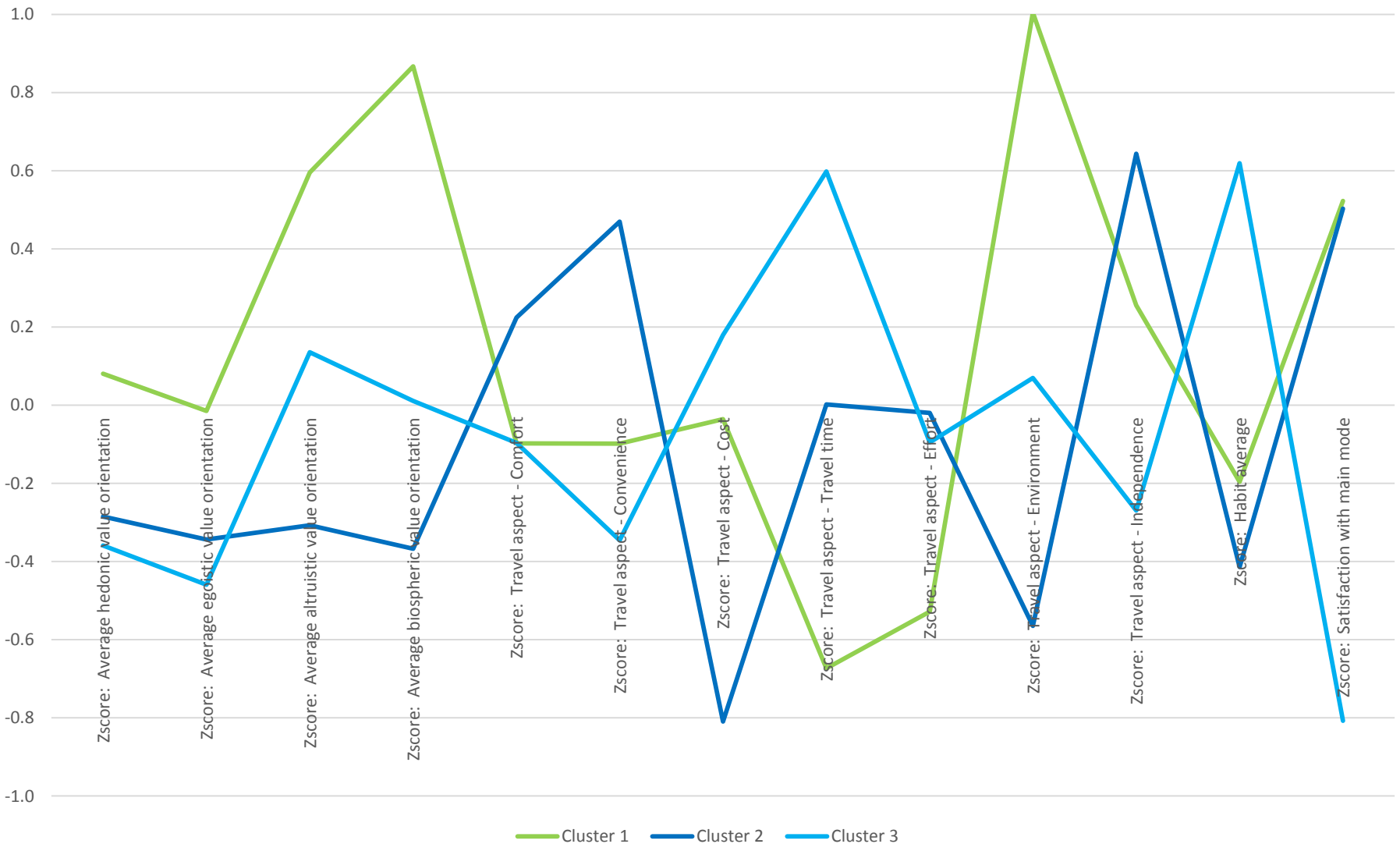


Figure 22. Staff mean z-scores for values and travel-related aspects (recoded) by cluster

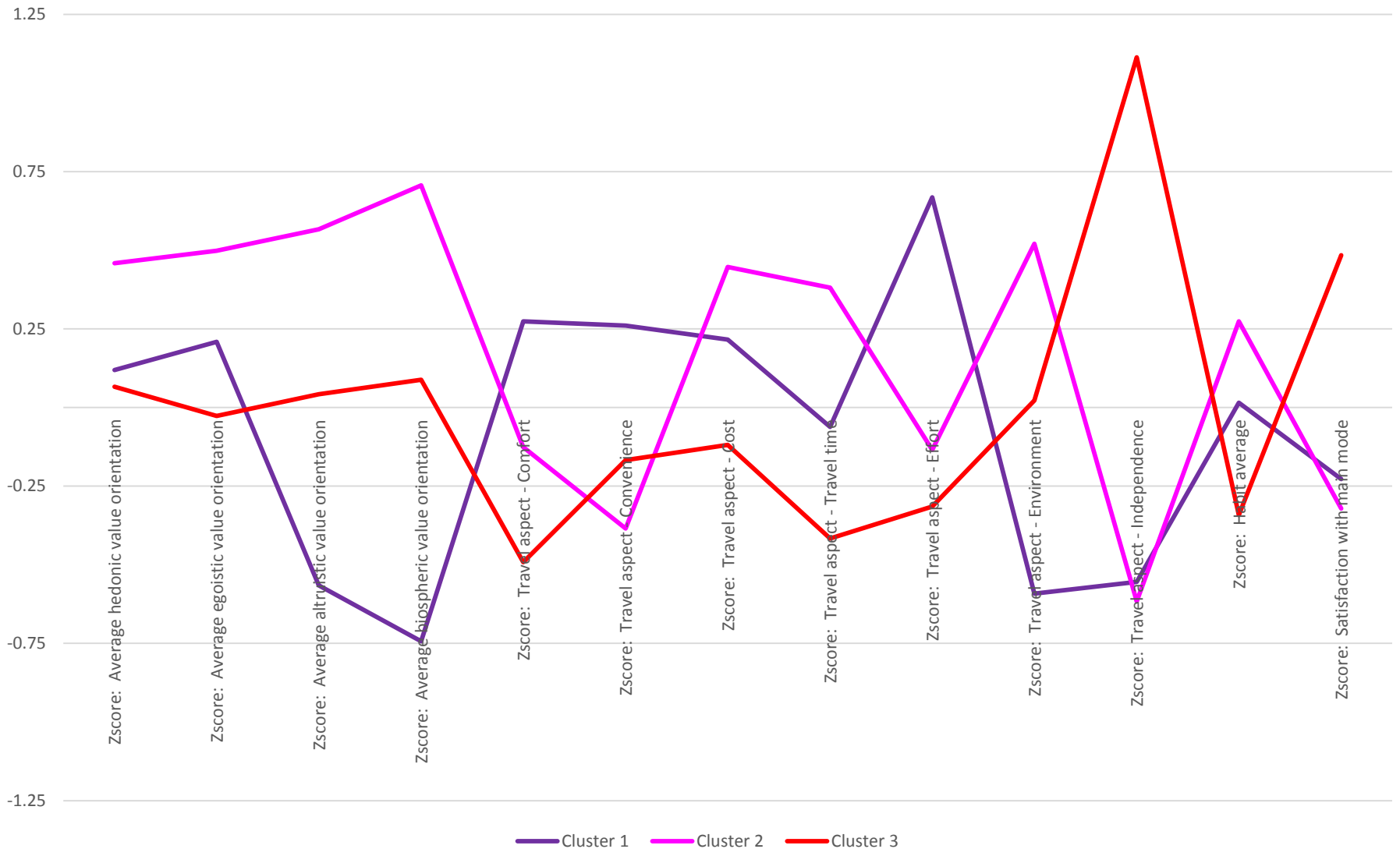


Figure 23. Student mean z-scores for values and travel-related aspects (recoded) by cluster

Table 29 shows the main mode proportions for each of the three extracted staff and student clusters, whereas **Table 30** shows the current and desired new mode, for those who expressed an inclination to switch modes in the future. For staff, the car represented the main mode of travel in all clusters (C 1: 48%; C2: 74%; C3: 62%), whereas the bus was dominant for students, yet only in the first two clusters (both 50%). Active travel (i.e. walking and cycling) was most common in the first cluster (33.3%) for staff and in the third cluster for students (43%). Among those who wanted to switch travel modes in the future, active travel was the most desired among both students (31% walk, 30% cycle) and staff (39% cycle, 18%), followed by driving alone (student: 20%; staff: 18%).

	Staff commuters				**Students commuters**			
Mode / Cluster	1	2	3	Total	1	2	3	Total
Bus	18	7	35	60	148	123	34	305
Car (alone)	56	132	77	165	17	15	21	53
Walk	20	23	5	48	23	18	37	78
Bicycle	31	12	7	50	9	10	33	52
Car (with passengers)	13	26	19	58	8	2	5	15
Train	3	7	16	26	2	2	-	4
Car (as passenger)	4	6	9	19	5	1	1	7
Motorcycle/Scooter	6	1	1	8	-	1	2	3
Other	2	7	0	9	1	1	-	2
Living on campus	-	-	-	-	81	73	31	185
Total	153	221*	169*	543	294	246	164	704

Table 29. Main mode by cluster membership (**N* = 1 missing in each)

	Current mode				**Desired mode**			
Mode / Cluster	1	2	3	Total	1	2	3	Total
Student **Bus**	62	55	17	134	8	4	3	15
Car (alone)	1	7	5	13	16	14	4	34
Walk	8	2	5	15	19	25	8	52
Bicycle	3	3	3	9	21	20	9	50
Train	1	2	-	3	-	-	-	-
Car (as passenger)	2	-	-	2	4	-	1	5
Motorcycle/Scooter	-	-	-	-	3	4	2	9
Other	-	-	-	-	1	1	-	2
Total	77	69	30	176	72	68	27	167
Staff **Bus**	6	1	19	26	3	1	5	9
Car (alone)	14	25	22	61	4	4	11	19
Walk	2	4	-	6	4	7	8	19
Bicycle	3	3	1	7	12	16	13	41
Train	-	3	1	4	1	1	3	5
Car (as passenger)	1	-	1	2	-	2	3	5
Motorcycle/Scooter	-	-	1	1	-	2	1	3
Other	-	-	-	-	-	2	1	3
Total	26	36	45	107	24	35	45	104

Table 30. Current and desired mode by cluster membership for students and staff

Self-classifications

Complementing the information above, respondents were also asked to classify themselves based on seven short traveller type descriptions, which were tested in the pilot study. **Tables 31 and 32** show the personal traveller type choices divided by cluster membership and main mode of travel. As might be expected, Convenience was the most popular choice for car drivers, whether driving alone (50.5%), with passengers (48.2%) or as passenger (45.4%). It should be noted, however, that more than every second Perceived Captive traveller (58.5%) was a car user (driving alone or with passengers). Convenience was also the most popular choice among bus users and people travelling by motorcycle/scooter, albeit with a significantly lower proportion (27.5% and 26.1%, respectively). Bus users, in particular, represented the largest proportion of True Captives (79%) and Carless Riders (68%). Cyclists tended to regard themselves as Aspiring Environmentalists (26.3%), but also as Dedicated or Convenience travellers (both 21%). In contrast, most Walkers self-classified as Utilitarianists (28.2%), followed by Aspiring Environmentalists (21.8%) and dedicated walkers (19.7%). Finally, the relatively low number of train users showed a very mixed picture with Carless Riders posing the highest proportion (29.7%).

Support for emission reduction policies

Respondents were also asked to indicate their support for various future travel options (see **Figure 24**) including the development of everyday exoskeletons to make walking faster and less effortful, subsidizing the purchase of electric bicycles, improving the sustainability of bus fleets by increasing the share of electric/gas/hybrid/hydrogen buses, rail electrification, improving drill-hole technology to retrieve deeper level oil reservoirs, subsidizing the purchase of electric/gas/ hybrid/hydrogen cars, setting emission standards for international aviation and shipping and increasing fuel economy/funding alternative fuels. Overall, fuel economy (72%) and sustainable buses (66%) received the strongest support, followed by the subsidy of green cars (57%). Emissions standards (44%), rail electrification (42%) and electric bicycles (36%) gained moderate support, while exoskeletons (12%) and the retrieval of deeper level oil reservoirs (5%) were the least supported. In line with their strong biospheric value orientation, members of Clusters 1 and 5 showed the strongest support for the subsidized purchase of electric bicycles (50% and 43%, respectively), while members of Cluster 5 also strongly supported the use of sustainable buses (82%).

Traveller type final choice	Staff				Student				Total
	1	2	3	Total	1	2	3	Total	
Convenience	42*	**113***	41	196	**103***	53*	54*	210	406
Utilitarianist	15	21	**22**	58	**40**	39	34	113	171
Perceived Captivity	17	20	**44***	81	**35**	**35**	13	83	164
Carless Rider	14	6	**23**	43	**41**	**42**	14	97	150
Aspiring Environmentalist	**37**	18	19	74	18	**31**	17	66	140
Dedication	19	**35**	8	62	19	15	**25**	59	121
True Captivity	3	1	**11**	15	**31**	23	2	56	71
Missing	6	8	2	16	7	8	5	20	36
Total	153	222	170	545	294	246	164	704	1249

*Table 31. Traveller type choice by cluster membership. (Note that the total N here includes students living on campus who were not asked to indicate their main mode of travel; N = 36 missing; ***** = highest category in cluster; bold = highest count of type option)*

Traveller type choice Main mode	Convenience	Utilitarianist	Perceived Captivity	Carless Rider	Aspiring Environmentalist	Dedication	True Captivity	N
Bus	99	43	53	81	26	9	45	356
Car (by yourself)	159	33	67	-	18	29	3	309
Walk	20	37	2	11	26	24	1	121
Bicycle	21	15	3	11	28	21	1	100
Car (driving with passengers)	34	7	11	-	7	9	-	68
Train	5	3	6	8	5	1	2	30
Car (passenger)	11	4	1	2	4	2	2	26
Motorcycle/Scooter	2	1	-	1	4	3	-	11
Other (please specify)	2	2	2	-	1	4	-	11
Total	353	145	145	114	119	102	54	1032

Table 32. Traveller type choice by main mode of travel (excluding students living on campus N = 185 and missing staff N = 2)

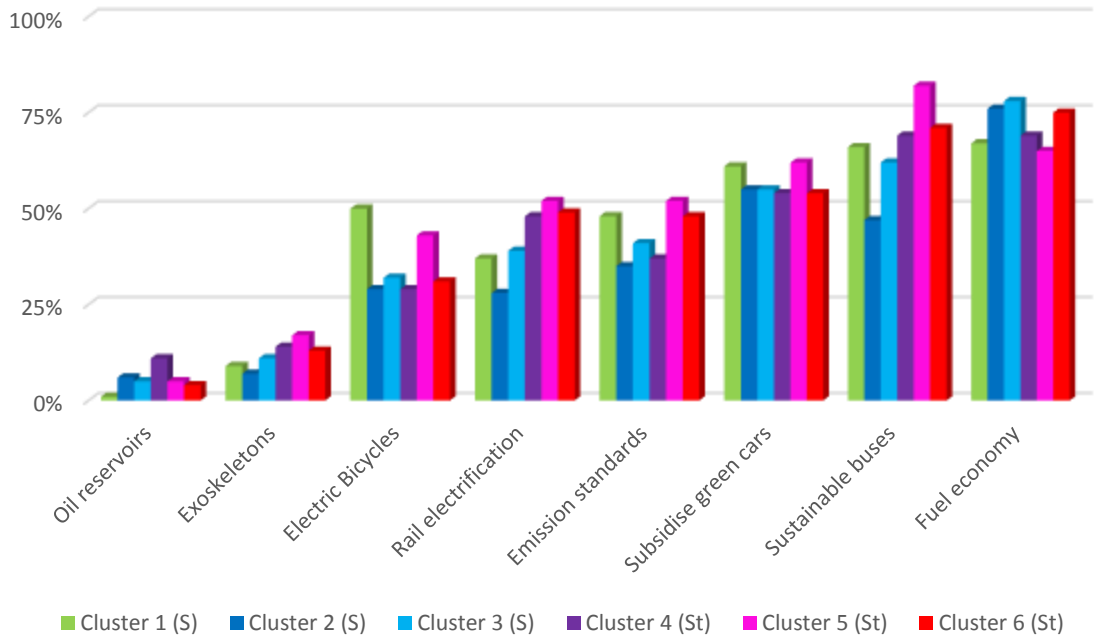


Figure 24. Support for future travel options (S = Staff, St = Student)

Cluster interpretations

Below, a brief summary of each supra-modal mobility type is offered. Two distinct clusters (*Convenience Lovers* and *Time Addicts*) were found among both students and staff, whereas one unique cluster could be distinguished for each group. A third type included *Aspiring/Committed Environmentalists* for staff and a fourth type was distinguished among students (*Mode Mixers*) that fitted an earlier segmentation study by Bösehans and Walker (2016). See **Table 33** for a summary of all clusters and their key aspects.

1) ***Normative goal – Aspiring/Committed Environmentalists* (Cluster 1, staff: 48% car, 20% bicycle, 13% walking and 12% bus)**

   Staff. Clearly, there are travellers who are strongly motivated by environmental concerns and have adjusted their travel behaviour accordingly (e.g. walking or cycling to work). This group has been variously labelled as *Civic ecologists* (Kaufmann, 2000), *Green cruisers* (Beirão & Cabral, 2008) or *Paying ecologists* (Pronello & Camusso, 2011) in previous literature. In the present sample, this group is represented in Cluster 1 and stands out due to its strong altruistic and biospheric (and low egoistic/high hedonic) value orientation (Table 27). Environmentalists place little emphasis on effort or travel time and only attribute a moderate importance to other instrumental factors, such as cost and comfort, or independence. In terms of mode choice, the cluster is almost equally divided by car (48%) and alternative (public) transport users (20% bicycle, 13% walking and 12% bus) which, at first sight, seems surprising given their strong ecological commitment. The high proportion of car users suggests that a distinction can be made between *Aspiring* and *Committed Environmentalists* (see also Anable, 2005; Prillwitz & Barr, 2011). The former have a desire to commit to more sustainable travel options (e.g. active travel or driving an electric vehicle), whereas the latter have already made such an advance. Further data suggested that Environmentalists generally regarded their travel behaviour as

moderately habitual and tended to be satisfied with their current form of travel, supporting the notion that active travel in particular may hold affective benefits (Gatersleben & Uzzell, 2007).

2) ***Hedonic goal – Convenience Lovers (Cluster 2, staff: 74% car; 15% active travel; Cluster 1, student: 50% bus; 10% Car; 8% Walking)***

Staff. Comparable to Anable's (2005) *Complacent Car Addicts* or Jensen's (1999) *Passionate car drivers* – these travellers are relatively satisfied with their current form of travel, do not perceive their travel behaviour as very habitual and neither care about the cost nor the environmental impact of their travel mode choice (Table 27). They desire convenience (highest) and independence (highest) at any cost. Due to their strong desire for autonomy and freedom (Anable, 2005; Jensen, 1999; Thomas, Walker & Musselwhite, 2014), these dedicated mode users may not be easily persuaded to travel more actively and sustainably, unless the alternative provides a similar degree of convenience and independence. It is likely that, even if members of this cluster were to acknowledge the environmental impact of their travel habits, attempts to encourage more sustainable travel that is less convenient, or limits their perceived freedom, would be met with strong resistance or provoke reactance, re-enforcing the already strong attachment to their mode (e.g. Tertoolen, Van Kreveld & Verstraten, 1998). In line with Paulssen et al. (2014), the desire for flexibility (here: independence) decreases the willingness to use public transport, which very likely explains the low proportion of public transport users in this particular cluster. However, there was a small proportion of active travellers in this cluster, implying that, even in the absence of environmental concern, walking and cycling may be perceived to provide both convenience and independence.

***Students*.** In some regards, student *Convenience Lovers* resembled staff *Convenience Lovers* in their strong desire for comfortable and convenient travel paired with low environmental concern (Table 28). Overall, student *Convenience Lovers* were neither particularly satisfied nor dissatisfied with their main mode of travel, felt their travel routine was moderately habitual, and were not willing to make sacrifices with regard to any of the "three Cs" (Chatterton et al., 2009) – that is, the **C**onvenience, **C**ost and **C**omfort – of their mode. This was underlined by their high emphasis placed on effort (highest overall), suggesting that these students desire to maximise both the experienced journey satisfaction and practicality of their trip (see the *Convenience* cluster by Jacques, Manaugh & El-Geneidy, 2013). A major difference to the staff cluster emerged in the importance attributed to cost and independence. These differences in characteristics may be explained by students having less financial resources available, and thus having to pay more attention to travel costs, while also having a lower need to be independent, or to demonstrate independence (e.g. through ownership of a car), at this stage of their lives.

3) ***Gain goal – Time addicts (Cluster 3, staff: 62% car, 30.5% bus or train; Cluster 2, student: 50% bus, 7% walking, 7% car)*** are fairly neutral (somewhat dissatisfied in the case of staff) towards their current form of travel, which they regard as fairly

automatically-driven (highest mean among both students and staff). They tend to be very cost-conscious and favour alternatives based on the level of trip practicality provided – that is, convenience and, above all, travel time performance (see Tables 27 and 28). Moreover, independence does not play a huge role in their decision and the environmental impact of their travel is unlikely to be a decisive factor for staff *Time addicts*, although environment was a concern for student *Time addicts*. In general, *Time addicts* may be likely to balance the costs and benefits of various travel options and then choose the option with the best value-for-money performance on relevant criteria, particularly cost and travel time (i.e. they could also be seen as *Utilitarianists* as defined by Jacques, Manaugh & El-Geneidy, 2013). For staff, *Time Addicts* showed a significantly higher travel time than the remaining clusters (about 7 minutes more on average) and the largest proportion of public transport users (30.5%). The latter spent on average 14-20 minutes more on their commute than either active travellers or car drivers, suggesting that increased time spent on public transport may account for the observed difference in satisfaction, as desired expectations regarding travel time were potentially not met. This is further supported by the relatively high number of individuals intending to switch to the car (24% of those considering a mode switch compared to 17% in Cluster 1 and 11% in Cluster 2).

4) ***Mode Mixers (Cluster 3, student:*** **22.5% walk; 21% bicycle; 20% bus; 17% car).**
Mode Mixers, as identified in previous research by the authors (Bösehans & Walker, 2016), are 'open to all possibilities' (Kaufmann, 2000). They have a very strong desire for independence (highest mean overall; see Table 28), regardless of the travel alternative chosen, suggesting that any mode, or any combination of modes, has the potential to fulfil the desire for independence and a given person's mode choice is likely influenced by the desire for this. Instrumental aspects such cost and travel time do matter to *Mode Mixers*, yet generally less so than to the remaining student clusters. Comfort and effort are no concern for them, and neither is environmental concern, thus setting them apart from the *Aspiring/Committed Environmentalists*. Members of this cluster were the most satisfied among student travellers and equally satisfied as the *Aspiring/Committed Environmentalists* and *Convenience Lovers*. Like the latter two clusters, they also perceived their travel to be less automatic and habitual. Due to little overlap with existing literature, it is not clear, however, whether *Mode Mixers* represent a truly unique cluster or one that is specific to the local context examined.

Cluster	Main mode	Habit	Satisfaction	Key travel aspects	Alt/bio values[1]	Ego/hed values[2]
Cluster 1 (Staff) Aspiring/Committed Environmentalists (Barr & Prillwitz, 2012)	48% car 20% bicycle 13% walk 12% bus	moderate (*M* = 3.70, *SD* = 1.62)	somewhat satisfied (*M* = 5.67, *SD* = 1.31)	Effort (lowest overall; *M* = 2.33, *SD* = 1.47) Travel time (lowest overall; *M* = 4.28, *SD* = 1.76) Environment (highest overall; *M* = 4.40, *SD* = 1.75)	very high (*M* = 7.85 / 7.88, *SD* = .84 / .91, respectively)	moderate/high (*M* = 4.70 / 6.58, *SD* = 1.18 / 1.28, respectively)
Cluster 2 (Staff) Convenience Lovers	74% car 10% walk 5% bicycle	lowest overall (*M* = 2.59, *SD* = 1.37)	somewhat satisfied (*M* = 5.64, *SD* = 1.28)	Cost (lowest overall; *M* = 3.36, *SD* = 1.56) Comfort and Convenience (highest among staff; *M* = 6.26 / 3.68, *SD* = .97 / 1.59) Environment (2nd lowest overall; *M* = 1.78, *SD* = 1.00)	high/moderate (*M* = 6.73 / 5.99, *SD* = 1.24 / 1.30, respectively)	moderate (*M* = 4.29 / 6.07, *SD* = 1.06 / 1.29, respectively)
Cluster 3 (Staff) Time addicts (Pronello & Camusso, 2011)	62% car 21% bus 9.5% train	highest overall (*M* = 4.25, *SD* = 1.48)	somewhat dissatisfied (*M* = 3.48, *SD* = 1.63)	Cost (highest among staff; *M* = 5.08, *SD* = 1.50) Travel time (highest overall; *M* = 6.24, *SD* = .85) Independence (lowest among staff; *M* = 2.58, *SD* = 1.83)	high (*M* = 7.28 / 6.57, *SD* = 1.07 / 1.32, respectively)	moderate (*M* = 4.14 / 5.96, *SD* = 1.12 / 1.39, respectively)
Cluster 1 (Student) Convenience Lovers	50% bus 28% campus 10% car 8% walk	moderate (*M* = 3.28, *SD* = 1.47)	neutral (*M* = 4.44, *SD* = 1.52)	Comfort and convenience (highest among students; *M* = 3.77 / 5.96, *SD* = 1.46) Effort (highest overall; *M* = 4.19, *SD* = 1.34) Environment (lowest overall; *M* = 1.74, *SD* = .82)	moderate (*M* = 6.40 / 5.41, *SD* = 1.23 / 1.32, respectively)	moderate/high (*M* = 4.99 / 6.63, *SD* = 1.21 / 1.36, respectively)
Cluster 2 (Student) Time addicts (Pronello & Camusso, 2011)	50% bus 30% campus 7% walking 7% car	moderate (*M* = 3.70, *SD* = 1.62)	neutral (*M* = 4.28, *SD* = 1.60)	Cost (highest overall; *M* = 5.55, *SD* = 1.40) Travel time (highest among students; *M* = 5.90, *SD* = 1.20) Independence (lowest overall; *M* = 1.85, *SD* = 1.23)	very high (*M* = 7.82 / 7.63, *SD* = .87 / .95, respectively)	moderate/high (*M* = 5.35 / 7.10, *SD* = 1.28 / 1.26, respectively)
Cluster 3 (Student) Mode Mixers (Bösehans & Walker, 2016)	23% walk 21% bicycle 20% bus 19% campus 17% car	low (*M* = 2.70, *SD* = 1.45)	somewhat satisfied (*M* = 5.60, *SD* = 1.20)	Comfort (lowest overall; *M* = 2.52, *SD* = 1.57) Cost and Travel time (lowest among students; *M* = 4.56 / 4.68, *SD* = 1.88 / 1.62) Independence (highest overall; *M* = 5.46, *SD* = 1.34)	high (*M* = 7.16 / 6.69, *SD* = 1.06 / 1.25, respectively)	moderate/high (*M* = 4.68 / 6.56, *SD* = 1.20 / 1.31, respectively)

Table 33. Student and staff cluster summaries ([1] altruistic/biospheric values, [2] egoistic/hedonic values)

5.1.3. Discussion

A primary purpose of travel behaviour market segmentations is to recognise the diversity in needs and perceptions of various road users (Jensen, 1999). The present study has illustrated that three supra-modal (i.e. mode-independent) traveller types could be distinguished across students and staff who place a different emphasis on three overarching goal frames (i.e. gain, hedonic and normative). The extracted segments broadly mirrored the results of earlier segmentation research, but intentionally excluded mode choice from cluster definitions (Pronello & Camusso, 2011) and added a theoretical framework, Goal Framing Theory (Lindenberg & Steg, 2007), as the basis for defining mobility types. The significant overlap between the present travel behaviour market segmentation based on GFT and past research (Anable, 2005; Barr & Prillwitz, 2012; Beirão & Cabral, 2008; Jacques et al., 2013; Jensen, 1999; Kaufmann, 2000; Prillwitz & Barr, 2011; Pronello & Camusso, 2011) suggests that modal choice should not be regarded as the outcome of a behavioural predisposition towards that mode (Krueger et al., 2016), but due to an interaction between the individual's goals – whether those be gain-related (e.g. managing one's resources such as time and money), hedonic (i.e. having an easy and pleasant journey) or normative (e.g. reducing the environmental impact of one's travel behaviour by choosing sustainable transport options) – and the context in which the travel behaviour occurs (Naess, 2015). This is also supported by Cools et al. (2009) who found that, except for car-dependent travellers who evidenced 'car stickiness' (Innocenti et al., 2013), none of their remaining segments showed an initial preference for a particular travel mode.

In addition to mode-independence, the proposed goal-based traveller type distinction also supports findings on the relative strength of gain and hedonic goal frames as opposed to a normative goal frame (Steg et al., 2014). Two of the major clusters distinguished in the present study and identified in one form or another in various previous segmentation work (Anable, 2005; Barr & Prillwitz, 2012; Jacques et al., 2013; Pronello & Camusso, 2011) – that is, *Convenience Lovers* and *Time Addicts* – appear to be strongly influenced by hedonic or instrumental (gain-related) motives and thus may be rather unlikely to be swayed by soft policy measures, especially those targeted at a normative goal frame. Instead, the latter segments might be better influenced by goal-congruent improvements in service provision and infrastructure or sufficiently strong (dis-)incentives, thus 'decreasing the (hedonic and gain) costs of pro-environmental choices' (Steg et al., 2014, p. 104). Of course, this is not to say that travellers may not base their modal choices on invalid or selective beliefs that lead to biased choices (Ajzen, 2015; Innocenti et al., 2013; López-Sáez, Lois & Morales, 2016). However, in line with Naess (2015), travel behaviour might arguably be better regarded as probabilistic rather than possibilistic. In other words, in spite of the variability in people's individual goals or instrumental, symbolic and affective beliefs (e.g. Lois & López-Sáez, 2009), the built environment is thought to place (absolute) constraints on an individual's travel behaviour to the extent that it makes certain transport options more attractive and feasible than others and thus may ultimately determine travel mode choice.

Due to this interdependence between goals and context, policies and interventions may thus need to reshape social, economic and urban environments to successfully tackle the various needs of different population segments in order to engender any lasting changes (Barr & Prillwitz, 2014). This also requires that common transport taboos are

addressed with sufficient rigour (Gössling & Cohen, 2014). Thus, interdisciplinary research should continue to investigate the factors affecting the public acceptance of legal measures (e.g. Gärling & Schuitema, 2007; Tørnblad, Westskog & Rose, 2014), understanding the adoption of new technologies (e.g. Bockarjova & Steg, 2014; Schuitema et al., 2013) and sustainable travel behaviours (Steg, Bolderdijk, Keizer & Perlaviciute, 2014), while evaluating changes in behaviour and attitudes in response to changes in the built environment (Ogilvie et al., 2012) or social practices. At the same time, it will be critical to further study the effectiveness of urban design and land use measures to encourage active travel and public transport usage, which has remained a largely understudied area (Ewing & Cervero, 2010; Goodman, Sahlqvist & Ogilvie, 2014; Heath et al., 2006; Khan, Kockelman & Xiong, 2014).

Strengths and limitations

The general problem with cluster analysis producing clusters regardless of whether or not extracted groupings may actually exist in the real world persists. Cluster analysis remains an exploratory tool and each cluster solution is merely one of many possible outcomes based on the researcher's choice of data included, clustering algorithm and distance measure applied, and number of clusters selected (Dolnicar, 2002). In addition, the input variables are always chosen subjectively, thus precluding the inclusion of other variables (e.g. health motives) which may have led to more nuanced results. For example, the omission of attitudes towards particular modes and other psychological constructs (e.g. environmental self-identity or social norms) renders a direct comparison of different segmentation approaches impossible. It is clear that segmentation can be realized in a myriad of ways. To determine the incremental validity of people's goals vis-à-vis other constructs such as attitudes, however, both need to be measured. Furthermore, it is unlikely that any individual will perfectly fit into any one of the extracted groupings due to the complex interaction of fluctuating internal and external factors, thus limiting the generalizability of any cluster solution. A traveller might, for instance, value both the environment and travel time highly, under which circumstances it might become difficult to classify him or her as either an *Aspiring (Committed*) *Environmentalist* or *Time Addict,* respectively. These limitations notwithstanding, the present typology of commuters can be distinguished from earlier segmentation research in several ways.

First, the current classification is more parsimonious than previous segmentation work (Prillwitz & Barr, 2011) by focusing solely on commuters' preferences and values while, at the same time, providing more detailed information about individual segments than comparable approaches (Jacques et al., 2013). Second, the classification did not include attitudes towards particular transport alternatives such as the car (Anable, 2005), thus avoiding any potential response bias due to identity threats (Murtagh et al., 2012). Third, similar to the work of Jacques et al. (2013), the study did not employ a general population sample (Cools et al., 2009; Diana & Mokhtarian, 2009; Pronello & Camusso, 2011), but rather a sample of demographically similar commuters with a homogeneous trip purpose and destination (i.e. the commute to university), thus controlling for potentially confounding factors such as trip purpose and destination (Barr & Prillwitz, 2012). Fifth, with one exception, the same clusters were found among both students and staff, suggesting a high degree of stability of the extracted segments, which were in line with past research.

Indeed, despite conceptual differences and methodological limitations, the present study has shown that a strong consensus prevails among previous segmentation solutions obtained by different researchers in different parts of the world and at different time points (Anable, 2005; Barr & Prillwitz, 2012; Beirão & Cabral, 2008; Cools et al., 2009; Jacques et al., 2013; Jensen, 1999; Kaufmann, 2000; Prillwitz & Barr, 2011; Pronello & Camusso, 2011). Most importantly, by omitting modal choice from the definition of clusters and by adding a theoretical basis to the vast array of past segmentation research, supra-modal traveller types could be identified (Pronello & Camusso, 2011) that provide an alternative to common TPB-based approaches (e.g. Anable, 2005). More specifically, in contrast to recent research which has argued that people may possess behavioural predispositions towards particular transport modes (Krueger et al., 2016), we argue the exact opposite. That is, rather than being predisposed towards certain modes of travel, individuals might be better thought of as being predisposed towards specific goals they wish to fulfil. In particular, the results suggests the presence of three mobility types that appear to closely mirror the three goal frames distinguished by Lindenberg and Steg (2007), reflecting peoples' hedonic goals (*Convenience Lovers*), gain goals (*Time addicts*) and normative goals (*Aspiring/ Committed Environmentalists*). Using these goal-based clusters, some tentative recommendations as to how their travel behaviour might be influenced towards more sustainable alternatives can be made.

Implications

The present study has illustrated that elaborate psychological models of modal choice (e.g. Donald, Cooper & Conchie, 2014; Paulssen, Temme, Vij & Walker, 2014) may actually overcomplicate the modal choice process, which may be much more reliant on *goal-based preference profiles* and *contextual factors* than some would like to make us believe. That is, while factors such as habit may be important to explain why people maintain their travel behaviour, the interaction between personal goals and the local context is proposed to be central to modal choice. A major argument being made is thus that modal choice is entirely uninformative about people's goals (e.g. someone may use the car, yet still be environmentally concerned), while the opposite is also true. That is, knowing someone's preferences does not allow to predict mode choice in the absence of contextual information. At the time, this is not to say that attitudes toward particular modes of travel or social norms have no bearing on modal choice. On the contrary, Social Psychology infused transportation research has proven incredibly valuable in revealing and testing a host of potential motives behind peoples' travel mode choices (e.g. Donald et al., 2014; Gatersleben & Uzzell, 2007; LaJeunesse & Rodríguez, 2012; Mann & Abraham, 2006; Paulssen et al., 2014; Steg, 2005; Steg, Vlek & Slotegraaf, 2001; just to name a few) and soft policy measures have shown a notable potential in reducing car use (García-Garcés, Ruiz & Habib, 2016; Möser & Bamberg, 2008). The current study as well supports the notion that specific psychological factors such as independence (Jensen, 1999; Thomas, Walker & Musselwhite, 2014) and environmental concern (Anable, 2005) may play a significant role in travel mode choice for some people, although the strength of hedonic and gain goals should not be underestimated. This has important implications for the way transport policies and interventions are designed, especially interventions based on social marketing approaches (Peattie & Peattie, 2009). Here, some tentative recommendations based on the extracted supra-modal traveller types are provided.

