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# A naturalistic study of commuter cyclists in the greater Stockholm area

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ABSTRACT

Few naturalistic studies have been carried out with commuter cyclists to discover the types of problems they encounter on a daily basis. The study presented here has been commissioned by the City of Stockholm municipality and focuses specifically on commuter cyclists in the Greater Stockholm area. The aim of the study was to describe and pinpoint accessibility and safety problems, but also to generate an accessible geographical interface that could serve as a traffic planning tool for cycle network improvement. Statistical surveys in the Stockholm area have shown a rapid growth in the number of cyclists as well as an increase in problems associated with an overburdened cycle infrastructure. Given the heightened emphasis on transport system sustainability, the City of Stockholm is faced with the challenging task of trying to maintain and encourage the upward trend in commuter cycling through a process that involves problem identification, classification, prioritisation and resolution. An innovative methodology involving the use of GPS logging devices and small video cameras was developed and supported with analysis software designed specifically for the purposes of this study. Experienced commuter cyclists were recruited to cycle 17 different major cycle routes to and from the suburbs and inner city area during morning and afternoon peak traffic hours during the main cycle season. Over 500 safety and accessibility/mobility problems were identified and recorded from the data collected from 16 commuter cyclists. The method and representation of data proved successful for strategic traffic planning work at City of Stockholm and has since provided invaluable input for and the development of a new cycle plan for Greater Stockholm. Indirectly, the results of this work have also contributed to longer term safety and environmental targets.



## 1. Introduction

Cycling is a healthy and environmentally friendly form of transportation. Research has shown that those who cycle to work on a regular basis live longer and experience long-term health benefits (Andersen et al., 2000; De Hartog et al., 2010; Matthews et al., 2007; Hillman, 1992). Increases in the numbers of commuter cyclists are also considered beneficial from a sustainability perspective when this leads to a consequent reduction in the use of private vehicle travel and alleviates traffic congestion and pollution problems (Eriksson et al., 2006).

In larger cities, commuter cycling can also reduce travel-time compared to other transport modalities. Studies in Stockholm have shown that cycling is a competitive with car and public transport travel up to a distance of 10 km from the city centre (Eriksson et al., 2006). This is known to be one of the main reasons for the rapid increase in the number of cyclists during the last decade (Ericsson and Erson, 2004; Blomquist, 2010). Cycle counts in Stockholm have indicated that there are in excess of 150,000 cyclists, mainly commuters, passing the inner city border on a daily basis during the warmer half of the year (mid-April to mid-October). Furthermore, the number of commuter cyclists who cycle all year round, despite sub-zero winter temperatures, has also shown an upward trend according to measurements and observations by the City of Stockholm. The number of winter-cyclists is, however, relatively small in terms of absolute numbers when compared to statistics for the summer period.

Cycling is a popular form of transport in Scandinavia. In Sweden, the modal split for cycling is currently estimated to be approximately 9–10 per cent (SIKA, 2007a,b). This figure is, however, notably smaller than the neighbouring country of Denmark where levels approach 16 per cent (Cycling Embassy of Denmark, 2010). In Copenhagen (the capital city of Denmark), 35 per cent of all trips are made by cycle; the corresponding figure for Stockholm is slightly less than 5 per cent (City of Copenhagen, 2011; SIKA, 2007a,b). Statistics suggest that the upward trend in cycle use over the past decade has been sustained. Furthermore, there is little to suggest a future decline given the increasing cost of fossil fuels and uncertainty in the economic climate. It is also evident that political

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interest in cycling has grown in Sweden, perhaps most notably in the capital city of Stockholm, as indicated by a large-scale government investigation that will conclude in mid-2012 and the promise of substantial investments aimed specifically at the cycle infrastructure. It is anticipated that a focused planning and investment strategy will encourage a future shift from motorised transport in order to meet environmental targets and sustainable transport system growth (City of Stockholm Executive Office, 2007).

A study by Ericsson (2000) has shown that the average commuter cyclist in the Greater Stockholm area cycles slightly more than 9 km to his or her workplace, even during winter months when snow and ice is prevalent. Most commuter cycle trips are made during the main peak periods for commuter travel during morning and afternoon hours. Typically, these trips originate in the outer suburbs and pass through several different municipal areas. A known problem in Greater Stockholm is the lack of continuity in the cycle network between municipalities and largely varying design standards in the cycle facilities provided.

A review of the literature suggests that levels of infrastructure investment are a major factor in determining cycle use. Cities with large numbers of daily cyclists generally tend to have extensive, carefully planned and well-maintained cycle networks of good standard (Dill and Carr, 2003; Pucher and Dijkstra, 2003; Pucher and Buhler, 2008). The increase in cycling in Stockholm has not been matched by proportionate investments in the cycle infrastructure until only recently. As a result of local political directives and the lower prioritisation of cycle traffic, a larger part of the limited economic resources that were available were directed towards the maintenance and repair of the existing cycle network and facilities. Consequently, the increasing numbers of cyclists and lack of network expansion and general improvements led to cycle-congestion and safety problems at many locations within the inner city area. Growing recognition for these problems and the threat posed to the goals of existing environmental and safety strategies resulted in a number of long-awaited policy changes. Arguably, one of the most important developments is the strategic move towards a higher prioritisation of cycle and public transport mobility and the allocation of resources to make sustainable transport infrastructure growth possible (City of Stockholm Executive Office, 2007).

