Summary

Analysing effects of infrastructure measures for cyclists in the cities of Oslo, Bergen, Trondheim and Stavanger using app data

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Authors: Aslak Fyhri, Tineke de Jong, Christian Weber & Espen Johnsson
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Creating better and safer cycle paths creates locally more cycling. An analysis of 36 measures in Norwegian cities show that streets that were received improved cycling facilities had on average 31 per cent increase in bicycle use, compared with the rest of the street network. TØI has collected data using a mobile app that records people's journeys in everyday life, and the results from these data have for the first time been used to provide better estimates to calculate the utility of investments for increased bicycle use. It is still not possible to say whether the measures lead to more cycling or if previous cyclists change their routes.

Background

There is a need for improved estimates of the effects of infrastructure measures for cyclists, among other things to give better input to socio-economic evaluations. The effect of measures for cyclists can be measured with different scopes, eg. traffic safety, sense of security, mode share and amount of cycling. In this report, we deal with the question of whether measures lead to more cycling.

The aim of the project has been to investigate whether we can use existing data sets to say something about the effects of infrastructure measures for cyclists in urban areas. It was desirable to have an overview of the amount of cycling on the relevant sections where measures have been implemented, as well as on alternative routes.

In the report, we first discuss possible data collection methods and their suitability. Then we examine the impact some selected infrastructure improvements has had on the bicycle use, using a given method (app data).

Methods to evaluate infrastructure measures for cyclist

TØI has since 1985 been responsible for the implementation of the national travel surveys (NTBS) in Norway. One challenge with this is that cycling constitutes a small part of people's daily journeys, and it is therefore not very suitable to say anything about changes as a result of measures. An alternative to NTBS is local bicycle surveys that have been carried out for the cycling cities. These surveys are aimed at cyclists, and are more suited to capture changes in bicycle use than the general NTBS. But not even these surveys have enough geographical sensitivity to evaluate individual infrastructure measures.

If there are permanent counters installed where measures have been implemented, they will be able to capture any changes in the bicycle use. In connection with infrastructure improvements, manual registrations or temporary counters are often used. Another approach used by TØI is the use of video data, possibly supplemented by automated analysis programs.

App technology is now increasingly used to record travel patterns. In the commercial market, there are both dedicated (active) training apps such as *Strava*, and more "passive" versions such as *Google Maps Timeline* and the discontinued *Moves*. These contain historical data that can tell if the distribution of cyclists has changed from before to after a measure.

As the basis for doing the analyzes in this project, we have chosen to use data from three surveys that TØI has carried out using the app Sense.DAT, in 2016, 2017 and 2018. In addition, we supplement these data with counting data from relevant counting loops, where such exists. We have looked at measures in Bergen, Trondheim and Stavanger, in addition to Oslo.

The first dataset comes from TØI's evaluation of Oslo municipality's subvention scheme for e-bikes in 2016. The data collection with Sense.DAT started on April 1 and ended on June 30. There were a total of 728 users (all trips) of the app, of which 707 were cyclists.

The second set of data came from a national collaborative project between TØI and a number of Norwegian bicycle towns, in order to increase the understanding of bicycle use in the cities. The project took place in September 2017, and there were data from 2295 app users in Oslo, Bergen, Trondheim and Stavanger that were used in the analyzes.

The third dataset came from the two Norwegian Research Council projects "Cycle to Zero" and "Push and Show". A total of 1148 had used the app Sense.DAT in the four cities.

The app Sense.DAT is a travel behavior app that maps route choices and mode choice. This is a "self-learning app" that records travel outside the house. The app uses the phone's positioning service to locate the mobile. The position may be determined by cellular network, wifi network and GPS data, or a combination of these. The measured positions are projected into an OpenStreetMap network.

The automatic categorization of travel modes is based on an algorithm that looks at the characteristics of the individual trip, such as speed and route selection. In addition, it can utilize several other sensors in the mobile phone, such as accelerometers. According to the supplier, the algorithm has an accuracy of 90 percent.

Procedure for analysis

An important part of the work on this report has been to prepare the data for analysis and to find a suitable analysis method.

The relevant road sections were drawn as polygons in a separate map layer in GIS. The data on cycling trips coming from the app are originally GPS points (these are so close that they appear as lines). These lines of bike rides were retrieved from the database to a separate map layer. The number of intersecting lines and the number of kilometers of lines were then counted.

The original method of polygons was in some cases found to give many errors in the number of passes. As an alternative method we therefore removed lines that covered less than 50 meters of the action polygon. This method in some cases removed over 50 percent of the passages, while the reduction in the number of kilometers cycled was below 10 percent.

