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Performance evaluation of extreme bicycle scenarios

Joerg Schweizer[a,]*, Federico Rupi[a]

[a]University of Bologna,DICAM, Viale Risorgimento 2, Bologna 40136, Italy

Abstract

This present work evaluates the performance of extreme bike scenarios for partners-cities of the Central Europe project "BICY". With extreme bike scenarios we mean that a city has implemented the best possible conditions for cycling. Our analyses confirm that approximately half of all urban trips are less than five km and could be done by bike. Some cities in the Netherlands have shown that bike mode shares of 40% and higher can be achieved. The question is how much cycling infrastructure and investments are required to convert a city into a top cycling city and what would be the benefits?

For the purpose of establishing a quantitative relation between infrastructure investments, increase in cycling and effects on the environment and health, we reduce the cycling conditions to the presence of cycling infrastructure. It is shown that such a reduction is a conservative assumption as promotion, mobility management and education are low cost measures to increase bike mode share even without expanding the cycling network. The health benefits have been calculated using the HEAT framework developed by the World Health Organization. This is a standard to determine the costs of lives saved due to reduced mortality as a consequence of more physical exercise.

Gathering official data and detailed information from mobility surveys in 13 central European cities with low to medium-high cycling levels, we have estimated the potential bike share with an average of approximately 50%, the required cycling infrastructure necessary to reach the potential between 30 and 370km of exclusive bikeways and cycling infrastructure costs between 10-60Million . The expected benefits/cost ratios have been found between 1.2 and 15, average 5.7. However, analyse of current stated preferences show that the share of persons willing to start cycling is far less than the potential, even if ideal cycling conditions were provided.

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Keywords: bicycling; cost-benefit analysis; CBA; HEAT; health impact assessment; transport economics; life expectancy; transport policy.

* Corresponding author. Tel.: +39-051-209-3338; fax: +39-051-209-3337.
E-mail address: joerg.schweizer@unibo.it

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1. Introduction

1.1. Cost benefit analyses for cycling

The primary goal of this paper is to estimate the cost-benefit of the health effects due to an increased level of cycling. Analyzing the justification for bicycle facilities has been a vexing goal for generations. By the end of the 60th the literature shows earnest efforts Everett (1977). The complexity of the inquiry, coupled with a lack of large-scale studies, and a lack shortage of real-world environments in which to base such studies, made such analyses difficult until recently. Sælensminde (2004) performed a cost benefit analyses for the construction of new walking and cycling tracks in three Norwegian cities, quantifying not only reduced health care costs, but also saved parking costs, reduced CO2 emissions and the benefits of reduced "insecurity felt" by bicyclists. He found that health related costs were the dominant cost factor (60-75%) while the overall benefit cost ratio have been estimated with 4-5. However, the change in demand due to the new walking and cycling facilities have been minimum-maximum assumptions backed up by elasticity models and taking into consideration the feeling of "reduced insecurity". Noteworthy is the study of Börjesson and Eliasson (2012), modelling the time benefit for cyclists riding on a bike path versus riding on streets.

Concerning health benefits, recent studies have formed a solid argument that health benefits outweigh the risk of having an accident; the health benefits of bicycling outweigh such risks by as much as 20:1, (British Medical Association, 1992; Hillman, 1992). A recent health impact analysis predicted mortality in Barcelona, limited to traffic incidents and air pollution, found that an increase in bicycling would save lives: not only bicyclists would fare better, but all residents would, due to reduced air pollution; the benefits of a shift to bicycling were greater than those of shifting to public transport Oja P et al. (2011). The literature is now complete enough to include powerful studies conducted in major cycling cities allowing predictions across many cities (De Hartog ET ALII, 2010; Cavill, 2008; Andersen, 2000). These and many more studies consistently find that the benefits outweigh the risks.

Some thematic areas where, at least in theory, benefits of bicycling might be demonstrated via CBA analysis include: Economic benefits, both local and national; Environmental benefits, including reduction of air- and noise pollution, and wildlife protections; Worker productivity; social benefits, including community cohesion; Mental health and intelligence benefits; emissions reductions, including greenhouse gas (GHG) reductions.

These benefits should only increase as bicycling increases, for an array of reasons including the expected "Safety in Numbers" effect, (Jacobsen 2003), whereby the risk to each cyclist would be reduced with each additional cyclist, thus promising exponentially increasing, rather than linear, returns. Unfortunately there is only limited data, and few studies are available, for most of these thematic areas, despite the theoretical basis that major benefits to individuals and society would be found, and externalities are not always easy to monetize.

Nomenclature

B	Bike mode share in %
I	Cycling index in meter exclusive bikeway per inhabitant
S	Slope (model parameter)
B_0	Base bike mode share in % (model parameter)
B_T	Target or potential bike mode share in %
I_T	Target cycling index in meter exclusive bikeway per inhabitant