



# Bicyclists' preferences for route characteristics and crowding in Copenhagen – A choice experiment study of commuters



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## ABSTRACT

Cycling as a mode of transportation is increasingly being advocated due to the many positive effects it has on people's health, the environment and to counteract increasing congestion on the transportation infrastructure. There is a long tradition of using cycling as a mode of transportation among the Danish public and this is widespread across people with different socio-demographic characteristics. Copenhagen has an extensive network of cycling facilities and is often used as a role model for other large cities when developing cycling facilities. This setting provides a unique basis for investigating bicycle commuters' preferences for route characteristics and crowding in particular, which is not studied before, but likely to become an issue around the world's cities with increases in number of bicyclists. The study is based on a choice experiment of 3891 active cyclists in Copenhagen. The investigated attributes are cycle track, crowding, stops, environment/road type, green surroundings, and travel distance which is used as a payment vehicle to gain more desirable route characteristics.

On average people state that they are willing to cycle 1.84 km longer if the route has a designated cycle track, and 0.8 km more if there are green surroundings too. Stops and crowding, based on number of cyclists on the route, have significant negative impacts on people's utility of a given route. People were willing to cycle one kilometre longer to avoid high levels of crowding and approximately 1.3 km longer to avoid routes with many stops. The most attractive road environment is a segregated path only for cyclists closely followed by shopping street. Looking into heterogeneity, we find that people who own a car have less disutility of cycling additional distance. The results may support future decision making when creating new infrastructure for cycling in cities by addressing the perceived importance of facilities and crowding in a population where commute cycling is very widespread.

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## 1. Introduction

Cycling is increasingly being promoted as a mode of transportation due to environmental concerns, health benefits, and to reduce congestion on the transportation infrastructure, especially in many large cities. One important task to reach a higher mode share of cycling is to create better infrastructure for cyclists (European Commission, 2011; Krizek et al., 2009; Forsyth

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and Krizek, 2009). Denmark has a long history of using bicycles for commuting, and Copenhagen is often used as a role model for other large cities across the world, when searching for ways to promote commuting by bicycle and developing sustainable infrastructure of cities (Gössling, 2013; Pucher and Buehler, 2008; Municipality of Copenhagen, 2013).

We investigate the implicit value commuters attach to specific route characteristics and road environments based on the travel distance they are willing to cycle to achieve a more desirable route. Data was gathered from 3891 cyclists in the area of Copenhagen, Denmark, through a web based survey including a stated choice experiment (CE). The facilities included here are presence of cycling track, crowding (with other cyclists), stops, road environment/road type, green surroundings and travel distance. The survey also collected information on travel behaviour, satisfaction with current facilities and socio-demographic information of the respondents in order to investigate potential systematic variation in preferences. An empirical model is constructed using independent socio-demographic and behavioural variables allowing us to assess the added distance people are willing to cycle to achieve or avoid different route characteristics.

In a comprehensive review of studies focusing on increasing the share of cyclists, Pucher et al. (2010) found that success requires an integrated approach consisting of many different types of interventions, among these it is of great importance to provide infrastructural changes which support commute cycling. This study adds knowledge on how to improve and target infrastructural changes based on what is important for cyclists.

Although Denmark has a strong culture for commute cycling, there is still much national focus on possible improvements of the urban infrastructure for cyclists. Commuters choose their routes from the feasible set of alternatives present today. Previous studies have emphasized the gap between routes that are desirable for cyclists and currently available routes (Winters and Teschke (2010)). Therefore a stated preference study is applied since it allows us to investigate the importance of route characteristics of which all are not necessarily available to the specific respondent today. Furthermore, the chosen approach allows us to investigate preferences in a setting where respondents are asked to focus only on the selected parameters. Thereby results are less likely to be affected by unobserved multisensory aspects which are difficult to control for city planners.

Sampling active bicyclists, in a city with a large bicyclist mode share, we are investigating a very experienced group of people with a likely well-defined set of preferences.<sup>1</sup> This provides valuable insights for urban planning and the design of infrastructure for cyclists in the future, not only in Denmark but also in other locations where, for example, crowding among cyclists is yet to become an issue. Consequently, the paper adds to this research gap also identified by Buehler and Dill, (2016).

## 2. Background and theory

The long historical perspective of using bicycles for commuting in Denmark provides a unique opportunity for studying commuters' route preferences in a 'nation of cyclists' where commute cycling is widespread across all socio-economics groups and people are likely to have well-known preferences for route facilities and characteristics. The municipality of Copenhagen – with a population of 594,000 (2016) covering 77.2 km<sup>2</sup> – is a city with a high mode share of bicycles; 35% of trips are made on bicycle which puts the city in the league of top biking cities of the World (Buehler and Pucher, 2012).<sup>2</sup> Since the first bicycle facility was developed in 1905 more than 350 km of cycling tracks have been constructed in the municipality of Copenhagen (Jensen, 2013). And it is a political intention to further increase the mode share of cyclists (Municipality of Copenhagen, 2013).

Across the world, commute cycling has been studied in many empirical settings within both transportation and health literature. Many studies focus on the mode choice between cycling and commuting by car or public transport, since the relative share of commute cycling is lower than the politically desired level in many cities (Buehler and Pucher, 2012). However, some studies have also investigated the route preferences of people who already commute by bicycle which is the main focus here. Early stated preference studies of cyclists' route choices, in a context similar to ours, took place in Delft in The Netherlands and showed that travel time was the most important attribute – in a study which also looked at traffic levels, facility types and surface quality (Bovy and Bradley, 1985). Stinson and Bhat (2003) and Bhat et al. (2015) also found that travel time was the most important attribute although the presence of cycling facilities (lane or paths) and level of car traffic were of importance too. Tilahun et al. (2007) investigated the trade-off between five different cycling environments and found that people were willing to cycle approximately 20 min longer to switch from a route with no facilities and on-street parking to an off-road cycling trail. In studies where respondents' choices are restricted to the available routes and facilities (e.g. revealed preferences studies using GPS trackers), it have been shown that people often do not cycle much longer distances compared with the shortest route (e.g. Menghini et al., 2010; Broach et al., 2012; Winters et al., 2010).

A few previous studies have also looked into potential systematic patterns in preference heterogeneity using behavioural and socio-economic variables. Some studies have linked people's cycling route preferences (and mode choice) with behavioural variables such as individual cycling confidence or experience with cycling for leisure (Caulfield et al., 2012; Willis et al., 2013). Studies also show that both experienced and inexperienced cyclists have large preference for basic facilities such as cycling lanes and off-road trails (Tilahun et al., 2007). Based on socio-economic variables, Tilahun et al. (2007) found

<sup>1</sup> Focus groups conducted before the survey also indicated this.

<sup>2</sup> The municipality the city of Frederiksberg (Population: 103.192 (2015). Area: 8.7 km<sup>2</sup>) is geographically embedded in the municipality of Copenhagen – is often regarded as part of the metropolis of Copenhagen, and also so in this study.

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