Introduction: Philosophy and Structure of this Book

Regine Gerike and John Parkin

Introduction

A growing number of stakeholders and authorities recognize the benefits of cycling. We see significant efforts to provide for cycle users in many cities around the world, and we see some promising developments in cycle use. Cycling is increasingly accepted as a vital feature for authorities wanting to tackle the challenges of congestion, air pollution, space scarcity and collisions and injuries caused by motor traffic.

Much is known already about the nature of cycling and the factors that influence it. We also know a lot about the impacts of cycling, such as the benefits to health. However, the need for research remains, particularly as practice develops. The framework of conditions and governance practices change, meaning that old wisdoms need to be critically scrutinized in the light of new approaches. Administrations responsible for transport now rarely have purely car-oriented policies. Strategies and visions are more finely tuned to the needs of localities, and they need to be, and are constantly, adapted to changing circumstances and requirements.

Methodologies for research also develop, resulting partly from the demands of new theory, which needs testing, and partly from the development of new techniques, which are often made possible because of technology. Overall, despite cycling now having a solid research base, there remain many open questions.

The goal of this book is to bridge the gap between research and practice by allowing for that vital transfer of knowledge between researchers and practitioners. We report research with high policy relevance and point to the future agenda for cycling research.

Each chapter presents complete pieces of research and reflections on research that can be read and understood on their own without studying additional literature or references. The chapters are presented in a way that will allow for their widest accessibility to non-specialist audiences. The material that we present has naturally fallen into the following groupings:

- 'health and safety', which discusses the impacts of cycling and the circumstances that cycle users find themselves in;

- 'planning and promotion', which discusses approaches and strategies; and
- 'methodologies' for researching cycling.

Each chapter provides a summary of important outcomes for policy making and outlines the lessons that practitioners can learn from the research. The book will be interesting to experts and advocates from all types of public administration, consultancies and non-governmental organizations. It is also valuable for students and researchers interested in moving into the field of cycling research.

Cycling promotion can only be successful as part of integrated planning approaches. While this book is particularly concerned with cycling for transport purposes, the relationship between cycling and other modes of transport is explicitly explored. So far as the motor car is concerned, this relates to the influence of the car on safety and the environment (for example, air quality, see Willems et al., this volume). So far as walking is concerned, the term 'active mobility' is suggested by Held et al. (this volume) as a unifying concept for policy-based work.

The first section following the introduction provides an overview of the research field covered by the book. The subsequent section introduces the individual chapters. Goals, methods and lessons learnt are discussed, with a focus on providing the necessary initial linkages between the chapters. The chapter ends with concluding remarks in the final section.

Determinants, Impacts and Strategies: Overview of the Research Field

Determinants

Handy et al. (2014) provides an excellent review of factors associated with engagement in cycling for transport purposes (see also Buehler 2012; Handy and Xing 2011; Heinen et al. 2010, 2011; Rietveld and Daniel 2004). Socio-demographic characteristics such as gender, income, car ownership and cycling ability are important indicators of propensity to cycle. At the level of the city, the percentage of college students has, interestingly, also been found by some to be a significant socio-demographic determinant of cycling mode share (Buehler and Pucher 2012; Heinen 2011).

Factors such as preferences, attitudes, habits, perceived controls on behaviour (for example, linked with ability to carry luggage), social and personal norms have also been found to determine individual mode choice and cycling mode shares (de Geus et al. 2008; Handy et al. 2014; Heinen 2011). Positive

opinions about the environment for cycling increase the likelihood of cycling (Heinen 2011).

Transport supply for cycling is concerned mainly with infrastructure and parking facilities. High quality, quantity and continuity of a network of routes for cycling are a necessary but not sufficient requirement to support cycling. Direct connections within a network, appropriate priority at traffic signal controlled junctions and crossings decrease waiting times and increase the absolute as well as the relative speed of the bicycle compared to other transport modes, and these factors have positive impacts on cycling mode shares (Buehler and Pucher 2012; Rietveld and Daniel 2004). Safety is an important concern, and remains an important barrier to cycling, but with significant differences in terms of perceptions between different groups of cyclists (Buehler and Pucher 2012; Degraeuwe et al., this volume; Handy et al. 2014). Cycling infrastructure in a wider sense includes employer-based offerings such as showers or bicycle repair facilities, and, depending on the context, these can also have an effect on cycling commute shares (Buehler 2012).