Aspiring/Committed Environmentalists

***Recommendations*.** Due to their relatively small emphasis placed on travel mode performance in terms of time and effort required, and high importance attributed to the environment, these users may have the greatest propensity to alter their travel behaviour. Financial incentives (e.g. subsidies for purchasing an electric bicycle or plug-in battery/hybrid EV; free charging/parking space at the workplace), infrastructure improvements (e.g. exclusive bus lanes, new segregated cycle paths) or Personalised Travel Planning Interventions (PTPIs; e.g. Graham-Rowe, Skippon, Gardner & Abraham, 2011) may enable the *Aspiring Environmentalist* to fully commit to more sustainable travel alternatives in the long run. Increasing trip comfort, the aesthetic quality of the trip route or trip safety would benefit the Committed Environmentalists (i.e. those already traveling by sustainable means), whereas appealing to individuals' environmental beliefs or local identity and improving the accessibility and cost of public transport (Collins & Chambers, 2005; Jaśkiewicz & Besta, 2014), may be particularly effective to target the drivers in this cluster.

Convenience Lovers

***Recommendations*.** Increasing the actual or perceived convenience of alternatives may be crucial for *Convenience Lovers*. Although not as time-sensitive as the *Time Addicts* below, for these users mode change will require the availability of highly competitive alternatives (e.g. a well-connected network of segregated cycle paths or frequent and reliable public transport with stops at convenient locations) that provide a high degree of comfort, flexibility and independence. At the same time, the convenience of unsustainable modes (i.e. car travel) could be reduced – for instance, reducing the availability of parking opportunities – thus increasing the competitiveness of alternative modes. In general, *Convenience Lovers* may be willing to pay whatever the price for the most convenient alternative but, at the same time, may settle for nothing less. Finally, for this cluster, appealing to normative considerations is unlikely to encourage a shift in behaviour.

Time addicts

Recommendations. Clearly, mode performance is vital in the eyes of *Time addicts* and thus any regulatory or physical changes that lower the cost and enhance the performance of sustainable travel modes (e.g. cycle superhighways or exclusive bus lanes) are likely to facilitate mode change for this group (e.g. Schneider, 2013). Information about trip time variability may be useful to convince *Time Addicts* to switch from the car to common alternative modes such as public transportation (López-Sáez, Lois, & Morales, 2016). Yet, in this case, the self-reported data clearly indicate that the car outperforms public transport in terms of travel time, thus making a switch unlikely, although active travel might still be an option.

Mode Mixers

Recommendations. Sixty-three percent of Mode Mixers who intended a switch in travel modes cited either walking or cycling as a desired alternative, suggesting that they might benefit from the same interventions directed at *Aspiring* or *Committed Environmentalists*. To preserve their strong desire for independence (see also research by Thomas, Walker & Musselwhite, 2014, for the importance that different mode users attribute to autonomy), flexible public transport tickets that can be used with multiple services (e.g. bus, train and

metro) could provide an additional benefit, or the flexibility and control of walking and cycling (Gatersleben & Uzzell, 2007) might be promoted.

Future research

Due to the consistent overlap between the current and previous segmentation work, it seems reasonable to assume that the traveller types distinguished here can broadly reflect the vast majority of commuters. The tentative integration of present and past work (Table XX) suggests that there may be additional clusters (*Perceived/True Captivity*, *Dedication* and *Mode Mixers*) that may represent preference profiles in their own right. To what extent each of the latter reflects true preference profiles, however, remains open to debate and is briefly discussed below.

The *True Captives* are known for their inability to travel using their desired mode, albeit revealing little about their actual preferences. These users are often pictured as reluctant public transport users (e.g. Anable, 2005; Jensen, 1999; Kaufmann, 2000; Prillwitz & Barr, 2011). The *Perceived Captives*, on the other hand, closely resemble the *Aspiring Environmentalists* by sharing their concern for the environment. They appear to differ, however, by being dissatisfied with and constrained to their current mode of travel, while perceiving little to no room for a change in their travel behaviour. These users are often pictured as *Malcontented Drivers* (Anable, 2005) or *Paying Ecologists* (Pronello & Camusso, 2011). Finally, the *Dedication* cluster represents travellers with a strong preference for their chosen mode, transcending all other considerations. These users have a very strong desire for freedom and independence and are often pictured as *Die Hard Drivers* (Anable, 2005) or *Obstinate Drivers* (Beirão and Cabral, 2008), although a strong attachment may also be forged to other modes, such as cycling and public transport, as illustrated by *Cyclists/Public Transport Users of the heart* (Jensen, 1999) and *Transit Enthusiasts* (Beirão and Cabral, 2008). Independence (*Mode Mixers*) emerged as a key theme for a further distinguishable group that has been identified in previous research by the authors (Bösehans & Walker, 2016). *Mode Mixers*, resemble the *Dedicated* in their strong desire for independence, yet appear not to be focused on any particular mode, but rather may be very flexible regarding their mode choices and may frequently alternate between different options.

There are, however, additional issues in segmentation research that remain unresolved and deserve attention. To date, little is also known about the formation of preference profiles. It is likely that parenting practices may have a strong impact on the preferences that their children develop (Pooley et al., 2013). Taking children to school in a car as opposed to active travel or public transport, could lead children to prioritize different goals and values, such as convenience and comfort, in the future. It is also conceivable, however, that goal-based preference profiles do not materialize until adulthood, when independent travel decisions, such as the commute to work, need to be made. Little is also known about the stability and permeability of traveller types over time and across different contexts (e.g. commute versus leisure). Major life events, such as a relocation or a change in family or occupation status, could also prove influential (SEGMENT, 2016; Verplanken & Roy, 2016). Longitudinal research studies may shed more light on this issue.

5.1.4. Conclusion

Earlier segmentation studies, including Study 2 of the present work, have shown that users of a single mode may have different individual preference profiles. The present study extends this by demonstrating that those who share a preference profile may use entirely different modes of transport. Individual traveller types may thus be better regarded independent of their travel mode choice. This has important implications for the promotion of active and sustainable travel which may have inordinately focused on attitudes towards different transport modes rather than on people's underlying supra-modal goal tendencies. Indeed, the first application of Goal Framing Theory to travel behaviour market segmentation research has suggested that motivations may be effectively reduced to gain, hedonic and normative goals, although this is not to undermine the value of context-specific segmentation studies that can be more nuanced and reveal important information about local people's behaviours. Undoubtedly, travel behaviour is a complex and multi-faceted process implying that any legal, structural or behavioural measures will need to address all traveller types' needs simultaneously. This implies that sustainable alternatives need to become not only more affordable, convenient and time-saving, but also need to provide a sufficient degree of autonomy. While this may be difficult to achieve in reality, it appears to be the only reliable way to effectively encourage behaviour change in the long run.

While the current study chapter suggests the existence of supra-modal traveller types, the final study chapter aims to further test this assumption by investigating people's implicit associations between travel modes and positive versus negative emotions. That is, if travel mode choice is indeed largely independent of people's attitudes towards particular modes of travel, they should not exhibit any initial preference for one mode over another. Study 5 tests this hypothesis by investigating different mode users' implicit associations between the four main modes of travel (i.e. walking, cycling, driving and using public transport) and their affective consequences (i.e. whether they are associated more with positive or negative affect or neither of the two), using a lexical decision task. Implicit attitudes, in contrast to explicit attitudes, are not subject to conscious reflection and potential social desirability biases and thus may reveal more about people's truly held attitudes than an investigation into people's explicit attitudes of which there is an abundance in the literature. If modal choice was dependent on individuals' (implicit) attitudes, then it would be expected that individuals express an initial preference for their own or a desired mode. If, however, modal choice was independent of people's (implicit) attitudes, then no favouritism towards either participants' own mode or any other mode would be expected. The latter would support the claim made in the present work that modal choice is largely dependent on people's overarching goals and values rather than on their attitudes towards particular modes of travel. The outcomes and conclusions of the lexical decision experiment are presented in the next chapter, which will be followed by a general discussion chapter, putting all study findings into perspective with existing literature, while highlighting their limitations, implications and suggestions for future research.

Chapter 6 – Implicit affective associations with different travel modes

6.1. Study 5 – Testing the strength of association between travel modes and positive versus negative emotion words in a lexical decision task

The following study had the objective to test the immediate affective (or implicit) rather than openly expressed (or explicit) affective evaluations (i.e. attitudes towards) different travel modes, as the latter have been extensively studied in previous literature (Anable, 2005; Beirão & Cabral, 2007, 2009; Cullinane, 1992; Ibrahim, 2003; Paulssen et al., 2014; Rubens et al., 2011; Steg, 2005). Studying implicit attitudes may be particularly revealing when there is an apparent dissociation between explicit and implicit attitudes (Greenwald & Krieger, 2006), as might be the case in the context of mode preferences. Nowadays, for instance, in the light of wide awareness of global warming, proclaiming love to one's polluting car may be less acceptable than it used to be and may attract frowns from environmentally conscious neighbours, although exceptions do exist as the recent phenomenon of *coal rollers* illustrates (i.e. diesel trucks modified with chimneys and equipment that can force extra fuel into the engine causing dark black smoke to pour out of the chimney stacks), a conservative movement against the Obama administration that aimed to encourage sustainable mobility practices and technology (Walker, 2014). Thus, a '*Complacent Car Addict*' (Anable, 2005) may refrain from openly expressing his love for the car, although he or she may still love it secretly.

Crucially, for the current research, in their model of dual attitudes, Wilson, Lindsey and Schooler (2000) argued that, whereas explicit attitudes may be changed more readily, implicit attitudes may remain relatively stable. That is, whereas common explicit attitudes represent more elaborate conscious thoughts about an attitude object that can be stated verbally after a moment of reflection and are subject to change (e.g. via a cognitive dissonance process), immediate affective evaluations of an attitude object (e.g. of a member of a minority group or a luxury sports car) may bypass cognitive processing and thus may be harder to change through cognitive effort (Gawronski & Strack 2004). Measuring people's implicit associations may thus have the advantage to unveil their *true* attitudes and beliefs, while circumventing any potential social desirability biases (Petty & Briñol, 2010). How people's implicit associations can be measured is detailed below.

Measuring implicit attitudes

In general, experiments that are designed to measure implicit attitudes employ indirect measures which often require the experimenter not to disclose the actual purpose of the measure until after completion of the study. Usually the participant is told that X is being assessed, although his or her response is actually used to infer Y. The direct measure of X can thus be seen as an indirect measure of Y (Greenwald & Banaji, 1995). A way to measure the strength of association between an attitude object and its evaluation is through *semantic priming* which has originated from research on the facilitation of word recognition.

In one of their word recognition studies, Meyer and Schvaneveldt (1971) presented participants with a series of two letter strings that were either both words or non-words or that were different (i.e. one word, one non-word). For each combination, participants were asked to respond "yes" or "same" if both letter strings were words and "no" or "different" if at least one of the letter strings was a non-word. With this procedure, called a *lexical decision task* (term first employed by Meyer & Schvaneveldt, 1971), the authors found that participants' reaction times were faster when the word pairs were semantically related (e.g. nurse-doctor) rather than unrelated (e.g. nurse-butter). Subsequent research on word recognition has extended the framework to include a prime manipulation (Baayen, 2014). That is, in a so-called *masked priming task* (using visual lexical decision), the target word(s) for which a word vs non-word decision is to be made, is preceded by another either related or unrelated stimulus for a very short duration of time (often less than a few hundred milliseconds). This stimulus (i.e. the prime) is usually preceded by a mask of random letters or hash marks (hence *masked* priming) and usually bypasses participants' awareness, although it may still be recognised and processed subconsciously. If prime and target are related, people's responses to correctly identify the target stimulus tend to be faster, as it is argued that the prime facilitates the lexical access to the target by partially pre-activating the latter (Forster, 1999). Priming tasks can be distinguished based on the degree of relatedness between the prime and target stimulus ranging from an identity condition (good priming good), to a related condition (goodness priming good), a form condition (food priming good) and an unrelated condition (hand priming good).

Affective priming

In *affective priming* – which can be regarded as a specific version of semantic priming – the prime is a positive (negative) attitude-object (e.g. mother, pet or food) whose presentation affects responses to subsequently presented emotional information (e.g. good). Here, the prime-target pairs are not necessarily related semantically, but tend to be related associatively (i.e. two words can be considered associatively related when a large percentage of people give the target as the first word they think of in response to the prime in a free association task; Perea & Rosa, 2002). As in semantic priming, it is thought that cognitive associations can be activated automatically and that the stronger the association between the object under consideration and the corresponding evaluation, the more likely does its automatic activation become (Fazio, Sanbonmatsu, Powell & Kardes, 1986). *Facilitation* in affective priming is said to occur when faster stimulus reaction times are the result of a congruence in valence between the prime and target stimulus (Ferré & Sánchez-Casas, 2014), such as when a positively valued attitude object (e.g. party) is being followed by a positive target (e.g. fun) or a negatively valued attitude object (e.g. funeral) is being followed by a negative target (e.g. sad). In contrast, *inhibition* is said to occur when reaction times are slowed down because either a positively valued attitude object (party) is followed by a negative target (sad) or a negatively valued attitude object (funeral) is followed by a positive target (fun).

Aims and objectives of the present study

In the current study, the objective was to measure participants' strength of cognitive association between different travel modes and their hidden affective evaluations. To this end, implicit associations were assessed through affective priming based on a lexical decision task in which participants were asked to correctly distinguish (by press of a button) positive and negative emotion or neutral words from corresponding non-words on a computer screen. All target emotion words and non-words requiring a response were preceded by a travel mode prime (i.e. the attitude object: bus, car, cycling and walking), or a letter string (AAA) for baseline assessment, that flashed up on the screen briefly. In line with the affective priming literature, facilitation (i.e. faster reaction times) was expected to occur when a positively or negatively valued attitude object preceded an affectively congruent target stimulus. For instance, a car user with a positive attitude towards cars would be expected to respond quicker to the target "happy" when preceded by the word "car" as a prime rather than "bus" or "walking". Vice versa, inhibition (i.e. slower reaction times) was expected to occur when a positively or negatively valued attitude object preceded an affectively incongruent target stimulus. Returning to the example above, a car user with a positive attitude towards cars would be expected to respond slower to the target "sad" when preceded by the word "car" as a prime. In general, positive and negative emotion words have been found to have a processing advantage over neutral stimuli (Kousta, Vinson & Vigliocco, 2009). Moreover, recent research has suggested that positive words may always be facilitated regardless of their frequency in everyday language, whereas the facilitation of negative words may be limited to high frequency negative words (Scott, O'Donnell & Sereno, 2014).

A lexical decision task was chosen for the current study because it allows the simultaneous testing of the strength of association between multiple prime-target combinations, which would not have been possible with other measures, such as the IAT (Greenwald, McGhee & Schwartz, 1998), which are frequently limited to binary comparisons (e.g. using positive/male versus negative/female as response categories). The latter has also been shown to produce implicit association effects in the absence of a pre-existing association between response categories (Mierke & Klauer, 2003), a further issue that might be overcome by application of a lexical decision task which does not require participants to apply fixed response sets. Finally, in a lexical decision task, various kinds of priming stimuli may be employed ranging from words to sounds or images. For instance, in an affective priming study using emotional pictures as primes, facilitation was observed for positive stimuli and inhibition for affectively incongruent prime-target pairs (Kissler & Koessler, 2011), illustrating the general robustness of the method.

Introduction – Affect and travel mode choice

The review of past literature in Chapter 1 and the studies presented in Chapters 2 to 5 leave little doubt that, for many commuters and travellers, journey-based affect is an important consideration in travel mode choice beyond mere instrumental or utility considerations (Gardner & Abraham, 2007; LaJeunesse & Rodríguez, 2012; Mann & Abraham, 2006). This is also reflected in recent research on car purchase decisions which has shown that, apart from cost and practicality, image and emotional considerations play a significant role in choosing a car (Hafner, Walker & Verplanken, 2017).

Needless to say, different travel modes may provide different affective qualities. In particular, walking has been shown to be associated with positive affect due to its potential for relaxation, whereas cycling may prove satisfying due to its greater potential for excitement (Gatersleben & Uzzell, 2007; Thomas & Walker, 2015). In general, commuters who travel actively have been shown to be more satisfied than either drivers or public transport users (Olsson et al., 2013; St-Louis et al., 2014), which may be due to relatively lower levels of stress and commute time dissonance (LaJeunesse & Rodríguez, 2012). Bus riders, especially, tend to be among the least satisfied travellers (St-Louis et al., 2014; Thomas & Walker, 2015), although a journey by bus or by train may be relaxing as well, as one may lean back and engage in a variety of work- or non-work related activities ranging from enjoying the scenery, to reading or chatting with other people (Beirão & Cabral, 2007). Finally, driving by car may be both comfortable and convenient, and the act of driving itself may be a source of joy (Steg, 2005). Recent evidence, however, also suggests that, at least for commuters, driving tends to be associated with an affective neutrality and may be primarily driven by contextual cues rather than positive affective appraisals arising from the journey experience itself (Thomas & Walker, 2015).

It is also important to note that what constitutes a pleasant journey or commute will differ from one person to the next. For Person A, a positive affective experience may consist of experiencing the speed rush of racing down a hill by bicycle, whereas Person B may prefer a calm bus ride which gives him or her the opportunity to chat with friends or colleagues. People may thus hold very different, and sometimes conflicting, *attitudes* towards various travel modes and their affective and/or practical qualities (Beirão & Cabral, 2007; Ibrahim, 2003). Importantly, however, even if people express positive attitudes towards certain travel modes, these rarely translate into behaviour change (Rubens, Gosling & Moch, 2011). One possible explanation for this gap is that their explicit attitudes do not reflect their implicit attitudes.

Implicit versus explicit attitude constructs

Attitudes are explicit or implicit *evaluative associations* with a physical object or target behaviour (Ajzen & Fishbein, 2005). *Explicit attitudes* are considered evaluative responses that can be retrieved and stated by the person who holds the attitude (Eagly & Chaiken, 2005), such as the statement “I like ice cream”, and are assumed to be important elements in the formation of intentions and behaviour (Ajzen, 1991). In short, if Helen says that she likes ice cream, there is a good chance that she won’t decline if you offer her some. *Implicit attitudes*, on the other hand, are characterized by their *automatic activation* upon encountering an attitude object (Gawronski & Bodenhausen, 2006). Like explicit attitudes, implicit attitudes may be crucial in guiding behaviour (Friese, Hofmann & Wänke, 2008). As an example, consider viewing a huge billboard portraying an ad for a new ice cream flavour. If you, like Helen, like ice cream, you might be tempted to try the new product and buy it on your next trip to the grocery shop. In general, in the absence of any controlled processes that tend to require both cognitive capacity and motivation (Fazio & Towles-Schwen, 1999), implicit attitudes are assumed to guide behaviour (Ajzen & Fishbein, 2005), whereas explicit attitudes may be dominant only when resources (and motivation) are high (Hofmann, Gschwendner, Friese, Wiers & Schmitt, 2008). Going back to the ice cream example, you might remind Helen that “Ice cream has a lot of sugar and fat. You should only eat it occasionally”, even if you share her positive implicit attitude (“I

like ice cream"). Openly stated attitudes thus do not necessarily reflect people's true beliefs (Eagly & Chaiken, 2005; Petty & Briñol, 2010). In the context of travel mode choice, being aware of the negative environmental impact that car use has on the environment, a strongly attached car user, for instance, might express a positive explicit attitude towards public transportation (e.g. because of economic or environmental considerations), yet may actually hold a rather negative *implicit* attitude towards PT services because (s)he tends to regard public transport as uncomfortable and underperforming when compared to the car.

Indeed, implicit and explicit attitudes do not need to be congruent, as earlier research has demonstrated that implicit and explicit attitudes may be regarded as related, yet distinct, constructs (Nosek & Smyth, 2007). It has further been suggested that implicit and explicit evaluations of an attitude object co-exist in people's minds (Wilson, Lindsey & Schooler, 2000). Thus, it is entirely possible that Person A may implicitly dislike public transport because it does not provide the comfort or excitement that is desired (or because of a host of other potential reasons such as the undesired intrusion of one's personal space), while he or she may still hold a positive overt (or explicit) attitude regarding public transport in general, as it tends to be considered a very safe and environmentally friendly transportation mode. A double-dissociation model of attitudes has been supported in other research as well (Perugini, 2005).

As travel behaviour may be largely guided by existing schemata, if habit is strong (Klöckner & Matthies, 2004), and thus may not be a controlled process, a central question of interest is whether mode users' automatically activated implicit associations favour their own main mode of travel when compared to other forms of transportation. A dedicated cyclist, such as Person A, will most likely have a very positive implicit *and* explicit attitude towards cycling. The mere thought of cycling might be sufficient to evoke an initial positive emotional response. In contrast, that same person may openly express a favourable attitude toward public transit, despite the thought of actually using public transit evoking a rather negatively-laden affective association. However, whereas past research has mainly focused on openly expressed attitudes (Beirão & Cabral, 2007; Rubens, Gosling & Moch, 2011), little research to date has attempted to investigate implicit associations in the context of travel behaviour (see Hatfield, Fernandes, Faunce & Job, 2008, for an exception) and especially with regard to mode choice. There thus appears to exist a gap in the literature that has not been addressed until the present day.

6.1.1. Method

Participants

Participants were recruited via the University noticeboard and through word of mouth. Forty participants (26 female, 13 male, 1 undisclosed) took part in the approved experiment (Ethics ref 15-039) of whom four were excluded from the main analysis because they either were the only ones to report a mode other than bus (N = 10), car (N = 9), cycling (N = 8) or walking (N = 9) as their main mode of travel (*N* =2) or because their response accuracy fell below three standard deviations of the average and thus did not provide reliable data (*N* =2). This left a sample of 36 participants (24 female, 12 male) aged 18 or older (M = 26.6, SD = 6.0; Min = 19, Max = 45). Participants were reimbursed £3 for their participation in the experiment.

Materials

Software. The open source software PsychoPy (Peirce, 2007, 2009) was used to create the lexical decision task. PsychoPy has been shown to be reliable software for experimental tasks involving reaction times, even for very short stimulus intervals (Garaizar & Vadillo, 2014). Participants completed the task on a lab pc with Windows 7 operating system.

Lexical decision task. The task included four blocks, containing 150 trials each (3 seconds per trial), that took a maximum of 30 minutes to complete (7.5 minutes per block), depending on participants' reaction times. The four blocks were separated by short breaks (the task auto-advanced after three minutes) and were preceded by a short practice block including 30 trials. In all trials (a one second pause separated each trial), participants were asked to make a decision on whether a given target stimulus displayed on the computer screen (i.e. either a positively- or negatively-valenced emotion- or neutral-word or non-word) is a word by pressing the "j" (word) or "f" (non-word) keyboard button, respectively. In the practice block, target words were preceded by the presentation of one of five non-travel-related primes (cat, beer, rollercoaster, funeral and shoe) for 200ms. The four blocks comprising the main task also displayed primes for 200ms but used travel mode primes (car, bus, bicycle or walk) and a neutral prime (letter string "AAA") instead. The primes were framed as "distraction words" in participants' instructions so as not to arouse suspicion about the true purpose of the task which was to measure the strength of association between the travel mode primes and the various emotion words. After presentation of the prime, a fixation cross appeared on the screen for 300ms. The target word was shown after disappearance of the fixation cross for a duration of 1500ms, during which the subject had to make the word/non-word decision. **Figure 25** below illustrates a single decision trial.

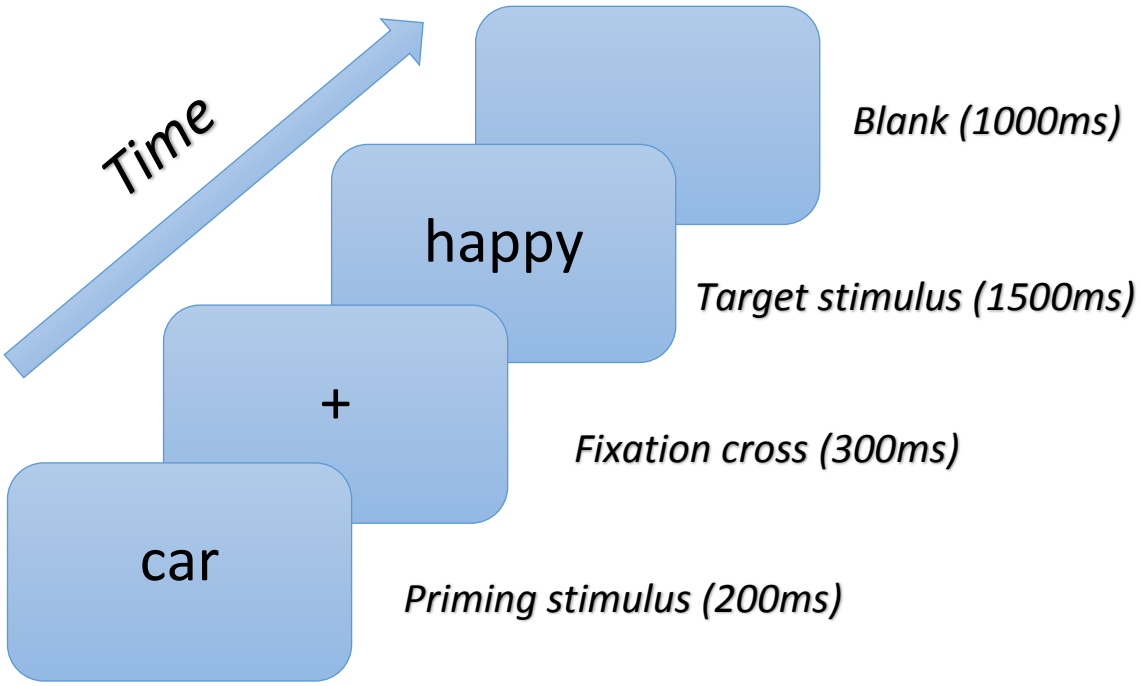


Figure 25. Structure of a single lexical decision task trial (3000ms in total)

Stimuli. Target words were made up of five positive and five negative emotion words such as “happy”, “joy”, “morbid” and “sad”. Non-words were identical to words and had only their vowels changed so as to remain pronounceable (e.g. “huppi”, “jey”, “marbud” and “sud”). The five neutral words included words such as “purple” or “moon” and corresponding non-word variations (e.g. “parple” and “mian”). Emotion and neutral words (see **Table 34** for the full list) were matched on reaction time and accuracy data based on the British Lexicon Project (Keuleers, Lacey, Rastle & Brysbaert, 2012).

The British Lexicon Project (BLP) provides a data base of lexical decision times for 28,730 English words and non-words (available at crr.ugent.be/blp). Reaction times ranged from 490 to 554 milliseconds for positive emotion words (average 523ms), from 517 to 602 milliseconds for negative emotion words (average 549ms) and from 486 to 567 milliseconds for neutral words (average 515ms). All selected emotion words had an accuracy rate of at least 95%. Together, the five primes for the main task and 15 emotion and neutral words as well as corresponding non-words resulted in 150 prime-target combinations of which each appeared once during each of the four blocks. After finishing the lexical decision task, participants were asked to fill in a brief questionnaire as outlined below.

Prime	**Target words**					
	Word			*Non-word*		
	Positive	Negative	Neutral	Positive	Negative	Neutral
Practice Cat, Beer, Rollercoaster, Funeral, Shoe	Pleasant	Dull	Yellow	Ploosint	Dall	Yollew
	Cheerful	Down	Purple	Choirfal	Diwn	Parple
	Happy	Gloomy	Sun	Huppi	Gluema	San
Main task AAA, Car, Bus, Bicycle, Walking	Great	Morbid	Moon	Groot	Marbud	Mian
	Joy	Sad	Wind	Jey	Sud	Wond

Table 34. Primes and target words/non-words used in the lexical decision task

Manipulation check. As it could not be foreseen whether the task would be able to induce an associative priming effect, due to the four travel mode primes being neither semantically nor necessarily associatively related to the target stimuli, a manipulation check was introduced. Thus, for a subset of the sample (N = 15), the priming stimuli in two of the four test blocks were replaced with emotionally-laden priming stimuli. That is, in addition to being primed with potentially non-emotionally-laden or associatively neutral stimuli (i.e. the travel mode primes) including “car”, “bus”, “cycling” or “walking”, participants were also exposed to emotionally-laden stimuli including “fun”, “friends”, “death” or “grief” on half of the trials. The latter are clearly either emotionally positive (fun and friends) or negative (death and grief) and would thus be expected to produce a strong associative priming effect (e.g. faster reaction times to “fun-happy” versus “fun-sad” prime-target pairs).

Questionnaire. The survey (to be delivered after the experimental task), resembled the Time 1 questionnaire employed in Study 3 (see appendix A4). First, respondents were asked to provide some basic demographic information and to indicate their main mode of travel to work/campus. Second, respondents were asked to indicate how often they travelled to campus/work by foot or bicycle and to classify themselves by selecting one of five *general* traveller type descriptions which they thought described themselves best. Finally, two questions focused on participants' future travel intentions by asking whether they owned or intended to purchase a bus pass and whether they intended to walk or cycle to campus more in the future.

Procedure

Participants were welcomed by the investigator in the University's laboratory facilities. After having read the information sheet, participants were asked to provide written consent to participate in the study. On the information sheet, participants were informed that they were taking part in an experiment assessing their reaction times to positive versus negative emotion words and non-words. The real purpose of the study was not revealed to participants until the end of the study because knowing the purpose (i.e. testing implicit attitudes towards different travel modes) might have falsified the results. More specifically, it was crucial for participants not to begin the experiment with any cognitions related to travel modes already triggered, as applying conscious elaborations of these modes would have defeated the purpose of the study. Before commencing the lexical decision task, study participants were given the opportunity to ask any questions regarding the procedure or to raise any concerns they might have. After completion of the experiment, participants were fully debriefed about the purpose of the study and were thanked and reimbursed for their participation.

6.1.2. Results

Manipulation check

Non-travel mode primes. A custom factorial analysis of the reaction times (correct responses only) to words presented following the emotionally-laden priming stimuli produced a significant three-way (prime*target*valence) interaction effect ($F_{149,\ 2081}$ = 2.05, $p < .001$). That is, average reaction times to the 30 (non-)word targets differed significantly depending on the priming stimulus that preceded it, albeit only rarely in a consistent manner as would be expected based on their valence. For instance, participants responded equally fast to the target word *joy* when preceded by the primes fun (495ms) or death (505ms) and equally slow when preceded by friends (549ms) or grief (547ms), suggesting a certain degree of randomness in participants' reaction times. When considering a different target such as *pleasant*, however, reaction times were congruent with expectations (friends/fun = 526ms versus grief/death = 540/544ms). Mirroring these results, no main effect was observed for prime ($F_{4,\ 2197}$ = 0.31, $p > .80$), but for the effects of target ($F_{29,\ 2201}$ = 8.65, $p < .001$) and valence ($F_{5,\ 2225}$ = 29.04, $p < .001$).

Pairwise post-hoc comparisons indicated that reaction times to positive and neutral target words were generally faster than to either negative target words or non-words with mean differences ranging from -29ms to -78ms (all $p < .001$). Negative target words, in contrast, only differed significantly from neutral non-words (*Mdiff* = -34ms, $p <$

.001), and marginally significant from negative non-words (*Mdiff* = -24ms, *p* = .06) and positive non-words (*Mdiff* = -21ms, *p* = .14). With regard to the main effect of specific target words, the largest differences in average reaction times emerged for the negative target stimuli "dull" and "morbid". The former was responded to significantly slower than all positive emotion words (71ms < *Mdiff* < 96ms, .034 < *p* < .001), except for cheerful, and slower than the neutral word "moon" (*Mdiff* = 87ms, p = .001). The negative target "morbid" was responded to even slower with mean differences for emotion *and* neutral words ranging from 70ms to 115ms (.053 < *p* < .001). The non-word variation of "moon" ("mian") differed significantly from this target as well (*Mdiff* = 70ms, *p* = .054). **Table 35** shows the average reaction times of correct responses for all target stimuli and valences, whereas **Figure 26** illustrates the differences in reaction times visually for ease of comparison (non-words excluded). Overall, the results of the manipulation check provided mixed results, suggesting no consistent affective priming effect.

The following section investigates reaction times for the travel mode primes.

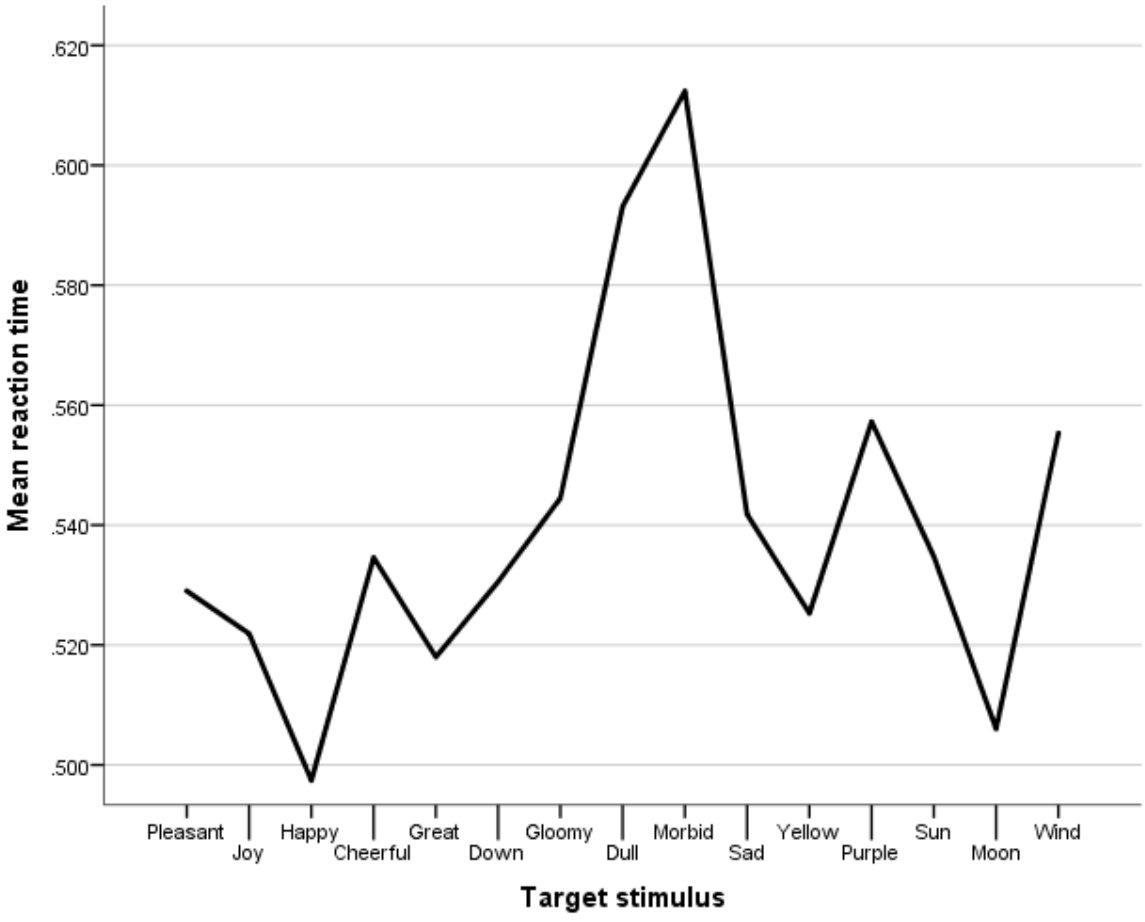


Figure 26. Average reaction times to target stimuli preceded by non-travel mode primes

				95% Confidence Interval for Mean			
	N	Mean	Std. Deviation	Lower Bound	Upper Bound	Minimum	Maximum
Pleasant	75	.52902	.090046	.50830	.54974	.263	.782
Joy	75	.52191	.095182	.50001	.54381	.305	.917
Happy	75	.49743	.092178	.47622	.51864	.370	.797
Cheerful	74	.53497	.092361	.51357	.55637	.313	.820
Great	75	.51799	.100421	.49488	.54109	.380	.824
Down	75	.53058	.119357	.50311	.55804	.245	1.107
Gloomy	75	.54450	.117684	.51742	.57157	.263	1.008
Dull	75	.59312	.134837	.56210	.62414	.407	.954
Morbid	73	.61217	.120431	.58407	.64026	.400	.949
Sad	74	.54217	.099926	.51902	.56532	.392	.876
Yellow	75	.52528	.112481	.49940	.55116	.279	.852
Purple	75	.55724	.121409	.52930	.58517	.394	1.089
Sun	74	.53512	.140358	.50260	.56764	.380	1.361
Moon	75	.50604	.080435	.48754	.52455	.354	.825
Wind	75	.55531	.138101	.52354	.58709	.387	1.294
Ploosint	75	.59260	.117136	.56564	.61955	.450	1.076
Jey	75	.56984	.094338	.54813	.59154	.450	.976
Huppi	75	.55398	.094326	.53228	.57569	.410	.904
Choirfal	74	.59995	.080007	.58142	.61849	.434	.815
Groot	66	.61607	.108289	.58945	.64269	.460	.975
Diwn	75	.55302	.085027	.53346	.57258	.437	.958
Gluema	75	.59537	.117745	.56828	.62247	.378	1.000
Dall	75	.60685	.111710	.58115	.63256	.440	1.018
Marbud	75	.60096	.117862	.57384	.62808	.433	1.071
Sud	72	.58288	.110496	.55691	.60884	.437	1.042
Yollew	74	.59662	.104781	.57234	.62090	.427	1.024
Parple	75	.63015	.130584	.60010	.66019	.464	1.106
San	75	.61403	.124672	.58535	.64272	.429	1.042
Mian	75	.54255	.085631	.52285	.56225	.387	.838
Wond	75	.60601	.127752	.57662	.63540	.443	1.160
Total	Total	Total	Total	Total	Total	Total	Total
Positive	374	.52022	.094481	.51062	.52983	.263	.917
Neutral	374	.53580	.121353	.52346	.54814	.279	1.361
Negative	372	.56431	.122619	.55181	.57681	.245	1.107
PosNW	365	.58572	.101305	.57529	.59615	.410	1.076
NeuNW	374	.59788	.119160	.58576	.60999	.387	1.160
NegNW	372	.58786	.110332	.57661	.59910	.378	1.071

Table 35. Average reaction times to target stimuli preceded by non-travel mode primes

Preliminary analysis of travel mode primes

Accuracy. Overall, participants (N = 40) achieved a mean accuracy level of 93.3% (SD = 5%). Two participants fell below 2.5 SDs of the overall accuracy mean (P13 and P16 with M = 79% and M = 80%, respectively) and thus were excluded from any further between-groups comparisons. Omitting these, in addition to the two participants who did not report using any of the four main modes as their main mode of travel, this left a sample of 36 participants for the main analysis.

