Measuring exposure for cyclists and micro-mobility users

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1 INTRODUCTION

Data about bicycle usage is an important input parameter for several purposes. They are used to describe changes towards more sustainable transport, and partly to say something about changes towards more active transport as opposed to passive modes of transport. Importantly such data are used as the denominator when calculating crash risk for cyclists. In Norway, as in most countries, these data are captured in several ways today. This is partly done by using data from the national travel behavior survey, partly using figures from stationary or mobile bicycle counters, and partly using other methods such as manual counts, etc. The technological development has provided several new opportunities to register such travel, in the form of more advanced stationary counters, advanced algorithms that interprets signal data, video recording solutions and app-based measurement systems.

At the same time, we see that development in the transport sector also creates new challenges. In just a few years, electric scooters have radically changed the traffic picture in cities and towns in Norway. There is therefore a need for more knowledge about different forms of ways to measure bicycle and micro-mobility use, their strengths and weaknesses, and what kind of strategies the authorities should have to be equipped to meet future changes in the transport field, as exemplified by the recent influx of e-scooters.

The current paper aims to respond to these challenges by answering the following research questions:

- What are the relative strengths and weaknesses of different data sources for measuring cycling and micromobility use?
- How well do the different sources function to capture micromobility and to differentiate between traditional cycling and micromobility?
- How can the different data sources be used as input for calculating crash risk for various forms of soft mobility (i.e. cycling and micromobility)?

2 METHODS

As a preparation for collecting and analysing empirical data, a scoping review as well as interviews with key stakeholders working with measuring cycling in Norway, Sweden, Denmark and the Netherlands were performed. The purpose of these was to give an account of State of the Art, recent advancements, as well as strategic initiatives for measuring cyclists and micromobility.

The study uses a variety of data sources to respond to these questions. The first is existing data from various travel behavior surveys. In Norway, national travel behavior survey (RVU) is conducted on a regular basis. The RVU has been conducted in Norway approximately every four years since 1984/1985. From 2016, continuous RVUs have been conducted, which only really got underway in 2018. That is, there are national travel behavior data for 1985, 1992, 1998, 2001, 2005, 2009, 2013/14, 2018/19 and 2020. Ruter (the regional Public transport provider for the capital region) has had rolling travel behaviour survey running since 2005, which also captures cycling and (potentially) micromobility (since 2019). Another survey resource is a number of studies more specifically aimed at capturing level of micromobility usage in the population in 2019, 2020 and 2020.

Data from Oslo city council's program of inductive counting loops (N=44), as well as the public road authorities' (NPRA) counters (N=4) are pooled and used as measures of cycling activity. For municipal data the number of counting stations included in the data material varies from year to year. In addition, data from municipal counters at locations in three other smaller towns were included.

The third empirical data source is data from series of studies using video recordings of traffic and annotated with the software program Road User Behaviour Analysis (RUBA), or manually. Video data was collected using a Miovision Scout camera. Data on traffic volumes were captured with RUBA software [1]. A presence detector created in RUBA provided a print screen every time an object crossed the detector. In final step, these print screens were manually sorted to distinguished between cyclists and e-scooters.

The fourth data source is data collected with a mobile phone app [2]. The app (Sense.DAT, Mobidot) is a travel behaviour 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, Wi-Fi network and GPS data, or a combination of these. 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 when identifying bike trips.

3 RESULTS

As an example of how well the different data sources are suitable for capturing micromobility and to differentiate between traditional cycling and micromobility we can look at two data sources, travel behavior surveys and inductive loop counters, and see how well these capture *changes in cycling over time* (figure 1). The data are indexed so that year 1 (2014) is set to the value 100.

