

Integrating Road Safety Data for Single-Bicycle Crash Causation

Julia Werneke, Marco Dozza

I. INTRODUCTION

In Sweden, more than 70% of all bicycle crashes are single-bicycle crashes [1], in which the bicyclist falls or collides with an obstacle, without any physical contact with another road user (e.g., vehicle, pedestrian, etc.). Despite this high share, very little research has addressed single-bicycle crashes thus far. Data used to investigate this type of crash to determine the circumstances, contributing factors and injuries are mainly from accident databases (e.g., STRADA [2]) and surveys [3-4]. However, it is also well known that single-bicycle crashes are highly underreported in accident databases [5]. As a result, only a limited understanding of the factors causing single-bicycle crashes can be achieved by continuing to query the accident databases.

The aim of the BikeSING project presented here was to pilot a new approach of exploring single-bicycle crashes by combining multiple road safety data sets. In addition to the two accident data sources mentioned above, five additional road data sets were considered. By combining such data, BikeSING was able to show how we can get a more complete picture of single-bicycle crashes and a better understanding of the contributing factors. As a first step in this project, multiple road safety data sets were analyzed to identify research questions related to single-bicycle crashes which each data set alone could not answer. Next, research questions and an analysis plan were developed. As a final step, a preliminary analysis showing the feasibility and potential of combining road safety data was performed. An extensive analysis plan was developed as a basis for a further project called BikeSING2.

I. METHODS

The seven road safety data sets used in the project were: 1) accident data from the Swedish Traffic Accident Data Acquisition STRADA, 2) insurance data from the Swedish If Insurance Company P&C Ltd [6], 3) naturalistic cycling data from Gothenburg [7], 4) subjective data (e.g., interviews), 5) exposure data from Göteborgs Stad, Trafikkontoret, 6) weather data and 7) the national road database in Sweden (Nationell Vägdatabas). Each data set was analyzed with regard to its accessibility, quality and potential to improve the understanding of the causation of single-bicycle crashes. In STRADA, which is based on police and hospital reports, information about time, place, demographics of (single-)bicycle crashes and their injuries is available. Thus, for example, analyses regarding when and where single-bicycle crashes occur most often over the day, season or year can be done. However, a detailed description of such scenarios as well as reactions and observations from road users involved are limited here. However, such information is often found in the files describing the accident in *insurance claims* [6]. This type of data, which is normally not used for safety research, contains not only detailed information about the circumstances of bicycle crashes but also enables access to single-bicycle crashes with minor injuries which are hard to find in accident databases. *Naturalistic cycling studies* overcome the limits of such post-crash data sources mentioned above by capturing the bicyclist's behavior *before* and *during* safety-critical events. Bicycles are instrumented with cameras and sensors to monitor bicyclists in their usual daily activities. This was done, for example, in the naturalistic cycling study from Dozza and Werneke [7], in which 16 bicyclists rode an instrumented bicycle for two weeks in the area of Gothenburg. In addition to safety-critical scenarios (incidents and crashes) with vehicles, pedestrians and other bicyclists, single-bicycle crashes were also found. *Interviews* conducted in this study with each bicyclist concerning these events enhanced the understanding of the circumstances and provided much more information than can be found in any other data sources.

The last three road safety data sets (i.e., exposure, weather and national road data) are not accident data but are useful to better understand factors contributing to single-bicycle crashes. For instance, *exposure* data from Göteborgs Stad, Trafikkontoret contain information about the number of bicyclists at different places around Gothenburg. Together with *weather* and *road characteristics* data, analysis regarding cycling volume and habits as well as risk of getting involved in single-bicycle crashes can be combined.

J. Werneke is a postdoc in Traffic Psychology (julia.werneke@chalmers.se, +46(0)76-768 2442) and M. Dozza is a senior lecturer and researcher, both in the Department of Applied Mechanics, Chalmers University of Technology in Gothenburg, Sweden.

With the evaluation of the different road safety data sets mentioned above, three main research questions for analysis of single-bicycle crashes were broken down in an analysis plan for a new project BikeSING2. The first research question combines STRADA and naturalistic cycling data to explore where and when single-bicycle crashes and incidents occur and their relationship. For example, with such analysis, black spots in Gothenburg can be detected. The second research question combines data from STRADA, If insurance, exposure and weather databases to better understand how cycling habits and cycling density influence single-bicycle crashes as well as how weather conditions affect cycling habits. The third research question combines all data sets to investigate which contributing factors (e.g., infrastructure, road surface, weather, interaction with other road users, etc.) make a single-bicycle black spot so dangerous.

II. PRELIMINARY RESULTS

In BikeSING, some preliminary analysis was done to prove the feasibility and potential of combining road safety data. In Figure 1, colored squares represent all single-bicycle crashes which were reported in STRADA from 2005 to 2012, geographically grouped. Red squares in Figure 1, including more than 4 single-bicycle crashes, suggest that in Gothenburg there are indeed a few black spots. By analyzing which factors are common across black spots and whether cycling dynamics (known from naturalistic data) are different in such spots, it will be possible to determine which factors contribute to single-bicycle black spots as such. In Figure 1, the orange pins show the geographical location of all safety-critical events collected in the naturalistic cycling study [7]. By comparing these two data sets it will also be possible to determine the relationship between single-bicycle crashes and incidents in Gothenburg.

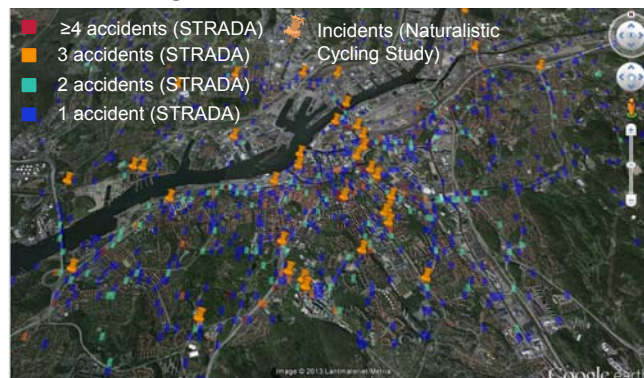


Figure 1. All squares: Single-bicycle crashes in Gothenburg from STRADA accident database. Red squares indicate black spots. Orange pins: Critical events from the naturalistic cycling study [7].

III. DISCUSSION

Combining different road safety data sets can answer new research questions which are not possible to be addressed with individual data sets. For instance, black spots for single-bicycle crashes can be identified and causation analysis for such black spots can be performed by combining incident and crash data. Thus, a better understanding of the factors contributing to single-bicycle crashes, the ones influencing cycling habits and the risk of getting involved in single-bicycle crashes can be achieved. This new knowledge can drive countermeasures development and infrastructure design to reduce single-bicycle crashes in road traffic.

IV. REFERENCES

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