Latencies. As expected, a significant main effect of target valence emerged ($F_{5, 144}$ = 37.08, $p < .001$). In general, participants (N = 40) responded faster to emotion and neutral words (M = 562ms, SD = 66ms) than to their non-word counterparts (M = 599ms, SD = 73ms; M_{diff} = -37ms, t_{39} = -6.37, $p < .001$). Reaction times to words and non-words were highly correlated ($r = .87$, $p < .001$) showing that the reaction time disadvantage for non-words was maintained regardless of the subject's personal average response time. Both positive emotion and neutral words were responded to faster than either negative or non-words (-49ms < M_{diff} < -59ms for neutral and -59ms < M_{diff} < -69ms for positive, all $p <$ .001), but were, at the same time, not distinguishable from one another (M_{diff} = 9ms, p = 1). Response latencies of negative emotion words did not differ significantly from those of non-words (-3ms < M_{diff} < -10ms, p = 1). These results are briefly summarised in **Table 36**.

	N	Mean	SD
Positive	25	.542[a]	.015
Neutral	25	.551[a]	.015
Negative	25	.600[b]	.037
Neutral non-word	25	.610[b]	.027
Positive non-word	25	.605[b]	.026
Negative non-word	25	.603[b]	.023
Total	150	.585	.037

Table 36. Average reaction times by target valence (means with a different subscript letter differ significantly at p < .001)

In order to assess whether the valence effect was equivalent for different mode users and primes, participants' reaction times to positive, negative and neutral target words were averaged for each priming stimulus (i.e. AAA, bus, car, cycling & walking), as shown in **Table 37**, and then compared between mode users (bus users, car drivers, cyclists and walkers) using a one-way Analysis of Variance (ANOVA). The results suggested no significant differences between mode users for fourteen of the fifteen prime-target combinations (0.37 < F < 2.15, all $p > .15$). Only for positive words following the baseline prime (AAA), a marginally significant result was obtained (p = .051) with post-hoc tests revealing that bus users (605ms) responded significantly slower on average than walkers (520ms; M_{diff} = -84ms, *95% CI*: -173ms, 5ms; p = .07).

Prime	Main	Plea	Joy	Hap	Che	Gre	Dow	Glo	Dull	Mor	Sad	Yell	Pur	Sun	Moo	Win	APo	ANg	ANe
AAA	Bus	.558	.653	.584	.618	.611	.600	.651	.641	.673	.616	.587	.574	.595	.570	.585	.605	.636	.582
AAA	Car	.537	.528	.560	.581	.507	.540	.615	.573	.586	.547	.526	.548	.526	.514	.562	.543	.572	.535
AAA	Cycle	.540	.515	.521	.558	.531	.549	.681	.606	.625	.547	.547	.576	.528	.532	.525	.533	.602	.542
AAA	Walk	.549	.516	.508	.519	.510	.521	.585	.559	.636	.569	.553	.569	.526	.507	.558	.520	.574	.543
Bus	Bus	.540	.594	.568	.557	.539	.564	.650	.640	.661	.619	.625	.601	.593	.569	.568	.560	.627	.591
Bus	Car	.562	.541	.524	.546	.503	.563	.577	.589	.606	.526	.513	.524	.575	.532	.542	.535	.572	.537
Bus	Cycle	.491	.589	.533	.513	.534	.546	.546	.634	.643	.555	.527	.594	.559	.505	.535	.532	.585	.544
Bus	Walk	.545	.543	.513	.531	.525	.521	.548	.587	.626	.549	.560	.540	.572	.499	.567	.531	.566	.548
Car	Bus	.595	.576	.549	.557	.601	.578	.628	.627	.699	.591	.588	.576	.570	.574	.590	.576	.625	.580
Car	Car	.569	.520	.536	.560	.500	.516	.594	.634	.631	.552	.528	.559	.497	.511	.504	.537	.585	.520
Car	Cycle	.533	.536	.521	.547	.518	.531	.616	.604	.699	.560	.512	.512	.529	.513	.553	.531	.602	.524
Car	Walk	.534	.531	.481	.549	.544	.525	.580	.565	.608	.544	.543	.537	.513	.529	.501	.528	.564	.525
Cycling	Bus	.548	.575	.539	.562	.537	.608	.614	.617	.730	.618	.612	.587	.609	.563	.590	.552	.637	.592
Cycling	Car	.532	.511	.491	.526	.502	.582	.596	.603	.582	.549	.530	.513	.539	.513	.509	.512	.582	.521
Cycling	Cycle	.536	.528	.507	.566	.500	.552	.573	.580	.630	.559	.501	.529	.550	.524	.519	.527	.579	.525
Cycling	Walk	.533	.524	.512	.545	.527	.547	.665	.610	.599	.542	.538	.555	.570	.511	.517	.528	.593	.544
Walking	Bus	.558	.610	.558	.557	.537	.586	.641	.608	.704	.612	.649	.621	.535	.568	.597	.564	.630	.594
Walking	Car	.544	.538	.497	.535	.529	.548	.584	.592	.635	.497	.546	.547	.507	.533	.566	.529	.571	.540
Walking	Cycle	.541	.522	.484	.507	.537	.595	.612	.585	.608	.566	.503	.589	.568	.511	.543	.518	.593	.543
Walking	Walk	.490	.512	.513	.502	.506	.518	.562	.584	.601	.565	.530	.504	.540	.533	.515	.505	.566	.524
Average RT		.542	.548	.525	.547	.530	.555	.606	.602	.639	.564	.551	.558	.550	.531	.547	.538	.593	.547

Table 37. Average reaction times to positive, negative and neutral target words by prime and main mode of participants (N =36); Plea = Pleasant, Hap = Happy, Che = Cheerful, Gre = Great; Dow = Down, Glo = Gloomy, Mor = Morbid; Yell = Yellow, Pur = Purple, Moo = Moon, Win = Wind; APo = Average Positive, ANg = Average Negative and ANe = Average Neutral

Main analysis

Preliminary analysis of response latencies already revealed a significant overall effect of target valence. The latter, however, will not be further considered, as it was not relevant to the research question, which aimed to investigate the strength of association between emotion words and travel mode primes within and between different mode users. For the main analysis part, a full factorial model investigating the average reaction times to the 5 prime by 10 target (positive and negative target words only) combinations was tested, the results of which are given in **Table 38** below.

Source	Type III SS	df	Mean Square	F	Sig.	Partial Eta Sq
Corrected Model	3.910[a]	199	.020	1.963	.000	.198
Prime	.044	4	.011	1.095	.357	.003
Target	2.147	9	.239	23.828	.000	.120
Main Mode	.873	3	.291	29.062	.000	.052
Prime * Target	.189	36	.005	.524	.991	.012
Prime * Main Mode	.042	12	.003	.347	.980	.003
Target * Main Mode	.178	27	.007	.660	.908	.011
Prime * Target * Main Mode	.436	108	.004	.403	1.000	.027
Error	15.808	1579	.010			
Corrected Total	19.718	1778				

Table 38. Full factorial model of average reaction time as a function of priming stimulus, target word and participants' main mode of travel (R^2 = .20; Adjusted R^2 = .10)

Overall, the full factorial model explained 20% of variance in reaction times (*Adj* R^2 = .10). In line with the earlier results examining differences in reaction times between mode users, no significant three-way interaction between priming stimulus, target stimulus and main mode emerged ($F_{108,1233}$ = .40, p = 1). In other words, there were no significant differences in the pattern of reaction times to the prime-target combinations between the four modes of travel (see also Table 37 earlier). Similarly, none of the two-way interactions turned out to be significant (.34 < F > .67, all ps > .90). Two significant main effects, however, emerged for main mode of travel and target word, respectively. That is, overall, response latencies differed significantly between modes (F = 47.44, p < .001). **Figure 27** shows a direct comparison of reaction times between mode users (emotion words only). As can be seen, the pattern of reaction times to the target stimuli was consistent between mode users. Notably, bus users' reaction times were significantly slower on average than any of the other mode users' (41ms < M_{diff} < 55ms, p < .001).

The main effect of target stimulus mirrored the earlier findings of target valence, with participants generally responding faster to positive and neutral targets than to negative target stimuli. In particular, the largest significant differences emerged between the reaction times to the negative target stimuli gloomy (M = 602ms, SD = 130ms), dull (M = 602ms, SD = 101ms) and morbid (M = 641ms, SD = 118), and reaction times to positive stimuli, especially happy (M = 526ms, SD = 86ms) and great (M = 531ms, SD = 87ms), with all pairwise comparisons being significant at p < .001. These results, however, may have been caused to a significant extent by a word frequency effect, with the chosen negative target stimuli being less frequent than the chosen positive target stimuli.

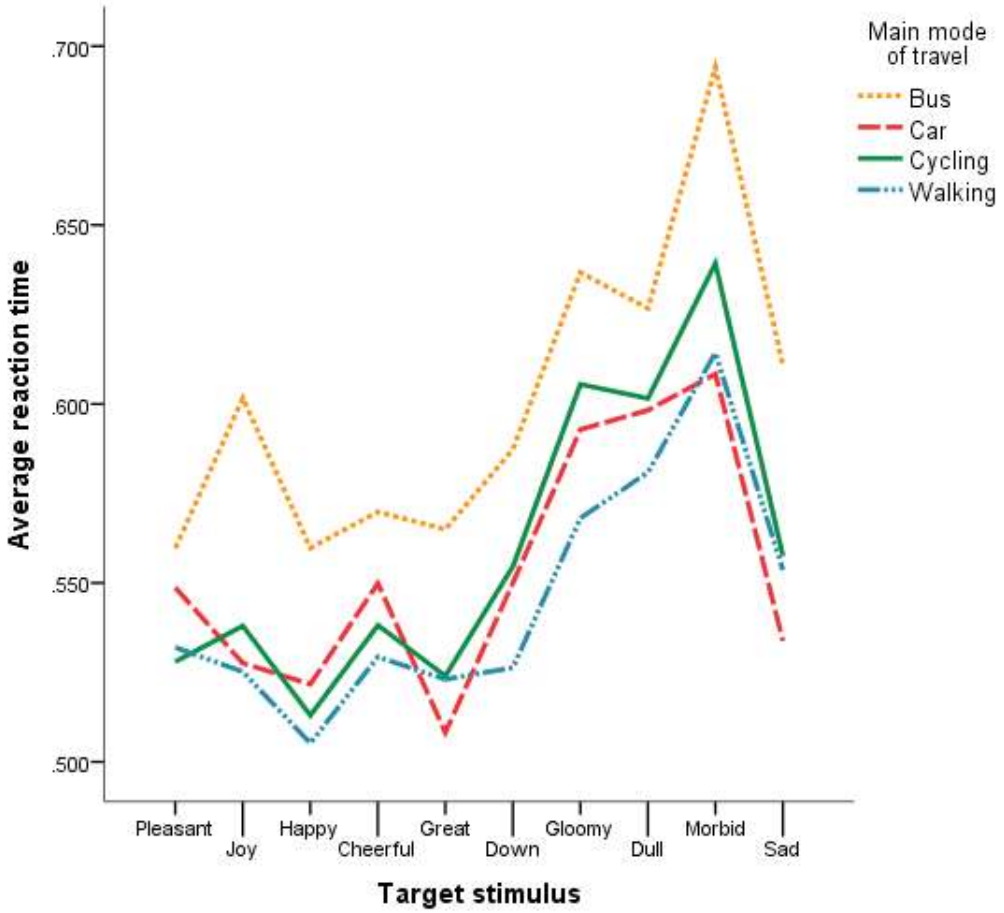


Figure 27. Average reaction times to positive and negative target stimuli by mode user

Figures 28-31 illustrate the within-group differences in average reaction times for all mode users to each of the five positive and five negative target stimuli in response to the baseline and four travel mode primes.

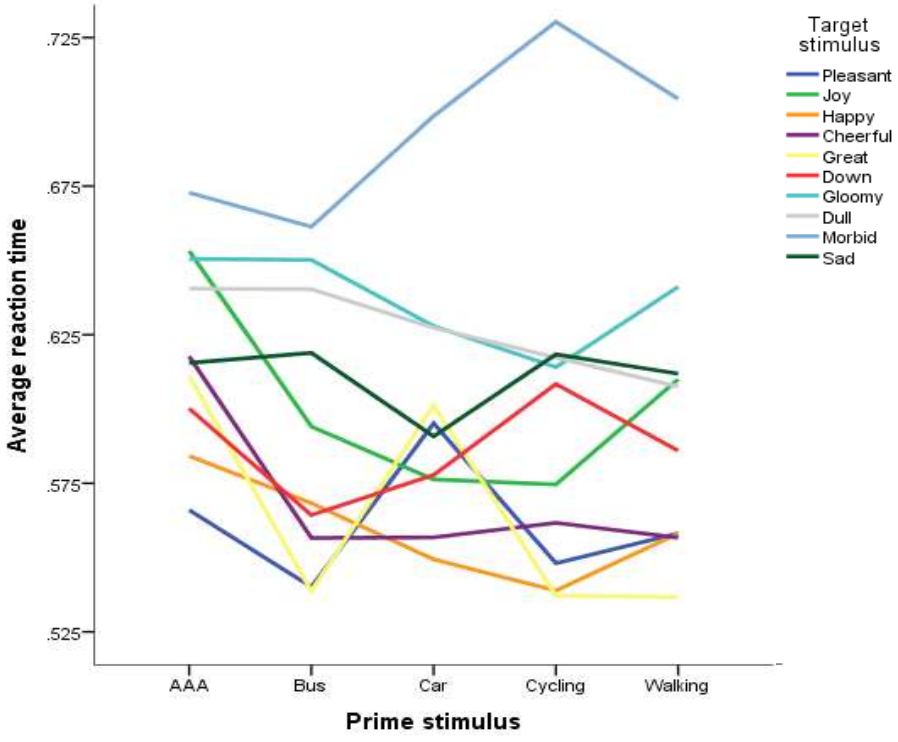


Figure 28. Bus users' (N = 10) average reaction times to all prime-target combinations

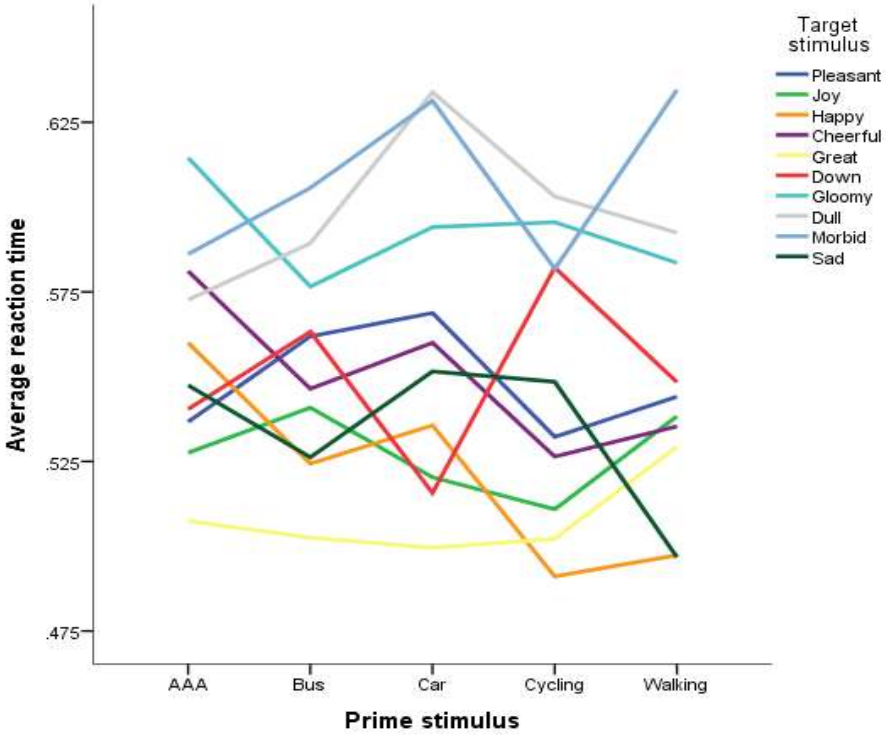


Figure 29. Car drivers' (N = 9) average reaction times to all prime-target combinations

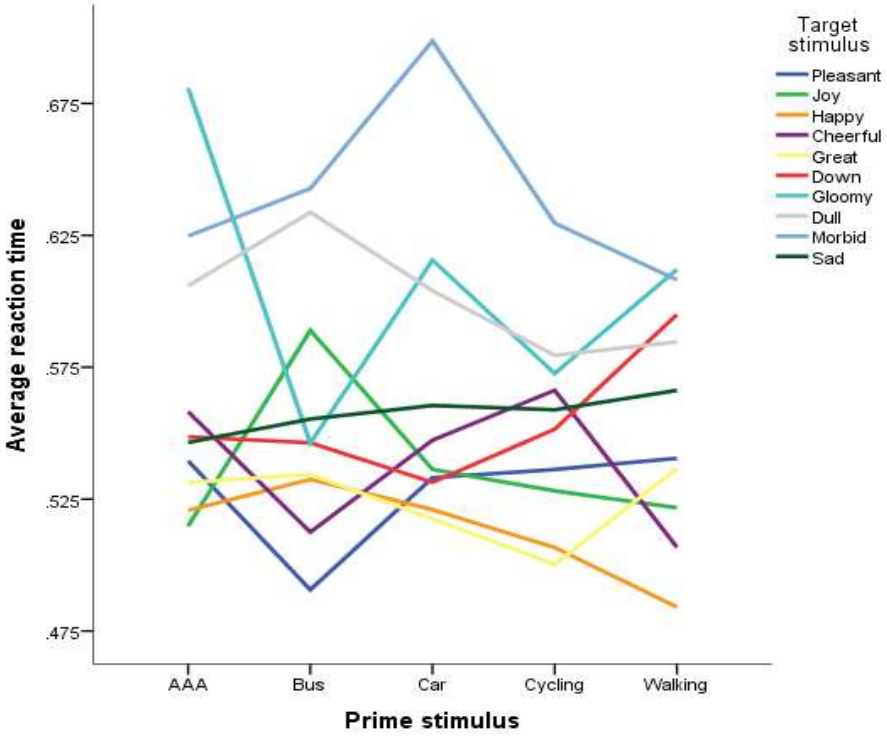


Figure 30. Cyclists' (N = 8) average reaction times to all prime-target combinations

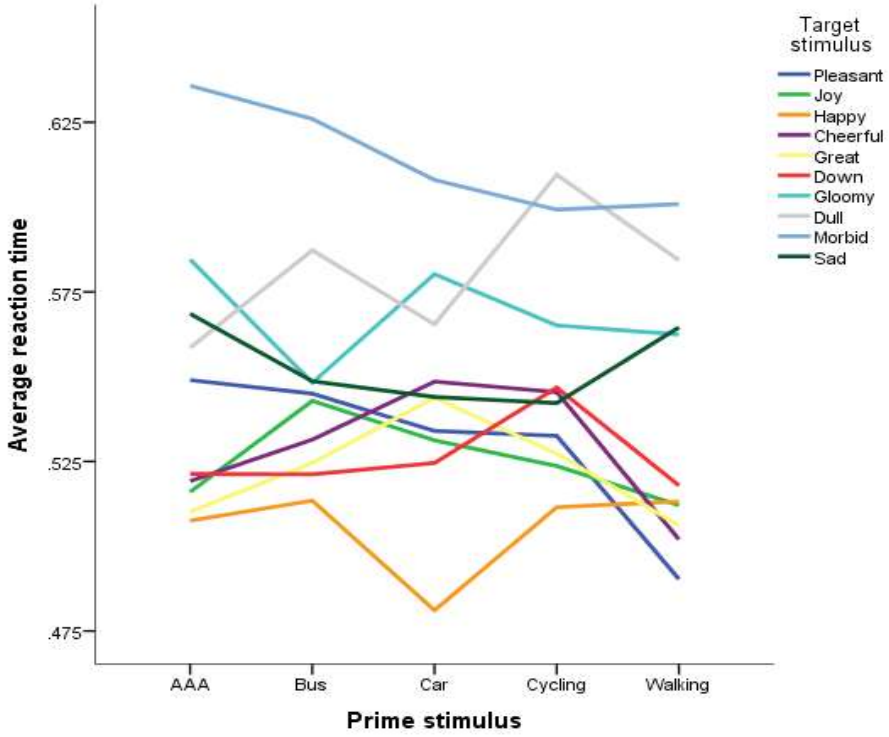


Figure 31. Walkers' (N = 9) average reaction times to all prime-target combinations

Some interesting response patterns emerged among different mode users although, due to the absence of a significant three-way interaction, these patterns may reflect little more than noise in the data. Thus, it cannot be excluded that any observed patterns are merely due to chance. Nevertheless, the following paragraphs provide a brief description of response patterns for each mode including some tentative interpretations, taking the findings at face value.

In particular, *bus users* (**Figure 28**) tended to be quicker to associate specific positive emotion words (great and pleasant) with their own mode, as well as walking and cycling, but not with the car. Yet, at the same time, they were also quicker to associate other positive emotion words (happy and joy) with both the car and cycling, which may reflect the positive affective experience including being in control, fun and speed, of those forms of transportation. Finally, bus users tended to be slower to associate active modes of travel (especially cycling) with negative emotion words, such as down or morbid, complementing the earlier findings.

Drivers (**Figure 29**) appeared to favour cycling above the other modes as indicated by faster reaction times to positive emotion words including happy, joy, pleasant and cheerful when preceded by 'cycling' as prime. Interestingly, drivers also made equally rapid associations between walking and happy and walking and sad. When responding to emotion words following their own mode, drivers were somewhat slower to react to the positive emotion words "pleasant" and "cheerful" (especially when compared to cycling), partly reflecting the results obtained from bus users. Drivers were also faster to react to the negative target word "down", but also tended to regard cars as less dull than the other travel modes, thus providing a mixed picture of their own mode.

Cyclists (**Figure 30**) appeared to have strong positive associations with both walking (happy and cheerful) and their own mode (happy and great, yet not cheerful). Furthermore, cyclists were quick to associate buses with positive (pleasant and cheerful),

but also negative emotions (gloomy) and also showed a tendency to react slower to the positive target "joy" when preceded by "bus" as a prime, compared to their own travel mode, walking or driving. Overall, cyclists did not seem to favour driving over other modes of transport, although they were slower to associate cars with either "gloomy" or "morbid".

Walkers (**Figure 31**), above all, responded most quickly to the combination car-happy. Like cyclists and drivers, walkers also tended to associate buses with "gloomy" more rapidly than the other modes. Other than that, there were no pronounced differences between reaction times following the "bus", "car" or "cycling" prime, with the only exceptions of "dull" and "down", which walkers were slower to react to when preceded by the cycling prime. Finally, walkers clearly favoured their own mode as suggested by faster reaction times to positive emotion words "cheerful", "pleasant" and "joy" and a slower average reaction time to the negative emotion word "down".

6.1.3. Discussion

Overall, the findings did not suggest a consistent biased responding towards participants' own or other modes of travel. That is, against expectations, reaction time patterns to the various travel mode prime by emotion word target combinations did not differ significantly between mode users, as indicated by the absence of a significant three-way prime by target by mode interaction. Congruent with past literature, however, a reaction time advantage was found for positive emotion words (Scott et al., 2014), suggesting that the core procedure worked. Yet, at the same time, contrary to past literature (Kousta et al., 2009), negative emotion word targets did not show a processing advantage to neutral words (or non-words) in the present study. This was the case especially for low frequency negative stimuli (e.g. dull, morbid), supporting the notion that the facilitation of negative stimuli may be limited to high frequency negative words (Scott et al., 2014), such as down and sad, which was also observed to some extent in the study at hand. Finally, albeit not significant, the results indicated that the strength of association between certain positive and negative emotion words and the four selected main modes of travel (bus, car, cycling and walking) may vary for different mode users.

Due to the limited sample size, however, it is difficult to determine whether these observed reaction time differences are merely a coincidence or reflect actual differences between mode users. This also applies to the finding that bus users tended to respond about 50ms slower on average than the remaining mode users. One can only speculate about the reasons for this observed difference. Public transport is the most passive of the four modes, requiring no effortful control by its user once having boarded the bus. It may be that using public transport ultimately leads to a numbing down of cognitive readiness as opposed to the travel modes requiring active control. With respect to power, a post-hoc analysis using G*Power (Version 3.1.9.2.) suggested that overall power was as low as .38 in the main analysis (Critical F = 1.18). For a power of .80, a sample size of 180 would have been required. For the test of a three-way interaction, power was somewhat higher (.56, Critical F = 1.24), yet insufficient to detect the small effect. This does not apply to the main effects of main mode and target, however, which together accounted for more than three quarters of the explained variance (see **Table 38**). While a larger sample size would have been desirable, the absence of an affective priming effect in preliminary analyses suggested that adaptations to the study design were necessary (see next section).

Limitations

There were several limitations regarding the current study design that need to be considered. First of all, the failure to find a consistent affective priming effect could have been due to the selected duration of the SOA (stimulus onset asynchrony). Associative priming effects have been obtained with SOAs as short as 67ms (Perea & Gotor, 1997). Here, however, the gap between presentation of the prime and onset of the target word was 500ms (200ms prime + 300ms fixation cross) which might have been too long for a priming effect to occur. In particular, the fixation cross may have been presented for too long (300ms), potentially preventing the prime from having an effect on the target word. That is, the activation of the priming stimulus and its associative network may already have dissipated before the onset of the target word, as has been shown with SOAs of up to 1000ms (Fazio et al., 1986). Only for associated and semantically related prime-target pairs, a priming effect has been obtained at very high (1750ms) response stimulus intervals (Perea & Rosa, 2002). Although the SOA in the present study was only 500ms rather than 1000ms, it is thus possible that participants responded to the emotion and neutral words without the prime influencing their lexical decisions. On the other hand, SOAs of up to 1000ms enable the prime to be processed to completion (Den Heyer, Briand & Dannenbring, 1983). Thus, if participants were able to make a conscious link between the prime and target word, an even stronger pattern of response facilitation for affectively congruent (or inhibition for affectively incongruent) prime-target pairs would have been expected because of their stronger activation/higher salience.

It is also possible that the prime duration (200ms) was not sufficiently short. Being displayed for 200ms, priming stimuli were clearly recognizable despite being on the screen for merely a fifth of a second. Participants were thus able to clearly identify the prime words which might have resulted in a deliberately driven response to the target words rather than an implicit one. In other words, participants may have had enough time to consciously evaluate the prime (e.g. car) based on the target word (e.g. happy). However, the prime duration was chosen in line with established priming research, which has used 150-200ms and has produced positive results before (Fazio et al., 1986; Ferré & Sánchez-Casas, 2014). This possibility can thus be ruled out.

Another potential limitation concerns the pause separating individual trials. In each of the four blocks there were 150 word/non-word decision trials (3s each) which were separated by one second each. Initially, this decision was made to shorten the time required for completion of the task, yet it may have lead participants to fall into a routine response pattern. That is, as stimuli appeared in quick succession, participants may have become used to the display sequence (i.e. prime-fixation-target) and may have responded to this flow (e.g. they knew when the target word would appear) rather than the actual content of stimuli. Regarding the latter (content), contrary to common research that has employed lexical decision tasks (Ferré & Sánchez-Casas, 2014; Perea & Rosa, 2002), the prime-target pairs in the current study were neither semantically nor, apparently, affectively/associatively related (except for the non-travel related prime-target pairs which were affectively congruent). This, however, is plausible, since the purpose of the current task was to uncover the existence of an affective link between travel modes and emotions which could not be confirmed.

Of course, the latter might suggest that people simply hold no implicit affective associations regarding travel modes and that these associations only become apparent upon conscious reflection. Whereas an implicit affective association would be expected between non-travel mode primes (i.e. fun, friends, death and grief) and emotion target words (e.g. happy, sad or gloomy), there may be no such connection in the case of travel mode primes, where there is no clear-cut expectation regarding their implicit affective association. Indeed, in line with the conclusions drawn in Study 4, travellers may have no particular preference towards any mode, but rather a general mobility style, thus potentially accounting for a missing implicit affective association between modes. The failure to obtain consistent response patterns with the non-travel related primes as well, however, suggests that no (affective) priming effect has occurred among participants and thus may point to a general weakness of the methodology, which may strongly depend on the chosen configuration settings for the desired priming effect to occur.

6.1.4. Follow-up study

In order to rule out some of the limitations of the present study, the earlier findings were extended in two ways.

First, explicit ratings of the association between the travel mode primes and target emotion words were obtained with an independent sample of respondents (56 female, 9 male, 52% aged 18 to 24) for comparison with the implicitly assessed associations. Respondents (43% bus users, 29% car and 21% walking) were asked to indicate their strength of association – that is, "For the following list of emotion words, please select to what extent you associate each emotion with the travel experience by [Mode]" – on a scale from 1 – Not true at all to 5 – Very true. This exercise showed that all modes, except for buses, were overwhelmingly associated with positive rather than negative emotion words, as can be seen in **Figure 32**. Given that journeys by bus tend to be the least active, it is conceivable that there may be a link between bus users' slower reaction times in the previous lexical decision task and the rather negative perception of public transport.

Second, a follow-up study with an improved study design, incorporating the insights from the first experiment, was conducted. Participants (N = 32) were recruited using the university's research participation pool (first-year undergraduate students only), as well as advertisements on the university's online noticeboard. Student participants were rewarded one credit for participation, whereas all other participants received a £3 cash compensation for their time. To avoid the problem of small group sizes and to increase the power of statistical tests, participants' main mode of travel was omitted from analyses. This increased overall power to .55 (Critical F = 1.24) for the corrected model and to an acceptable level of .79 (Critical F = 1.36) for a test of the prime*target* valence interaction. However, due to the omission of participants' main mode variable, potential biases towards travel modes (i.e. bus, car, cycling and walking) were examined independent of participants' own regular travel mode choice and, as a consequence, no conclusions about potential biases between different mode users could be drawn.

Figure 32. Explicit travel mode/emotion word ratings (1 - Not true at all to 5 - Very true)

Materials

Lexical decision task. The new study design adopted the core procedure from Ferré & Sánchez-Casas (2014). That is, on any given trial, priming stimuli were now preceded by a fixation cross that appeared after 1500ms and lasted for 500ms, after which the priming stimulus was displayed for 150ms. The priming stimulus was immediately replaced by the target stimulus and participants had 1850ms to identify the target as a word or non-word by a key-press. Each trial thus lasted a maximum of four seconds. The key-press ended the current trial and started the subsequent trial. Due to the longer duration of trials compared to the first experiment, only two rather than four test blocks were employed.

Stimuli. For the follow-up experiment target stimuli were again matched using data from the British Lexicon Project (BLP). However, this time, target stimuli included not only positive and negative emotion words, but also two positive (fast and safe) and two negative (risky and slow) travel aspects that were expected to be differentially associated with the travel modes in question. Baseline reaction time differences between positive (490ms to 586ms; *M* = 530ms) and negative target stimuli (491ms to 577ms, M = 542ms) were kept to a minimum. Attention was also paid to the word frequency of target stimuli, as frequently encountered words are processed quicker than less frequently encountered words, making word frequency a critical variable to consider for research using word recognition (Brysbaert et al., 2011). The latter were thus chosen based on the SUBTLEX UK index (Van Heuven, Mandera, Keuleers & Brysbaert, 2014), although differing word frequencies had to be taken into account for the happy-sad and boring-exciting target pairs. Moreover, neutral target words were omitted from the task as corresponding reaction times did not differ significantly from those to positive emotion words in the

previous task. Practice stimuli featuring emotionally-laden positive and negative primes served as a manipulation check, similar to the first study. **Table 39** shows the prime and target (word and non-word) stimuli that were used for the follow-up study.

Prime	**Word**		**Non-word**	
	Positive	Negative	Positive	Negative
Practice Death, Friends, Funeral, Rollercoaster	Happy Pleasant Exciting	Sad Nasty Boring	Huppi Ploosint Excatung	Sed Nistu Barung
Main task AAA, Car, Bus, Bicycle, Walking	Fast Safe	Slow Risky	Fost Sufa	Sliw Raske

Table 39. Revised target stimuli (emotion words and non-words)

Results

Practice stimuli

Results for the practice stimuli appeared mixed (see **Table 40**), as some of the results were intuitive whereas others were not. For instance, participants responded fastest to the target stimulus "cry" (684ms) when preceded by "death" as a prime. Similarly, subjects reacted quicker to "fun" (690ms) and "happy" (673ms) when preceded by "rollercoaster" rather than any of the other primes. Surprisingly, however, some intuitive reaction time advantages were not observed. There was, for example, no reaction time advantage of "cry" (752ms) or "sad" (773ms) when preceded by the "funeral" prime, although subjects did react remarkably slower to the targets "fast" (849ms) and "fun" (761ms) following the prime. Finally, some counter-intuitive RTs were observed, such as between the prime-target pairs "death" and "fun" (704ms and thus quicker than "friends" and "fun", 734ms) or "friends" and "sad" (761ms; quicker than both "death" [798ms], and "funeral" [773ms] preceding the target).