In addition to polygons, we also tested a method in which we made counting sections that cover the entire width of the road at three points per section, at each end and approx. at the middle. Washing short trips has minimal significance when using counting cuts as a method (instead of polygons.).

In the report we have therefore chosen to use the method with polygons, combined with a washing of short trips. We report both the number of kilometers cycled and the number of passes.

To see how well the data we have collected with the app Sense.DAT fits with "reality" we have extracted data from Oslo municipality's permanent inductive loop counters for the same periods (May 2017 and September 2018) that we have used the app.

On average, 1.16 cyclists pass a counter measured with Sense.DAT for every 100 cyclists passing one of the municipality's counters. This is virtually the same in 2017 and 2018. But behind these averages there is a rather large variation in how well our counts fit the official figures for the individual streets. In some cases, the ratio is above 2, and it is not so that the streets have the same ratio from one year to another. This indicates that some of the differences we find at street level are not due to the infrastructure measure, but may random effects of changes in single individuals who have participated in the data collection.

An important lesson from this work is about the opportunities and limitations of using app data to evaluate measures for increased bicycle use. There are two factors that are important to consider in this context. First, app data are as vulnerable as traditional surveys for any sample bias, since it is necessary to recruit users to download and activate them. Although passive apps should theoretically be less vulnerable to skewed samples than active apps, we see that there is a pretty large drop off rate from recruitment survey to actual app usage. Secondly, there is the uncertainty resulting from geolocation of trips. All steps involved in the geolocation process involve possible sources of error. Most of these sources of error are random and will not be of great importance when the data is large enough. Both of these factors contribute to becoming vulnerable to any errors when breaking down data into smaller units. Based on these considerations, we find that overall or aggregated results are less sensitive to these sources of error than individual road sections.

The measures that have been evaluated

A total of 41 measures have been evaluated. The measures were grouped by city, since there are partly different measures in each city.

In Oslo, 27 sections with red asphalt, red asphalt combined with increased width, or new bicycle lane combined with removal of car parking were analyzed. In addition, five measures with bicycle thoroughfares were included.

In Trondheim we have looked at two case areas, the Innherredsveien and Olav Tryggvason's gate. Both of these measures were relatively simple measures, with little investment and fixed infrastructure. The Innherredsvei was nevertheless an extensive traffic intervention, where large parts of the car traffic were removed, and the cyclists got their own shielded bicycle lane.

In Bergen, we analyzed a separate bike path in Møllendalsveien. The route has a new sidewalk and a separate cycle path. At the time of data collection, it was almost finished, only a few short stretches were missing. The measure contributes to a first-class facility on the entire stretch from Solheimsviken to Møllendalselven.

In Stavanger, six sections were analyzed. Most of the measures were relatively extensive developments with separate bicycle facilities, or completion of large road improvements conducted in several stages.

How much did cycling increase?

In total, the measures that have been analyzed have led to an increase in cycling of 31 per cent measured as the number of kilometers cycled, and of 19 per cent measured as the number of passing cyclists. These figures are net increases, after we have adjusted for the total change in cycling that is registered with the app.

In Oslo, six of the ten streets analyzed during the period 2016 to 2017 saw an increase in bicycle traffic. During the period from 2017 to 2018, seven of the 17 streets had an increase in cycling. The measures with bicycle thoroughfares had a small growth (four per cent) in bicycle traffic compared to the rest of Oslo.

In Trondheim, all the measured sections had a greater growth in bicycle traffic than Trondheim as a whole. For Innherredsveien, the measure led to a doubling of cycling, measured as the number of kilometers cycled.

Also in Bergen, the measured sections had a much larger growth in bicycle traffic than Bergen as a whole. On average, the relative increase in Møllendalsveien is 158 per cent when measured as kilometers cycled and 137 per cent when we measure in the number of passes.

We found the largest increase on a single stretch on Møllegata in Stavanger, with a tripling of the number of kilometers cycled. Altogether, the streets that have been upgraded have had a relative growth of 88 per cent in the number of kilometers and 65 per cent in the number of passes compared to the rest of Stavanger.

In general, the most comprehensive measures have seen the largest increase. Another thing that characterizes the streets with the greatest increase is that they to some extent serve as a “missing link” in a network.

Therefore, we see that the measures we have analyzed in Oslo have led to smaller increases than the other cities. The measures included from Oslo are mostly measures that derives from the sitting city councils deliberate policy of conducting step-by-step interventions, where they do what they can achieve in the short term. If we had included some of the larger measures that have also been implemented such as the Ring 2 upgrade and Queen Eufemias gate, we might have found larger effects.

This report shows that many of the “small measures” have actually had an effect in them-selves. Whether this is a better strategy than focusing on a few, but major developments, cannot be answered by this analysis.