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CAN A MODE SHIFT TO WALKING AND CYCLING BENEFIT HEALTH AND THE CLIMATE?

A modelling study on scenarios on how a mode shift to active travel can benefit both population health and reduce greenhouse gas emissions

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Summary

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About the authors

Dr. James Woodcock is a public health modeller at the Centre for Diet and Activity Research, University of Cambridge, specialising in transport. He has modelled the health benefits that could be achieved from a transition to more sustainable transport systems, in particular through more walking and cycling. He has developed a simulation model of transport (ITHIM) that is being used in the UK and the US. His work is also now focusing on how we could achieve the transition to a more active, lower carbon system. He is using two complex system modelling approaches; agent based modelling (leading the ESRC funded project "Changing Commutes") and system dynamics (cycling in London).

Dr. Felix Creutzig is principal investigator of the Land Use, Infrastructures, and Transport group at the Berlin-based Mercator Research Institute on Global Commons and Climate Change. His research focuses on low-carbon urban infrastructures, land rent and the challenges of comprehensively assessing large-scale bioenergy. He studied various aspects of climate change mitigation as a postdoctoral researcher in Beijing, Berkeley and Princeton, holds a Ph.D. in computational neuroscience from Humboldt-Universität zu Berlin and graduated with a Master of Advanced Studies from the University of Cambridge. His most recent book, *Sustainable Low Carbon Transport*, complements his contribution to the IPCC as lead author of the upcoming assessment report.

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Abstract

CAN A MODE SHIFT TO WALKING AND CYCLING BENEFIT HEALTH AND THE CLIMATE?

A modelling study on scenarios on how a mode shift to active travel can benefit both population health and reduce greenhouse gas emissions

The need for reducing carbon emissions is pressing and will not be realised without cuts from all the main sectors. Transport emissions are often seen as one of the hardest areas to tackle.[1] However, recent studies have identified potential benefits of reducing carbon emissions from transport. In particular, studies have identified large public health impacts from a modal shift to active travel, with smaller population health benefits from less driving through reduced air pollution and road traffic injury exposure.[2-4]

The potential to achieve both climate and population health benefits has been termed 'co-benefits', and research has identified potential co-benefits in other sectors. Further work is needed to identify when substantive transport sector health and climate co-benefits are to be expected and what role active travel can play in achieving emission reductions in addition to benefiting health.

Studies usually take around 5-8 km as the upper limit for cycling and 2-3 km for walking (e.g.[5]). Although these short trips make up a large proportion of trips and a substantial proportion of travel time, they do not contribute a large percentage of total travel distance. For example, in the UK in terms of trips, around one quarter of trips are less than 1 mile, half are shorter than 2.5 miles, and three quarters are less than 7 miles (calculated from National Travel Survey 2002-2010). However, in terms of total distance, only one quarter of the distance is on trips under 7 miles, one half on trips under 20 miles, and three quarters on trips under 65 miles. In total it has been estimated that in the UK trips shorter than 5 miles generate around 16% of the total carbon dioxide from transport.5 Therefore, whilst a mode shift from car to walking or cycling for short trips could achieve large health benefits, on its own it is unlikely to be sufficient to achieve large carbon emission reductions.

However, there are different strategies which could be used to complement a mode shift that would increase the potential for adding substantial climate benefits to the health benefits. In this study we will develop and model scenarios for three potential additional approaches that might lead to substantive co-benefits.

We define a mode shift from car to active transport as a proportionally constant increase in the odds of walking or cycling for trips of all lengths. The three complementary strategies are:

1. Reducing travel distances (through land use and planning) - this would lead to both mode shift and additional emission reductions for the remaining car trips;

[1] Core Writing Team Contribution of Working Groups I II and III to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change Climate Change 2007: Synthesis Report In: Pachauri RK, Reisinger AE, editors. Geneva, Switzerland. pp 104: IPCC; 2007.

[2] Maizlish N, Woodcock J, Co S, Ostro B, Fanai A. Health Co-Benefits and Transportation-Related Reductions in Greenhouse Gas Emissions in the San Francisco Bay Area. Am J Public Health Accepted for publication 2013.

[3] Woodcock J, Givoni M, Morgan AS. Health Impact Modelling of Active Travel Visions for England and Wales Using an Integrated Transport and Health Impact Modelling Tool (ITHIM). PLoS One 2013;8(1):e51462.

[4] Creutzig F, Mühlhoff R, Römer J. Decarbonizing urban transport in European cities: four cases show possibly high co-benefits. Environ Res Lett 2012;7(4):044042.

[5] Department for Transport. Creating Growth, Cutting Carbon Making Sustainable Local Transport Happen; Presented to Parliament by the Secretary of State for Transport by Command of Her Majesty, 2011.

2. Increasing walking and cycling distances through faster routes and technologies such as electric bikes. That is, a greater than proportional increase in the odds of undertaking medium distance trips by an active (or semi-active) mode;
3. Public transport combined with active travel modes. That is, increased odds of undertaking longer distance trips through a combination of active and public modes.

We compare these approaches and investigate combinations of these approaches. In particular we look for synergetic effects; that is, points at which combinations of approaches would achieve substantive health and climate co-benefits.

Scenarios will be generated from a range of sources. Baseline data will be taken from travel surveys covering different-sized cities and modal split data in the UK and Germany. Alternative scenarios will be generated from analysis of travel patterns in other countries - in particular the high cycling Netherlands and high walking Switzerland. Other scenarios will be generated based on travel time trade-offs for electric bikes, faster routes, and multimodal journeys.

Modelling will be undertaken using a modified version of the stochastic simulation model ITHIM3. Uncertainty will be modelled around key parameters. Health impacts will be modelled using the comparative risk assessment approach. The focus will be on physical activity due to the large size of the potential benefits compared with other pathways. In this model physical activity is represented as age group and gender-specific distributions of MET hours per week. The impact of changes to these distributions is modelled on the disease burden attributable to selected diseases, with disease-specific exposure response curves. Given the importance of age for health behaviours and risks, we will add age-specific trip distance distributions and corresponding mode splits.

An online interface will be created to allow users to manipulate input values to develop their own scenarios and test interventions.

Future developments of this work will allow further analysis based on factors such as trip purpose (e.g. different potential to change different kinds of trips) and additional health impact pathways.

In conclusion, this study provides insights into when substantive improvements on health and climate could be achieved from mode shift to active travel. These results suggest that low-cost infrastructure interventions in European cities, focussing on non-motorised transport, could produce substantial overall benefits for citizens, while contributing to climate change mitigation. Such interventions could be particularly effective in combination with campaigns that incentivise and foster social learning in modal uptake (see the accompanying paper by Dr. Goetzke 'Social Interactions and Social Learning in Transportation Behavior').