A two-way ANOVA did neither indicate a significant prime by target interaction ($F_{12,562}$ = .88, p > .5) nor a significant main effect of prime ($F_{3,562}$ = .99, p > .3) or target ($F_{4,562}$ = 1.23, p > .2). In sum, as in the first study, no consistent affective priming effect was observed despite changes to the study design based on previous literature, potentially highlighting a general problem with the suitability of the chosen method.

Target / Prime	Death	Friends	Funeral	Rollercoaster	Total (SE)
cry	.684/.293	.737/.255	.752/.277	.769/.303	.737/.280
fast	.826/.412	.614/.221	.849/.294	.729/.277	.753/.317
fun	.704/.290	.734/.280	.761/.353	.690/.262	.722/.295
happy	.689/.360	.703/.303	.709/.289	.673/.276	.694/.306
sad	.798/.366	.761/.306	.773/.326	.767/.269	.775/.314
Total/SD	.740/.348	.709/.276	.768/.308	.725/.277	.735/.303

Table 40. Mean reaction times (and SDs) to practice target stimuli (N = 32)

Main task

The main task largely mirrored the findings from the first study and practice block, showing some intuitive, but also some unexpected results. To test whether participants reacted faster to positive or negative target stimuli after having being presented with specific travel mode primes, a full factorial model was computed for the prime by valence by target interaction on average reaction times (correct responses only). Overall, neither a significant three-way interaction effect ($F_{49,1535}$ = 1.08, p > .3) nor any significant two-way interactions were observed (all p > .90). In line with results of the first study, however, a significant main effect of valence emerged ($F_{1,1575}$ = 20.64, p < .001) indicating that positive target stimuli were responded to significantly faster (30ms less on average) than negative target words across all primes, as shown in **Table 41**. Contrary to the first study, a significant main effect was also observed for prime ($F_{4,1575}$ = 2.81, p = .02). In particular, for positive targets, reaction times differed significantly following the car prime compared to baseline (M_{diff} = -.033, 95% CI: .003, .063; p = .02). Finally, a significant main effect was observed for target ($F_{9,1535}$ = 3.28, p < .01). In particular, the target word happy was responded to significantly quicker than nasty (M_{diff} = -.063, p < .01), boring (M_{diff} = -.054, p = .02) and slow (M_{diff} = -.052, p = .03).

All average reaction times to the five prime (AAA, bus, car, cycling, walking) by ten target (positive: happy, exciting, pleasant, fast and safe; and negative: sad, boring, nasty, slow and risky) combinations are summarised in **Table 42**.

Prime	Positive	Negative	Total
AAA	.598 (.115)	.628 (.154	.613 (.136)
Bus	.572 (.130)	.607 (.144)	.590 (.138)
Car	.564 (.121)	.596 (.136)	.580 (.130)
Cycling	.576 (.134)	.598 (.149)	.587 (.142)
Walking	.568 (.122)	.603 (.131)	.586 (.128)
Total	.576 (.125)	.606 (.143)	.591 (.135)

Table 41. Mean reaction times (and SDs) to positive and negative target words

Target / Prime	AAA	Bus	Car	Cycling	Walking	Total/SD
boring	.654/.175	.616/.156	.604/.171	.600/.136	**.584**/.111	.611/.151
exciting	.604/.137	.571/.126	.575/.126	.597/.172	**.565**/.122	.582/.137
fast	.609/.108	.582/.132	**.559**/.117	.570/.142	.572/.125	.578/.125
happy	.568/.100	**.545**/.113	.551/.112	.558/.098	.563/.125	.557/.109
nasty	.636/.162	.631/.152	.593/.107	**.591**/.149	.649/.139	.620/.143
pleasant	.600/.132	.581/.107	**.577**/.138	.585/.127	.587/.119	.586/.124
risky	.604/.122	.599/.123	**.587**/.111	.619/.170	.604/.135	.603/.133
sad	.617/.144	**.566**/.100	.596/.145	.586/.147	.578/.114	.589/.131
safe	.606/.093	.583/.167	.559/.116	.568/.125	**.556**/.123	.574/.127
slow	.630/.165	.622/.175	.599/.144	**.592**/.150	.601/.149	.609/.156
Total/SD	.613/.136	.590/.138	.580/.130	.587/.142	.586/.128	.591/.135

Table 42. Mean reaction times (and SDs) to positive and negative target stimuli (correct responses only) preceded by either a baseline (AAA) or one of four travel mode primes (N = 32), fastest in bold

Figures 33 and 34 illustrate the average reaction times to the positive and negative target stimuli preceded by either the baseline or four travel mode primes. As in the initial study, some rather unintuitive and surprising differences were observed.

For positive target stimuli, the quickest association was found between "happy" following the bus prime (545ms), whereas cars were primarily associated with being fast (559ms) and safe (559ms). Somewhat counterintuitive, respondents took longer to react to the target exciting after being presented with the cycling prime (597ms) compared to the reaming three travel modes (bus: 571ms; car: 575ms; and walking 565ms). Notably, reaction times were generally faster following any of the four travel mode primes compared to baseline although, as indicated earlier, the only significant difference emerged between the car and baselines primes.

For negative target stimuli, the fastest association was observed between "sad" and the bus prime (566ms), which is particularly interesting given the earlier observed quick association between "happy" and bus (545ms). Interestingly, reaction times following the car and cycling primes were quite similar with the only exception of "risky", which was more easily associated with the car (587ms) rather than cycling (619ms). Both primes, however, led to markedly quicker reaction times for the target "nasty" (car: 593ms and cycling: 591ms) compared to baseline (636ms) or bus (631ms) and walking (649ms). Overall, the reaction time differences to baseline were less extreme than for positive target stimuli and nonsignificant in magnitude.

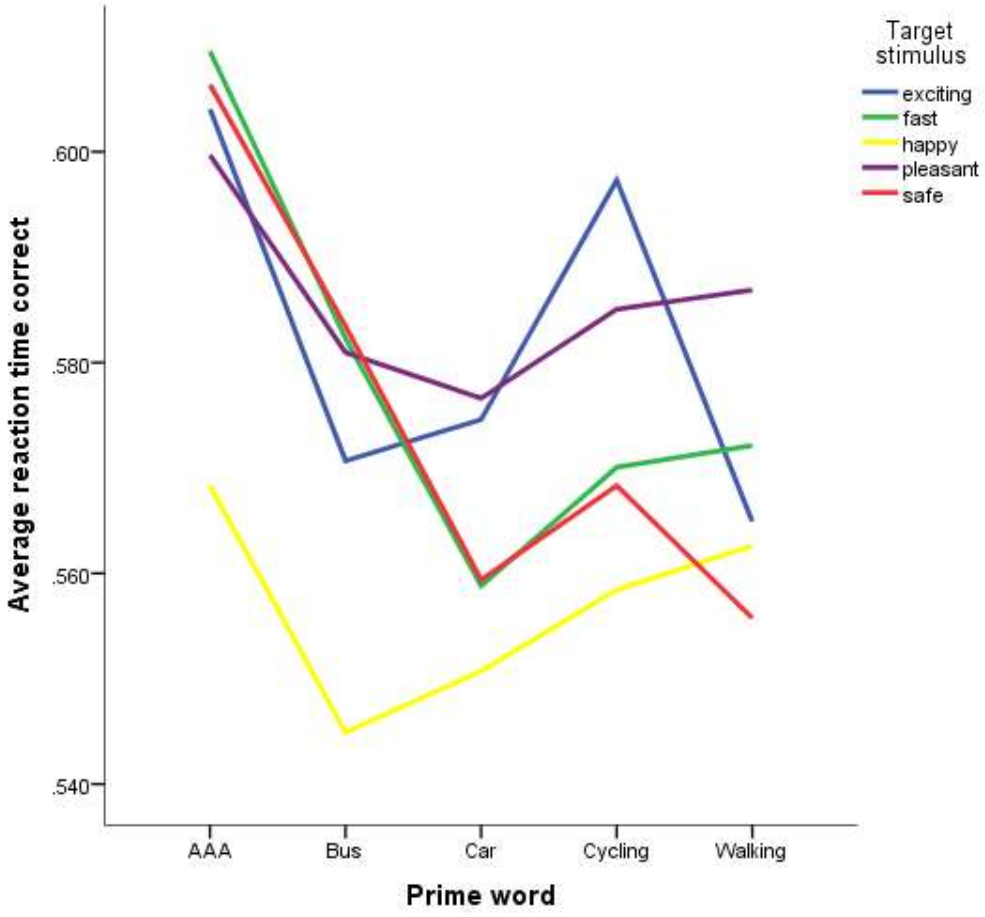


Figure 33. Average reaction times to positive target stimuli (N =32)

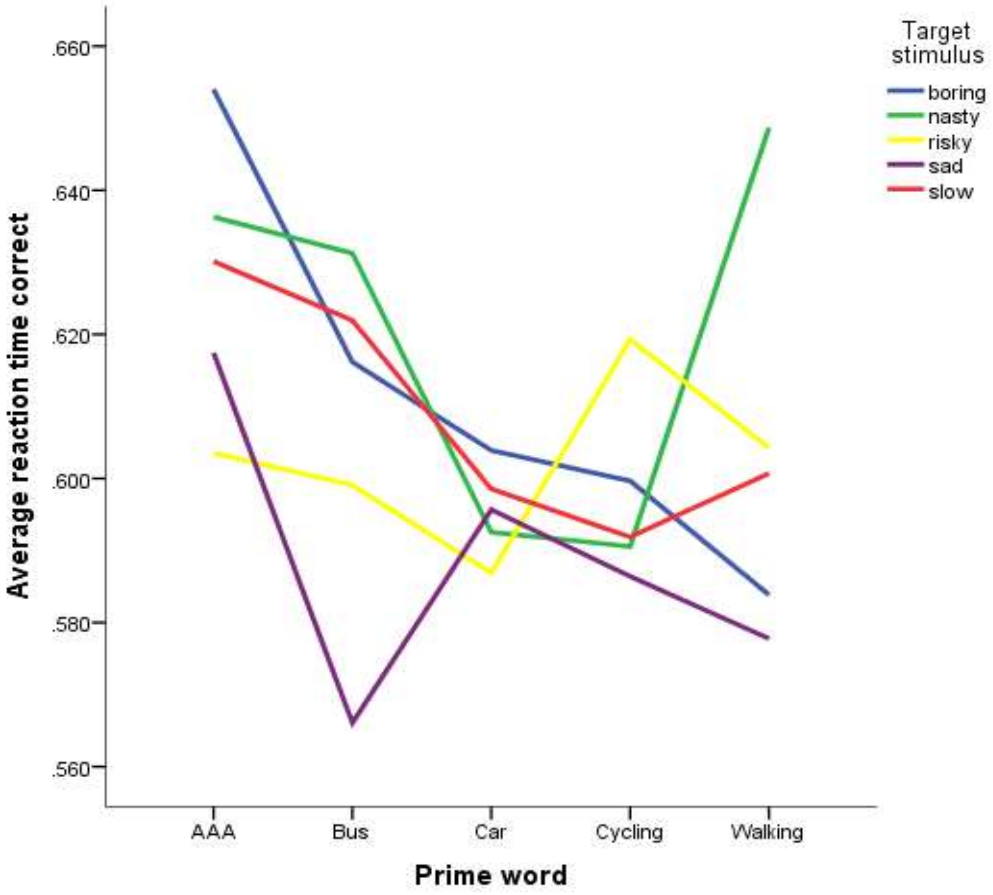


Figure 34. Average reaction times to negative target stimuli (N = 32)

6.1.5. Conclusion

Study 5 aimed to investigate whether people hold implicit affective associations towards particular travel modes. This was tested by having participants respond to a series of positive and negative emotion words that were preceded by travel mode stimuli in a lexical decision task. Due to methodological flaws, however, the initial study failed to produce a consistent affective priming effect, even with clearly emotionally-laden stimuli. Findings of the initial study did suggest that mode users may associate specific emotion words with their own and other modes, although findings were limited due to the small sample size and unexpected response latencies, even to stimuli that would be expected to bear a strong implicit association. The subsequent changes made in the follow-up study could not overcome these limitations – that is, despite employing a study design based on past literature, no consistent affective priming effect emerged, highlighting some general weaknesses of the chosen methodology. The failure to find an affective priming effect could also be due to the fact that prime-target pairs were neither semantically nor, apparently, associatively related. It follows that another possibility to explain the observed results, is the strict absence of such implicit associations in people's minds.

Explicit ratings of emotion word targets in relation to the four travel mode primes considered, showed that except for buses, all remaining travel modes (car, walking and cycling) were equally associated with positive emotions and, to a lesser extent, with negative emotions. This, to some extent, reflects earlier research hinting to the rather unfavourable affective experience of bus use (Gatersleben & Uzzell, 2007; LaJeunesse & Rodríguez, 2012), but also underlines the seemingly affective indifference to the other

modes in question. That is, contrary to previous research which has found car use to be affectively neutral (e.g. Thomas & Walker, 2015), explicit emotion word ratings in the present study suggested that car use was actually seen on par with active travel in its potential for generating positive affect. This is in stark contrast to the results of the lexical decision task, which suggested no such associations. Consequently, if the present findings were to be taken at face value, the possibility remains that for most people, any affective evaluations of travel modes may be based predominantly on effortful conscious thought rather than being implicit in nature, such as prejudices based on ethnicity or age (Rudman, Greenwald, Mellott & Schwartz, 1999).

Such a conclusion is supported by the earlier findings of Study 4 (see Chapter 5), which proposes that people's goals and values, rather than their attitudes towards particular modes of travel, are decisive in guiding travel mode choice. This, in turn, would have significant implications for the way people's travel behaviour is being understood and how behaviour change interventions are designed. That is, if people are not predisposed to use one mode (e.g. car) rather than another (i.e. alternative modes), based on the attitudes they have acquired over time (revisit Section 1.2.2. *Rise of the automotive*), then enabling sustainable alternatives to address people's goals and values as or more effectively than unsustainable alternatives, through structural or psychological interventions, should assume particular importance. At the same time, however, this is not to say that there is no role of attitudes at all. People's attitudes and personality traits have been shown to affect the evaluation of certain (goal- or value-congruent) travel aspects (Johansson, Heldt & Johansson, 2006), such as comfort and safety (hedonic), convenience and flexibility (gain and autonomy) as well as environmental concerns (normative). While it is tempting to conclude, based on the current study findings, that mode-specific (implicit) attitudes have little to no bearing on travel mode choice, due to the limitations of the present study, no firm conclusions in this direction can be drawn. Instead, the presence, or absence, of any implicit associations between travel modes and affective outcomes, in particular, need to be further investigated.

For future research on the implicit affective associations between travel modes, the following considerations should be made. First, to choose the target stimuli for a lexical decision task or any other procedure using word recognition, it might be worthwhile to elicit associated terms with a free association task. In this way, target stimuli can be chosen using a bottom-up approach rather than based on the researcher's expectations. Second, target stimuli should be matched as closely as possible on average reaction time, word length and word frequency. Although this may strongly limit the choice of potential target stimuli, this will strongly improve the validity and reliability of results. Third, future replications should vary SOAs and preferably use short prime durations (150ms or less) to rule out the possibility that priming stimuli can be fully processed. Alternatively, a different method altogether might be used, such as the IAT, which has been successfully applied as an implicit measure in previous research on environmental values amongst others (Thomas & Walker, 2016). Although limited to binary comparisons, response categories such as *positive-active* and *negative-inactive* or *pleasant-unsustainable* and *unpleasant-sustainable* could be used to test associations with different travel modes (i.e. car, bus, walking and cycling). Regarding the latter, train or car-sharing could be introduced as further potential target stimuli.

Chapter 7 – General discussion and conclusions

With natural disasters, such as hurricane Sandy, flooding, summer droughts and melting polar ice caps, the immediacy of climate change as a serious issue has grown in peoples' minds, although a decline in interest has occurred in some developed countries due to economic downturn and other political events near the end of the late 2000s (Capstick, Whitmarsh, Poortinga, Pidgeon, & Upham, 2015). More recently, however, public interest in climate change has been reinvigorated, as is illustrated in climate change marches around the world before and during the 2014 climate change summit of UN leaders in Manhattan, New York, which has been the first meeting of international leaders on climate change since the last summit which was held in Copenhagen in 2009. That climate change concern is on the rise is also supported by Carmichael & Brulle (2017) who suggest that political mobilization by elites and advocacy groups have played an important role in raising concerns about climate change, in contrast to the public dissemination of scientific information which was found to have no effect.

According to the Global Risks Perception Survey 2013-2014 (WEF, 2014), climate change (including water crises and the occurrence of extreme weather events), along with fiscal crises and un- or underemployment, is viewed as a risk that both is likely to happen and will have a severe impact on the world we live in. In the same report, failure of climate change mitigation and adaptation was ranked fifth in a list of 31 global risks by the survey's respondents. As outlined in the beginning of the thesis, global transport is a significant contributor to the greenhouse gas effect that is accelerating global warming. Whereas non-road transport consumes approximately a quarter of transport-related energy (23%), individual travel mode choices (light-duty vehicles) still contribute most heavily to transport-related energy consumption (52%) and thus to emissions (WEC, 2011). It follows that continuing to encourage the reduction of travel demand or the use of more sustainable travel alternatives remains of critical importance for a greener future.

In order to achieve this, a combination of behavioural, technological and legislative approaches will be necessary. Technological advances – first and foremost, hybrid, plug-in or full electric vehicles (Poullikkas, 2015) – will likely play a huge role in this regard, as has been predicted as early as two decades ago (Sperling, Delucchi, Davis & Burke, 1995). Further technological developments, including the introduction of self-driving cars gradually replacing manually controlled vehicles (Azmat & Schuhmayer, 2015; Narla, 2013; Spieser et al., 2014), are likely going to have a significant impact on individual travel patterns in the future. Yet, while these novel technological solutions can make transport greener, they also serve to maintain the status quo of current consumption patterns. That is, replacing one technology with another does not address other pressing issues caused by private motorised transport, such as the prevalence of non-communicable diseases (Reis, Hino, Parra, Hallal & Brownson, 2013) or congestion (Barth & Boriboonsomsin, 2008). Behaviour change and built environment solutions will thus remain imperative in changing people's travel behaviour to address these issues, while producing emissions reductions and thus mitigating climate change outcomes.

With regards to an increasing world population, transportation systems will need to be adapted to deal more adequately and more equitably with larger capacities, especially in developing countries (Vasconcellos, 2014). In addition, creating urban environments that encourage active and sustainable travel will be pivotal in addressing

population health in ageing societies, potentially saving billions of pounds to national health care systems (Jarrett et al., 2012). Within this broader context, the primary objective of this thesis has been to increase our understanding of the various contextual and social-psychological influences on people's travel behaviour in order to shift travel behaviour towards more active and sustainable alternatives.

7.1. Contribution to knowledge

In total, two major conclusions can be drawn from this thesis, adding to how routine travel mode choices can be explained from a social psychological perspective. Importantly, the present work recognises individual behaviour as both a driving force of change yet, at the same time, subject to external developments and constraints including technological advances, built environment factors and legislative regulations. As a result, some of the common limitations of the behaviour change perspective adopted in this thesis will be outlined, as well as methodological limitations of the conducted studies. Finally, based on the obtained evidence, suggestions for future research are made and implications for the four major transport modes used to travel in a university setting (i.e. bus, cycling, walking and driving) are drawn, based on which some tentative policy recommendations are made. Since the first part of this thesis has dealt with bus use specifically, the conclusions drawn from this research will be considered separately from the remaining content that has focused on travel behaviour more broadly.

7.1.1. Efforts to promote sustainable travel should not stop at car drivers (Studies 1-3)

As mentioned before, despite being a more sustainable form of transport than the car in terms of per passenger emissions, regular buses (with the exception of electric, gas or hydrogen powered vehicles) still do neither provide an entirely sustainable nor a healthy travel solution. Thus, while reducing levels of car use is important, increasing public transport patronage and frequency are not the only solution, especially since truly sustainable options (i.e. walking or cycling) are available. If (dissatisfied) bus users could be persuaded to travel more actively, this would not only benefit themselves (e.g. through increased physical activity and well-being), as has been shown in various past literature (Gatersleben & Uzzell, 2007; LaJeunesse & Rodríguez, 2012; Olson et al., 2013; St-Louis et al., 2014; Thomas & Walker, 2015), but might also benefit the environment since they may free up space for people who have previously avoided buses (e.g. current car drivers) due to overcrowding, queuing etc. Those may consider using public transport instead of their current travel mode (i.e. car), once these issues are improved.

To date, however, most research that has focused on public transport users and non-users has been preoccupied with shifting single-occupancy (SOP) trips by car to public transport alternatives (Beirão & Cabral, 2009; Krizek & El-Geneidy, 2007; Pronello & Rappazzo, 2010). Underlying this work is the assumption that public transport is a desirable alternative most of the time. The present research questions this assumption. Studies 1 to 3 have illustrated that, as with the car, hedonic goals such as comfort and convenience play a major role in the selection of the bus as travel mode over more active and sustainable alternatives such as walking or cycling (e.g. in Study 3, 50% of participants classified themselves as Convenience users). The results thus support the a priori strength and superiority of the hedonic goal frame vis-à-vis gain and normative goals (Lindenberg

& Steg, 2007). At the same time, however, the research results have demonstrated that convenience is not the only driving factor in choosing the bus and that not everyone may be equally satisfied with his or her 'choice', as shown in previous segmentation work (see Jensen, 1999). In Study 2, six different types of bus users were distinguished, four of which were largely congruent with the literature (*All fine on the Weston front, First Fans, Car Curtailed* and *Daily Drag*) and two that were novel (*Mode Mixers* and *Wannabe Walkers*). The former can be regarded as convenience (hedonic goal) driven choice users (*First Fans* who use the bus and *Car Curtailed* who prefer to drive), whereas the *All fine on Weston front* and *Daily Drags* can be seen to represent "malcontented" and "captive" bus users, respectively. At least one of the groups – that is, the *Wannabe Walkers* – showed potential to travel more actively in the future and may be supported to overcome their real or imagined barriers through tailored interventions. How this might be achieved was tested with a small-scale intervention delivered to second-year students in Study 3.

Building on Studies 1 and 2, Study 3 was designed to encourage walking rather than using the bus to campus among second-year Psychology students. To this end, three different messages (autonomy, cognitive dissonance and cost, health and environment) were created in combination with information on the University's own walking network. Although the flyer-based intervention did not produce any tangible behaviour change, it highlighted common obstacles to behaviour change that show clear parallels to attempts at reducing car use, which usually face similar obstacles. Those obstacles included, amongst others, effort minimisation (Gardner & Abraham, 2007), the influence of sunk costs (Arkes & Blumer, 1985) and the local physical environment (Rodríguez & Joo, 2004). The important role of habit was illustrated as well (see Gardner, 2009; Verplanken & Roy, 2016). With the intervention being conducted about four weeks into the semester, almost all second-year students had already purchased a bus pass, establishing bus use as a new habit. Once this habit was established, the outlook for behaviour change further decreased. Thus, a further conclusion that can be drawn is that heuristics and biases in mode choice may not be limited to the car (Innocenti et al., 2013), but may also be present for public transport, causing a "public transport stickiness".

While Study 3 did not allow any firm conclusions to be drawn regarding the effectiveness of different message types, it provided useful insights for approaches relying on habit discontinuity (Walker et al., 2008). According to Verplanken and Roy (2016), the so-called *window of opportunity* (i.e. a transition period in which people may be more receptive to novel information encouraging particular types of behaviour) exists for up to three months after relocation. The flyer-intervention, aimed at second-year students, fell right within this window of opportunity, yet could not produce any change. Other limitations, such as the presentation of flyers, notwithstanding, the third study indicated that the window for change may be significantly shorter than previously assumed. Rather than intervening in the period up to three months after relocation, a more promising route to instigate lasting behaviour change may be to target recipients of the intervention well ahead of the planned relocation, thus preventing the relapse into old habits early on (Walker, Thomas & Verplanken, 2014). This also includes a stronger focus on social norms, as "people frequently ignore or severely underestimate the extent to which their actions in a situation are determined by the similar actions of others" (Cialdini, 2007, p. 264). It follows that social norms may be particularly influential in guiding behaviour when new (travel) routines have yet to be established.

7.1.2. Traveller types are supra-modal, not unimodal (Studies 4 & 5)

Countless travel (behaviour) market segmentations have been conducted in the last two decades alone, focusing on either a single travel mode (e.g. Beirão & Cabral, 2008; Bergstrom & Magnusson, 2003; Krizek & El-Geneidy, 2007; Pronello & Rappazzo, 2010; Tarigan, Susilo & Joewono, 2014; Zhibin, Wang, Yang & Ragland, 2013) or no specific mode (e.g. Jacques et al., 2013; Pronello & Camusso, 2011), while usually drawing on a combination of attitudinal data and more objective travel-related information such as the reported amount or frequency of travel (e.g. Anable, 2005; Barr & Prillwitz, 2012; Cools et al., 2009; Diana & Mokhtarian, 2009; Diana & Pronello, 2010; Jensen, 1999). This has illuminated the motivations of different mode users, but has also resulted in a neglect of potentially shared motives including convenience, the environment and travel time. Thus, an all-encompassing traveller type distinction was offered in the second part of the thesis (Study 4), followed by an exploration of the immediate (implicit) associations between different travel modes and affect (Study 5).

The former provided an integration of existing (attitudinal) travel behaviour market segmentation research to date, resulting in a taxonomy of seven traveller types that may be distinguished across modes. Applying Goal Framing Theory (Lindenberg & Steg, 2007), a supra-modal segmentation was conducted, which supported the notion that neither do users of the same travel mode necessarily share the same values or travel preferences, nor do users of different modes necessarily hold different preferences or values. In other words, people's preferences might be better regarded as *independent* of their mode choice. Based on values affecting the chronic strength of the three goal frames (i.e. hedonic, gain and normative) and goal-congruent travel aspects, three supra-modal traveller types were distinguished (i.e. *Aspiring/Committed Environmentalists*, *Convenience Lovers* and *Time Addicts*). These clearly illustrated the superiority of the gain and hedonic goal frames vis-à-vis the normative goal frame. That is, *Convenience Lovers* favoured alternatives based on a desire for comfort, convenience and general effort minimisation, whereas *Time Addicts* primarily favoured alternatives based on time and cost considerations. The former thus can be regarded as very much focused on hedonic goals and values, whereas the latter are particularly concerned with the management of their resources, reflecting a dominant gain goal frame or egoistic values, respectively. Those prioritizing altruistic and biospheric values, affecting the chronic strength of the normative goal, were in the minority and, at the same time, evidenced a conflict with regard to carrying out behaviour congruent with their values. That is, whereas the *Committed Environmentalists* showed strong environmental concern and acted accordingly (i.e. they avoided use of the car), the *Aspiring Environmentalists* showed similar concerns, yet did not act in line with their values (i.e. they were car users).

Overall, the findings thus reflect the relative superiority of egoistic and hedonic concerns over normative considerations, which has been well documented in previous literature (Hurst, Dittmar, Bond & Kasser, 2013; Steg, 2005; Steg, Perlaviciute et al., 2014). As a result, the findings also imply the importance of either reducing the instrumental (egoistic) and affective (hedonic) benefits of unsustainable travel – or increasing the instrumental and affective benefits of sustainable travel – while strengthening the normative goal frame (Steg, Bolderdijk et al., 2014). Whether this can be achieved via behaviour change interventions (i.e. soft measures) alone, remains to be seen (see also Section 7.2.3.). Some suggestions for travel to campus are outlined in Section 7.3.1.-3.

Crucially, however, the research findings presented here further suggest that travellers do not tend to be predisposed towards particular travel modes, as has been argued in recent research (Krueger, Vij & Rashidi, 2016), but rather seem to negotiate their individual goals and preferences within their local context. This was indirectly supported by the findings of Study 6 which, despite methodological limitations, showed that people do not appear to exhibit an initial preference for any travel mode, as evident in the lexical decision task. Here, participants' associations, between travel modes and specific positive versus negative emotions, did not show any favouritism towards any particular mode of travel, although explicit ratings of the very same stimuli suggested a disadvantage for public transport (see Section 6.1.4.) that has been repeatedly observed in past literature (Olsson et al., 2013; St-Louis et al., 2014; Thomas & Walker, 2015). This has important implications for the behaviour change agenda which, despite its significant importance, might have been too preoccupied with people's obsession with the car (e.g. Gardner & Abraham, 2007; Innocenti, Lattarulo & Pazienza, 2013; Lois & López-Sáez, 2009; Steg, 2005). Rather people may negotiate their individual preferences within a given context. Travel mode choice may thus be better regarded as the result of a match between goals and context and, as a result, general attitudes towards particular travel modes may be unsuitable for the prediction of behaviour, in this case, agreeing with the conclusions drawn by Krueger and colleagues (2016). The process of negotiation between personal goals and the (built) environment, however, has not received much attention and should be investigated in more detail in future research. General suggestions for future research in this direction are addressed in Section 7.2.3., which complements the future research suggestions of individual study chapters.

7.2. General limitations and directions for future research

Studies 1 to 3 have highlighted how external constraints – amongst others, distance, the influence of old habits and sunk costs, as well as a hilly environment – may restrict a traveller's choice to more convenient, yet also more unpleasant and disliked alternatives such as the bus. The University of Bath campus thus represents a particular challenge for the promotion of healthy and sustainable travel due to many barriers that are not present in other contexts. Nevertheless, despite these contextual constraints, common barriers to active and sustainable travel were identified suggesting that the University of Bath can easily be regarded as a setting that is representative of other institutions and workplaces. Study 4 has illustrated that for the majority of travellers convenience and time are primary motives, despite the recent focus in the literature on non-instrumental motives (Gardner & Abraham, 2007; Lois & López-Sáez, 2009; Mann & Abraham, 2006; Steg, 2005) and biases (Innocenti et al., 2013; López-Sáez et al., 2016). As the latter were only partly addressed in the present work (i.e. through affective motives), however, no conclusions about their relative influence vis-à-vis instrumental motives can be drawn. These limitations notwithstanding, the work presented within the current thesis thus poses a difficult question for the behaviour change literature.

7.2.1. Methodological limitations

The following section highlights some general limitations of the studies conducted as part of the current thesis. For a more detailed discussion of the methodological limitations of specific studies, please revisit the corresponding study chapter.

Convenience samples

In general, relationships between variables are assumed to withstand sample bias, if the sample is sufficiently diverse (Blair & Zinkhan, 2006). However, all of the research presented in previous chapters relies on convenience samples of students and staff based at the University of Bath. This raises some valid concerns about the generalizability of the obtained findings to other non-academic populations. Although student samples may minimise extraneous variability, as they tend to be more homogenous than non-student samples (Peterson, 2001), they suffer from sample bias and low generalizability. In the context of the present research, however, this may not be a major issue for two reasons. First, the conducted research focuses on travel in a university setting in particular. As a result, the outcomes should be considered within this specific environment. This is not to say, however, that the findings do not have implications that go beyond this restrained context. That is, second, due to the universalistic nature of the concepts (e.g. autonomy) and theory (e.g. Goal Framing Theory) applied, any observed relationships between variables (especially the segments extracted in Study 4) are presumed to be invariant (i.e. to hold regardless of the population or specific methodology; Kruglanski, 1975). In other words, as the constructs and theories employed do not make specific assumptions about the individual decision maker, findings may be generalizable in the broadest sense.

There is, however, another concern regarding the generalizability of findings. As briefly discussed in Chapter 3, it may be difficult to transfer the findings to other settings or locations, especially with regard to the studies on bus users, which highlighted many contextual constraints that may not be present or as extreme in different environments. Due to the rather unique setting of the University of Bath campus, given its off-centre location and steep incline towards the top, the generalizability to other contexts may thus be limited.

Lack of inclusion of contextual variables

A further limitation of the presented work relates to the lack of inclusion of contextual variables. Travel behaviour is characterised by a "context-dependent multi-causality" (Naess, 2015, p. 280). That is, it rarely has a single cause, but usually originates from the interplay of a multitude of potential casual influences. Those causal influences normally relate to the powers of agency (i.e. individuals' knowledge, attitudes, goals and resources) and structure (i.e. the built environment encompassing features such as street connectedness, city compactness and mixed land use). The latter necessarily mediates the relationship between individual factors and preferences (goals) and travel behaviour or modal choice, respectively (see **Figure 35**).

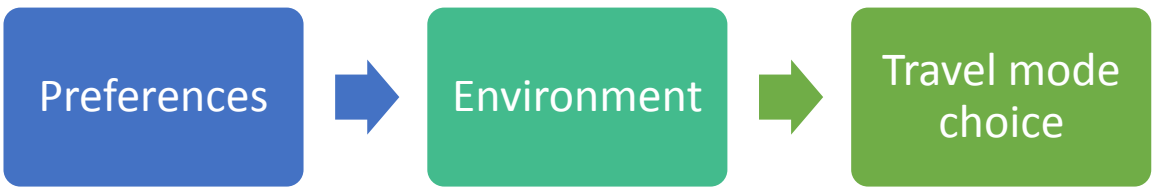


Figure 35. Basic model of travel behaviour with the environment mediating the relationship between peoples' preferences and travel mode choice

This is especially evident in the event of an office- or household relocation (Walker et al., 2014; Verplanken & Roy, 2016), where new contextual factors may play a significant role in negotiating existing personal goals and attitudes with available behavioural options (Steg & Vlek, 2009). Consequently, this is also the case for many students and staff at the University of Bath who, despite different life situations, need to find new ways of commuting to campus after relocating. The challenging topology of Bath has been shown to be a major barrier to sustainable transport alternatives for commuting to campus. However, factors such as the urban environment (Banerjee & Hine, 2014), were not considered in the present research, thus leaving the interaction between different traveller types' goals and the environment open to further investigation. Specifically, how urban environment factors impact on different traveller types remains unclear. Committed Environmentalists, for instance, would be expected to the least influenced by contextual variables, whereas the opposite might be expected for the Convenience Lovers and Time Addicts (Study 4). Other contextual factors that might be considered include the quality of public transport services (e.g. Jain et al., 2014), the availability of facilities (Larsen & El-Geneidy, 2011) or legal restrictions (e.g. taxes, congestion charges; Hensher, 2008), although individual perceptions and attitudes may play a role (Redman et al., 2013). Yet, which contextual factors affect which goals and in what magnitude requires further investigation. It may be expected that hedonic goals will be most strongly affected by contextual factors improving the comfort and convenience of alternatives, whereas gain and normative goals may be most strongly related to the relative cost of alternatives and environmental friendliness of alternatives, respectively.

7.2.3. Are behaviour change initiatives sufficient?

The tendency for the recent research agenda on sustainable mobility has been a continued focus on internal determinants of behaviour, potentially obscuring and delaying urgently required action on a broader scale. Due to its various negative environmental impacts (i.e. noise, air pollution, congestion, consumption of road space, road accidents), discouraging private motorized transport has received the lion's share of attention. Yet, as previous research has demonstrated repeatedly, people may be very reluctant to reduce their car use (e.g. Cullinane, 1992; Gärling & Schuitema, 2007; Steg, 2005; Tertoolen, van Kreveld & Verstraten, 1998) because travelling by car tends to be comfortable, fast and convenient or at least is perceived that way (Gärling & Schuitema, 2007). The work presented in this thesis suggests that this is also the case for other forms of (public) motorized transport, such as the bus, even if active travel is a viable option.

The basic underlying problem with behaviour change is that we have built an infrastructure that was designed to accommodate the increased demand for motorized traffic. Now that the long-term negative environmental consequences of this form of travel are known, people are being asked to use that very same infrastructure less, while not offering any truly competitive alternatives. People thus tend to be more motivated to maintain the status quo of driving (Gärling, Gärling & Loukopoulos, 2002) rather than to switch less convenient, albeit more sustainable, alternatives. In fact, there may have been an overemphasis on individual decision-making in recent years, despite the urgency of impending climate change developments (Barr & Prillwitz, 2014). Two examples are the United Nations Environment Programme which outlines "Twelve steps to help you kick the CO_2 habit" (UNEP, 2008) or the popular *Framework for pro-environmental behaviours*

(DEFRA, 2008). In the latter, as is by now well established, mobility behaviours are marked by a low willingness to act, albeit not as heavily as dietary consumption habits. When it comes to what we consume or how we travel then, retaining control may be critical for most people (Gardner & Abraham, 2007; Gough & Conner, 2006). Still, if reduced emission targets in the UK are to be achieved, drastic changes in travel behaviour will be imperative, since changes in the built environment or technological advances may only become effective in the medium or long term (Hickman & Banister, 2007).