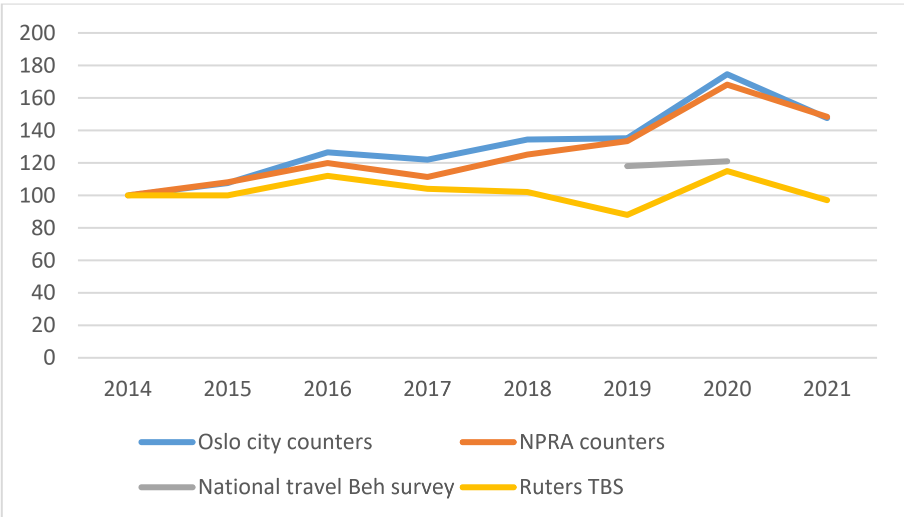

Figure 1 comparison of two counter sources and two survey sources for measuring cycling.

As we can see there are large discrepancies in the assessed increase in cycling is in Oslo is, depending on source. The inductive loop counters estimate an increase of up to 75 % from 2014 to 2020, whereas the increase is only 21 % according to the survey data.

Another analysis we have made is an assessment of how well an inductive loop counter (Eco Counter) performs as a counting device for cyclists and micromobility compared to a simple video-recording software (RUBA) .

Figure 2 shows the example of hourly numbers of detected road users in a bicycle lane during Thursday, June 2021 at one of five locations that are analysed.

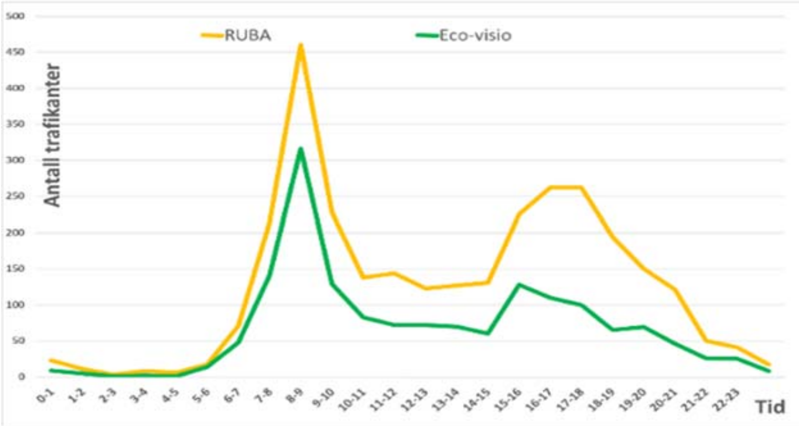

Figure 2 comparison of Eco Counter and video data for measuring and micromobility (Thursday, June 2021).

At this location on Thursday, Eco-Counter detected 53 % of all RUBA based detections from the video recording. The main reason for the large discrepancy is that Eco-Counter does not count e-scooters. If we only look at counts of cyclists, Eco-Counter still has a lower detection rate, as it detected 84% of the cyclists that RUBA counted. Sensitivity tests (using manually counts from video) under different traffic conditions and lightning conditions showed that RUBA was sensitive to these conditions, but that the performance was still well above acceptable limits –combination of RUBA and manual recognition of detections identified more than 99 % of cyclists and above 95 % of e-scooters in the most challenging observational times (night; rush hour).

When comparing app data with data from a travel behavior survey, the app recorded substantially more km, minutes and non-zero trip days than the one-day survey. On the individual level there was a tendency for the app to register modes not self-reported by the respondents for all modes except public transport, possibly indicating that the app captures trips that the user may have forgot or intentionally left out. For bike the Spearman correlations between app and survey registered (one-day) distances and durations were moderate ($r > 0.5$) or strong ($r > 0.8$) when based on observations that were non-zero in both data sources, and moderate or weak when based on all observations.

Further analyses, looking at different generations of counting loops as well more detailed accounts of how the various sources functions to capture risk exposure will be presented at the conference.

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