Land use planning and the built environment determine distances from relevant generators to attractors, and journey distance is one of the core determinants of choice in relation to cycling. Parkin and Koorey (2009) lists the following requirements for cycle friendly spatial structures: density, destination accessibility, design, distance to public transport and diversity. They additionally stress the need for planning policy to provide and protect corridors for cycling-related infrastructure.

Climate and topography also affect cycling levels. Rain, snow and extreme temperatures decrease cycling mode shares, while flat topography encourages cycling (Buehler and Pucher 2012; Thomas et al. 2013).

Handy et al. (2014) stress the importance of the ready availability of the bicycle at the home or origin of a journey and its strong correlation with bicycle use. Bicycle ownership could be generally high, but if bicycles are stored away safely with limited access to the street, then use will be lower.

Besides these direct determinants of use, cycling mode shares are also influenced by transport supply and demand for the competing modes. The speed of cars and public transport, parking management for cars, free car parking at work, public transport benefits, and the pricing of fuel for motor cars and public transport ticket prices are all relevant indirect determinants of the propensity to cycle (Buehler 2012; Buehler and Pucher 2012; Rietveld and Daniel 2004).

Commonly cited factors that deter people from choosing the bicycle for transport are the perceived lack of time (i.e. the bicycle is understood, often incorrectly, to be a slower option than other forms of transport); the distance to relevant destinations; bad weather; a lack of bicycle facilities at the workplace or other destinations; and a lack of appropriate cycling infrastructure (Heinen

2011). The physical constraints, as a result of hilly terrain and poor fitness levels, are also important parameters to take into account. For some people, cycling for transport on a conventional bicycle is therefore not seen as an option.

Another often-mentioned reason for not cycling to work involves perceptions around sweating. It is for such reasons that employers often feel the need, despite the logistical difficulties, to provide employees with a place to shower and change. There may also be practical problems linked with the additional time spent changing and showering at work.

Impacts

The main positive impact of cycling on human beings is improved health and quality of life as a consequence of the physical activity inherent in cycling. The World Health Organization (WHO 2007) recommends moderate-intensity physical activity for a minimum of 30 minutes on most, preferably all, days of the week. More than 30 per cent of adults in the world do not take enough physical exercise compared to these levels (Hallal et al. 2012). This results in an increased risk of non-communicable diseases such as obesity, cardiovascular diseases, respiratory diseases, type 2 diabetes, cancer, dementia, depression and a reduced life-expectancy (WHO 2011a; see also de Geus and Hendriksen, this volume). The WHO (2011a) lists the promotion of active mobility as one core strategy to overcome this problem.

Cyclists' health can be negatively affected by the risk of injury in collisions and exposure to air pollution and noise. The risk of being injured is higher for cycle users than for car drivers and passengers, but of course the source of the risk is generally motorized traffic. Increased levels of cycling may therefore be related to an increased risk of being injured in collisions (de Geus et al. 2012; Wegman et al. 2012). At the same time though, they can be ameliorated by the so-called 'safety in numbers' effect (Luukkonen and Vaisma, this volume). This effect results from the well-established, non-linear relationship between the rate of collisions and injuries, and volume of use. We do need to know more, however, about the casual mechanisms (see Bhatia and Wier 2011 and Elvik 2009 for a discussion of these issues). Under-reporting of minor injuries and incidents involving only one vehicle (the bicycle) need also to be understood and considered further (de Geus et al. 2012).

Int Panis et al. (2010) find that the rate of inhalation of air pollutants while cycling are five to nine times higher than for car occupants on the same routes (see also Willems et al., this volume). Clearly, this results in significantly higher exposure to air pollution for cyclists than for car occupants. More research is thus needed on the transferability of these results as air pollution concentration is highly dependent on the pollutant, the road geometry and adjacent buildings, the meteorology and cyclists' route choice.