Clearly, using energy-efficient light bulbs or buying a more environmentally friendly washing detergent do not require the kind of lifestyle change or (infra-)structural adaptations as do the uptake of cycling to work or reducing short-haul flights. As a result, behaviour change or soft measures may primarily be suited to encourage behaviours that already benefit from a supportive infrastructure, such as recycling (Dai et al., 2015), whereas more radical hard measures (e.g. driving restriction policies; Liu, Hong & Liu, 2016), may be required to promote shifts in environmental behaviours with strong psychological and physical barriers, such as frequent driving or aviation. Yet, even if people do hold pro-environmental attitudes and behave in an environmentally friendly manner, their actions "do not always reduce the environmental impacts of consumption" (Csutora, 2012, p. 145). Indeed, it should also be noted that voluntary changes in travel behaviour on their own are fairly unlikely to produce the large-scale shifts in travel behaviour that are required to mitigate climate change outcomes (Mackett, 2001). Consequently, various scholars, such as Shove (2010), who have criticised the dominant individual-focused behaviour change paradigm, have argued that we need to move beyond overly simplistic ABC (Attitude-Behaviour-Choice) models of travel mode choice and need to consider the deeper underlying physical (e.g. urban design and land-use) and societal structures (e.g. family planning and work) that shape mobility patterns. As she argues, "the ABC and the research industry which it sustains (and which sustains it) are part of an interlocking landscape of thought which constrains and prevents policy imagination of the kind required" (p. 1282). Similarly, Semenza et al. (2008) acknowledge that individual-level mitigation efforts are desirable, yet require broad legislative and regulatory changes to support them. So, while concerted efforts to encourage behaviour change on the individual level are important and desirable, the pivotal role of the built environment, social practices and legislative environment must be considered as well.

In general, the battle for sustainable consumption or consumption reduction, which includes the way we travel, calls into question the highly consumption-orientated dominant social paradigm. As Peattie and Peattie (2009) argue, social marketers need to ameliorate the profile and push the acceptance of sustainable consumption as a social proposition. This may involve both the managing of expectations (i.e. bringing material expectations more in line with sustainable consumption levels) and a simultaneous *downshifting* from a consumption-focused to a less materially rewarding, yet more balanced and satisfying lifestyle (Andrews & Holst, 1998). Especially with the sensitive (due to notions of freedom of choice and independence; e.g. Jensen, 1999) and resource-intensive area of travel mode choice, we are still at a stage where consumption reduction – including purchasing smaller, more fuel-efficient or battery-/hybrid-electric powered vehicles; eco-driving; trip chaining; and switching to more sustainable alternatives such as public transport, walking or cycling – may be perceived as an injunctive or prescriptive norm, yet is not supported by a descriptive norm, as the continuously high share of

private motorized transport so blatantly suggests. It inevitably follows that travel mode choice needs to be incorporated into the circle of daily behaviours that are amenable to consumption reduction, like recycling (Dai et al., 2015) or energy saving (Pothitou, Kolios, Varga & Gu, 2016).

7.2.3. Directions for future research

The main contribution of this work suggests that people's goals and values may be more decisive for people's travel mode choices than previously thought. In particular, the supra-modal mobility styles approach adopted in Chapter 5 assigns only a subordinate role to people's attitudes towards specific travel modes, such as the car. Instead, it is proposed that people are not predisposed towards one travel mode rather than another, but that they negotiate their individual goals and preferences, which are influenced by the values they hold dear, with their immediate local environment. Study 4 suggested that these goals are primarily related to the convenience, time-saving potential and environmental impact of travel alternatives (see Section 5.1.2.). Which travel alternative will be the most convenient, most time-saving or most sustainable one, however, will likely depend on local contextual factors. That is, it may be mainly due to variations in context (e.g. the local topography, availability of segregated cycling facilities or public transport access), that the same preferences may result in varying travel mode choices, just as varying preferences may result in identical mode choices. Understanding how travellers negotiate their individual preferences in a given context will thus be of major importance for future research efforts and recognizing the context-dependent multi-causality of people's travel behaviour should thus assume particular importance (Næss, 2015). The inclusion and consideration of contextual variables in people's decision making processes and their close interaction with personally held beliefs and values should be investigated in more detail (see also Section 7.2.1.).

Another crucial task for future research efforts is to test the incremental predictive power of supra-modal mobility styles in predicting modal choice vis-à-vis attitudes and other social psychological constructs. In the present work, supra-modal travellers types were identified based on Goal Framing Theory (Lindenberg & Steg, 2007), yet their utility in predicting mode choice has not been further addressed, mainly because complementary individual-level contextual information was not available. Crucially, the prediction of people's (regular) modal choices can only be achieved by the simultaneous consideration of contextual factors, without which any prediction of modal choice can be considered incomplete and fallible. However, it is also clear that travel mode choice is very complex and influenced by many additional factors that were not addressed in the current work, including attitudes (Anable, 2005), normative beliefs (Krueger, Vij & Rashidi, 2016) or pro-environmental self-identity (Van der Werff, Steg & Keizer, 2013). This also includes the consideration of people's implicit attitudes. Due to severe methodological limitations, the results of Study 5 remained inconclusive, not allowing to draw any firm conclusions regarding whether people do or do not possess an emotional predisposition towards particular travel modes. The absence of such a link would support the supra-modal approach that has been assumed here. Consequently, an important task for future research includes the further testing of people's implicit attitudes towards common travel modes and their potential impact on people's travel mode choices. Using alternative implicit measurement methods, such as the IAT, may shed more light on this issue.

7.3. Implications and recommendations

The current thesis started out by focusing on travel in a university setting in particular. Institutions of higher education tend to be major trip generators. It thus comes as no surprise that transport usually contributes heavily to a university's ecological footprint (Bonham & Koth, 2010). Also, universities warrant special attention due to their great potential to influence the travel behaviour of the next generation lastingly. The campus-based University of Bath with its decentralized location on top of a steep hill poses a significant challenge to the promotion of active and sustainable travel, thus resulting in staff members' strong reliance on the car and students' heavy reliance on the local bus services. With approximately 15,155 enrolled students and 2,628 members of staff, who commute to campus in more or less regular intervals, the University of Bath is responsible for a significant part of the local traffic volume in Bath.

According to the 2014/15 University Travel Survey, close to 80% of trips to campus are undertaken by motorized transport modes including the bus, motorcycle or car. When it comes to private and public motorized transport, there is a clear divide between student and staff commuters to the University of Bath. Whereas private motorized transport represents the most important travel mode for staff with 64% of users (car alone 48%, car share 16%), public transport is the major travel mode for students (about 63%). However, as about 95% of students and more than two third (68%) of staff live within a 15 kilometre radius of the university (UTS 2014/ 15), there is a huge potential to transfer trips from polluting motorized transport to healthy and sustainable alternatives – that is, walking and cycling in particular. The research presented in this work also suggests though that there may be only little scope for markedly changing the behaviour of those travelling to campus regularly, due to heavy contextual constraints including a hindering local topography, as well as a profound lack of cycling infrastructure and missing incentives for staff to not commute by car. Consequently, measures that go beyond the scope of the current thesis may be required and are briefly addressed further below. Nevertheless, by applying lessons learned from other countries, such as the Netherlands (Pucher & Buehler, 2008), significant progress might be realised in the future.

7.3.1. Recommendations to promote walking and cycling

"A safe cycle path is a symbol of democracy; it shows that a person on a $40 bicycle is as important as a person in a $40 000 car" – Enrique Penãlosa (quoted in Rissel, 2009)

The government has recently released £64 million of local transport funding to support walking or cycling to work (https://www.gov.uk/government/news/64-million-government-funding-to-encourage-more-cycling-and-walking-to-work, accessed February 16, 2017). This funding will aim to provide more safety and awareness training for cyclists, extra secure cycle storage, bike repair and maintenance courses, road safety measures, mapping information for pedestrians, real time bus information through smart phone apps or information at bus stops and an increased focus on car sharing clubs. Complementing these measures, the following sections outline specific (local) suggestions and recommendations for sustainable travel in a university setting and beyond, based on both the insights gained from the study findings presented and available past literature, which might aid the uptake of active and sustainable travel options in the future.

Cycling to campus

Cycling in Bath, as in most of the UK, is far from being the norm, as the local terrain and sparse cycling infrastructure remain both a physical and mental challenge to overcome. In the first focus group, Anna described how she thought it was "too much hard work to cycle up the hill", a view that was widely shared among other focus group participants and that was confirmed in Study 2 as well. Here, "You have to be really fit in order to cycle up that hill" was among the Top 3 statements with the highest agreement (see appendix A1). In addition, storage issues on campus, such as not being allowed to keep the bike in communal areas, and concerns about the availability of shower and locker room facilities contributed to the view of cycling as no viable travel alternative. Nevertheless, there is a small cycling community at the University of Bath, composed of student and staff cyclists (approx. 2.6% according to a traffic count carried out by IMA Consulting in November 2014; see UTS 2014/15), albeit there seems only little hope of increasing these numbers substantially in the near future.

The public resistance to cycling in Bath may, amongst other reasons, be due to the fact that adequate cycling infrastructure in most parts of Bath, such as separate cycle paths or cycle lanes, is largely or even entirely absent. This is supported by previous research (Panter, Griffin, Jones, Mackett & Ogilvie, 2011), pointing to convenience of the route between home and work as one of the central factors increasing people's likelihood to cycle to work. The lack of adequate cycling facilities may also contribute to the perception of cycling as "not extremely safe" that emerged during the focus group discussions in Study 1 which, in turn, may prevent students, staff members and Bath citizens alike from cycling for their regular (commuting) trips. This is particularly unfortunate, as the majority of potential cyclists may actually be regarded as "Interested but Concerned" (Dill & McNeil, 2013). That is, they may be willing to cycle yet, at the same time, are particularly concerned about being hit by a motor vehicle, although research has shown that, as more people walk and cycle, the risk of accidents and injuries is actually likely to decrease (the so-called "safety in numbers" effect; Elvik, 2009). Consequently, making cycling a truly viable and safe alternative through city-wide infrastructure investments, as well as improving the cycling culture on campus, should assume particular importance.

Improving cycling culture on campus and infrastructure improvements

Investigating cycling in university settings, in particular, Bonham and Koth (2008, 2010) revealed specific measures that may be undertaken to improve the cycling culture on campus. In addition to general improvements to cycling facilities, some of the suggestions made by their participants included campus-based bike clubs, cycling buddy schemes or group rides after work, monthly free breakfasts, an on-campus bike repair shop, a dedicated page on the university website and free ride-to-work information kits distributed during orientation. Unfortunately, however, there is only little research that has explored the effectiveness of these or related measures (see also Wunsch et al., 2015), especially in university settings.

Importantly, beyond merely improving the cycling culture on campus, cities such as Bath need to provide the required infrastructure for cycling to be a positive experience with separate bicycle lanes and paths, improved bicycle security and lower traffic speeds being among the key requirements (Tin et al., 2009). Prominent examples of such

developments can be found in other European countries. Many medium-sized or large-scale Dutch cities, such as Groningen in the North of the Netherlands for instance, provide separate cycle paths with their own traffic light system, making cycling a safe choice for children and adults alike (see **Figure 36**). Investigating the perception of risk on levels of cycling, Parkin, Wardman and Page (2007) found that cycling facilities along trafficked routes only had a moderate effect on the perception of risk. However, they also found that facilities that were either off-road or adjacent to roads had the greatest effect on perceptions of risk, supporting the segregation of cyclists from road traffic and questioning the utility of on-road cycle lanes. Similar conclusions were drawn by Larsen and El-Geneidy (2011) who showed that cyclists are willing to undertake longer trips when segregated from vehicle traffic, with the additional benefit of being less exposed to dangerous air pollutants such as black carbon (Hatzopoulou et al., 2013).

However, despite the importance attributed to accessibility and connectivity for walking and cycling (Afsar, Nikjooy & Yazid, 2015), road facilities are rarely changed to accommodate the needs of cyclists, if at all, and funding constraints as well as the reluctance to implement cycling infrastructure into the 'strategic network' (i.e. railways, motorways, power stations etc.) may hinder any real progress on a broader scale (Aldred, 2012). Cycling thus frequently remains marginalised as a means of transport (Bonham & Koth, 2010). But, even if adequate cycling infrastructure is in place, this by itself may not be sufficient to stimulate cycling levels as observed in countries with a long-term focus on active travel like the Netherlands. The example of Stevenage suggests that, even if adequate infrastructure is provided, the uptake of cycling may still be low if driving is at least as or more attractive than cycling (see http://www.roadswerenotbuiltforcars.com/stevenage/). However, in combination with adequate trip end facilities (e.g. showers and locker rooms) and financial incentives, some of these barriers might be overcome (Wardman, Tight & Page, 2007).

Figure 36. Cyclists waiting on a separate cycle path with its own traffic light system (photograph by Dr Byron Miller, University of Calgary; reprinted with permission)

Cycling for access versus egress trips

As shown by Martens (2007), cycling is also a popular choice for access or so-called 'bike-and-ride' trips, such as the combined use of bus and bicycle or train and bicycle. As she argues, simply providing adequate and sufficient bicycle parking facilities may have great potential for increasing access trips to train stations and, by extension, bus stations. More of a challenge appears to be posed by egress trips (e.g. after getting off the bus or train). Close to 5% of commuters to the University of Bath campus arrive in Bath by train and the vast majority of those turn to buses for their egress trip to campus (an estimated 72% of train users according to 2014/15 University Travel Survey data), putting additional strain on the bus companies who already struggle to cope with the high travel demand to campus during peak hours. Being a train user, Jess shared her doubts about the possibility of taking the bike on the train regularly, as she observed people occasionally not being allowed to take their bicycle along due to space issues (unless it happens to be a small, foldable one), thus having to resort to walking, taxis or other public transport instead (see Study 1). However, easily rentable public transport-bicycles (PT-bicycles) may be effective in closing this gap, not only for commuters to campus, but also for infrequent business trips or visits of friends and family (Martens, 2007). Bicycle sharing programs may especially boost (recreational) cycling in metropolitan areas, as suggested by an evaluation study of a public bicycle share program in Montreal, Quebec (Fuller et al., 2013). Success in promoting cycling has also been reported in relation to so-called "Cycling Demonstration Towns", where spending on cycling infrastructure and projects was as much as 10-fold compared to the national UK average (i.e. 10£ versus 1£ per head of population per year; Sloman, Cavill, Cope, Muller & Kennedy, 2009), effectively increasing cycling levels.

Considerations and recommendations regarding cycling in a university setting (and beyond)

i. *Structural and legislative measures*
   To address some of the road safety (and other) concerns by current non-cyclists that emerged in Study 1, restructuring the local built environment in support of cycling – for instance, through an increased number of segregated cycle paths, on-road cycle lanes and cycling facilities (e.g. secure bicycle storage, bike repair shops and shower and locker rooms at public and workplaces) would be desirable, yet usually requires drastic and costly action on part of the local city council. However, such action could be paired with the introduction of a road congestion charge, such as the London congestion charge introduced in 2003 which has reduced the entering traffic volume of motorized transport by 14% (Transport for London, 2008; see also *tfl.gov.uk* for more information). In this way, levels of motorized traffic could be substantially reduced and especially encourage those who merely use the car out of convenience, rather than necessity, to cycle or to use other means of transport rather than to drive. As these measures might be met with strong resistance from other road users, such as commuting drivers, it will be crucial for any taken measures to demonstrate sizeable improvements in transport alternatives vis-à-vis the car.

ii. Facilitating egress trips for train users

Some participants, such as Jess (Study 1), were in doubt about the possibility of taking the bicycle on the train. Yet, despite there being only a limited opportunity of doing so, there are still solutions that train users may adopt if they desire to travel actively rather than solely relying on public transport. One is the purchase of a foldable bicycle that can easily be taken on public transport. Another option includes the use of rentable bicycles. In Bath, rentable bikes are available at the train station from Nextbike (nextbike.co.uk), although there are at least two problems with the scheme being of any use to regular campus commuters. First, renting a Nextbike for an entire working day costs £5 as a subscription member (which costs £60 annually; http://www.nextbike.co.uk/en/bath/ prices/, Feb 2016) compared to only approx. £2 for a return bus ticket. Second, the availability of bicycles for rent is restricted and most people may use them for leisure rather than the commute to campus. As a result, the scheme may be of little use in its current form. An additional bike rental station on campus could make the scheme interesting for commuters, however, as the first 30 minutes of use are free.

iii. Soft measures and incentives

Finally, whereas there may be little to be done to directly influence the local physical terrain or people's level of physical fitness, support and encouragement could be delivered to motivate people to attempt cycling to campus. The possible actions identified by Bonham and Koth (2010) may serve as a good starting point in this respect. To facilitate motivation, the University is already offering an electric bicycle loan scheme which allows current standard parking permit holders to hire an electric bicycle for free for a trial period of up to two weeks. In addition, a tax-free cycle to work scheme/loan and lease agreement enables University staff to acquire a bike and safety accessories up to a value of £1000, given that they can confirm that the bike will be their main mode of travel to and from work, that they maintain the bike and equipment in a reasonable and safe condition and insure the bike against theft. As is true of walking (below), any such measures should preferably be promoted to students and staff during a period of transition (e.g. during relocation) and well before any sunk costs due to a previously made, potentially conflicting, commitment may arise (see Study 3).

Walking to campus

Commuter walking needs to be considered as a health-enhancing activity (Hamer & Chida, 2008; Pucher, Buehler, Bassett & Dannenberg, 2010), since as much as a third of adults worldwide do not reach recommended levels of physical activity (i.e. at least 30 minutes of moderate-intensity physical activity on five days of the week or more), partly due to increases in occupational physical inactivity (e.g. Hallal et al., 2012). Walking was by far the most frequently mentioned alternative to using the bus in the focus group discussions and was recognized for its potential to increase physical fitness, to provide relaxation and to combine trips with other modes (e.g. getting to campus by bus, yet walking home). However, as in the case of cycling, participants also reflected on the disadvantages of walking including longer journey times, higher physical effort ("feel sweaty and disgusting") and instrumental impracticalities (e.g. carrying equipment).

With walking being the slowest form of travel, urban design plays a critical role in facilitating and encouraging people to walk for utilitarian purposes. Whereas low-density, single land use residential areas that are insufficiently connected provide a poor basis for high levels of walking, higher-density environments with good inter-connectivity and a more varied mixture of land use may significantly influence observed levels of active travel (Saelens, Sallis & Frank, 2003). While the local topography may hinder active travel (e.g. due to sloping terrain), the mere availability of sidewalks and walking paths may increase the likelihood that people walk to work or for leisure (Rodríguez & Joo, 2004). Importantly, it's not only the infrastructure and population density in the proximity of peoples' homes that needs to be considered, but also that of the destination (e.g. work, shopping centre). If people can only travel comfortably for half of the journey, they may be less inclined to consider walking or cycling as a viable alternative to the car. In terms of infrastructure, however, there is little to worry about walking in Bath. The University of Bath campus is widely accessible by foot from various directions, as illustrated by the map shown in the beginning of this thesis (see Figure 1, p. 4) and the Walking Network (see Chapter 4, p. 81). Nevertheless, as is the case with cycling, the local topography – with Widcombe hill reaching an incline of up to 12% – is a major counter-acting factor when it comes to walking. Furthermore, most non-campus based student areas are located in the City Centre, Combe Down or Oldfield Park, and require a 30-50 minute walk to campus, which may be too long in the eyes of most people. It should be noted though that taking the bus at peak hours may result in an equally long travel time, as the mean travel time by bus, reported by respondents to the University Travel Survey, was about 44 minutes. Making commuters more aware of this inconsistency between actual and perceived travel time duration using different modes, should thus assume particular importance.

The results of Studies 2 and 4 suggested at least two potential target groups that might be encouraged to walk to campus through future interventions (i.e. *The Wannabe Walkers* and *Aspiring Environmentalists*), although Study 3 has highlighted a general lack of interest into walking to campus by the majority of students, to a significant extent due to the sunk costs of having purchased a bus pass pre-term and the lower effort of taking the bus. In general, the informational/motivational approach taken in Study 3 has proven ineffective in encouraging more active travel. However, different approaches not tested in the current thesis, could prove effective. In particular, a block leader approach could be worthwhile investigating (Abrahamse & Steg, 2013), as one of the problems with the informational approach taken in Study 3 was that information was provided by someone from a different social network (i.e. a PhD student). Block leaders, however, belong to one's own social network (e.g. another student from the same course or year) and thus possess greater social influence. Choosing (student) block leaders to administer future interventions could thus be a promising way to encourage active travel. Ideally, these interventions would be delivered to tailored subgroups, as the results of Study 2 have indicated that only few (public) transport mode users may be willing to switch modes in the first place (*Wannabe Walkers*). Further recommendations are outlined below.

Recommendations for walking in university settings (and beyond)

i. Timing of information campaigns and interventions

The findings of Study 3 have suggested that many students (like staff members) may make a commitment (e.g. purchasing a bus pass) without being fully informed

about all of the available travel alternatives. Consequently, to avoid sunk costs through previously made commitments, alternatives need to be promoted ahead of time. In the case of the University of Bath, for instance, the *Walking Network* (which outlines the best walking routes to campus from major locations in Bath) should be promoted before or during relocation/orientation (i.e. at the same time or earlier as promotion for bus passes).

ii. Stressing of affective aspects and providing practical experiences
Although Study 3 could not confirm the effectiveness of autonomy messages in encouraging active travel, stressing the autonomy, physical and mental well-being gains and predictability (easier time management) of active travel remains crucial (at least in the case of public transport users). In addition, hands-on experience through offerings of regular guided walking or cycling groups (staff or student-led) for students and staff, especially during orientation, may be promising (18% of bus users in Study 3 indicated such an interest).

7.3.2. Recommendations to reduce (the impact of) private motorized transport

Although car users have not been intensively investigated in this work, reducing motor vehicle emissions by promoting shifts to active travel offers enormous potential benefits for the environment and population health due to improved air quality and exercise, additionally resulting in huge economic benefits (Grabow et al., 2012; Xia et al., 2015). However, *Convenience Lovers* and *Time Addicts* (Study 4), in particular, may pose the biggest challenge for environmentally concerned policy makers because, as this work and previous work has shown, they may be the most difficult to persuade target groups when it comes to switching to alternative modes of travel (Anable, 2005).

This is because the aspects they prioritize – that is, comfort and convenience in the case of *Convenience Lovers* and cost and travel time in the case of *Time Addicts* – are practically impossible to change by applying behavioural measures. That is, alternatives such as walking or cycling necessarily require more resources (i.e. time and effort) and are thus often less comfortable and convenient than the car, especially for longer distances. Furthermore, as the environment is not a decisive factor in their modal choices, attempts to strengthen the normative goal frame may be equally in vain (the latter may, however, work for the *Aspiring Environmentalists*). Alternative solutions to reduce car use by staff and students that either do not involve behaviour change (i.e. technological solutions) or that force change (i.e. legislative measures) might be considered. Although the latter go (slightly) beyond the thesis scope, their importance should not be dismissed and, as a consequence, some of these measures are briefly outlined below.

Technological solutions

Since the 1970s, great advances have been made in relation to fuel economy, although much of the progress has been offset by larger and heavier vehicles that come with ever more amenities and accessories (Lutsey & Sperling, 2005). Nevertheless, fuel efficiency continues to be the most promising emissions reduction tool in the short term because it is, amongst other things, easier to implement and achieve than policy solutions such as carbon taxing (Hensher, 2008). Instead of merely increasing the vehicle's fuel efficiency, however, a further option includes embracing new technology altogether.

Although still in its early infancy, electric vehicles (EVs) may enable commuters to continue driving without compromising their freedom or polluting the environment directly (Sperling et al., 1995). According to IEA (April 2013) projections, the transport sector could account for more than a fifth of the reduction in CO_2 emissions to acceptable levels, if all but a quarter of newly purchased vehicles used plug-in battery technology by 2050. Indeed, recent evidence suggests that grid-independent EVs charged by means of low-carbon energy sources may outperform even the most fuel-efficient internal combustion engine vehicles (ICEVs; Hawkins, Gausen & Strømman, 2012). However, the authors also suggest that taking into account the carbon footprint of EV production, and reliance on coal power for charging the vehicles, may actually put their global warming potential (GWP) into the same range to that of conventional ICEVs. In addition, there still exist substantial practical and psychological barriers to the widespread uptake of such technology (Graham-Rowe et al., 2012). In general, consumers' EV purchasing intentions are strongly influenced by the current disadvantages of EVs, which tend to outweigh the potential benefits, such as enhanced fuel economy (Carley, Krause, Lane & Graham, 2013). In particular, practical aspects, such as cost and performance (e.g. battery duration; Chéron & Zins, 1997) tend to outweigh any prospects of the potential environmental benefits of EVs (Egbue & Long, 2012).

Instrumental functions of EVs (e.g. range and speed) have also been found to strongly affect consumer evaluations of the anticipated hedonic (e.g. pleasure of driving) and symbolic (e.g. the 'green' image) aspects of EVs (Schuitema et al., 2013), including a sense of 'strangeness' and loss of control (Axsen, Langman & Goldberg, 2017). This suggests that affect-utility integration (see Mann & Abraham, 2006) not only poses a key concern for conventional vehicles, but may also pose a key consideration in the case of EVs. Although battery- and hybrid-electric cars are still limited in range and their market share is small (IHS Automotive, Q1 2015), they hold promise of becoming a temporary mobility solution as a precursor to the likely impending hydrogen era (Van Mierlo, Maggetto & Lataire, 2006). Financial incentives and good charging infrastructure may facilitate EV adoption in the short-term (Sierzchula, Bakker, Maat & van Wee, 2014). An even more ground-breaking invention, however, is on its way.

As cars are becoming smarter and communicate increasingly with each other and the environment (Narla, 2013), the replacement of manually controlled vehicles by automated, smart, driver-less vehicles appears inevitable. Yet not only may cars be self-driving in the future, they may also not even be owned by its passenger. That is, Automated Mobility-on-Demand (AMoD) services will question the utility of individual car ownership (since the average British car is only used 4% of the time; RAC Foundation, 2012), revolutionizing the way we currently travel. Using the example of Singapore, Spieser et al. (2014) demonstrated that a fleet of shared automated vehicles would render two thirds of the city's currently used vehicles redundant, which would have an enormous impact on levels of noise, pollution and congestion. Yet, before this is going to happen, decades may pass – time that we cannot afford to lose in the pursuit of climate change mitigation. Behaviour change and policy interventions thus remain an important route, especially for present car drivers, and also with regards to population health, as technology cannot address the lack of physical activity caused by an overreliance on private motorized travel.

Behaviour change and policies

Some hope may be given when old habits are disrupted. New staff members at the university, for instance, might be encouraged to use sustainable travel modes before/after relocating. However, the evidence for habit discontinuity through relocation as an effective measure for behaviour change interventions is mixed (Bamberg, 2006; Walker, Thomas & Verplanken, 2015). As an example, Bamberg (2006) investigated the effectiveness of a travel intervention, including a free public transport ticket and personalised travel information, delivered to participants after a residential relocation. The intervention proved effective in increasing levels of public transport usage, although objective PT service quality and the intention to reduce own car use emerged as the decisive factors rather than the mere disruption of habit. In contrast, in another relocation scenario, Walker and colleagues (2014) found support for habit discontinuity as a potential driver for behaviour change, yet also acknowledged that "it is not going to be possible to reduce individual driving below a certain non-trivial level, even after a major disruption in which people are extensively supported with information and incentives" (p. 15). Likewise, De Vos, Derudder, Van Acker and Witlox (2012) argued that a relocation involves substantial personal costs and new residents might carry over their old commuting habits to the new environment, especially when relocating from more rural areas. Residential relocation may thus not be the Holy Grail to behaviour change, although it should not be dismissed as an opportunity to encourage change.

For major trip generators, such as the University of Bath, a rethinking of parking permits may also be appropriate, as recent research has shown that seasonal passes, in particular, tend to increase the utility of driving due to sunk costs if unused (Whalen, Páez & Carrasco, 2013). Offering reloadable flex passes (e.g. http://parking.mcmaster.ca/flexpass.html) may overcome this problem in the future. In addition, even when a switch to alternative modes of travel cannot be encouraged, there is still room for improving current consumption patterns. Eco-driving, in particular, has the potential to save significant amounts of fuel, saving not only the planet's resources, but also peoples' resources (see Barkenbus, 2010, for more detail on the benefits of eco-driving). Eco-driving lessons sponsored by the University could thus encourage better driving habits.

Behaviour change might also be encouraged by broader legislative changes. For instance, driving restriction policies have been introduced in many Chinese cities, albeit with limited success (Liu, Hong & Liu, 2016; Wang, Xu & Qin, 2014). As Brand, Anable and Tran (2013) suggested, incentive schemes (such as car purchase fee bate policies) should be introduced on a broad scale to encourage the purchase of low carbon vehicles. In addition, a carbon tax could be introduced, generating significant government revenue and accelerating the transition to a low carbon transport society (Brand et al., 2013). For example, Hensher (2008) examined a scenario entailing a charge of 20c (Australian $)/kg CO_2 compared to a business-as-usual scenario. The former would have increased vehicle operating costs (+16.6%), while generating government revenue (+9.3%), increasing public transport patronage (+7.7%) and decreasing total CO_2 emissions (-2.7%). However, although carbon taxing may be effective in terms of equity (since the polluter pays), sustainability (reduced emissions) and efficiency (less congestion, higher public transport usage), it would be more difficult to implement for relevant stakeholders than the mere adoption of technological solutions and would presumably also face strong opposition from both current drivers and manufacturers.

General recommendations for university settings and other institutions/workplaces

- Inform about and subsidize the purchase of EVs
- Provision of EV charging stations powered by renewable energy
- Allowance of parking permits based on distance (e.g. no permit granted when living within a 3 mile radius of the institution/workplace) and free parking for registered EVs and other zero- or low-emission vehicles
- Establishing an accessible and comprehensive car-/lift-sharing scheme
- Offer eco-driving lessons to student and staff drivers

7.3.3. Recommendations for public transport

The first part of this thesis has focused on bus travel in particular, providing an in-depth investigation of bus users' motives for using the bus and a segmentation study of bus users. Unlike previous research, this research has not investigated public transport users with the goal of increasing patronage, but rather with the prospect of encouraging current PT users to travel more actively. Although public transport is responsible for a significant amount of access and egress trips by other (active) travel modes (Brands, Romph, Veitch & Cook, 2014; Tan, Raveau, Lee & Ben-Akiva, 2016), bus journeys generally tend to be sufficiently short (Statista, 2015) to be substituted by active modes of transportation (Shaw & Gallent, 1999). Encouraging current PT users to travel more actively, such as by walking or cycling, does not only offer potential health benefits, but may also lead people to rediscover the joy and autonomy of active travel, while relieving acute public transport problems (such as overcrowded services during peak times) which in turn may attract new PT customers (e.g. current dissatisfied drivers who have avoided public transport previously) and thus may pose a win-win situation.

With roughly 63% of student and 13% of staff journeys (UTS, 2014), the bus is one of the major transport alternatives for the commute to campus. Although essentially most public transport journeys could be easily replaced with trips by walking or cycling, the bus remains the most common transport mode for students. For approximately half the proportion of bus users (Study 3), convenience could be identified as the main motive driving the choice of local bus services over sustainable alternatives (i.e. walking and cycling). Given the local topography (up to 12% inclines) and long (walking) distance to campus (3-4 miles or 35-50 minutes), this is hardly surprising. However, two bus user segments were identified – *Wannabe Walkers* and *Daily Drags* (see Study 2) – who were sufficiently dissatisfied with the bus services to be encouraged to travel more actively and sustainably.

The *Wannabe Walkers*, for instance, have a strong desire to travel more actively, yet they are still fairly dependent on the bus. Stressing the cost, environmental and health benefits of active travel (including the autonomy that active travel offers in comparison to the reliance on public transport) may strengthen the *Wannabe Walker's* already existing intention to increase his or her level of active travel which, in turn, may lead to actual behaviour change. This, however, may only work when no sunk costs arise from the desired switch (see Study 3). In contrast, the *Daily Drags* do not have a strong desire to travel more actively, despite being deeply dissatisfied with the services. Consequently, it may be more difficult to convince them to travel more actively. When encouraging *Daily Drags* to reduce their reliance on the bus, it may be particularly

important to address their perceptions of the required time and (physical) effort of available alternatives. In the particular case of Bath, it may be important to show commuters that cycling or walking up the hill to campus does not require as much time and effort as assumed. This could be achieved with organized walking or cycling groups, for instance. In the case of walking, it may be especially important to focus *Daily Drags'* attention on the positive experience of walking (nature, fresh air, outbalancing physical inactivity after a day in the office etc.) instead of regarding the potentially increased commuting time as "time lost". Although not having a direct impact on emissions, a mode shift from public transport (bus) to active travel among these segments may relieve some of the current problems with the services (especially overcrowding at peak times; see Study 1) which, in turn, may invite more staff members living in Bath to use the bus instead of their car. This might then result in an actual decrease in emissions through a decrease in car use by staff.

In the end, however, it is the bus companies who may have the greatest propensity to effectively reduce emissions. The local bus companies should be encouraged to renew their fleets with buses running on either diesel-electric engines or hydrogen fuel cells, which would significantly cut down on emissions and improve local air quality (Potter, 2003). Alternatively, a system could also be introduced with buses running purely on electricity (e.g. trolley buses with braking energy recuperation; Kühne, 2010), albeit this would require major structural changes. Convincing the local bus companies of implementing any changes may pose a significant challenge in itself, considering the financial assets that would be required. Part of the solution may be on its way, however. The Office for Low Emission Vehicles (OLEV) has launched a £30 million Low Emission Bus Scheme for local authorities and transport operators to "increase the uptake of low and ultra-low emission buses, speeding up the full transition to an ultra-low emission bus fleet in England and Wales, and reducing the need for subsidy support" (OLEV, 2015). In collaboration with the Department for Transport and other stakeholders, transport operators, such as the FirstGroup, have also declared their commitment to employ more low emission vehicles. The latter have announced to upgrade and retro-fit vehicles currently in use complemented by the addition of 50 Streetlite micro hybrid buses to their current West of England bus fleet (roughly 80% of which are expected to be employed in Bristol) which are said to be 30% more fuel efficient than conventional single deck buses and also make use of braking energy recuperation (seen in "First West of England unveils new fleet of Micro Hybrid buses"; http://www.firstgroup.com/latest_news/?id=012401, accessed on May 14, 2015). An extension of these efforts to other cities in the UK beyond Bristol, the 2015 European Green Capital, is urgently needed and should be facilitated through funding support.

Finally, a less cost intensive measure would be the introduction of cross-boarding passes offered by the university in collaboration with the two competing bus companies. With cross-boarding passes (i.e. passes that allow the boarding of any available public transport service), a more efficient use of bus capacity could be achieved, eventually requiring less vehicles to be employed, while at the same time reducing waiting times and thus increasing user satisfaction. In the 2014/15 UTS, 90% of respondents were in favour of cross-boarding passes.

General recommendations for university settings and other institutions/workplaces

- Encourage the substitution of shorts trip by bus through active travel, especially among current dissatisfied users (i.e. *Wannabe Walkers* and *Daily Drags*; see Study 2)
- Encourage bus companies to employ a more sustainable vehicle fleet (does not solve crowding or congestion issues, yet may reduce air pollution and noise substantially)
- Enable cross-boarding passes to reduce waiting times and increase efficiency (very effective and, in theory, easy to implement – yet, requires agreement between the competing bus companies)

References

Abdi, H. (2003). Factor rotations in factor analyses. In M. Lewis-Beck, A. Bryman & T. Futing (Eds.), *Encyclopaedia for Research Methods for the Social Sciences* (pp. 978-982). *Thousand Oaks, CA*: Sage.

