Identifying E-Scooter Hazard Hotspots
Extended Abstract

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1. Introduction

In recent years, e-scooters have been introduced in many European cities. In several places we witnessed a rapid uptake of this new mode of transport mainly via public sharing schemes. After several incidents, injuries and even fatalities questions regarding the safety of these vehicles arose. These are mainly being researched using official accident data as well as data specifying injuries and hospital treatments. Till now, the focus of the research lays in investigating typical injury patterns and estimating risk levels. Only little is known about where exactly conflicts and accidents occur. Knowledge about hazard hotspots is crucial when aiming to investigate risk levels and improving the safety for all road users. Hence, this paper develops an approach to investigate locations with potentially dangerous interactions within the system of active mobility in the city of Berlin.

2. Methodology

The approach is shown in Figure 1. It contains different modules and combines qualitative and quantitative methods (Schreier & Odağ, 2020). First, expert interviews are conducted in an explorative pre-study to gain knowledge and to set the basis for the quantitative estimations. Second, a public online poll of users and non-users is carried out to collect detailed information on experienced conflicts. Third, a quantitative approach is performed based on three individual datasets to provide a longlist of potential locations. The first dataset are accidents recorded by the police (a). The second dataset are incidents recorded by a smartphone app (b). The third dataset are trip data of e-scooters generated from the sharing operator's API (c). For the identification of the e-scooter hazard spots, datasets (a) and (b) are clustered using the density-based spatial clustering of applications with noise (DBSCAN) (Ester, Kriegel, Sander, & Xu, 1996) algorithm. To calculate the route of every trip based on start and end location from dataset (c) through the Berlin road network in a shortest-path approach, we used the UrMo Accessibility Computer (Krajzewicz, Heinrichs, & Cyganski, 2017). From accidents and incidents, the clusters are sorted by the number of e-scooter traffic volume normalized by the length of the network inside the cluster that are suitable for bikes / e-scooters. Fourth, the qualitative expert workshop is hold to merge the results and condense the findings to a shortlist of hazard hotspots on the basis of the longlist.

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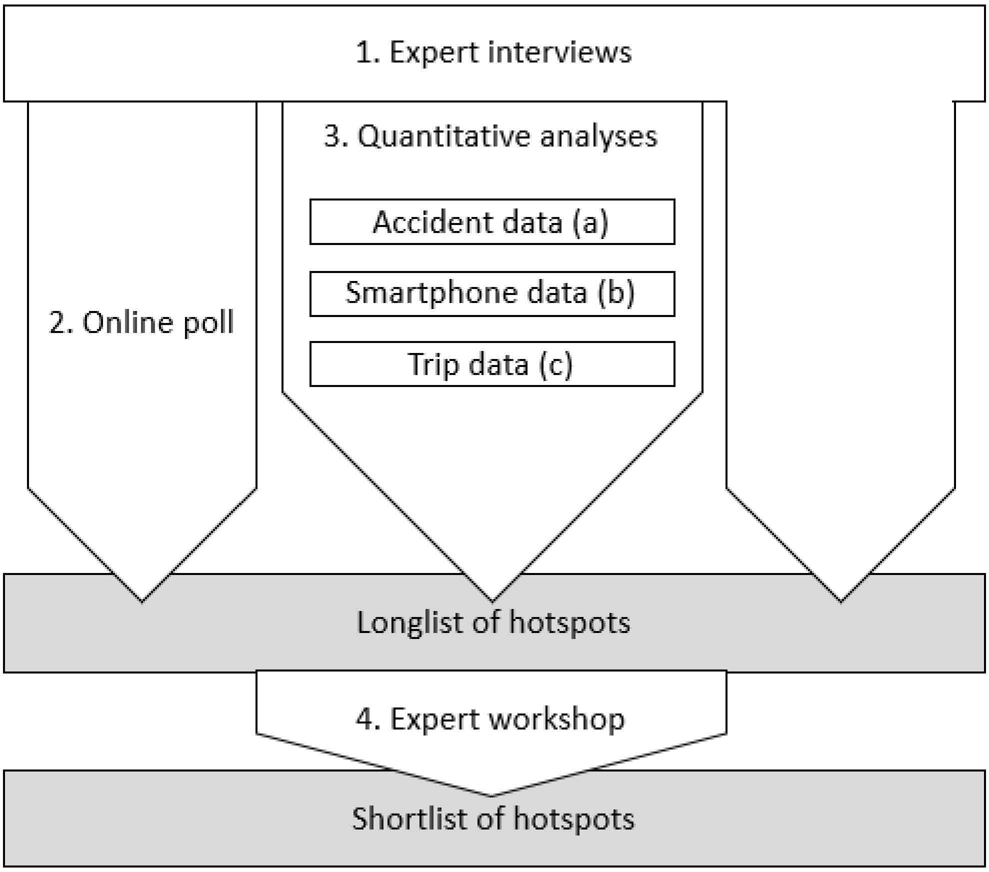

Figure 1: Methodological approach

3. Results

Each of the methodological modules delivers individual results. 13 expert interviews reveal characteristics of locations potentially causing conflicts like shared road spaces, places with many tourists, or large junctions in general. A total of 3,834 people participated in the online poll. The participants described conflicts from the perspective of pedestrians, cyclists, and e-scooter drivers. This allows for detailed analyses on the type and cause of conflicts as well as the characteristics of the locations where conflicts occur. From the clustering of quantitative datasets, the top 20 are selected as a longlist. The presented results are described the full paper in detail. Here we show the final results consisting of a short list of locations. These are selected in an expert workshop on the basis of the previous analyses. All locations selected for shortlist are shown in Figure 2, with accident clusters in red and incident clusters in yellow. All locations are located in the inner city of Berlin. As seen, at two locations accident and incident cluster overlay.