Environmental noise is, after air pollution, the second most important environmental health risk in Europe (WHO 2011b). However, it has been neglected so far as health impact assessments for cycling are concerned. Noise mapping is required every five years for all cities with more than 100,000 residents (European Commission 2002; see also Gerike et al. 2012) but these noise maps are not specifically focused on cycling and not detailed enough to learn more about the health effects resulting from noise exposure during cycling compared to other transport modes.

All studies assessing the impacts of cycling on health consistently show that the positive effects of physical activity far outweigh the negative effects from air pollution (Rojas-Rueda et al. 2013). Increased health and quality of life are the most important individual benefits of cycling; they also reduce societal health costs significantly. High cycling mode shares, with their low speed, low space requirements and low risk to other road users, additionally contribute to cities that are more pleasant to live in and multi-modal mobility patterns. In this area, various research gaps still remain though, for example, in relation to the substitution effects relating to physical activity in transport and non-transport activities, or on the dependencies between mode choice and destination choice (Handy et al. 2014).

Strategies

Packages of measures are needed for successfully achieving and maintaining high modal shares of cycling. The '4 Es' have been used as a useful short-form for classifying measures for promoting cycling (see for example Winters et al. 2011):

E1: Engineering. Measures in this category address the transport supply, and are supported by the processes of transport planning and traffic engineering. These measures should be well-coordinated with, and arguably led by, high quality urban design and land-use planning. Examples are the strategic development of infrastructure networks, traffic signalling, layout of streets and intersections, bicycle parking facilities and the integration of transport modes.

E2: Enforcement. This category includes all legal issues such as speed limits and rights-of-way. There is a lot of ground to be made up in a number of jurisdictions, especially those which appear to 'blame the victim', rather than to 'protect the vulnerable'.

E3: Economy. Measures in this category use monetary instruments for incentivizing or discouraging specific behaviours. For example, some cities and companies subsidize pedelecs or bike-sharing systems. Many more economic incentives are possible that would indirectly encourage

cycling by directly discouraging car use, e.g. parking management in cities. These measures are effective but often lack public or political acceptance and support.

E4: Education. This category includes all types of knowledge and understanding provided through information, campaigning, personalized travel planning, training and social marketing. For maximum effect, these measures will usually target specific user groups such as repeat speeding offenders, school children learning to navigate the public realm, company staff, the elderly or new residents moving into a city.

This scheme is similar to the classification used by Hoogerwerf and Herweijer (2008; cited in Scheepers et al. 2014). The authors make a distinction between legal (similar to E2), economic (similar to E3), communicative (similar to E4) and physical tools (similar to E1). They further distinguish economic measures into the following classes: subsidy, reward systems and penalties. Communicative tools were distinguished in two sub-groups of, firstly, written materials, and secondly, tools aimed at directly changing behaviour. Two sub-groups were also defined for the physical tools: adjustments in the environment in general, and the provision of better bicycle facilities as well as the provision of bicycles.

The Lancet published a classification of physical activity intervention strategies used in the public health field (Heath et al. 2012). These are similarly, but slightly differently, classified into three domains as follows:

L1: Campaigns and informational approaches. This category 'includes community-wide campaigns, mass media campaigns, and decision prompts encouraging the use of stairs versus lifts and escalators' (Heath et al. 2012: 272).

L2: Behavioural and social approaches. These interventions are meant to 'increase social support for physical activity within communities, specific neighbourhoods, and worksites' (Heath et al. 2012: 272). The main difference to the first category is that measures in this second category target specific institutions that are classified in five different settings: school, workplace, community, clinical or health care, several settings. Strategies for schools can encompass for example 'physical education, classroom activities, after-school sports' (Heath et al. 2012: 272) and the promotion of active transport.

L3: Policy and environmental approaches. These interventions 'create or enhance access to places for physical activity with outreach activities' (Heath et al. 2012: 272) and include mainly measures from the 'Engineering' category as described above.

Heath et al. (2012) thus give more weight to campaigning. They assign the first two out of the three categories to community-wide versus institution-specific

measures classified altogether as 'Education' in the classification system of the '4 Es'.