Abrahamse, W., & Steg, L. (2013). Social influence approaches to encourage resource conservation: A meta-analysis. *Global Environmental Change*, *23*, 1773-1785.

Abrahamse, W., Steg, L., Gifford, R., & Vlek, C. (2009). Factors influencing car use for commuting and the intention to reduce it: A question of self-interest or morality? *Transportation Research Part F: Traffic Psychology and Behaviour*, *12*(4), 317-324.

Adams, M. A., Todd, M., Kurka, J., Conway, T. L., Cain, K. L., Frank, L. D., & Sallis, J. F. (2015). Patterns of walkability, transit, and recreation environment for physical activity. *American Journal of Preventive Medicine*. DOI: 10.1016/j.amepre.2015.05.024

Afsar, B., Nikjooy, G., & Yazid, M. Y. (2015). The Consequences of the Physical-Environmental Factors on Encouraging Pedestrian and Cycling Activities in UPM Campus. *International Journal of Scientific & Engineering Research, v6 (1)*.

Ajzen, I. (1985). From intentions to actions: A theory of planned behaviour. In J. Kuhl & J. Beckman (Eds.), *Action-control: From cognition to behaviour* (pp. 11-39). Heidelberg, Germany: Springer.

Ajzen, I. (1991). The theory of planned behaviour. *Organizational Behaviour and Human Decision Processes*, *50*, 179-221.

Ajzen, I. (2015). The theory of planned behaviour is alive and well, and not ready to retire: a commentary on Sniehotta, Presseau, and Araújo-Soares. *Health Psychology Review*, *9*(2), 131-137.

Ajzen, I. and Fishbein, M. (2005). The influence of attitudes on behavior. In D. Albarracin, B.T. Johnson & M.P. Zanna (Eds.), *Handbook of Attitudes and Attitude Change: Basic Principles* (pp. 173-221). Mahwah, NJ: Erlbaum.

Aldred, R. (2012). Governing transport from welfare state to hollow state: The case of cycling in the UK. *Transport Policy*, *23*, 95-102.

Aldred, R. (2015). A matter of utility? Rationalising cycling, cycling rationalities. *Mobilities*, *10*(5), 686-705.

Aldred, R., & Jungnickel, K. (2014). Why culture matters for transport policy: the case of cycling in the UK. *Journal of Transport Geography*, *34*, 78-87.

Anable, J. (2005). 'Complacent Car Addicts' or 'Aspiring Environmentalists'? Identifying travel behaviour segments using attitude theory. *Transport Policy*, *12*, 65-78.

Anable, J., & Gatersleben, B. (2005). All work and no play? The role of instrumental and affective factors in work and leisure journeys by different travel modes. *Transportation Research Part A*, *39*, 163-181.

Andrews, C., & Holst, C. B. (1998). The real meaning of "inwardly rich". *Journal of Voluntary Simplicity*, May 28. Annual Sustainability Report (September 2014). University of Bath. Retrieved January 6, 2017, from http://www.bath.ac.uk/estates/docs/Energy_and_Environment_Report_2014.pdf

Anta, J., Pérez-López, J. B., Martínez-Pardo, A., Novales, M., & Orro, A. (2016). Influence of the weather on mode choice in corridors with time-varying congestion: A mixed data study. *Transportation*, *43*(2), 337-355.

Arkes, H.R., & Blumer, C. (1985). The psychology of sunk cost. *Organizational Behavior and Human Decision Processes*, *35*(1), 124-140.

Audrey, S., Procter, S., & Cooper, A. R. (2014). The contribution of walking to work to

adult physical activity levels: a cross sectional study. *International Journal of Behavioral Nutrition and Physical Activity*, *11:37*. DOI: 10.1186/1479-5868-11-37

Aupers, S., Houtman, D., Achterberg, P., de Koster, W., Mascini, P., & van der Waal, J. (2012). Beyond the domestication of nature? Restructuring the relationship between nature and technology in car commercials. *European Journal of Cultural Studies*, *15*(1), 3-18.

Axsen, J., Langman, B., & Goldberg, S. (2017). *Confusion of Innovations: Mainstream Consumer Perceptions and Misperceptions of Electric-Drive Vehicle Technology* (No. 17-01013).

Azmat, M. M., & Schuhmayer, C. (2015). *Self-Driving Cars – The future has already begun*. Conference paper presented at the Innovation Platform – e-Mobility workshop of the Federal Procurement Agency Austria (BBG).

Azmat, M., Schuhmayer, C., & Kummer, S. (2016, May). Innovation in mobility: Austrian expert's perspective on the future of urban mobility with self-driving cars. In *Innovation Arabia 9: Quality and Business Management Conference (Business Innovation-Imperative for knowledge Economy)* (Vol. 9, pp. 142-160). HBMSU Publishing House.

Baayen, R. H. (2014). Experimental and psycholinguistic approaches to studying derivation In *Handbook of Derivational Morphology* (pp. 95-117).

Bamberg, S. (2006). Is a residential relocation a good opportunity to change people's travel behavior? Results from a theory-driven intervention study. *Environment and Behavior*, *38*(6), 820-840.

Bamberg, S., & Schmidt, P. (2003). Incentives, morality, or habit? Predicting students' car use for university routes with the models of Ajzen, Schwartz, and Triandis. *Environment and Behavior*, *35*(2), 264-285.

Bamberg, S., Ajzen, I., & Schmidt, P. (2003). Choice of travel mode in the theory of planned behavior: The roles of past behavior, habit, and reasoned action. *Basic and Applied Social Psychology*, *25*(3), 175-187.

Bamberg, S., Fujii, S., Friman, M., & Gärling, T. (2011). Behaviour theory and soft transport policy measures. *Transport Policy*, *18*, 228-235.

Bandura, A. (1991). Social cognitive theory of self-regulation. *Organizational Behavior and Human Decision Processes*, *50*(2), 248-287.

Banerjee, U., & Hine, J. (2014). Identifying the underlying constructs linking urban form and travel behaviour using a grounded theory approach. *International Journal of Environmental Science and Technology*, *11*(8), 2217-2232.

Banister, D. (2008). The sustainable mobility paradigm. *Transport Policy*, *15*, 73-80.

Barbour, R. S. (2007). *Doing focus groups*. London, UK: SAGE Publications Ltd.

Barkenbus, J. N. (2010). Eco-driving: An overlooked climate change initiative. *Energy Policy*, *38*(2), 762-769.

Barr, S. (2011). Climate forums: virtual discourses on climate change and the sustainable lifestyle. *Area*, *43*(1), 14-22.

Barr, S., Gilg, A., & Shaw, G. (2011). 'Helping People Make Better Choices': Exploring the behaviour change agenda for environmental sustainability. *Applied Geography*, *31*(2), 712-720.

Barr, S., & Prillwitz, J. (2012). Green travellers? Exploring the spatial context of sustainable mobility styles. *Applied Geography*, *32*(2), 798-809.

Barr, S., & Prillwitz, J. (2014). A smarter choice? Exploring the behaviour change agenda for environmentally sustainable mobility. *Environment and Planning C: Government and Policy*, *32*(1), 1-19.

Barth, M., & Boriboonsomsin, K. (2008). Real-world carbon dioxide impacts of traffic

congestion. *Transportation Research Record: Journal of the Transportation Research Board*, (2058), 163-171.

Bartlett, M. S. (1950). Tests of significance in factor analysis. *British Journal of Psychology*, *3*, 77-85.

Basilevsky, A. (1994). *Statistical Factor Analysis and Related Methods: Theory and Applications*. Wiley Series in Probability and Mathematical Statistics.

Beaudoin, J., Farzin, Y. H., & Lawell, C.-Y. C. L. (2015). Public transit investment and sustainable transportation: A review of studies of transit's impact on traffic congestion and air quality. *Research in Transportation Economics*, *52*, 15-22.

Beimborn, E., Greenwald, M., Jin, X. (2003). Accessibility, connectivity, and captivity: Impacts on transit choice. *Transportation Research Record: Journal of the Transportation Research Board*, *1835*, 1-9.

Beirão, G., & Cabral, J. S. (2007). Understanding attitudes towards public transport and private car: A qualitative study. *Transport Policy*, *14*, 478-489.

Beirão, G., & Cabral, J. S. (2008). Market segmentation analysis using attitudes toward transportation: Exploring differences between men and women. *Transportation Research Record: Journal of the Transportation Research Board*, *2067*, 56-64.

Beirão, G., & Cabral, J. S. (2009). *Measuring Dissatisfaction with Public Transport Service.* Presented at the 88th Transportation Research Board Annual Meeting, Washington, DC.

Bergstrom, A., & Magnusson, R. (2003). Potential of transferring car trips to bicycle during winter. *Transportation Research Part A*, *37*, 649-666.

Besser, L. M., & Dannenberg, A. L. (2005). Walking to public transit: Steps to help meet physical activity recommendations. *American Journal of Preventive Medicine*, *29*(4), 273-280.

BHFNC (2014). *Economic costs of physical inactivity*. Retrieved December 2, 2015, from http://www.bhfactive.org.uk/userfiles/Documents/eonomiccosts.pdf

Biermann, F., & Boas, I. (2010). Preparing for a warmer world: Towards a global governance system to protect climate refugees. *Global Environmental Politics*, *10*(1), 60-88.

Biggerstaff, D., & Thompson, A. R. (2008). Interpretative Phenomenological Analysis (IPA): A Qualitative Methodology of Choice in Healthcare Research. *Qualitative Research in Psychology*, *5*(3), 214-224.

Blair, E., & Zinkhan, G. M. (2006). From the editor: Nonresponse and generalizability in academic research. *Journal of the Academy of Marketing Science*, *34*(1), 4-7.

Böcker, L., Dijst, M., & Faber, J. (2016). Weather, transport mode choices and emotional travel experiences. *Transportation Research Part A: Policy and Practice*, *94*, 360-373.

Böcker, L., Dijst, M., Faber, J., & Helbich, M. (2015). En-route weather and place valuations for different transport mode users. *Journal of Transport Geography*, *47*, 128-138.

Bohle, H. G., Downing, T. E., & Watts, M. J. (1994). Climate change and social vulnerability: Toward a sociology and geography of food insecurity. *Global Environmental Change*, *4*(1), 37-48.

Bolderdijk, J. W., Gorsira, M., Keizer, K., & Steg, L. (2013). Values determine the (in) effectiveness of informational interventions in promoting pro-environmental behavior. *PloS one*, *8*(12), e83911.

Bonham, J., & Koth, B. (2008). Uni-cycle: Universities fostering a culture of cycling. In *THINKING ON TWO WHEELS CYCLING CONFERENCE,* 2005-2007. Adelaide, South Australia.

Bonham, J., & Koth, B. (2010). Universities and the cycling culture. *Transportation Research Part D: Transport and Environment*, *15*(2), 94-102.

Börjesson, M., Eliasson, J., Hugosson, M. B., & Brundell-Freij, K. (2012). The Stockholm congestion charges—5 years on. Effects, acceptability and lessons learnt. *Transport Policy*, *20*, 1-12.

Bösehans, G. (2013). Has voluntary carbon offsetting become the magic pill? Testing the effects of moral cleansing in travel mode choices (Unpublished Master's thesis). University of Groningen, Groningen, The Netherlands.

Bösehans, G., & Walker, I. (2016). 'Daily Drags' and 'Wannabe Walkers'–Identifying dissatisfied public transport users who might travel more actively and sustainably. *Journal of Transport & Health*, *3*(3), 395-403.

Borken-Kleefeld, J., Fuglestvedt, J., & Berntsen, T. (2013). Mode, load, and specific climate impact from passenger trips. *Environmental science & technology*, *47*(14), 7608-7614.

Bradshaw, C. J. A., & Brook, B. W. (2014). Human population reduction is not a quick fix for environmental problems. *Proceedings of the National Academy of Sciences*, 201410465.

Brand, C., Anable, J., & Tran, M. (2013). Accelerating the transformation to a low carbon passenger transport system: The role of car purchase taxes, fee bates, road taxes and scrappage incentives in the UK. *Transportation Research Part A*, *49*, 132-148.

Brand, C., & Boardmann, B. (2008). Taming of the few – The unequal distribution of greenhouse gas emissions from personal travel in the UK. *Energy Policy*, *36*, 224-238.

Brands, T., de Romph, E., Veitch, T., & Cook, J. (2014). Modelling public transport route choice with multiple access and egress modes. *Transportation Research Procedia*, *1*(1), 12-23.

Braun, V., & Clarke, V. (2006). Using thematic analysis in psychology. *Qualitative Research in Psychology*, *3*(2), 77-101.

Brehm, J. W. (1966). *A theory of psychological reactance*. New York: Academic Press.

Broach, J., Dill, J., & Gliebe, J. (2012). Where do cyclists ride? A route choice model developed with revealed preference GPS data. *Transportation Research Part A: Policy and Practice*, *46*(10), 1730-1740.

Bryman, A. (2012). Social research methods (4th edition). New York: Oxford University Press Inc.

Brysbaert, M., Buchmeier, M., Conrad, M., Jacobs, A. M., Bölte, J., & Böhl, A. (2011). The word frequency effect: A Review of Recent Developments and Implications for the Choice of Frequency Estimates in German. *Experimental Psychology*, *58*, 412-424.

Bulkeley, H., & Newell, P. (2015). *Governing climate change*. New York, NY: Routledge.

Burns, L. D. (2013). Sustainable mobility: a vision of our transport future. *Nature*, *497*(7448), 181-182.

Burns, R., & Burns, R. (2008). *Business Research Methods and Statistics using SPSS.* Sage Pub.

Button, K., & Nijkamp, P. (1997). Social change and sustainable transport. *Journal of Transport Geography*, *5*(3), 215-218.

Buunk, A. P., & Van Vugt, M. (2008). *Applying Social Psychology: from problems to solutions*. Sage Pub.

Campbell, C. (2007). *The Easternization of the West: A Thematic Account of Cultural Change in the Modern Era.* Boulder, CO: Paradigm Publishers.

Capstick, S., Whitmarsh, L., Poortinga, W., Pidgeon, N., & Upham, P. (2015). International

trends in public perceptions of climate change over the past quarter century. *Wiley Interdisciplinary Reviews: Climate Change*, *6*(1), 35-61.

Carley, S., Krause, R. M., Lane, B. W., & Graham, J. D. (2013). Intent to purchase a plug-in electric vehicle: A survey of early impressions in large US cites. *Transportation Research Part D: Transport and Environment*, *18*, 39-45.

Carmichael, J. T., & Brulle, R. J. (2017). Elite cues, media coverage, and public concern: An integrated path analysis of public opinion on climate change, 2001–2013. *Environmental Politics*, *26*(2), 232-252.

Carver, C. S., & Scheier, M. F. (1981). The self-attention-induced feedback loop and social facilitation. *Journal of Experimental Social Psychology*, *17*(6), 545-568.

Cattell, R. B. (1966). The Scree test for the number of factors. *Multivariate Behavioral Research*, *1*(2), 245-276.

Cattell, R. B. (1978). *The scientific use of factor analysis.* New York: Plenum.

Cazorla, M., & Toman, M. (2001). International equity and climate change policy. In M. Toman (Ed.), *Climate change economics and policy: An RFF Anthology*, pp. 235-247. Routledge.

Cervero, R. (1998). *The transit metropolis: a global inquiry*. Island press.

Cervero, R. (2013). Transport Infrastructure and the Environment: Sustainable Mobility and Urbanism. In K. Etingoff (Ed.), *Urban Development for the 21st century: Managing Resources and Creating Infrastructure* (pp. 155-182). Oakville, Canada: Apple Academic Press, Inc.

Chapman, L. (2007). Transport and climate change: a review. *Journal of Transport Geography*, *15*, 354-367.

Chatterton, T. J., Coulter, A., Musselwhite, C., Lyons, G., & Clegg, S. (2009). Understanding how transport choices are affected by the environment and health: Views expressed in a study on the use of carbon calculators. *Public Health*, *123*, e45-e49.

Chéron, E., & Zins, M. (1997). Electric vehicle purchasing intentions: The concern over battery charge duration. *Transportation Research Part A: Policy and Practice*, *31*(3), 235-243.

Cialdini, R.B. (2001). *Influence: Science and practice* (4th Ed.). Boston: Allyn & Bacon.

Cialdini, R. B. (2003). Crafting normative messages to protect the environment. *Current Directions In Psychological Science*, *12*(4), 105-109.

Cialdini, R. B. (2007). Descriptive social norms as underappreciated sources of social control. *PSYCHOMETRIKA*, *72*(2), 263–268.

Cialdini, R.B., Reno, R.R., & Kallgren, C.A. (1990). A focus theory of normative conduct: Recycling the concept of norms to reduce littering in public places. *Journal of Personality and Social Psychology*, *58*, 1015-1026.

Ciampi, A., González Marcos, A., & Castejón Limas, M. (2005). Correspondence analysis and 2-way clustering. *SORT, 29*(1)*, 27-42*.

Clatworthy, J., Buick, D., Hankins, M., Weinman, J., & Horne, R. (2005). The use and reporting of cluster analysis in health psychology: A review. *British Journal of Health Psychology*, *10*, 329-358.

Clayman, S., & Gill, V.T. (2004). Conversation Analysis. In M. Hardy and A. Bryman (Eds.), *Handbook of Data Analysis* (pp. 589-606). London: Sage.

Collins, C. M., & Chambers, S. M. (2005). Psychological and situational influences on commuter-transport-mode choice. *Environment and Behavior*, *37*(5), 640-661.

Committee on Climate Change (2014). *Meeting Carbon Budgets – 2014 Progress Report to Parliament.* Retrieved November 8, 2016, from https://www.theccc.org.uk/publication/meeting-carbon-budgets-2014-progress-report-to-parliament/

Comrey, A. L., & Lee, H. B. (1992). *A first course in factor analysis.* Hillsdale, NJ: Erlbaum.

Cools, M., Fabbro, Y., & Bellemans, T. (2016). Free public transport: A socio-cognitive analysis. *Transportation Research Part A: Policy and Practice*, *86*, 96-107.

Cools, M., Moon, E., Janssens, B., & Wets, G. (2009). Shifting towards environment-friendly modes: Profiling travelers using Q-methodology. *Transportation*, *36*, 437-453.

Corbin, J. M., & Strauss, A. (1990). Grounded theory research: Procedures, canons, and evaluative criteria. *Qualitative Sociology*, *13*(1), 3-21.

Corner, A., & Randall, A. (2011). Selling climate change? The limitations of social marketing as a strategy for climate change public engagement. *Global Environmental Change*, *21*(3), 1005-1014.

Coumou, D., & Rahmstorf, S. (2012). A decade of weather extremes. *Nature Climate Change*, *2*(7), 491-496.

Csutora, M. (2012). One more awareness gap? The behaviour–impact gap problem. *Journal of Consumer Policy*, *35*(1), 145-163.

Cullinane, S. (1992). Attitudes towards the car in the UK: Some implications for policies on congestion and the environment. *Transportation Research Part A: Policy and Practice*, *26*(4), 291-301.

Dai, Y. C., Gordon, M. P. R., Ye, J. Y., Xu, D. Y., Lin, Z. Y., Robinson, N. K. L., ... & Harder, M. K. (2015). Why doorstepping can increase household waste recycling. *Resources, Conservation and Recycling*, *102*, 9-19.

Daley, M., & Rissel, C. (2011). Perspectives and images of cycling as a barrier or facilitator of cycling. *Transport Policy*, *18*, 211-216.

Danish Ministry of Transport (2012). *A Greener Transport System in Denmark*. http://www.trm.dk/~/media/Files/Publication/English/EUprecidency2012/Agreenertransportsystem-netversion.ashx (accessed April 9, 2015).

Dant, T., & Martin, P. J. (2001). By car: Carrying modern society. In J. Gronow & A. Warde (Eds.), *Ordinary Consumption* (pp. 143-158). London: Routledge.

Davies, J., Foxall, G. R., & Pallister, J. (2002). Beyond the intention–behaviour mythology: An integrated model of recycling. *Marketing Theory*, *2*(1), 29-113.

De Bruijn, G. J., Kremers, S. P., De Vet, E., De Nooijer, J., Van Mechelen, W., & Brug, J. (2007). Does habit strength moderate the intention–behaviour relationship in the Theory of Planned Behaviour? The case of fruit consumption. *Psychology and Health*, *22*(8), 899-916.

Deci, E. L., & Ryan, R. M. (2000). The" what" and" why" of goal pursuits: Human needs and the self-determination of behavior. *Psychological Inquiry*, *11*(4), 227-268.

De Groot, J. I. M., & Steg, L. (2008). Value orientations to explain environmental attitudes and beliefs: How to measure egoistic, altruistic and biospheric value orientations. *Environment and Behavior*, *40*, 330-354.

De Groot, J. I. M., & Steg, L. (2009). Morality and prosocial behavior: The role of awareness, responsibility and norms in the norm activation model. *Journal of Social Psychology*, *149*, 425-449.

De Groot, J. I. M., & Steg, L. (2010). Relationships between value orientations, self-determined motivational types and pro-environmental behavioural intentions. *Journal of Environmental Psychology*, *30*(4), 368-378.

Den Heyer, K., Briand, K., & Dannenbring, G. L. (1983). Strategic factors in a lexical-decision task: Evidence for automatic and attention-driven processes. *Memory & Cognition*, *11*(4), 374-381.

Department of the Environment Food and Rural Affairs (DEFRA, 2008). *Framework for environmental behaviours*. London: DEFRA.

Department for Transport (DfT, 2016). *Annual bus statistics: year ending, March 2016*.

Retrieved November 23, 2016, from https://www.gov.uk/government/statistics/annual-bus-statistics-year-ending-march-2016

Department for Transport (DfT, 2016). *National Travel Survey: England 2015*. London: DfT.

Department for Transport (DfT, 2017). *Passenger journeys, vehicle miles and occupancy (LRT01)*. Retrieved July 25, 2017, https://www.gov.uk/government/statistical-data-sets/lrt01-ocupancy-journeys-and-passenger-miles

Department for Transport (DfT, 2014). *Transport Statistics Great Britain 2014*. Retrieved May 26, 2015, from https://www.gov.uk/government/statistics/transport-statistics-great-britain-2014

Devitt, M. (2006). *Scientific Realism*. In F. Jackson & M. Smith (Eds.), *The Oxford Handbook of Contemporary Philosophy* (pp. 100-124). Oxford: Oxford University Press.

De Vos, J., Derudder, B., Van Acker, V., & Witlox, F. (2012). Reducing car use: changing attitudes or relocating? The influence of residential dissonance on travel behavior. *Journal of Transport Geography*, *22*, 1-9.

De Witte, A., Macharis, C., & Mairesse, O. (2008). How persuasive is 'free' public transport? A survey among commuters in the Brussels Capital Region. *Transport Policy*, *15*(4), 216-224.

Diana, M., & Mokhtarian, P. I. (2009). Desire to change one's multimodality and its relationship to the use of different transport means. *Transportation Research Part F*, *12*, 107-119.

Diana, M., & Pronello, C. (2010). Traveler segmentation strategy with nominal variables through correspondence analysis. *Transport Policy*, *17*, 183-190.

Dickerson, C. A., Thibodeau, R., Aronson, E., & Miller, D. (1992). Using cognitive dissonance to encourage water conservation. *Journal of Applied Social Psychology*, *22*(11), 841-854.

Dietz, T. (2015). Environmental value. In T. Brosch & D. Sander (Eds.), *Handbook of Value: Perspectives from Economics, Neuroscience, Philosophy, Psychology and Sociology* (pp. 329-350).

Dill, J., & McNeil, N. (2013). Four Types of Cyclists? *Transportation Research Record: Journal of the Transportation Research Board*, *2387*(1), 129-138.

Dittmar, H. (1992). *The social psychology of material possessions: To have is to be.* Hemel Hempstead, UK: Harvester Wheatsheaf; New York: St Martin's Press.

Dittmar, H. (2004). Are you what you have? *The Psychologist*, *17*(4), 206-210.

Dolnicar, S. (2002). A review of data-driven market segmentation in tourism. *Journal of Travel & Tourism Marketing*, *12*(1), 1-22.

Domarchi, C., Tudela, A., & González, A. (2008). Effect of attitudes, habit and affective appraisal on mode choice: an application to university workers. *Transportation*, *35*, 585-599.

Donald, I. J., Cooper, S. R., & Conchie, S. M. (2014). An extended theory of planned behaviour model of the psychological factors affecting commuters' transport mode use. *Journal of Environmental Psychology*, *40*, 39-48.

Doney, S. C., Fabry, V. J., Feely, R. A., & Kleypas, J. A. (2009). Ocean acidification: the other CO2 problem. *Annual Review of Marine Science*, *1,* 169-192.

Dubuy, V., De Cocker, K. A., De Bourdeaudhuij, I. M., Maes, L., Metsu, P., Van Acker, R., & Cardon, G. M. (2013). '10 000 Steps Flanders': evaluation of the state-wide dissemination of a physical activity intervention in Flanders. *Health education research*, DOI: 10.1093/her/cyt039

Dwyer, W. O., Leeming, F. C., Cobern, M. K., Porter, B. E., & Jackson, J. M. (1993). Critical

review of behavioral interventions to preserve the environment: Research since 1980. *Environment and Behavior*, *25*(5), 275-321.

Dziekan, K., & Kottenhoff, K. (2007). Dynamic at-stop real-time information displays for public transport: effects on customers. *Transportation Research Part A*, *41*, 489-501.

Dziuban, C. D., & Shirkey, E. C. (1974). When is a correlation matrix appropriate for factor analysis? *Psychological Bulletin*, *81*(6), 358-361.

Eagly, A. H., & Chaiken, S. (2005). The advantages of an inclusive definition of attitude. *Social Cognition*, *25*(5), 582-602.

EEA (2014). *Annual European Union greenhouse gas inventory 1990-2012 and inventory report 2014*. Luxembourg: Publications Office of the European Union.

Egbue, O., & Long, S. (2012). Barriers to widespread adoption of electric vehicles: An analysis of consumer attitudes and perceptions. *Energy Policy*, *48*, 717-729.

Ehrlich, P. R., & Ehrlich, A. H. (2013). Can a collapse of global civilization be avoided? *Proceedings of the Royal Society of London B: Biological Sciences*, *280*(1754), DOI: 10.1098/rspb.2012.2845

Ellaway, A, Macintyre, S., Hiscock, R., & Kearns, A. (2003). In the driving seat: psychosocial benefits from private motor vehicle transport compared to public transport. *Transportation Research Part F*, *6*, 217-231.

Elliot, J. (2013). *An Introduction to Sustainable Development* (4th Ed.). New York: Routledge, Taylor & Francis Group.

Elvik, R. (2009). The non-linearity of risk and the promotion of environmentally sustainable transport. *Accident Analysis and Prevention*, *41*, 849-855.

Evans, G. W., Wener, R. E., & Phillips, D. (2002). The morning rush hour: Predictability and commuter stress. *Environment and Behavior*, *34*(4), 521-530.

Ewing, R., & Cervero, R. (2010). Travel and the built environment. *Journal of the American Planning Association*, *76*(3), 265-294.

Faber, V. (1994). Clustering and the continuous k-means algorithm. *Los Alamos Science*, *22*, 138-144.

Farbotko, C. (2010). Wishful sinking: Disappearing islands, climate refugees and cosmopolitan experimentation. *Asia Pacific Viewpoint*, *51*(1), 47-60.

Fazio, R. H., Sanbonmatsu, D. M., Powell, M. C., & Kardes, F. R. (1986). On the Automatic Activation of Attitudes. *Journal of Personality and Social Psychology*, *50*(2), 229-238.

Fazio, R. H., & Towles-Schwen, T. (1999). The MODE model of attitude-behavior processes. In S. Chaiken & Y. Trope (Eds.), *Dual-process theories in Social Psychology* (pp. 97–116). New York: Guilford.

Ferré, P., & Sánchez-Casas, R. (2014). Affective priming in a lexical decision task: Is there An effect of words' concreteness? *Psicológica*, *35*, 117-138.

Festinger, L. (1954). A theory of social comparison processes. *Human Relations*, *7*(2), 117-140.

Festinger, L. (1957). *A Theory of Cognitive Dissonance*. Stanford, CA: Stanford University Press.

Flowerdew, A. D. J. (1993). *Urban traffic congestion in Europe: Road pricing and public transport finance* (EIV Special Report No. R452). Economist Intelligence Unit, London.

Forster, K. (1999). The Microgenesis of Priming Effects in Lexical Access. *Brain and Language*, *68*(1-2), 5–15.

Forward, S. (1998). Mode of transport on short journeys: Attitudes and behaviour of the

inhabitants of Gothenburg. In VTI report (Issue 437), Swedish National Road and Transport Research Institute. Linköping, Sweden.

Fuller, D., Gauvin, L., Kestens, Y., Daniel, M., Fournier, M., Morency, P., & Drouin, L. (2013). Impact evaluation of a public bicycle share program on cycling: A case example of BIXI in Montreal, Quebec. *American Journal of Public Health*, *103*(3), 85-92.

Frank, L. D., Greenwald, M. J., Winkelman, S., Chapman, J., & Kavage, S. (2010). Carbonless footprints: Promoting health and climate stabilization through active transportation. *Preventive Medicine*, *50*, S99-S105.

Franzen, A., & Vogl, D. (2013). Two decades of measuring environmental attitudes: A comparative analysis of 33 countries. *Global Environmental Change*, *23*, 1001-1008.

Freijy, T., & Kothe, E. J. (2013). Dissonance-based interventions for health behaviour change: A systematic review. *British Journal of Health Psychology*, *18*(2), 310-337.

Friese, M., Hofmann, W., & Wänke, M. (2008). When impulses take over: Moderated predictive validity of explicit and implicit attitude measures in predicting food choice and consumption behaviour. *British Journal of Social Psychology*, *47*(3), 397-419.

Friman, M. (2010). Affective dimensions of the waiting experience. *Transportation Research Part F*, *13*, 197-205.

Fujii, S., & Taniguchi, A. (2006). Determinants of the effectiveness of travel feedback programs — a review of communicative mobility management measures for changing travel behaviour in Japan. *Transport Policy*, *13*(5), 339-348.

García-Garcés, P., Ruiz, T., & Habib, K. M. (2016). Effect of travel behaviour change programmes on time allocated to driving. *Transportmetrica A: Transport Science*, *12*(1), 1-19.

Gärling, T., Ettema, D., & Friman, M. (2013). *Handbook of sustainable travel*. Dordrecht, Netherlands: Springer Netherlands. DOI: 10.1007/978-94-007-7034-8_1

Gärling, T., Gärling, A., & Loukopoulos, P. (2002). Forecasting psychological consequences of car use reduction: A challenge to an Environmental Psychology of transportation. *Applied Psychology: An international review*, *51*(1), 90-106.

Gärling, T., & Schuitema, G. (2007). Travel demand management targeting reduced private car use: Effectiveness, public acceptability and political feasibility. *Journal of Social Issues*, *63*(1), 139-153.

Garaizar, P., & Vadillo, M. A. (2014). Accuracy and Precision of Visual Stimulus Timing in PsychoPy: No Timing Errors in Standard Usage. *PloS one*, *9*(11), e112033.

Gardner, B. (2009). Modelling motivation and habit in stable travel mode contexts. *Transportation Research Part F: Traffic Psychology and Behaviour*, *12*(1), 68-76.

Gardner, B., & Abraham, C. (2007). What drives car use? A grounded theory analysis of commuters' reasons for driving. *Transportation Research Part F*, *10*, 187-200.

Gatersleben, B. (2007). Affective and symbolic aspects of car use. In T. Gärling & L. Steg (Eds.), *Threats from Car Traffic to the Quality of Urban Life: Problems, Causes, and Solutions* (pp. 219-233). Oxford, UK: Elsevier.

Gatersleben, B., & Appleton, K. M. (2007). Contemplating cycling to work: Attitudes and perceptions in different stages of change. *Transportation Research Part A*, *41*, 302-312.

Gatersleben, B., & Haddad, H. (2010). Who is the typical cyclist? *Transportation Research Part F*, *13*, 41-48.

Gatersleben, B., & Uzzell, D. (2007). Affective appraisals of the daily commute: Comparing perceptions of drivers, cyclists, walkers, and users of public transport.

Environment and Behaviour, *39*(3), 416-431.
Gawronski, B. (2012). Back to the future of dissonance theory: Cognitive consistency as a core motive. *Social Cognition*, *30*(6), 652-668.
Gawronski, B., & Bodenhausen, G. V. (2006). Associative and propositional processes in evaluation: An integrative review of implicit and explicit attitude change. *Psychological Bulletin*, *132*(5), 692-731.
Gawronski, B., & Strack, F. (2004). On the propositional nature of cognitive consistency: Dissonance changes explicit, but not implicit attitudes. *Journal of Experimental Social Psychology*, *40*(4), 535-542.
Gehlert, T., Dziekan, K., & Gärling, T. (2013). Psychology of sustainable travel behavior. *Transportation Research Part A*, *48*, 19-24.
Gifford, R., & Nilsson, A. (2014). Personal and social factors that influence pro-environmental concern and behaviour: A review. *International Journal of Psychology*, *49*(3), 141-157.
Giles-Corti, B., & Donovan, R. J. (2003). Relative influences of individual, social environmental, and physical environmental correlates of walking. *American Journal of Public Health*, *93*(9), 1583-1589.
Gill, P., Stewart, K., Treasure, E., & Chadwick, B. (2008). Methods of data collection in qualitative research: Interviews and Focus groups. *British Dental Journal*, *204*(6), 291-295.
Glaser, B. G., & Strauss, A. L. (1967). *The Discovery of Grounded Theory: Strategies for Qualitative Research*. Chicago: Aldine.
Golbuff, L., & Aldred, R. (2011). *Cycling Policy in the UK: A historical and thematic overview*. London, UK: University of East London. Retrieved November 25, 2016, from http://rachelaldred.org/wp-content/uploads/2012/10/cycling-review1.pdf
Goldstein, N. J., Cialdini, R. B., & Griskevicius, V. (2008). A room with a viewpoint: Using social norms to motivate environmental conservation in hotels. *Journal of Consumer Research*, *35*(3), 472-482.
Goodman, A., Sahlqvist, S., & Ogilvie, D. (2014). New walking and cycling routes and increased physical activity: One-and 2-year findings from the UK iConnect Study. *American Journal of Public Health*, *104*(9), e38-e46.
Gorsuch, R. L. (1983). *Factor Analysis* (2nd Ed.). Hillsdale, NJ: Erlbaum.
Gössling, S., & Cohen, S. (2014). Why sustainable transport policies will fail: EU climate policy in the light of transport taboos. *Journal of Transport Geography*, *39*, 197-207.
Gough, B., & Conner, M. T. (2006). Barriers to healthy eating amongst men: A qualitative analysis. *Social Science & Medicine*, *62*(2), 387-395.
Gower, J. C. (1967). A comparison of some methods of cluster analysis. *Biometrics*, *23*(4), 623-637.
Grabow, M. L., Spak, S. N., Holloway, T., Stone Jr, B., Mednick, A. C., & Patz, J. A. (2012). Air quality and exercise-related health benefits from reduced car travel in the Midwestern United States. *Environmental Health Perspectives*, *120*(1), 68-76.
Graham-Rowe, E., Gardner, B., Abraham, C., Skippon, S., Dittmar, H., Hutchins, R., & Stannard, J. (2012). Mainstream consumers driving plug-in battery-electric and plug-in hybrid electric cars: A qualitative analysis of responses and evaluations. *Transportation Research Part A: Policy and Practice*, *46*(1), 140-153.
Graham-Rowe, E., Skippon, S., Gardner, B., & Abraham, C. (2011). Can we reduce car use and, if so, how? A review of available evidence. *Transportation Research Part A: Policy and Practice*, *45*(5), 401-418.
Greenacre, M. (2007). *Correspondence analysis in practice (2nd edition)*. Florida, US:

CRC press.
Greene, D. L., & Wegener, M. (1997). Sustainable transport. *Journal of Transport Geography*, *5*(3), 177-190.
Greenwald, A. G., & Banaji, M. R. (1995). Implicit Social Cognition: Attitudes, Self-esteem, and Stereotypes. *Psychological Review*, *102*(1), 4-27.
Greenwald, A. G., & Krieger, L. H. (2006). Implicit bias: Scientific foundations. *California Law Review*, *94*(4), 945-967.
Greenwald, A. G., McGhee, D. E., & Schwartz, J. L. (1998). Measuring individual differences in implicit cognition: The implicit association test. *Journal of Personality and Social Psychology*, *74*(6), 1464-1480.
Guadagnoli, E., & Velicer, W. F. (1988). Relation of sample size to the stability of component patterns. *Psychological Bulletin*, *103*(2), 265-275.
Guo, Z. (2009). Does the pedestrian environment affect the utility of walking? A case of path choice in downtown Boston. *Transportation Research Part D: Transport and Environment*, *14*(5), 343-352.
Guy, S., Kashima, Y., Walker, I., & O'Neill, S. (2014). Special issue article: The social psychology of climate change – Investigating the effects of knowledge and ideology on climate change beliefs. *European Journal of Social Psychology*, *44*, 421-429.
Hafner, R. J., Walker, I., & Verplanken, B. (2017). Image, not environmentalism: A qualitative exploration of factors influencing vehicle purchasing decisions. *Transportation Research Part A: Policy and Practice*, *97*, 89-105.
Hair, J. F., Anderson, R. E., Tatham, R. L., & Black, W. C. (1998). *Multivariate Data Analysis* (5th Ed.). Upper Saddle River, NJ: Prentice Hall.
Hallal, P. C., Andersen, L. B., Bull, F. C., Guthold, R., Haskell, W., Ekelund, U., & Lancet Physical Activity Series Working Group. (2012). Global physical activity levels: Surveillance progress, pitfalls, and prospects. *The Lancet*, *380*(9838), 247-257.
Hamer, M., & Chida, Y. (2008). Active commuting and cardiovascular risk: A meta-analytic review. *Preventive Medicine*, *46*(1), 9-13.
Haraldsson, K., Folkesson, A., Saxe, M., & Alvfors, P. (2006). A first report on the attitude towards hydrogen fuel cell buses in Stockholm. *International Journal of Hydrogen Energy*, *31*(3), 317-325.
Hares, A., Dickinson, J., & Wilkes, K. (2010). Climate change and the air travel decisions of UK tourists. *Journal of Transport Geography*, *18*(3), 466-473.
Haskell, W. L., Lee, I. M., Pate, R. R., Powell, K. E., Blair, S. N., Franklin, B. A., Macera, C. A., Heath, G. W., Thompson, P. D., & Bauman, A. (2007). Physical activity and public health: updated recommendation for adults from the American College of Sports Medicine and the American Heart Association. *Circulation*, *116*(9), 1081-1093.
Hatfield, J., Fernandes, R., Faunce, G., & Job, R. S. (2008). An implicit non-self-report measure of attitudes to speeding: Development and validation. *Accident Analysis & Prevention*, *40*(2), 616-627.
Hatzopoulou, M., Weichenthal, S., Dugum, H., Pickett, G., Miranda-Moreno, L., Kulka, R., ... & Goldberg, M. (2013). The impact of traffic volume, composition, and road geometry on personal air pollution exposures among cyclists in Montreal, Canada. *Journal of Exposure Science and Environmental Epidemiology*, *23*(1), 46-51.
Haustein, S. (2012). Mobility behavior of the elderly: An attitude-based segmentation approach for a heterogeneous target group. *Transportation*, *39*(6), 1079-1103.
Hawkins, T. R., Gausen, O. M., & Strømman, A. H. (2012). Environmental impacts of hybrid and electric vehicles - A review. *The International Journal of Life Cycle Assessment*,

17(8), 997-1014.

