

18th Euro Working Group on Transportation, EWGT 2015, 14-16 July 2015,  
Delft, The Netherlands

## Interventions in bicycle infrastructure, lessons from Dutch and Danish cases

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### Abstract

Today the interest in cycling is increasing worldwide and in many countries authorities are faced with the question how cycling can be promoted efficiently. In the Netherlands and Denmark, this question came up already in the 1970s when the downsides of the rapidly increasing motorisation became evident. At the time, in both countries large scale interventions in bicycle infrastructure were introduced and evaluated extensively in order to create knowledge on efficient promoting of cycling in urban areas. The interventions included the construction of new bicycle routes on urban arterials in some larger cities and an area wide comprehensive upgrade of the bicycle network one medium sized city (Delft). The evaluations were based on before and after studies where in the case of Delft also a long-term after study was performed. The evaluations produced a wealth of information about the impacts of interventions in bicycle infrastructure on travel choices, safety, design appreciation, and other factors. These clarify under which conditions certain measures are effective or not and inform about the effectiveness of improving a single route versus upgrading a whole network. The information from the studies was used in both countries for formulating guidelines for road and bicycle infrastructure design. However, at that time the study results were not shared with the international scientific audience. The paper describes briefly the classical cases and the main study results.

The outcomes of the classical studies are compared with those of some more recent cases of assessed interventions in urban bicycle infrastructure in the Danish largest cities. Generally the outcomes are in line with those from the classical studies. This indicates that results of the latter are rather timeless and are likely to be still generally valid. In addition to studies that traditionally focus on dedicated bicycle infrastructure, two cases of shared space are discussed, a rather new type of intervention that assumes mixed use of infrastructure. One case is from Denmark, the other from the Netherlands.

The paper will so uncover the valuable results of the possibly largest evaluations of interventions in bicycle infrastructure ever made, verify these by examining more recent studies, and contribute to the discussion of shared space.

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Peer-review under responsibility of Delft University of Technology

*Keywords:* interventions bicycle infrastructure; bicycle promotion; travel behaviour; traffic safety; shared space

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## 1. Introduction

In countries all over the world a growing interest in the bicycle can be observed. There is an increasing acknowledgement that a shift from motorized modes to the bicycle relieves traffic problems regarding congestion and environment, and that cycling contributes to the fitness and health (Oja *et al.*, 1998). The importance of bicycle promotion is recognized in a number of European countries (ECMT, 2004) and the United States (U.S. Department of Transportation, 2010), and in many other regions initiatives are taken to raise the level of bicycle use. The higher interest in cycling generates demand for knowledge on effective bicycle promoting policy.

The Netherlands and Denmark, the two countries with the highest level of bicycle use in the western world (Pucher and Buehler, 2008), are credited with a guiding role. Phil Jones Associates (2014) report in their search for best practices for cycling infrastructure that “almost every authority we visited outside the Netherlands or Denmark explicitly stated that they had looked to cities in these countries for guidance on how they might grow cycling” (p. 16). In these countries, the acknowledgement that the bicycle is an important mode that should be promoted came up early, in the 1970’s, and gave cause for a number of sometimes extensive research projects. The projects gave a wealth of knowledge on design, travel behaviour, safety, and other aspects that are relevant for a good bicycle policy, and they are at the root of the current leading role of the countries regarding cycling. However, at the time it was no common practice to publish results in international journals, even if studies had good scientific standards, and dissemination to an international audience was almost lacking. Recently, the largest early Dutch projects were extensively described by Van Goeverden and Godefrooij (2011).

The paper aims to give a brief overview of the results of a number of the older classical studies in both the Netherlands and Denmark, to discuss the results of these studies in connection with those of later research in the two countries, and to indicate what policy makers can learn from these studies. Inclusion of some recent studies gives the opportunity to verify the current validity of the old results and to discuss a topic that became more recently subject of discussion: shared space. Shared space cuts across the general notion that cyclists preferably can use dedicated infrastructure, which was fed by the results of most of the early studies.

Section 2 outlines the development of political attitudes towards the bicycle in the Netherlands and Denmark, and the related demand for research. It also lists the case studies that are reviewed in the paper. Sections 3 to 6 discuss the study results by theme: travel behaviour, safety, appreciation of design, and economy. The concluding Section 7 summarizes the study outcomes and gives recommendations for enhancing bike-ability.

## 2. Bicycle research in the Netherlands and Denmark

After the rise of the bicycle in the 19<sup>th</sup> and first half of the 20<sup>th</sup> century in Europe, usage of this mode dropped in the 1950’s and 1960’s when the private car manifested a breathtaking growth. Whereas initially the policies supported and facilitated the rapidly growing motorization, in the 1970s people became aware of its downsides. The toll on the roads soared; the report of the Club of Rome noticed that growth has its limits; and the oil crisis in 1973 demonstrated that motorized transport is vulnerable. In some countries, including the Netherlands and Denmark, the policies changed dramatically in favour of the non-motorized modes (Pucher and Buehler, 2008). To create knowledge on efficient promotion of cycling, in the 1970s and 1980s in both counties a number of bicycle projects were implemented and evaluated. The Dutch national government funded the construction and extensive evaluation of two demonstration projects, new bicycle routes traversing the cities of Tilburg and The Hague, and contributed significantly to the funding and evaluation of the upgrade of the bicycle network in the city of Delft. In Denmark, there were several initiatives at the national level and particularly the cities of Copenhagen and Odense were active

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