This volume addresses all types of measures and presents some successful solutions for integrated approaches.

Overview of the Book Chapters

The first part of this book is dedicated to the impacts of cycling on 'Health and Safety'. De Geus and Hendriksen give an overview of the health benefits of physical activity in general, and cycling in particular, and by so doing introduce the main benefits of cycling. They then compare the health and safety effects of cycling by conventional bicycles with the effects derived from using pedelecs. Their work confirms that pedelecs are a promising tool for enhancing physical activity, and for initiating mode shift from motorized modes to cycling. This is especially beneficial for physically inactive people such as the elderly and the overweight. The substitution of trips made by conventional bicycles with trips made by pedelecs can have adverse effects on health if trip distance remains unchanged and physical activity intensity is low. The authors stress the need for appropriate infrastructure for pedelecs and more research is needed on the particular safety issues in connection with these bicycles.

The next two chapters are based on the SHAPES project (Systematic analysis of Health risks and physical Activity associated with cycling PoliciES) (Int Panis et al. 2010). In this project, a major online survey was carried out to collect data on determinants of cycling and collisions. Cyclists were asked, through a trip diary, about their involvement in collisions and injury while cycling, and thus a large and unique dataset was created.

Degraeuwe et al. present the SHAPES sample and analyse cycling behaviour including weekly distances travelled, trip durations and average speeds. Age, sex and employment were found to be significant socio-demographic variables that describe cycling use. The availability of a cycling path on the way to work was a significant variable, and this emphasizes the fundamental importance of suitable networks of routes for cycle traffic. Cycling distances, times and speed are significantly higher in rural areas compared to urban areas and this is due to the presence of fewer intersections and fewer stops per unit distance travelled. The determinants of cycling trips to work are very similar to trips for non-work purposes. Age, sex and the level of urbanization significantly affect the number and severity of collisions. Collisions with acute body injuries occur on average every 7,266 km. This rate decreases with increasing age and is lower in rural areas compared to urban areas. Cycling speed and the use of helmets were not found to be significant factors.

Willems et al. report research on air pollution exposure of cyclists. They find the exposure of cyclists to be four times higher than for car occupants on the same road, and this may result in adverse health effects for cyclists. The authors analyse the effects of different cycling speeds and intensities of physical activity relative to the rate if inhalation of air. They show that cycling at speed, with the lowest inhalation rate per kilometre, does not significantly reduce air intake, and hence pollution intake. Rates of inhalation are shown to be quite stable over the range of speeds usually cycled, but they increase at high speed. The authors recommend that networks of routes for cycle traffic are planned to be remote from motorized traffic routes in order to reduce cyclists' exposure to air pollution.

Luukkonen and Vaismaa present a review of the phenomenon of 'safety in numbers' based on a literature search. Importantly, they report factors impacting both bicycle use and safety. They then discuss the connections between these two to illuminate the area of investigation in a new light. Land use, the density and connectivity of cycling networks, and the quality of the infrastructure were consistently found to be significant determinants of both cycling volumes and cycling safety. The review confirms the necessity of suitable infrastructure supply as the basis for high cycling mode shares.

The second part of the book, 'Planning and Promotion', deals with strategies for supporting cycling. Tschoerner opens this part with a chapter describing the importance of governance, stakeholders and institutions for appropriate framing and for successfully generating funding and public support for cycling. As a case study example, the author reports the development of strategic transport and cycling policy over the last 40 years for the German city of Munich. She shows the importance of the socio-historical context. The language, the framing of discourse and the implementation of practices have all been aligned for many years, and still are aligned, with a paradigm which presumes the dominance of the car. It is suggested that cycling promotion in Munich is successful because it works within and through the specific understandings and terminology, and because it respects the importance of the other transport modes. Tschoerner also shows the influence of organized citizen initiatives on policy making and on re-articulating historical understandings and practices.