Heath, G. W., Brownson, R. C., Kruger, J., Miles, R., Powell, K. E., Ramsey, L. T., & the Task Force on Community Preventive Services (2006). The effectiveness of urban design and land use and transport policies and practices to increase physical activity: A systematic review. *Journal of Physical Activity & Health*, *3*, S55-76.

Heath, Y., & Gifford, R. (2002). Extending the theory of planned behavior: Predicting the use of public transportation. *Journal of Applied Social Psychology*, *32*(10), 2154-2189.

Heinen, E., Maat, K., & Van Wee, B. (2011). The role of attitudes toward characteristics of bicycle commuting on the choice to cycle to work over various distances. *Transportation Research Part D: Transport and Environment*, *16*(2), 102-109.

Hensher, D. A. (2008). Climate change, enhanced greenhouse gas emissions and passenger Transport – What can we do to make a difference? *Transportation Research Part D: Transport and Environment*, *13*(2), 95-111.

Hickman, R., & Banister, D. (2007). Looking over the horizon: Transport and reduced CO_2 emissions in the UK by 2030. *Transport Policy*, *14*(5), 377-387.

Higher Education Funding Council for England (HEFCE, 2010). Carbon reduction target and strategy for higher education in England. Last retrieved January 6, 2017, from http://www.hefce.ac.uk/media/hefce1/pubs/hefce/2010/1001/10_01a.pdf

Hill, M. O. (1974). Correspondence analysis: A neglected multivariate method. *Applied Statistics*, *23*(3), 340-354.

Hofmann, W., Gschwendner, T., Friese, M., Wiers, R. W., & Schmitt, M. (2008). Working memory capacity and self-regulatory behavior: Toward an individual differences perspective on behavior determination by automatic versus controlled processes. *Journal of Personality and Social Psychology*, *95*(4), 962-977.

Holden, E. (2007). *Achieving Sustainable Mobility: Everyday and Leisure-time Travel in the EU*. Ashgate Publishing Limited, Hampshire, UK.

Hopkins, D. (2016). Can environmental awareness explain declining preference for car-based mobility amongst generation Y? A qualitative examination of learn to drive behaviours. *Transportation Research Part A: Policy and Practice*, *94*, 149-163.

Horton, D. (2007). Fear of cycling. In D. Horton, P. Rosen & P. Cox (Eds.) *Cycling and Society*, (pp. 133-152). Hampshire, England: Ashgate Publishing Limited.

Horton, D., Rosen, P., & Cox, P. (2007). *Cycling and society*. Hampshire, UK: Ashgate Publishing Limited.

Howe, K. R. (1988). Against the quantitative-qualitative incompatibility thesis or dogmas die hard. *Educational Researcher*, *17*(8), 10-16.

Howe, K. R. (1992). Getting over the quantitative-qualitative debate. *American Journal of Education*, *100*(2), 236-256.

Hull, A. (2008). Policy integration: What will it take to achieve more sustainable transport solutions in cities? *Transport Policy*, *15*, 94-103.

Hurst, M., Dittmar, H., Bond, R., & Kasser, T. (2013). The relationship between materialistic values and environmental attitudes and behaviors: A meta-analysis. *Journal of Environmental Psychology*, *36*, 257-269.

Ibrahim, M. F. (2003). Car ownership and attitudes towards transport modes for shopping purposes in Singapore. *Transportation*, *30*(4), 435-457.

IEA (2005). *CO_2 emissions from fuel combustion*. International Energy Agency, Paris.

IEA (2013). *CO_2 emissions from fuel combustion - Highlights*. International Energy Agency, Paris.

IEA (April 2013). *Global EV Outlook – Understanding the Electric Vehicle Landscape to 2020*.

IHS (Q1 2015). *Plug-in Electric Vehicle Index Uncovers Surprising Country Leaders.* Englewood, Colorado, USA.

Innocenti, A., Lattarulo, P., & Pazienza, M. G. (2013). Car stickiness: Heuristics and biases in travel choice. *Transport Policy*, *25*, 158-168.

IPCC (2014). *Summary for policymakers*. In Climate Change 2014: Impacts, Adaptation, and Vulnerability. Part A: Global and Sectoral Aspects. Contribution of Working Group II to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change [Field, C.B., V.R. Barros, D.J. Dokken, K.J. Mach, M.D. Mastrandrea, T.E. Bilir, M. Chatterjee, K.L. Ebi, Y.O. Estrada, R.C. Genova, B. Girma, E.S. Kissel, A.N. Levy, S. MacCracken, P.R. Mastrandrea, and L.L. White (eds.)]. Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA, pp. 1-32.

Jacobsen, P. L., Racioppi, F., & Rutter, H. (2009). Who owns the roads? How motorised traffic discourages walking and bicycling. *Injury Prevention*, *15*, 369-373.

Jacques, C., Manaugh, K., & El-Geneidy, A. M. (2013). Rescuing the captive [mode] user: an alternative approach to transport market segmentation. *Transportation*, *40*(3), 625-645.

Jain, S., Aggarwal, P., Kumar, P., Singhal, S., & Sharma, P. (2014). Identifying public preferences using multi-criteria decision making for assessing the shift of urban commuters from private to public transport: A case study of Delhi. *Transportation Research Part F: Traffic Psychology and Behaviour*, *24*, 60-70.

Jarrett, J., Woodcock, J., Griffiths, U. K., Chalabi, Z., Edwards, P., Roberts, I., & Haines, A. (2012). Effect of increasing active travel in urban England and Wales on costs to the National Health Service. *The Lancet*, *379*(9832), 2198-2205.

Jaśkiewicz, M., & Besta, T. (2014). Heart and mind in public transport: Analysis of motives, satisfaction, and psychological correlates of public transportation usage in the Gdańsk-Sopot-Gdynia Tricity Agglomeration in Poland. *Transportation Research Part F*, *26*, 92-101.

Jensen, M. (1999). Passion and heart in transport – a sociological analysis on transport behaviour. *Transport Policy*, *6*, 19-33.

Johansson, M. V., Heldt, T., & Johansson, P. (2006). The effects of attitudes and personality traits on mode choice. *Transportation Research Part A: Policy and Practice*, *40*(6), 507-525.

Johansson, M., Hartig, T., & Staats, H. (2011). Psychological benefits of walking: Moderation by company and outdoor environment. *Applied Psychology: Health and well-being*, *3*(3), 261-280.

Johnson, S. C. (1967). Hierarchical clustering schemes. *Psychometrika*, *32*(3), 241-254.

Johnson, R. B., & Onwuegbuzie, A. J. (2004). Mixed methods research: A research paradigm whose time has come. *Educational Researcher*, *33*(7), 14-26.

Jones, T. (2008). *The Role of Nation Cycle Network Traffic-Free Paths in Creating a Cycling Culture.* Ph.D. Thesis Oxford Brookes University, unpublished.

Kaiser, H. F. (1958). The varimax criterion for analytic rotation in factor analysis. *Psychometrika*, *23*(3), 187-200.

Kaiser, H. F. (1960). The application of electronic computers to factor analysis. *Educational and Psychological Measurement, 20,* 141-151.

Kaiser, H. F. (1970). A second generation little jiffy. *Psychometrika*, *35*, 401-416.

Kanungo, T., Mount, D. M., Netanyahu, N. S., Piatko, C. D., Silverman, R., & Wu, A. Y. (2002). An efficient k-means clustering algorithm: Analysis and implementation. *Pattern Analysis and Machine Intelligence*, *IEEE Transactions on*, *24*(7), 881-892.

Katsoulis, M., Dimakopoulou, K., Pedeli, X., Trichopoulos, D., Gryparis, A., Trichopoulou, A., & Katsouyanni, K. (2014). Long-term exposure to traffic-related air pollution

and cardiovascular health in a Greek cohort study. *Science of The Total Environment*, *490*, 934-940.

Kaufmann, V. (2000). Modal Practices: From the rationales behind car & public transport use to coherent transport policies. Case studies in France & Switzerland Vincent Kaufmann. *Editorial board*, *6*(3), 8-17.

Kaufmann, V., Bergman, M. M., & Joye, D. (2004). Motility. Mobility as Capital. *International Journal of Urban and Regional Research 28*(4), 745–756.

Kelly, P., Kahlmeier, S., Götschi, T., Orsini, N., Richards, J., Roberts, N., Scarborough, P., & Foster, C. (2014). Systematic review and meta-analysis of reduction in all-cause mortality from walking and cycling and shape of dose response relationship. *International Journal of Behavioral Nutrition and Physical Activity*, *11:132*.

Keuleers, E., Lacey, P., Rastle, K., & Brysbaert, M. (2012). The British Lexicon Project: Lexical decision data for 28,730 monosyllabic and disyllabic English words. *Behavior Research Methods*, *44*(1), 287-304.

Kim, S., & Ulfarsson, G. F. (2004). Travel mode choice of the elderly: Effects of personal, household, neighborhood, and trip characteristics. *Transportation Research Record: Journal of the Transportation Research Board*, *1894*(1), 117-126.

Kissler, J., & Koessler, S. (2011). Emotionally positive stimuli facilitate lexical decisions – An ERP study. *Biological Psychology*, *86*, 254-264.

Klein, N. (2014). *This changes everything: capitalism vs. the climate.* New York, NY: Simon and Schuster.

Klöckner, C. A., & Matthies, E. (2004). How habits interfere with norm-directed behaviour: A normative decision making model for travel mode choice. *Journal of Environmental Psychology*, *24*(3), 319-327.

Koetse, M. J., & Rietveld, P. (2009). The impact of climate change and weather on transport: An overview of empirical findings. *Transportation Research Part D: Transport and Environment*, *14*(3), 205-221.

Kopnina, H., & Williams, M. (2012). Car attitudes in children from different socio-economic backgrounds in the Netherlands. *Transport Policy*, *24*, 118-125.

Kousta, S.-T., Vinson, D. P., & Vigliocco, G. (2009). Emotion words, regardless of polarity, have a processing advantage over neutral words. *Cognition*, *112*, 473-481.

Krizek, K. J., El-Geneidy, A. (2007). Segmenting preferences and habits of transit users and non-users. *Journal of Public Transportation*, *10*(3), 71-94.

Kroesen, M. (2013). Exploring people's viewpoints on air travel and climate change: Understanding inconsistencies. *Journal of Sustainable Tourism*, *21*(2), 271-290.

Krueger, R., Vij, A., & Rashidi, T. H. (2016). Normative beliefs and modality styles: A latent class and latent variable model of travel behaviour. *Transportation*, 1-37.

Kruglanski, A.W. (1975). The Human Subject in the Psychology Experiment: Fact and Artifact. In L. Berkowitz (Ed.), *Advances in Experimental Social Psychology, Vol*. 8*,* pp. 101-147. Academic Press, New York.

Kühne, R. (2010). Electric buses – An energy efficient urban transportation means. *Energy*, *35*, 4510-4513.

LaJeunesse, S., & Rodríguez, D. A. (2012). Mindfulness, time affluence, and journey-based affect: Exploring relationships. *Transportation Research Part F*, *15*, 196-205.

Lajunen, A. (2014). Energy consumption and cost-benefit analysis of hybrid and electric city buses. *Transportation Research Part C: Emerging Technologies*, *38*, 1-15.

Larsen, J., & El-Geneidy, A. (2011). A travel behavior analysis of urban cycling facilities in Montréal, Canada. *Transportation Research Part D: Transport and Environment*, *16*(2), 172-177.

Lawley, D. N. (1943). The application of the maximum likelihood method to factor

analysis. *British Journal of Psychology. General Section*, *33*(3), 172-175.
Lazar, C. (2012). *Cluster analysis*. Retrieved July 17, 2015, from https://ai.vub.ac.be/sites/default/files/lecturemaster2011.pdf
Lee, I. M., & Buchner, D. M. (2008). The importance of walking to public health. *Medicine and Science in Sports and Exercise*, *40* (7 Suppl), S512-8.
Leplin, J. (1984). *Scientific Realism*. London, England: University of California Press, Ltd.
Le Masurier, G. C., Sidman, C. L., & Corbin, C. B. (2003). Accumulating 10,000 steps: Does this meet current physical activity guidelines? *Research Quarterly for Exercise and Sport*, *74*(4), 389-394.
Li, Z., Wang, W., Yang, C., & Ragland, D. R. (2013). Bicycle commuting market analysis using attitudinal market segmentation approach. *Transportation Research Part A*, *47*, 56-68.
Lindenberg, S., & Steg, L. (2007). Normative, gain, and hedonic goal frames guiding environmental behaviour. *Journal of Social Issues*, *65*(1), 117-137.
Liu, Y., Hong, Z., & Liu, Y. (2016). Do driving restriction policies effectively motivate commuters to use public transportation? *Energy Policy*, *90*, 253-261.
Liu, C., Susilo, Y. O., & Karlström, A. (2015). The influence of weather characteristics variability on individual's travel mode choice in different seasons and regions in Sweden. *Transport Policy*, *41*, 147-158.
Lois, D., & López-Sáez, M. (2009). The relationship between instrumental, symbolic and affective factors as predictors of car use: A structural equation modelling approach. *Transportation Research Part A*, *43*, 790-799.
López-Sáez, M., Lois, D., & Morales, J. F. (2016). Influence on the choice of transportation mode of travel time variability, personal benefits, and environmental damage from cars versus public transportation. *Anales de Psicología/Annals of Psychology*, *32*(2), 555-564.
Lorenzoni, I., Nicholson-Cole, S., & Whitmarsch, L. (2007). Barriers perceived to engaging with climate change among the UK public and their policy implications. *Global Environmental Change*, *17*, 445-459.
Lorenzoni, I., & Pidgeon, N. F. (2006). Public views on climate change: European and USA perspectives. *Climate Change*, *77*, 73-95.
Loukopoulos, P., Jakobsson, C., Gärling, T., Schneider, C. M., & Fujii, S. (2004). Car-user responses to travel demand management measures: Goal setting and choice of adaptation alternatives. *Transportation Research Part D: Transport and Environment*, *9*(4), 263-280.
Lowe, M., Aytekin, B., & Gereffi, G. (2009). Public transit buses: A green choice gets greener. In *Manufacturing Climate Solutions*. Center on Globalization, Governance & Competitiveness, Duke University.
Lupton, D. (1996). *Food, the body and the self*. London: Sage.
Lutsey, N., & Sperling, D. (2005). Energy efficiency, fuel economy, and policy implications. *Transportation Research Record: Journal of the Transportation Research Board*, *1941*(1), 8-17.
Lyons, G., & Urry, J. (2005). Travel time use in the information age. *Transportation Research Part A: Policy and Practice*, *39*(2), 257-276.
MacCallum, R. C., Widaman, K. F., Zhang, S., & Hong, S. (1999). Sample size in factor analysis. *Psychological Methods*, *4*(1), 84-99.
Macionis, J., & Gerber, L. (2010). *Sociology* (7th edition). Don Mills: Pearson Education, Canada.
Mackett, R. L. (2001). Policies to attract drivers out of their car for short trips. *Transport Policy*, *8*, 295-306.

Mackie, D. M., & Hamilton, D. L. (1993). *Affect, cognition and stereotyping: Interactive processes in group perception*. London: Academic Press Ltd.

MacQueen, J. (1967). Some methods for classification and analysis of multivariate observations. In Lucien M. Le Cam & Jerzy Neyman (Eds.), *Proceedings of the fifth Berkeley symposium on mathematical statistics and probability, 1*(14), 281-297. Oakland: University of California Press.

Mann, E., & Abraham, C. (2006). The role of affect in UK commuters' travel mode choices: An interpretative phenomenological analysis. *British Journal of Psychology*, *97*, 155-176.

Manolas, E. (2016). The Paris climate change agreement. *International Journal of Environmental Studies*, *73*(2), 167-169.

Marchetti, C. (1994). Anthropological Invariants in Travel Behaviour. *Technical Forecasting and Social Change, 47*(1), 75-78.

Marmot, M., on behalf of the Commission on Social Determinants of Health (2007). Achieving health equity: from root causes to fair outcomes. *The Lancet*, *370*(9593), 1153-1163.

Marsden, G., Mullen, C., Bache, I., Bartle, I., & Flinders, M. (2014). Carbon reduction and travel behaviour: Discourses, disputes and contradictions in governance. *Transport Policy*, *35*, 71-78.

Marsden, G., & Rye, T. (2010). The governance of transport and climate change*. Journal of Transport Geography*, *18*, 669-678.

Marsh, P., & Morris, D. (1988). *Tribes*. London: Pyramid.

Martens, K. (2007). Promoting bike-and-ride: The Dutch experience. *Transportation Research Part A*, *41*, 326-338.

Martin, A., Goryakin, Y., & Suhrcke, M. (2014). Does active commuting improve psychological wellbeing? Longitudinal evidence from eighteen waves of the British Household Panel Survey. *Preventive Medicine*, *69*, 296-303.

Maxwell, J. A. (2012). *A Realist Approach for Qualitative Research*. SAGE Publications, Inc.

McCarthy, J. J. (2001). *Climate change 2001: Impacts, adaptation, and vulnerability: Contribution of Working Group II to the third assessment report of the Intergovernmental Panel on Climate Change*. Cambridge University Press.

Metz, D. (2013). Peak car and beyond: The fourth era of travel. *Transport Reviews*, *33*(3), 255-270.

Meyer, D.E., & Schvaneveldt, R.W. (1971). Facilitation in recognizing pairs of words: Evidence of a dependence between retrieval operations. *Journal of Experimental Psychology, 90*, 227–234.

Mierke, J., & Klauer, K. C. (2003). Method-specific variance in the Implicit Association Test. *Journal of Personality and Social Psychology*, *85*(6), 1180-1192.

Milligan, G. W. (1980). An examination of the effect of six types of error perturbation on fifteen clustering algorithms. *Psychometrika*, *45*(3), 325-342.

Monzon, A., Vega, L. A., & Lopez-Lambas, M. E. (2011). Potential to attract drivers out of their cars in dense urban areas. *European Transport Research Review*, *3*, 129-137.

Morgan, D. L. (1998). Practical strategies for combining qualitative and quantitative methods: Applications to health research. *Qualitative Health Research*, *8*(3), 362-376.

Morgan, D. L. (2007). Paradigms lost and pragmatism regained – Methodological implications of combining qualitative and quantitative methods. *Journal of Mixed Methods Research*, *1*(1), 48-76.

Möser, G., & Bamberg, S. (2008). The effectiveness of soft transport policy measures: A critical analysis and meta-analysis of empirical evidence. *Journal of Environmental*

Psychology, *28*, 10-26.
Murtagh, N., Gatersleben, B., & Uzzell, D. (2012). Multiple identities and travel mode choice for regular journeys. *Transportation Research Part F*, *15*, 514-524.
Næss, P. (2015). Built environment, causality and travel. *Transport reviews*, *35*(3), 275-291.
Narla, S. R. (2013). The evolution of connected vehicle technology: From smart drivers to smart cars to… self-driving cars. *ITE Journal*, *83*(7), 22-26.
Newman, P., & Kenworthy, J. (2011). Peak Car Use: Understanding the Demise of Automobile Dependence. *World Transport Policy & Practice*, *17*(2), 31-42.
Newman, P., Kenworthy, J., & Glazebrook, G. (2013). Peak car use and the rise of global rail: Why this is happening and what it means for large and small cities. *Journal of Transportation Technologies*, *3(*4*),* 272-287.
Nilsson, A., Von Borgstede, C., & Biel, A. (2004). Willingness to accept climate change strategies: The effect of values and norms. *Journal of Environmental Psychology*, *24*(3), 267-277.
Nordlund, A. M., & Garvill, J. (2003). Effects of values, problem awareness, and personal norm on willingness to reduce personal car use. *Journal of Environmental Psychology*, *23*(4), 339-347.
Norušis, M. J. (2011). *IBM SPSS Statistics 19 Statistical Procedures Companion*. Upper Saddle River, NJ: Prentice Hall.
Nosek, B. A., & Smyth, F. L. (2007). A multitrait-multimethod validation of the Implicit Association Test: Implicit and explicit attitudes are related but distinct constructs. *Experimental Psychology*, *54*(1), 14-29.
Nowell, L. S., Norris, J. M., White, D. E., & Moules, N. J. (2017). Thematic Analysis: Striving to Meet the Trustworthiness Criteria. *International Journal of Qualitative Methods*, *16*(1). DOI 10.1177/1609406917733847.
Nykvist, B., & Nilsson, M. (2015). Rapidly falling costs of battery packs for electric vehicles. *Nature Climate Change*, *5*(4), 329-332.
Office for Low Emission Vehicles (OLEV, 2015). *Low Emission Bus Scheme.* London: Department for Transport.
Office for National Statistics (2011). *2011 Census: Key Statistics for England and Wales.* Accessed December 18, 2014, at http://www.ons.gov.uk/ons/rel/census/2011-census/key-statistics-for-local-authorities-in-england-and-wales/stb-2011-census-key-statistics-for-england-and-wales.html#tab-Key-points
Office for National Statistics (2013). *Table K1-1, Young Age Structure Variant – UK Summary, 2012-based*. Accessed April 22, 2015, at http://www.ons.gov.uk/ons/taxonomy/index.html?nscl=National+Population+Projections#tab-data-tables
Ogilvie, D., Bull, F., Cooper, A., Rutter, H., Adams, E., Brand, C., ... & Preston, J. (2012). Evaluating the travel, physical activity and carbon impacts of a 'natural experiment' in the provision of new walking and cycling infrastructure: methods for the core module of the iConnect study. *BMJ open*, *2*(1), e000694.
Ogilvie, D., Egan, M., Hamilton, V., & Petticrew, M. (2004). Promoting walking and cycling as an alternative to using cars: systematic review. *BMJ*, *329*, 763-766.
Ogilvie, D., Foster, C. E., Rothnie, H., Cavill, N., Hamilton, V., Fitzsimons, C. F., & Mutrie, N. (2007). Interventions to promote walking: systematic review. *BMJ*, DOI: 10.1136/bmj.39198.722720.BE
Oja, P., Vuori, I., & Paronen, O. (1998). Daily walking and cycling to work: their utility as health‐enhancing physical activity. *Patient education and counselling*, *33*, 87-94.
Olsson, L. E., Gärling, T., Ettema, D., Friman, M., & Fujii, S. (2013). Happiness and satisfaction with work commute. *Social Indicators Research*, *111*(1), 255-263.

Orr, J. C., Fabry, V. J., Aumont, O., Bopp, L., Doney, S. C., Feely, R. A., ... & Yool, A. (2005). Anthropogenic ocean acidification over the twenty-first century and its impact on calcifying organisms. *Nature*, *437*(7059), 681-686.

d'Ovidio, F. D., Leogrande, D., Mancarella, R., Schinzano, A., & Viola, D. (2014). A multivariate analysis of the quality of public transport services. *Procedia Economics and Finance*, *17*, 238-247.

Panter, J., Griffin, S., Jones, A., Mackett, R., & Ogilvie, D. (2011). Correlates of time spent walking and cycling to and from work: baseline results from the commuting and health in Cambridge study. *International Journal of Behavioral Nutrition and Physical Activity*, *8*(1), 124.

Páez, A., & Whalen, K. (2010). Enjoyment of commute: A comparison of different transportation modes. *Transportation Research Part A: Policy and Practice*, *44*(7), 537-549.

Papoulis, D., Kaika, D., Bampatsou, C., & Zervas, E. (2015). Public Perception of Climate Change in a Period of Economic Crisis. *Climate*, *3*(3), 715-726.

Parkin, J., Wardman, M., & Page, M. (2007). Models of perceived cycling risk and route acceptability. *Accident Analysis & Prevention*, *39*(2), 364-371.

Parkin, J., Wardman, M., & Page, M. (2008). Estimation of the determinants of bicycle mode share for the journey to work using census data. *Transportation*, *35*(1), 93-109.

Pearce, D., Barbier, E., & Markandya, A. (1990*). Sustainable Development: Economics and Environment in the Third World.* London: Earthscan Ltd.

Peattie, K., & Peattie, S. (2009). Social marketing: A pathway to consumption reduction? *Journal of Business Research*, *62*(2), 260-268.

Peek, L., & Fothergill, A. (2009). Using focus groups: Lessons from studying Daycare Centers, 9/11, and Hurricane Katrina. *Qualitative Research*, *9*, 31-59.

Peirce, J. W. (2007). PsychoPy—Psychophysics software in Python. *Journal of Neuroscience Methods*, *162*(1), 8-13.

Peirce, J. W. (2009). Generating stimuli for neuroscience using PsychoPy. *Frontiers in Neuroinformatics*, *2*(10). DOI 10.3389/neuro.11.010.2008

Peirson, J., & Vickerman, R. (2008). The London congestion charging scheme: The evidence. In C. Jensen-Butler, B. Sloth, M. M. Larsen, B. Madsen & O. A. Nielsen (Eds.), *Road Pricing, the Economy and the Environment* (pp. 79-91). Berlin, Heidelberg: Springer.

Perea, M., & Gotor, A. (1997). Associative and semantic priming effects occur at very short stimulus-onset asynchronies in lexical decision and naming. *Cognition*, *62*(2), 223-240.

Perea, M., & Rosa, E. (2002). The effects of associative and semantic priming in the lexical decision task. *Psychological Research*, *66*(3), 180-194.

Perugini, M. (2005). Predictive models of implicit and explicit attitudes. *British Journal of Social Psychology*, *44*(1), 29-45.

Peterson, R.A. (2001). On the Use of College Students in Social Science Research: Insights from a Second-Order Meta-Analysis. *Journal of Consumer Research, 28,* 450-461.

Petty, R. E., & Briñol, P. (2010). Attitude change. In R. F. Baumeister & E. J. Finkel (Eds.), *Advanced Social Psychology: The State of the Science* (pp. 217-259). Oxford, UK: Oxford University Press.

Pizzato, G., Guimarães, L., & Ten Caten, C. (2012). The perception of pleasantness in a product of collective use: The bus shelter. *Work*, *41*, 282-289.

Pooley, C. G., Horton, D., Scheldeman, G., Tight, M., Jones, T., Chisholm, A., ... & Jopson,

A. (2011). Household decision-making for everyday travel: a case study of walking and cycling in Lancaster (UK). *Journal of Transport Geography*, *19*(6), 1601-1607.

Pooley, C. G., Horton, D., Scheldeman, G., Mullen, C., Jones, T., Tight, M., ... & Chisholm, A. (2013). Policies for promoting walking and cycling in England: a view from the street. *Transport Policy*, *27*, 66-72.

Pothitou, M., Kolios, A. J., Varga, L., & Gu, S. (2016). A framework for targeting household energy savings through habitual behavioural change. *International Journal of Sustainable Energy*, *35*(7), 686-700.

Potter, J. (1997). Discourse analysis as a way of analysing naturally occurring talk. In D. Silverman (ed.), *Qualitative Research: Theory, Method and Practice* (pp. 140-160). London: Sage.

Potter, S. (2003). Transport energy and emissions: Urban public transport. In D. A. Hensher, & K. J. Button (Eds.), *Handbook of Transport and the Environment* (pp. 247-262). *Handbooks in Transport (Volume 4)*. Amsterdam, Netherlands: Elsevier.

Poullikkas, A. (2015). Sustainable options for electric vehicle technologies. *Renewable and Sustainable Energy Reviews*, *41*, 1277-1287.

Pratt, R. H. (1970). A utilitarian theory of travel mode choice. Paper sponsored by Committee on Origin and Destination and presented at the 49th Annual Meeting. *Highway Research Record*, 322, 40-53.

Prestwich, A., Perugini, M., & Hurling, R. (2008). Goal desires moderate intention-behaviour relations. *British Journal of Social Psychology*, *47*(1), 49-71.

Pretty, J., Peacock, J., Hine, R., Sellens, M., South, N., & Griffin, M. (2007). Green exercise in the UK countryside: Effects on health and psychological well-being, and implications for policy and planning. *Journal of Environmental Planning and Management*, *50*(2), 211-231.

Prillwitz, J., & Barr, S. (2011). Moving towards sustainability? *Mobility types, attitudes and individual travel behaviour. Journal of Transport Geography*, *19*, 1590-1600.

Prillwitz, J., Harms, S., & Lanzendorf, M. (2006). Impact of life-course events on car ownership. *Transportation Research Record: Journal of the Transportation Research Board*, *1985*(1), 71-77.

Prillwitz, J., Harms, S., & Lanzendorf, M. (2007). Interactions between residential relocations, life course events, and daily commute distances. *Transportation Research Record: Journal of the Transportation Research Board*, *2021*(1), 64-69.

Pronello, C., & Camusso, C. (2011). Travellers' profiles definition using multivariate statistical analysis of attitudinal variables. *Journal of Transport Geography*, *19*, 1294-1308.

Pronello, C., & Rappazzo, V. (2010). The modal diversion induced by high quality public transport: Use of attitudinal variables for travellers' segmentation. *Proceedings of the 12th WCTR, Lisbon, Portugal*.

Public Health England (May 2015). *Health effects of air pollution*. PHE Board Paper. Retrieved December 8, 2015, from https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/445448/PHE15-16_Air_pollution.pdf

Pucher, J., & Buehler, R. (2008). Making Cycling Irresistible: Lessons from The Netherlands, Denmark and Germany. *Transport Reviews: A Transnational Transdisciplinary Journal*, *28*(4), 495-528.

Pucher, J., Buehler, R., Bassett, D. R., & Dannenberg, A. L. (2010). Walking and cycling to health: A comparative analysis of city, state, and international data. *American Journal of Public Health*, *100*(10), 1986-1992.

Pucher, J., & Dijkstra, L. (2003). Promoting safe walking and cycling to improve public

health: Lessons from the Netherlands and Germany. *American Journal of Public Health*, *93*(9), 1509-1516.

Pucher, J., Dill, J., & Handy, S. (2010). Infrastructure, programs, and policies to increase bicycling: An international review. *Preventive Medicine*, *50*, 106-125.

Punj, G., & Stewart, D. W. (1983). Cluster analysis in marketing research: Review and suggestions for application. *Journal of Marketing Research*, *20*(2), 134-148.

Qualtrics (2014). *The World's Leading Enterprise Survey Platform*. Utah, US: Qualtrics.

Quarmby, D. A. (1967). Choice of travel mode for the journey to work: some findings. *Journal of Transport Economics and Policy*, *1*(3), 273-314.

RAC Foundation (2012). *Spaced out: Perspectives on parking policy*. Parking fact sheet. Retrieved November 12, 2016, from http://www.racfoundation.org/assets/rac_foundation/content/downloadables/parking_fact_sheet.pdf

Rail Executive (2015). *Rail trends factsheet: 2014 to 2015*. Retrieved July 25, 2017, from https://www.gov.uk/government/statistics/rail-factsheets-2015

Redman, L., Friman, M., Gärling, T., & Hartig, T. (2013). Quality attributes of public transport that attract car users: A research review. *Transport Policy*, *25*, 119-127.

Reis, R. S., Hino, A. A., Parra, D. C., Hallal, P. C., & Brownson, R. C. (2013). Bicycling and walking for transportation in three Brazilian cities. *American Journal of Preventive Medicine*, *44*(2), e9-e17.

Riessman, C. K. (1993). *Narrative Analysis*. Newbury Park, CA: Sage.

Rissel, C. E. (2009). Active travel: a climate change mitigation strategy with co-benefits for health. *New South Wales public health bulletin*, *20*(2), 10-13.

Rissel, C. E., Bonfiglioli, C., Emilsen, A., & Smith, B. J. (2010). Representations of cycling in metropolitan newspapers – changes over time and differences between Sydney and Melbourne, Australia. *BMC Public Health*, *10:371*. Retrieved January 27, 2014, from http://www.biomedcentral.com/1471-2458/10/371

Roberts, I., & Coggan, C. (1994). Blaming children for pedestrian injuries. *Social Science and Medicine*, *38*(5), 749-753.

Rodríguez, D. A., & Joo, J. (2004). The relationship between non-motorized mode choice and the local physical environment. *Transportation Research Part D: Transport and Environment*, *9*(2), 151-173.

Rogelj, J., Den Elzen, M., Höhne, N., Fransen, T., Fekete, H., Winkler, H., ... & Meinshausen, M. (2016). Paris Agreement climate proposals need a boost to keep warming well below 2 °C. *Nature*, *534*(7609), 631-639.

Rose, G. (2008). Encouraging sustainable campus travel: Self-reported impacts of a University Travel Smart Initiative. *Journal of Public Transportation*, *11*(1), 85-108.