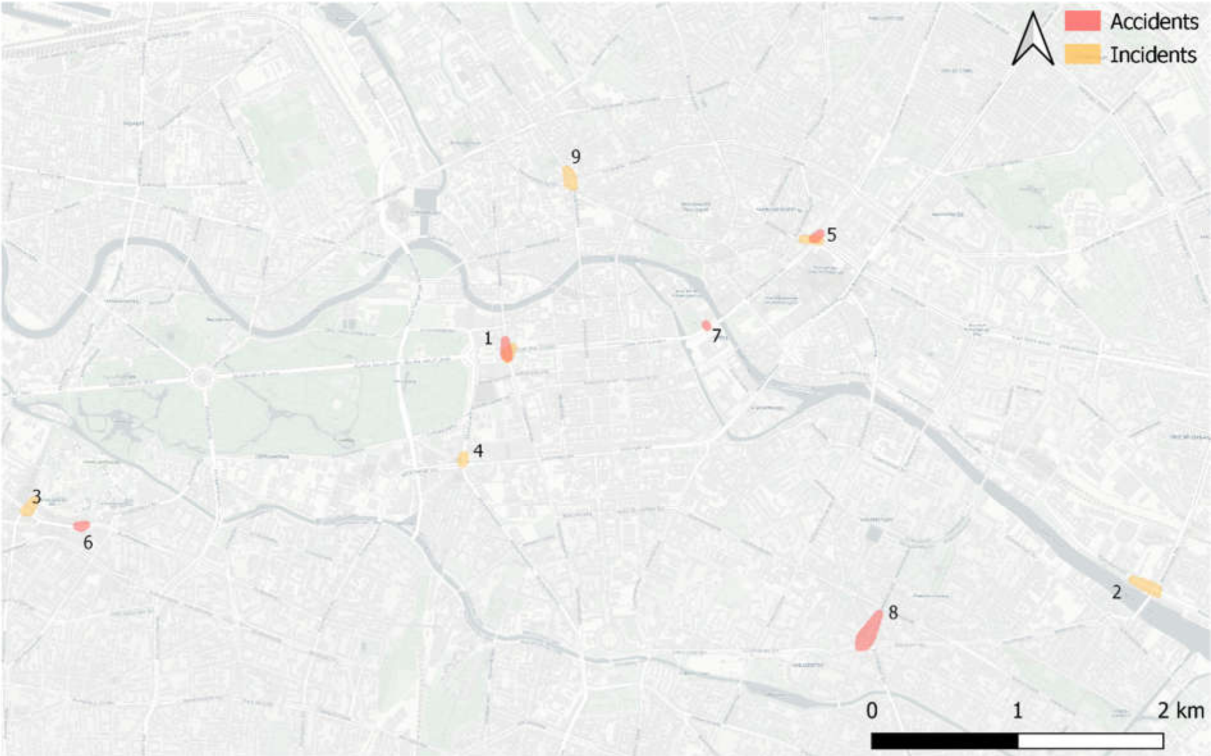

Figure 2: Locations of hazard hotspots in the city of Berlin

4. Conclusions

E-Scooters are a relatively new phenomenon in urban mobility. The present contribution demonstrates an approach for identifying hazard hotspots where conflicts and accidents between e-scooters and active modes of transport occur at a high risk. The main findings are as follows. First, a great many of conflicts with pedestrians are caused by parked and unused e-scooters. Second, as scooter trips are concentrated in the inner city and along specific routes, hotspots along these routes can be identified using data gathered by cyclists. Third, these hotspots are mainly located at large intersections and to a lesser extent along roads between junctions. Results show that the approach is suitable for the task and delivers the basis for further research.

Based on the results, we draw recommendations for future research as well as practice and planning. First, future research should focus on the identified locations and investigate the movements of scooters as well as interactions with cyclists and pedestrians e.g. using video analyses. This may add to the state of research which to date focuses on the analyses of reported accidents and injuries in order to evaluate the risk of the new type of vehicle. This research is currently conducted by the authors. Second, more data on e-scooters is necessary since the present approach uses mainly bicycle data and e-scooter data are available only most recently. Third, municipalities and operators need to address the issue of e-scooter parking. A great many of conflicts could be prevented by orderly parking. The full paper is submitted to the Journal of Traffic and Transportation Engineering. It includes a comprehensive introduction section, details about each component of the methodology and the according results as well as a discussion section.

Acknowledgment

The project was funded by the German Federal Ministry for Digital and Transport using resources from the National Cycling Plan 2020 (NRVP). We acknowledge all experts participating in the interviews and the workshop. We would like to thank Anton Galich for comments on the manuscript. Thanks also to the project partners Martina Hertel, Victoria Langer and Uta Bauer (Difu –German Institute of Urban Affairs) and Claudia Leschik (DLR Institute of Transportation Systems).

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