The following three chapters work on the effectiveness of and requirements for planning strategies. Gerike and Jones develop an approach for systematic network development for all road transport modes, based on the assumption that scarce road space can only be used efficiently by a coordinated development of the network for all transport modes. 'Link' functions should be assigned to transport routes according to the requirements of land use planning. 'Place' functions for street sections are determined by the importance of an area for dwelling relative to the needs of the section for movement. The combination of link and place functions determines the final layout for specific street

sections as part of a consistent and efficient network for the different road users and usages.

Twisk et al. present lessons learnt from cycling safety policies implemented in the Netherlands. They discuss improvements to road infrastructure, measures for enforcement and education, and changes to vehicle design. The following measures turned out to be the most beneficial for cycling safety: traffic calming, changes to the intersections such as conversion to roundabouts, and bicycle reflectors and truck side under ride protection as vehicle measures. The authors stress the need for more naturalistic evaluation studies in order to improve the empirical evidence on the effectiveness of specific measures. They also name the investigation of underreporting of single accidents and collisions between cyclists as a research need.

Schreiber et al. move from the aggregated level to one specific collision type. They investigate collisions between cyclists travelling straight on along a main road and motor traffic turning off the main road into side roads. These are, particularly in built-up areas, one of the most common types of collision for cyclists. Road infrastructure design and maintenance are the main factors determining the number and severity of these types of collision. Visibility is a key determinant, and was not good at many of the intersections examined. The infrastructure layout of cycle tracks, cycle lanes and cycle crossings needs to be clear and distinctive to ensure drivers' awareness and compliance. The use of designated cycle crossings is recommended. Cycling in the wrong direction was found to be an important cause for conflicts and collisions and should be prevented by the way the infrastructure is laid out. Road user education, driver training and public campaigns are recommended for increasing awareness and behaviour consistent with the rules.

Tapp and Parkin complement the section on planning and promotion with a chapter focused on the contribution that social marketing can make. They discuss first the concept and the underlying theories of behaviour change. The authors then present an example of social marketing to promote cycling in Bristol. The example shows how social marketing as a technique can be embedded at a strategic level in the development of programmes to promote cycling. The authors recommend integrating social marketing as a function alongside other functions such as transport planning and engineering design from the very beginning of a project, and recommend including sufficient funding and professional capacity to carry social marketing activities.

The third part of the book is called 'Methodologies'. Chapters in this part capture descriptions of methods for assessing demand and supply.

Held et al. discuss the terminology used to promote cycling. They argue for the use of 'active mobility' on the basis that this could begin to be viewed as a coherent set of transport opportunities which, in a policy sense, are at the same level of importance as motorized private transport and public transport.

Ghekiere et al. describe methods relating to the supply side; that is the physical infrastructure and environment for walking and cycling. They present the state-of-the-art for objective and subjective methods of investigation in relation to cycling. Objective measures discussed include on-site and off-site audit tools and GIS based data. Subjective measures include questionnaires such as the Neighbourhood Environment Walkability Survey (NEWS) and the Perceptions of the Environment in the Neighbourhood Scale (PENS). Individual interviews, focus groups, photo-voice, walk-along and bike-along methods are described as examples for qualitative research. These can reveal valuable insights about factors behind the quantitative findings.

Böhmer discusses a subjective method for assessing the cycling environments in aggregate. He presents methods and results for the German customer satisfaction survey the 'ADFC Bicycle Climate Test'. The chapter presents data taken over time from the historical back catalogue of surveys and also compares cities of different sizes and with different levels of cycling. The data provide a useful snap-shot of the public perception of cycling and he suggests that the information is valuable to policy makers in relation to the next steps that they may take to promote cycling in particular circumstances.

Beecham presents an interesting data source that is increasingly used for research: usage data from public bikeshare schemes. Based on a literature review, Beecham collates and synthesizes current research and analysis of these data. He thus gives inspiration and ideas on how this large observational data can be used and which questions can be answered with the help of this data. Longitudinal analyses of individual-level usage offer substantial opportunities for policy evaluation and behavioural research.

The Way Forward

Cycling is a mode that ought to be core to transport policy for public authorities, and this is because of its economic and energy efficiency as well as its health benefits. It ought to be seen, along with other active modes such as walking, as a vital feature of transport systems that create attractive, comfortable, safe and healthy communities.