Rosli, N. S., Adnan, S., Alyia, S. A., Ismail, F. D., Hamsa, K., & Azeez, A. (2012). *A theoretical review on sustainable transportation strategies: The role of park and ride facility as a generator of public transport mode shift*. Presented at 23rd EAROPH World Congress.

Rubens, L., Gosling, P., & Moch, A. (2011). Investigating justifications concerning transport mode choice in order to promote public transport. *Pratiques psychologiques*, *17*, 19-29.

Rudman, L. A., Greenwald, A. G., Mellott, D. S., & Schwartz, J. L. (1999). Measuring the automatic components of prejudice: Flexibility and generality of the Implicit Association Test. *Social Cognition*, *17*(4), 437-465.

Russell, J. A. (1980). A circumplex model of affect. *Journal of Personality and Social Psychology*, *39*, 1161–1178.

Ryan, G. W., & Bernard, H. R. (2003). Techniques to identify themes. *Field Methods*, *15*(1), 85-109.

Ryan, R. M., & Deci, E. L. (2000). Self-determination theory and the facilitation of intrinsic motivation, social development, and well-being. *American Psychologist*, *55*(1), 68-78.

Saelens, B. E., Sallis, J. F., & Frank, L. D. (2003). Environmental correlates of walking and cycling: Findings from the transportation, urban design, and planning literatures. *Annals of Behavioral Medicine*, *25*(2), 80-91.

Sager, T. (2006). Freedom as mobility: Implications of the distinction between actual and potential travelling. *Mobilities*, *1*(3), 465-488.

Sakamoto, K., Abhayantha, C., & Kubota, H. (2007). Effectiveness of bus priority lane as countermeasure for congestion. *Transportation Research Record: Journal of the Transportation Research Board*, *2034*, 103-111.

Sale, J. E., Lohfeld, L. H., & Brazil, K. (2002). Revisiting the quantitative-qualitative debate: Implications for mixed-methods research. *Quality and Quantity*, *36*(1), 43-53.

Saneinejad, S., Roorda, M. J., & Kennedy, C. (2012). Modelling the impact of weather conditions on active transportation travel behaviour. *Transportation Research Part D: Transport and Environment*, *17*(2), 129-137.

Sarlioglu, B., Morris, C. T., Han, D., & Li, S. (2017). Driving Toward Accessibility: A Review of Technological Improvements for Electric Machines, Power Electronics, and Batteries for Electric and Hybrid Vehicles. *IEEE Industry Applications Magazine*, *23*(1), 14-25.

Scheiner, J., & Holz-Rau, C. (2007). Travel mode choice: affected by objective or subjective determinants? *Transportation*, *34*(4), 487-511.

Schmitt, L., Currie, G., & Delbosc, A. (2013). Measuring the impact of unfamiliar travel using a university access survey. *Transport Policy*, *30*, 301-307.

Schmöcker, J. D., Quddus, M. A., Noland, R. B., & Bell, M. G. (2008). Mode choice of older and disabled people: a case study of shopping trips in London. *Journal of Transport Geography*, *16*(4), 257-267.

Schneider, R. J. (2013). Theory of routine mode choice decisions: An operational framework to increase sustainable transportation. *Transport Policy*, *25*, 128-137.

Schuitema, G., Anable, J., Skippon, S., & Kinnear, N. (2013). The role of instrumental, hedonic and symbolic attributes in the intention to adopt electric vehicles. *Transportation Research Part A: Policy and Practice*, *48*, 39-49.

Schultz, P. W. (1999). Changing behavior with normative feedback interventions: A field experiment on curbside recycling. *Basic and Applied Social Psychology*, *21*(1), 25-36.

Schultz, P. W., Nolan, J. M., Cialdini, R. B., Goldstein, N. J., & Griskevicius, V. (2007). The constructive, destructive, and reconstructive power of social norms. *Psychological Science*, *18*(5), 429-434.

Schultz, P. W., & Zelezny, L. C. (1998). Values and Pro-environmental Behavior: A Five-Country Survey. *Journal of Cross-cultural psychology*, *29*(4), 540-558.

Schultz, P. W., & Zelezny, L. (1999). Values as predictors of environmental attitudes: Evidence for consistency across 14 countries. *Journal of Environmental Psychology*, *19*(3), 255-265.

Schwandt, T. A. (1997). *Qualitative inquiry: A dictionary of terms*. SAGE Publications, Inc.

Schwartz, S. H. (1977). Normative influences on altruism. *Advances in Experimental Social Psychology*, *10*, 221-279.

Schwartz, S. H., (1992). Universals in the content and structure of values: Theoretical advances and empirical tests in 20 countries. In M. Zanna (Ed.), *Advances in Experimental Social Psychology* (pp. 1-65). Orlando, FL: Academic Press.

Schwartz, S. H. (1994). Are there universal aspects in the structure and contents of human values? *Journal of Social Issues*, *50*, 19-45.

Schwartz, S. H., & Howard, J. A. (1981). A normative decision-making model of altruism. In J. P. Rushton (Ed.) *Altruism and helping behavior: Social, personality and developmental perspectives* (pp. 189-211). Hillsdale, NJ: Erlbaum.

Schweickart, D. (2009). Is sustainable capitalism an oxymoron? In J. Harris (Ed.), *The Nation in the Global Era* (pp. 449-470). Brill.

Scott, G. G., O'Donnell, P. J., & Sereno, S. C. (2014). Emotion words and categories: Evidence from lexical decision. *Cognitive Processing*, *15*(2), 209-215.

Seidell, J. C. (2000). Obesity, insulin resistance and diabetes – A worldwide epidemic. *British Journal of Nutrition*, *83*, Suppl. 1, S5-S8.

Semenza, J. C., Hall, D. E., Wilson, D. J., Bontempo, B.D., Sailor, D. J., George, L. A. (2008). Public Perception of Climate Change: Voluntary Mitigation and Barriers to Behavior Change. *American Journal of Preventive Medicine*, *35*(5), 479-487.

Shannon, T., Giles-Corti, B., Pikora, T., Bulsara, M., Shilton, T. & Bull, F. (2006). Active commuting in a university setting: Assessing commuting habits and potential for modal change. *Transport Policy*, *13*, 240-253.

Shaw, C. B., & Gallent, N. (1999). Sustainable Commuting: A contradiction in terms? *Regional Studies*, *33*(3), 274-280.

Shergold, I., Lyons, G., & Hubers, C. (2015). Future mobility in an ageing society – Where are we heading? *Journal of Transport & Health*, *2*(1), 86-94.

Shove, E. (2010). Beyond the ABC: climate change policy and theories of social change. *Environment and Planning A*, *42*(6), 1273-1285.

Sierzchula, W., Bakker, S., Maat, K., & van Wee, B. (2014). The influence of financial incentives and other socio-economic factors on electric vehicle adoption. *Energy Policy*, *68*, 183-194.

Sloman, L., Cavill, N., Cope, A., Muller, L., & Kennedy, A. (2009). Analysis and synthesis of evidence on the effects of investment in six Cycling Demonstration Towns. Retrieved October 16, 2016, from http://www.transportforqualityoflife.com/u/files/AnalysisandSynthesisNov2009.pdf

Simmons, R. A., Shaver, G. M., Tyner, W. E., & Garimella, S. V. (2015). A benefit-cost assessment of new vehicle technologies and fuel economy in the US market. *Applied Energy*, *157*, 940-952.

Smith, J. A., Flowers, P. & Larkin, M. (2009). *Interpretative phenomenological analysis: Theory, method and research*. London: Sage.

Smith, J.A., Jarman, M. and Osborn, M. (1999). Doing Interpretative Phenomenological Analysis. In M. Murray and K. Chamberlain (Eds.), *Qualitative Health Psychology: Theories and methods* (pp. 218-240). London: Sage.

Smith, J. A., & Osborn, M. (2003). Interpretative Phenomenological Analysis. In J. A. Smith (Ed.), *Qualitative Psychology: A practical guide to research methods* (pp. 51-80). London: Sage.

Sokal, R. R., & Michener, C. D. (1958). A statistical method for evaluating systematic relationships. *University of Kansas Science Bulletin*, *38*, 1409-38.

Solomon, S., Plattner, G.-K., Knutti, R., & Friedlingstein, P. (2009). Irreversible climate change due to carbon dioxide emissions. *Proceedings of the National Academy of Sciences of the United States of America*, *106*(6), 1704-1709.

Sperling, D., Delucchi, M. A., Davis, P. M., & Burke, A. F. (1995). *Future drive: Electric vehicles and sustainable transportation*. Washington, DC: Island Press.

Sperling, D., & Gordon, D. (2009). *Two billion cars: driving toward sustainability*. Oxford University Press.

Spieser, K., Treleaven, K., Zhang, R., Frazzoli, E., Morton, D., & Pavone, M. (2014). Toward a systematic approach to the design and evaluation of automated mobility-on-demand systems: A case study in Singapore. In *Road Vehicle Automation* (pp. 229-245). Springer International Publishing.

Stanley, J. K., Hensher, D. A., & Loader, C. (2011). Road transport and climate change: Stepping off the greenhouse gas. *Transportation Research Part A*, *45*, 1020-1030.

Starrs, M., & Perrins, C. (1989). The markets for public transport: the poor and the transport disadvantaged. *Transport Reviews*, *9*(1), 59-74.

Statista (2015). *Average distance travelled by bus per journey in Great Britain (UK) in 2012 By region*. Retrieved December 17, 2015, from http://www.statista.com/statistics/301038/average-bus-trip-distance-by-region-uk/

Steg, L. (2003). Can public transport compete with the private car? *IATSS Research*, *27*(2), 27-35.

Steg, L. (2005). Car use: lust and must. Instrumental, symbolic and affective motives for car use. *Transportation Research Part A*, *39*, 147-162.

Steg, L. (2007). Sustainable Transportation: A Psychological Perspective. *IATSS Research*, *31*(2), 58-66.

Steg, L. (2015). Environmental Psychology and Sustainable Consumption. In L. A. Reisch and J. Thøgersen (Eds.), *Handbook of Research in Sustainable Consumption* (pp. 70-83).

Steg, L., Bolderdijk, J. W., Keizer, K., & Perlaviciute, G. (2014). An integrated framework for encouraging pro-environmental behaviour: The role of values, situational factors and goals. *Journal of Environmental Psychology*, *38*, 104-115.

Steg, L., & De Groot, J. I. M. (2012). Environmental values. In S. Clayton (Ed.), *The Oxford Handbook of Environmental and Conservation Psychology* (pp. 81-92). New York: Oxford University Press.

Steg, L., Lindenberg, S., & Keizer, K. (2016). Intrinsic Motivation, Norms and Environmental Behaviour: The Dynamics of Overarching Goals. *International Review of Environmental and Resource Economics*, *9*(1-2), 179-207.

Steg, L., Perlaviciute, G., Van der Werff, E., & Lurvink, J. (2014). The significance of hedonic values for environmentally relevant attitudes, preferences, and actions. *Environment and Behavior*, *46*(2), 163-192.

Steg, L., Van den Berg, A. E., & de Groot, J. I. M. (2013). *Environmental Psychology: An introduction*. Sussex: John Wiley & Sons, Ltd.

Steg, L., & Vlek, C., (2009). Encouraging pro-environmental behaviour: An integrative review and research agenda. *Journal of Environmental Psychology*, *29*, 309-317.

Steg, L., Vlek, C., & Slotegraaf, G. (2001). Instrumental-reasoned and symbolic-affective motives for using a motor car. *Transportation Research Part F: Traffic Psychology and Behaviour*, *4*(3), 151-169.

Stevens, J. P. (2009). *Applied Multivariate Statistics for the Social Sciences* (5th edition). New York: Routledge, Taylor & Francis Group.

Stewart, D. W., Shamdasani, P. N., & Rook, D. W. (2007). *Focus groups: Theory and practice* (2nd ed.). Thousand Oaks, CA: SAGE.

St-Louis, E., Manaugh, K., Van Lierop, D., & El-Geneidy, A. (2014). The happy commuter: A comparison of commuter satisfaction across modes. *Transportation Research Part F: Traffic Psychology and Behaviour*, *26*, 160-170.

Stokes, G., & Hallett, S. (1992). The role of advertising and the car. *Transport Reviews*, *12*(2), 171-183.

Stopher, P. R. (1968). Predicting travel mode choice for the work journey. *Traffic Engineering & Control, 9,* 436-439.

Stradling, S. G. (2002). Transport user needs and marketing public transport. *Municipal Engineer ISI*, *March 2002*, *Issue 1*, 23-28.

Stradling, S. G. (2011). Travel Mode Choice. In B. E. Porter (Ed.), *Handbook of Traffic Psychology* (pp. 485-502). London, England: Academic Press.

Stradling, S. G., Carreno, M., Rye, T., & Noble, A. (2007). Passenger perceptions and the Ideal urban bus journey experience. *Transport Policy*, *14*, 283-292.

Stradling, S. G., Noble, A., Carreno, M., Jeffrey, G., & Marshall, I. (2004). Eight reasons people don't like buses. Paper presented at ICTTP 2004.

Tan, R., Raveau, S., Lee, D. H., & Ben-Akiva, M. E. (2016). A Public Transport Route Choice Model with Multimodal Access and Egress: Application to the Large-Scale Network of Singapore. In *Transportation Research Board 95th Annual Meeting* (No. 16-3110).

Taniguchi, A., & Fujii, S. (2007). Process model of voluntary travel behavior modification and effects of travel feedback programs. *Transportation Research Record: Journal of the Transportation Research Board*, *2010*(1), 45-52. DOI: 10.3141/2010-06

Tarigan, A. K. M., Susilo, Y. O., & Joewono, T. B. (2014). Segmentation of paratransit users based on service quality and travel behavior in Bandung, Indonesia. *Transportation Planning and Technology*, *37*(2), 200-218.

Tertoolen, G., van Kreveld, D., & Verstraten, B. (1998). Psychological resistance against attempts to reduce private car use. *Transportation Research Part A*, *32*(3), 171-181.

Thøgersen, J. (2006). Understanding repetitive travel mode choices in a stable context: A panel study approach. *Transportation Research Part A: Policy and Practice*, *40*(8), 621-638.

Thomas, G. O., & Walker, I. (2015). Users of different travel modes differ in journey satisfaction and habit strength but not environmental worldviews: A large-scale survey of drivers, walkers, bicyclists and bus users commuting to a UK university. *Transportation Research Part F: Traffic Psychology and Behaviour*, *34*, 86-93.

Thomas, G. O., & Walker, I. (2016). The development and validation of an implicit measure based on biospheric values. *Environment and Behavior*, *48*(5), 659-685.

Thomas, G. O., Walker, I., & Musselwhite, C. (2014). Grounded Theory analysis of commuters discussing a workplace carbon-reduction target: Autonomy, satisfaction, and willingness to change behavior in drivers, pedestrians, bicyclists, motorcyclists, and bus users. *Transportation Research Part F*, *26*, 72-81.

Thorne, R., Filmer-Sankey, W., & Alexander, A. (2013). Transportation. In T. Randall & M. Fordham (Eds.), *Sustainable Urban Design* (pp. 25-32). Abingdon, Oxon: Taylor & Francis.

Tight, M. R., Bristow, A. L., Pridmore, A., & May, A. D. (2005). What is a sustainable level of CO_2 emissions from transport activity in the UK in 2050? *Transport Policy*, *12*, 235-244.

Tolley, R. (2008). Walking and cycling: easy wins for a sustainable transport policy. In I. Docherty & J. Shaw (Eds.), *Traffic Jam: Ten Years of 'Sustainable' Transport in the UK* (pp. 117-137). Bristol: The Policy Press.

Transport for London (2006, 2008). *Central London Congestion Charging – Impacts monitoring*. Fourth (Sixth) Annual Report for the Mayor of London. TfL: London.

Triandis, H. C. (1977). *Interpersonal behavior*. Monterey, CA: Brooks/Cole Publishing Company.

Triandis, H. C. (1979). *Values, attitudes, and interpersonal behavior*. In Nebraska symposium on Motivation, University of Nebraska Press.

Tucker, L. R., & Lewis, C. (1973). A reliability coefficient for maximum likelihood factor

analysis. *Psychometrika*, *38*(1), 1-10.
Tudor-Locke, C., Hatano, Y., Pangrazi, R. P., & Kang, M. (2008). Revisiting "How many steps are enough?". *Medicine & Science In Sports & Exercise*, *40*, S537-S543.
United Nations Environment Programme (UNEP, 2008). *Twelve steps to help you kick the CO2 habit*. Accessed on July 7, 2015, at http://www.unep.org/wed/2008/english/Information_Material/factsheet.asp
United Nations Framework Convention on Climate Change (1997). *Kyoto Protocol.* Retrieved November 8, 2016, from http://unfccc.int/kyoto_protocol/items/2830.php
United Nations Framework Convention on Climate Change (2016). *The Paris Agreement.* Retrieved November 8, 2016, from http://unfccc.int/paris_agreement/items/9485.php
University of Bath Carbon Management Plan (March 2011). Available at http://www.bath.ac.uk/estates/docs/University_of_Bath_HECM6_Carbon_Management_Plan.pdf
University of Bath Travel Survey (UTS) 2014/15 (February 2015). Available at http://www.bath.ac.uk/estates/docs/University_2014_15_Travel_Survey_Report.pdf
Van der Werff, E., Steg, L., & Keizer, K. (2013). It is a moral issue: The relationship between environmental self-identity, obligation-based intrinsic motivation and pro-environmental behaviour. *Global Environmental Change*, *23*(5), 1258-1265.
Van Exel, J., & Rietveld, P. (2010). Perceptions of public transport travel time and their effect on choice-sets among car drivers. *Journal of Transport and Land Use*, *2*(3-4), 75-86.
Van Heuven, W. J., Mandera, P., Keuleers, E., & Brysbaert, M. (2014). SUBTLEX-UK: A new and improved word frequency database for British English. *The Quarterly Journal of Experimental Psychology*, *67*(6), 1176-1190.
Van Mierlo, J., Maggetto, G., & Lataire, P. (2006). Which energy source for road transport in the future? A comparison of battery, hybrid and fuel cell vehicles. *Energy Conversion and Management*, *47*(17), 2748-2760.
Varo, J. J., Martínez-González, M. A., de Irala-Estévez, J., Kearney, J., Gibney, M., & Martínez, J. A. (2003). Distribution and determinants of sedentary lifestyles in the European Union. *International Journal of Epidemiology*, *32*, 138-146.
Vasconcellos, E. A. (2014). *Urban Transport Environment and Equity: The case for developing countries*. Routledge.
Verplanken, B., & Aarts, H. (1999). Habit, attitude, and planned behaviour: Is habit an empty construct or an interesting case of goal-directed automaticity? *European Review of Social Psychology*, *10*(1), 101-134.
Verplanken, B., Aarts, H. & Knippenberg, A. (1997). Habit, information acquisition, and the process of making travel mode choices. *European Journal of Social Psychology*, *27*, 539-560.
Verplanken, B., Aarts, H., Knippenberg, A., & Knippenberg, C. (1994). Attitude Versus General Habit: Antecedents of Travel Mode Choice. *Journal of Applied Social Psychology*, *24*(4), 285-300.
Verplanken, B., Aarts, H., Knippenberg, A., & Moonen, A. (1998). Habit versus planned behaviour: A field experiment. *British Journal of Social Psychology*, *37*(1), 111-128.
Verplanken, B., & Orbell, S. (2003). Reflections on Past Behavior: A Self-Report Index of Habit Strength. *Journal of Applied Social Psychology*, *33*(6), 1313-1330.
Verplanken, B., & Roy, D. (2016). Empowering interventions to promote sustainable lifestyles: Testing the habit discontinuity hypothesis in a field experiment. *Journal*

of Environmental Psychology, *45*, 127-134.
Verplanken, B., Walker, I., Davis, A., & Jurasek, M. (2008). Context change and travel mode choice: Combining the habit discontinuity and self-activation hypotheses. *Journal of Environmental Psychology*, *28*, 121-127.
Vigar, G. (2013). *The politics of mobility: Transport planning, the environment and public policy*. Routledge.
Vörösmarty, C. J., Green, P., Salisbury, J., & Lammers, R. B. (2000). Global Water Resources: Vulnerability from Climate Change and Population Growth. *Science*, *289*(5477), 284-288.
Walker, H. (2014). *Conservatives Are Purposely Making Their Cars Spew Black Smoke To Protest Obama And Environmentalists*. Retrieved August 15, 2016, from http://www.businessinsider.com/conservatives-purposely-making-cars-spew-black-smoke-2014-7?IR=T
Walker, I., Thomas, G. O., & Verplanken, B. (2015). Old habits die hard: Travel habit formation and decay during an office relocation. *Environment & Behaviour*, *47*(10), 1089-1106.
Wallis, M., & Wallis, S. F. (2015). *The Art of Cars*. San Francisco, CA: Chronicle Books.
Wang, L., Xu, J., & Qin, P. (2014). Will a driving restriction policy reduce car trips? The case study of Beijing, China. *Transportation Research Part A: Policy and Practice*, *67*, 279-290.
Ward, J. (1963). Hierarchical Grouping to Optimize an Objective Function. *Journal of the American Statistical Association*, *58*, 236-44.
Wardman, M., Tight, M., & Page, M. (2007). Factors influencing the propensity to cycle to work. *Transportation Research Part A: Policy and Practice*, *41*(4), 339-350.
Weitz, R. (2008). Who's afraid of the big bad bus? NIMBYism and popular images of public transit. *Journal of Urbanism*, *1*(2), 157-172.
Whalen, K. E., Páez, A., & Carrasco, J. A. (2013). Mode choice of university students commuting to school and the role of active travel. *Journal of Transport Geography*, *31*, 132-142.
Whitmarsh, L., & O'Neill, S. (2010). Green identity, green living? The role of pro-environmental self-identity in determining consistency across diverse pro-environmental behaviours. *Journal of Environmental Psychology*, *30*(3), 305-314.
Whyte, G. (1986). Escalating commitment to a course of action: A reinterpretation. *Academy of Management Review, 11, 311–321.*
Williams, B., Brown, T., & Onsman, A. (2010). Exploratory factor analysis: A five-step guide for novices. *Australasian Journal of Paramedicine*, *8*(3). Retrieved October 5, 2015, from http://ro.ecu.edu.au/jephc/vol8/iss3/1
Wilson, T. D., Lindsey, S., & Schooler, T. Y. (2000). A model of dual attitudes. *Psychological Review*, *107*(1), 101-126.
Wolff, J., Parker, C., Borisoff, J., Mortenson, W. B., & Mattie, J. (2014). A survey of stakeholder perspectives on exoskeleton technology. *Journal of Neuroengineering and Rehabilitation*, *11*:169. DOI: 10.1186/1743-0003-11-169
World Commission on Environment and Development (1987). *Our Common Future*. Brundtland Report. Oxford University Press, Oxford.
World Economic Forum (2014). *Global Risks 2014* (9th edition). Insight Report. WEF: Geneva.
World Energy Council (2011). *Global Transport Scenarios 2050*. WEC: London, UK.
WHO (2010). *Global Recommendations on Physical Activity for Health*. Geneva: World Health Organisation.
WHO (2015). *Mortality from ambient air pollution*. Global Health Observatory (GHO) data.

Accessed Feb 15, 2016, from ttp://www.who.int/gho/phe/outdoor_air_pollution/burden/en/

WHO Regional Office for Europe, OECD (2015). *Economic cost of the health impact of air pollution in Europe: Clean air, health and wealth*. Copenhagen: WHO Regional Office for Europe.

World Meteorological Organization (2014). The state of greenhouse gases in the atmosphere based on global observations through 2013. *WMO Greenhouse Gas Bulletin*, *10*, 1-8.

Wunsch, M., Stibe, A., Millonig, A., Seer, S., Dai, C., Schechtner, K., & Chin, R. C. (2015, June). What makes you bike? Exploring persuasive strategies to encourage low-energy mobility. In *International Conference on Persuasive Technology* (pp. 53-64). Springer International Publishing.

Xia, T., Nitschke, M., Zhang, Y., Shah, P., Crabb, S., & Hansen, A. (2015). Traffic-related air pollution and health co-benefits of alternative transport in Adelaide, South Australia. *Environment International*, *74*, 281-290.

Yik, M., Russell, J. A., & Steiger, J. H. (2011). A 12-point circumplex structure of core affect. *Emotion*, *11*(4), 705-731.

Zhibin, L., Wang, W., Yang, C., & Ragland, D. R. (2013). Bicycle commuting market analysis using an attitudinal market segmentation approach. *Transportation Research Part A*, *47*, 56-68.

Appendices

	Questionnaire statements	N	Mean	SD
1.	"It would be convenient to be able to get on any service with one's bus pass."	250	4.57	.737
2.	"At certain times of the day I find the buses really awful."	250	4.33	.926
3.	"You have to be really fit in order to cycle up that hill."	248	4.23	.945
4.	"I hate being on the bus when it's packed."	248	4.21	.890
5.	"Even though the buses are expensive, I think I wouldn't mind so much if I knew that I could get to a bus stop and get on a bus within like ten minutes or so. That'd be okay. But if you wind up waiting ages and paying a lot, that's when the price becomes questionable."	250	4.20	.940
6.	"Waiting/Queuing for the bus is frustrating and annoying."	249	4.11	.933
7.	"The daily commute is not exactly something that you look forward to or enjoy, it's just something that's there."	247	4.00	.824
8.	"When I just want to get home or it's raining very hard, I take the bus."	248	3.98	1.040
9.	"Being able to get on the bus doesn't just depend on the point of time of the day or the weekday as such. It also depends on where you are trying to get on the bus, which is unfair."	248	3.97	.983
10.	"Sometimes you're standing in the cold and rain and are waiting...not for the buses to come, but for the buses actually to stop, which is really annoying."	248	3.97	.969
11.	"The bus company keeps saying that their service is running normally, but everybody knows that it doesn't."	248	3.86	.927
12.	"There's 'a leaky pipeline in terms of communication' between the bus company and its customers."	246	3.84	.879
13.	"The buses are not reliable on their schedules. I think [the bus] is not...it's late or earlier, but never on time."	250	3.83	1.044
14.	"When I'm on the bus, I just let my mind wander."	248	3.81	.764
15.	"It's really horrendous. You can end up queuing for a long time and don't get a seat."	250	3.73	1.089
16.	"If I don't get a seat and I'm standing, then I don't do anything."	250	3.68	.946
17.	"Buses are hot and sweaty."	246	3.65	.858
18.	"For me, using the bus is really an average experience. I don't find it terrible, but I don't find it great either. It gets you from A to B."	250	3.62	.983
19.	"I almost always take the bus to university. It's a habit."	250	3.54	1.329
20.	"I get the bus because it is the most convenient choice for me (for instance, because the next bus stop is very close)."	248	3.54	1.049
21.	"Most of the bus drivers are quite nice."	247	3.50	1.024
22.	"Commuting time on the bus really is wasted time for me."	246	3.45	1.016
23.	"Sometimes you take more time to take the bus than when you run up."	250	3.44	1.178

24.	"I think it [the bus] is quite expensive. It just feels like such a rip-off."	250	3.38	1.099
25.	"I don't know, [when you walk] you just get more awake to your lectures, whatever it is that you need to do. When you walk back, you just kind of...it allows you to relax and leave everything like back here at Uni. And by the time you get home, you're like really relaxed…just like home and enjoy. Plus, the fresh air helps just to calm down."	248	3.34	1.083
26.	"If I could drive, I'd do that instead of getting the bus."	248	3.33	1.392
27.	"If there was no bus service, I would walk up to Uni."	249	3.31	1.312
28.	"I can't get home fast anyways because I'd have to queue. So, I can as well spend the time by doing something nice or useful, such as talking to friends/colleagues or studying."	248	3.29	.846
29.	"When on the bus, I'm usually busy with my smartphone (other than simply listening to music)."	250	3.28	1.138
30.	"The quality of the buses is good."	249	3.15	1.036
31.	"They [the local bus services] have got better over the years."	247	3.14	.802
32.	"It's easy to find information about bus routes, fares and timetables."	250	3.10	1.200
33.	"After you start taking the bus, it's harder to quit."	248	3.10	1.079
34.	"I often chat with friends or colleagues on the bus."	249	3.09	1.165
35.	"Taking the bus is the easiest way to save your time and energy."	248	3.07	1.045
36.	"I usually listen to music on the bus."	249	3.04	1.414
37.	"Being on the bus is depressing and tiring."	248	3.02	.981
38.	"It's comfortable to get the bus."	247	3.01	.935
39.	"I do think Bath has a pollution problem."	248	3.00	1.040
40.	"Going down, I think, there's really not much reason to get the bus."	250	2.94	1.122
41.	"There's nothing social about bus rides."	248	2.93	1.066
42.	"To walk up that hill...I don't know how people do it. It's hard."	247	2.91	1.318
43.	"Getting the bus makes me feel good in terms of environment."	248	2.89	.954
44.	"Being on the bus allows me to relax."	250	2.74	1.042
45.	"Actually, I like being on the bus."	248	2.63	1.002
46.	"I prefer to read when I'm on the bus."	249	2.58	1.193
47.	"I can't think of any good aspects of the bus services here."	250	2.39	1.052
48.	"The main reason I take the bus is because everyone else does."	247	2.24	1.085
49.	"I have never thought about using alternatives to the bus."	249	2.22	1.100
50.	"I don't have any problems with delays."	247	1.79	.837

A1. Study 2 questionnaire items including means and standard deviations

Your participation is voluntary and you can withdraw your cooperation at any point. All of your data will be kept confidential and used for research purposes only. In order to match your responses to the current survey, we would like to ask you to provide a combination of your initials and your birth date on the first page of the survey. We will ask you for this combination again during the follow-up survey. This information will be used solely for matching purposes. This study has received ethical approval by the Psychology Ethics Committee of the University of Bath (reference number: 14-216).

If you consent to participate, please tick the corresponding box below.

☐ I understand the information displayed above and consent to participate.

Please provide a combination of your initials and birth date so that we can match your responses with the follow-up survey. For instance, if your name was "John Rambo" or "Poison Ivy" and you were born on May 12, you would write "JR512" or "PI512", respectively.

My combination is: _____

Age ____ Gender (*please circle*) M / F

I live in… ☐ The City Centre ☐ Oldfield Park ☐ Other, namely _____

For *how long* have you been living in your current **accommodation**? (*please circle*)

< 4 weeks < 3 months < 6 months < 1 year > 1 year

What's your **main mode** of travel to campus? (please circle the mode that you use *most frequently*)

Bus Bicycle Car Car (passenger) Motorcycle/Scooter Train Walking

In the past week, *how many* trips to/from campus (each journey counts as 1) did you undertake…

by bus? 0 1-5 5-10 >10

by walking/cycling? 0 1-5 5-10 >10

How **satisfied** are you with the following aspects of the bus services? (*please cross*)

	1- Very dissatisfied	2 - Dissatisfied	3 - Somewhat dissatisfied	4 - Neither dissatisfied nor satisfied	5 - Somewhat satisfied	6 - Satisfied	7 - Very satisfied
Cost							
Frequency							
Reliability							
Personal space on the bus							
Quality of the buses							
Behaviour of bus drivers							
Information about routes and fares							

Below you will see six descriptions of different types of bus users. Please read each description carefully as you will be asked to indicate which description fits you best.

Type 1 – Although you don't mind taking the bus to/from campus now and then, you prefer to travel more actively and sustainably, such as by walking or cycling, and do so frequently.

Type 2 – You really dislike travelling to/from campus by bus and intend to walk or cycle more. However, your choice is constrained by various barriers (e.g. distance to campus, time constraints, safety or physical effort associated with walking or cycling up the hill).

Type 3 – You use the bus to/from campus because it's convenient. Although you don't particularly enjoy being on the bus, the main reason you don't start travelling another way is because it would cost you more time (or money) and/or take more effort.

Type 4 – You actually enjoy travelling to/from campus by bus and you have no intention of switching to a different mode.

Type 5 – You avoid the buses as much as you can. You prefer to travel to/from campus by car (as driver or passenger) and, unless you already own a car, plan to buy a car in the future.

Type 6 – You use the bus on an almost daily basis, but are deeply dissatisfied with the bus services. Most journeys, especially in the mornings, are a real drag. However, you don't really like walking or cycling to/from campus either.

If you had to select *only one* of the traveller types above to describe yourself, which would it be? (*please circle*)

Type 1 2 3 4 5 6

Comment:

_____

_____

_____

Finally, we would like to know how you intend to travel in the future.

Do you own or intend to purchase a bus pass?

Yes No

Do you plan to walk (or cycle) to/from campus more in the future?

Yes No

Are you interested in attending the walking group on December 1?

(if "yes", details will be sent to your webmail address, given that you provide your BUCS username below)

Yes No

This is the end of the questionnaire. If you have any further questions, feel free to ask them now or contact the investigator at g.bosehans@bath.ac.uk. If you'd like to enter the prize draw, please provide your BUCS username here: _____

Thank you for participating!

A2. Study 3 Message intervention – Time 1 questionnaire

Follow-up survey

Your participation is voluntary and you can withdraw your cooperation at any point. All of your data will be kept confidential and used for research purposes only. In order to match your responses from the initial to the current survey, we would like to ask you to provide the combination of your initials and your birth date that you provided in the first survey. This information will be used solely for matching purposes. This study has received ethical approval by the Psychology Ethics Committee of the University of Bath (reference number: 14-216).

If you consent to participate, please tick the corresponding box below.

☐ I understand the information displayed above and consent to participate.

Please provide the combination of your initials and birth date so that we can match your responses. For instance, if your name was "Bruce Wayne" or "Scarlett Johansson" and you were born on August 24, you would write "BW824" or "SJ824", respectively.

My combination is: _____

Age ____ Gender (*please circle*) M / F

Q1 Three weeks ago you were given a flyer along with the first questionnaire. Can you remember the content of the flyer and describe it?

_____
_____
_____
_____
_____
_____

Q2 In the past week, *how many* trips to/from campus (each journey counts as 1) did you undertake…

by bus?	0	1-5	5-10	>10
by walking/cycling?	0	1-5	5-10	>10

Q3 Have you looked up or made use of the Walking Network during the past 3 weeks?

☐ Yes, I've looked it up/made use of it at least once.

☐ No, it's not for me.

☐ What is the Walking Network? ⇨

Thank you for taking part in this study!

A3. Study 3 Message intervention – Time 2 follow-up questionnaire

Questionnaire

Age ____ Gender (please circle) M / F / Other: _____

What's your main mode of travel to/from campus? (please circle the mode that you use most frequently)

Bus Bicycle Car Car (passenger) Motorcycle/Scooter Train Walking

In the past week, how many trips to and/or from campus did you undertake…

by bus?	0	1-5	5-10	>10
by walking/cycling?	0	1-5	5-10	>10

Below you will see five descriptions of different types of commuter. Please read each description carefully as you will be asked to indicate which description fits you best.

Type 1 – Travelling sustainably is very important to you. You are very conscious of the environment and (try) to travel in a way that causes as little harm to the environment as possible, whenever you can.

Type 2 – You are not very content with the way you are travelling at the moment. You would like to switch to another mode, yet you either lack the necessary resources for this change (e.g. money) or your choice is constrained by various external barriers (e.g. a disability, distance, time constraints, safety or physical effort).

Type 3 – You use your current mode mainly because it is convenient. Although you don't necessarily enjoy travelling by that mode, the main reason you don't start travelling another way is because it would cost you more time, money and/or take more effort.

Type 4 – You truly enjoy travelling by your current mode and, even if it may not always be the most practical choice, you have no intention of switching to a different mode.

Type 5 – Cost-benefit considerations are the main reason why you have chosen your current form of travel. While your chosen alternative may not be the most comfortable or convenient one, it offers you the best comprise of cost, effort and travel time.

If you had to select *only one* of the traveller types above to describe yourself, which would it be? (please circle)

Type 1 2 3 4 5

Finally, we would like to know how you intend to travel in the future.

Do you own/intend to purchase a bus pass?
Yes No

Do you plan to walk (or cycle) to and/or from campus more in the future?
Yes No

A4. Questionnaire to be completed after the experimental task