From a safety perspective, Stockholm has a relatively low number of fatalities in relation to the number of cyclists and the overall size of the cycle network. On average, approximately two cyclists are killed in traffic accidents in central Stockholm each year. In 2010, a total of 33 traffic fatalities were reported for the entire County of Stockholm with over two million inhabitants; only four of these were cyclists. A further 78 cyclists were severely injured (Swedish Transport Administration, 2011). At the national level, 21 cyclists were killed and a further 269 were severely injured during 2010 in road traffic accidents in Sweden. The actual numbers of cyclist injuries is unknown given the extent of under-reporting evident for pedestrians and cyclists in accident statistics (e.g. Elvik et al., 2009).

Although somewhat presumptuous, the "safety in numbers" hypothesis is often put forward by traffic planners at the City of Stockholm to explain the relatively low numbers of fatalities and serious injuries in the Stockholm area given knowledge of the population and number of cycle trips. The "safety in numbers" hypothesis in the context of cyclists (it is also equally applicable to pedestrians) is supported by a wealth of independent research from many different countries and suggests that the number cyclists killed or injured increases disproportionately than anticipated (i.e. at a slower rate) given the general increase in the number of cyclists (e.g. Jacobsen, 2003; Robinson, 2005; Elvik, 2009). The review of the "safety in numbers" hypothesis by Jacobsen (2003) includes, amongst others, several Swedish studies though none specific to Stockholm. A review of accident statistics in Sweden suggests that there are very few counties where the number of severely injured cyclist has actually increased since 1990. While Stockholm can be identified as one of the few exceptions, the 10 per cent increase is far less than the 80 per cent increase in the number of cyclists during the same period (SIKA, 2007a,b). This suggests that the "safety in numbers" hypothesis is plausible for the Stockholm area.

A number of relatively inexpensive measures have been widely implemented in Stockholm although the safety effects related to these are invariably inconclusive and unsubstantiated by robust follow-up studies. Such measures include the use of coloured cycle-lanes and cycle-boxes. Cycle-boxes are commonplace at junctions and entail a relocation of the stop-line for motorised traffic to a position 5 m further upstream in order to increase cyclist-awareness and improve visibility (Underlien, 2008a,b; Elvik et al., 2009; Hunter et al., 2000; Dill et al., 2010; Allen et al., 2005; Newman, 2002; Rodgers, 2005; Wall et al., 2003; Wallberg et al., 2010).

The City of Stockholm's need to conduct an in-depth study to identify and locate common problems for commuter cyclists led to a new project that was carried out by the authors. Most importantly, the project required the development of a new methodology in order to collect, analyse and represent commuter cyclist data according to the needs of the City of Stockholm. It was intended that the output generated from the project would serve as a basis for future cycle planning and investment prioritisation in the Greater Stockholm area. An inspiration for this project was a study undertaken in 2008 to determine bottlenecks in the transport network for motorised traffic (Kronborg and Davidsson, 2008). At the outset, the cycle-study was envisaged to focus predominantly on mobility and accessibility. However, it soon became evident that useful and important safety problems could also be identified at little extra expense.

The main goals of the project, and also the subject of this article, are summarised below:

- To identify the frequency and location of temporary and permanent accessibility/mobility and safety problems and their causes.
- To map and document these problems in a way that makes them easily accessible and useful to municipal traffic planners
- To provide an input for strategic cycle-planning to enable the development of new policies and strategies
- To enable traffic planners to gain a better understanding of commuter cycling and the problems faced by cyclists on a daily basis.

Based on the above goals, the authors developed a methodology and supporting software to facilitate the data-collection and analysis process, the overview and visualisation of problems and project documentation. The methodology proposed was built around the idea of being able to follow and document the trips made by commuter cyclists as closely as possible using video-recording equipment and GPS-logging devices.

When the study was initiated in March 2009, no other commuter cycling studies of a comparative nature could be found in the literature, the closest being the work of Dill and Gliebe (2008) which focused more specifically on route-choice. There is, however, other work that has explored the use of cameras in conjunction with cyclists and walkers. Perhaps the most prolific example is the award winning sociological study by Brown and colleagues (2008) that used head-mounted video-cameras to gain a deeper insight into the social lives of mountain bikers and walkers. Since the completion of the commuter cyclist study in Stockholm, a number of studies that have used similar methodologies have been carried out. These include the work of Brown and Spinney (2010) and also a naturalistic cycling study in Australia by Johnson and colleagues (2010) based on similar data-collection methods to study risk factors in cyclist collisions.