Cycling will only ever form part of the whole mix of transport options and choices, as will any other mode including private motorized travel. It is an excellent complement to longer distance public transport and in combination they offer a very efficient travel package. Other means of increasing the overall attractiveness and hence share of cycling as part of the modal mix is to ensure that suitably comprehensive networks of routes for cycle traffic are developed. Infrastructure is a necessary condition to allow for the growth of cycling, but, in addition, there needs to be support from a range of other methodologies,

which are generally encompassed within social marketing and which ensure that potential cycle users are aware of the opportunities and benefits.

There are an increasing number of examples of good practice from municipal authorities that have been able to identify and implement over a series of years often quite ambitious programmes of investment in cycling. The difficulties of re-introducing cycling infrastructure and a cycling culture into physical and political spaces, which are both congested and contested, is an extremely challenging proposition.

We can set against the opportunities and challenges of promoting cycling the offerings of the various insights from the contributions of the authors to this volume.

Degraeuwe et al. demonstrate that infrastructure is needed, and de Geus and Hendriksen note the positive contribution that developments towards electric propulsion can offer. Willems et al. emphasize the need, based on air quality, for cycling's separation from motor traffic. Remaining with the theme of infrastructure, but considering it at a more strategic level, Luukkonen and Vaismaa consider the relation between volumes of cycle traffic and the issue of danger posed by motor traffic: they suggest mechanisms which help explain 'safety in numbers'. Gerike and Jones offer insights into methodologies for planning infrastructure and land use. While infrastructure is important, so too is the way that we frame our policy approaches to cycling. Held et al. offer the concept of active mobility as a third pillar (relative to private motorized transport and public transport) as a means of enhancing the policy status of cycling and walking. Tschoerner offers insights on framing based on the story of Munich and its steady transformation into a city that is friendlier towards bicycles. Tapp and Parkin operationalize the process of empowering the decision making of citizens to change their behaviour and become users of the bicycle.

We hope that this book gives good reasons for promoting cycling and that it also provides inspiration for activities to be taken, with the final goal to develop cycling as one core component of multimodal, healthy, liveable and economically viable communities.

References

Bhatia, R. and Wier, M. 2011. 'Safety in Numbers' Re-Examined: Can We Make Valid or Practical Inferences from Available Evidence? *Accident Analysis & Prevention*, 43(1), 235–40.

Buehler, R. 2012. Determinants of Bicycle Commuting in the Washington, DC Region: The Role of Bicycle Parking, Cyclist Showers, and Free Car Parking at Work. *Transportation Research D*, 17(7), 525–31.

Buehler, R. and Pucher, J. 2012. Cycling to Work in 90 Large American Cities: New Evidence on the Role of Bike Paths and Lanes. *Transportation*, 39(2), 409–32.

European Commission 2002. Environmental Noise Directive (2002/29/EC).

Elvik, R. 2009. The Non-Linearity of Risk and the Promotion of Environmentally Sustainable Transport. *Accident Analysis and Prevention*, 41(4), 849–55.

Gerike, R., Becker, T., Friedemann, J., et al. 2012. Mapping External Noise Costs to the Transport Users – Conceptual Issues and Empirical Results. Euronoise 2012: 9th European Conference on Noise Control, Proceedings, 10–13 June 2012, Prague.

de Geus, B., Bourdeaudhuij, D.I., Jannes, C. and Meeusen, R. 2008. Psychosocial and Environmental Factors Associated with Cycling for Transport Among a Working Population. *Health Education Research*, 23(4), 697–708.

de Geus, B., Vandenbulcke, G., Int Panis, L., et al. 2012. A Prospective Cohort Study on Minor Accidents Involving Commuter Cyclists in Belgium. *Accident Analysis and Prevention*, 45, 683–93.

Hallal, P.C., Andersen, L.B., Bull, F.C., et al. 2012. Global Physical Activity Levels: Surveillance Progress, Pitfalls, and Prospects. *Lancet*, 380(9838), 247–57.

Handy, S.L., van Wee, B. and Kroesen, M. 2014. Promoting Cycling for Transport: Research Needs and Challenges. *Transport Reviews*, 34(1), 4–24.

Handy, S.L. and Xing, Y. 2011. Factors Correlated with Bicycle Commuting: A Study in Six Small U.S. Cities. *International Journal of Sustainable Transportation*, 5(2), 91–110.

Heath, G.W., Parra, D.C., Sarmiento, O.L., et al. (for the Lancet Physical Activity Series Working Group) 2012. Evidence-Based Intervention in Physical Activity: Lessons from Around the World. *Lancet*, 380(9838), 272–81.

Heinen, E. 2011. Bicycle Commuting. PhD thesis, TU Delft. Available at: http://repository.tudelft.nl/assets/uuid:9849a615-b60a-4203–87e1-37f1af45376d/OTB_SUA043_web.pdf [accessed: 31 January 2015].

Heinen, E., van Wee, B. and Maat, K. 2010. Commuting by Bicycle: An Overview of the Literature. *Transport Reviews: A Transnational Transdisciplinary Journal*, 30(1), 59–96.

Hoogerwerf, A. and Herweijer, M. 2008. *Overheidsbeleid. Een inleiding in de beleidswetenschap*. Kluwer, Alphen aan den Rijn.

Int Panis, L., de Geus, B., Vandenbulcke, G. et al. 2010. Exposure to Particulate Matter in Traffic: A Comparison of Cyclists and Car Passengers. *Atmospheric Environment*, 44(19), 2263–70.

Parkin, J. and Koorey, G. 2009. Network Planning and Infrastructure Design. In: Parkin, J. Bingley (ed.), *Cycling and Sustainability*. Emerald, 131–60.

Rietveld, P. and Daniel, V. 2004. Determinants of Bicycle Use: Do Municipal Policies Matter? *Transportation Research A: Policy and Practice*, 38(7), 531–50.

Rojas-Rueda, D., de Nazelle, A., Teixidó, O. and Nieuwenhuijsen, M.J. 2013. Health Impact Assessment of Increasing Public Transport and Cycling Use in Barcelona: A Morbidity and Burden of Disease Approach. *Prev Med (Baltim)*, 57(5), 573–609. Elsevier Inc.

Scheepers, C.E., Wendel-Vos, G.C.W., den Broeder, J.M., et al. 2014. Shifting from Car to Active Transport: A Systematic Review of the Effectiveness of Interventions. *Transportation Research Part A: Policy and Practice*, 70(December 2014), 264–80.

Thomas, T., Jaarsma, R. and Tutert, B. 2013. Exploring Temporal fluctuations of Daily Cycling Demand on Dutch Cycle Paths: The Influence of Weather on Cycling. *Transportation*, 40(1), 1–22.

Wegman, F., Zhang, F. and Dijkstra, A. 2012. How to Make More Cycling Good for Road Safety? *Accident Analysis and Prevention*, 44(1), 19–29.

WHO 2007. Steps to Health, a European Framework to Promote Physical Activity for Health. Copenhagen, Denmark: WHO Regional Office for Europe. Available at: http://www.euro.who.int/en/health-topics/disease-prevention/physical-activity/publications/2007/steps-to-health.-a-european-framework-to-promote-physical-activity-for-health-2007 [accessed: 31 January 2015].

——— 2011a. Action Plan for Implementation of the European Strategy for the Prevention and Control of Noncommunicable Diseases 2012–2016. Available at: http://www.euro.who.int/en/what-we-do/health-topics/noncommunicable-diseases/cancer/publications/2011/eurrc6112-action-plan-for-implementation-of-the-european-strategy-for-the-prevention-and-control-of-noncommunicable-diseases-20122016 [accessed: 31 January 2015].

——— 2011b. Burden of Disease from Environmental Noise. Available at: http://www.euro.who.int/__data/assets/pdf_file/0008/136466/e94888.pdf [accessed: 31 January 2015].

Winters, M., Davidson, G., Kao, D. and Teschke, K. 2011. Motivators and Deterrents of Bicycling: Comparing Influences on Decisions to Ride. *Transportation*, 38(1), 153–68.