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From the Guest Editors: Mobile Phones, Travel, and Transportation

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Transportation researchers have used GPS data loggers as a supplement and replacement of pen-and-paper surveys since the late 1990s. The use of mobile phone data in transportation studies is more recent; early studies go back a decade or so (e.g., Caceres et al., 2007; González et al., 2008). However, the use of mobile phone data is increasing rapidly. GSM and GPS data generated by phones are used for analysis varying from determining the average speed at certain road sections to gathering revealed preference data of travelers regarding their travel behavior (e.g., mode and route choice). The majority of currently used tracking data is related to mobile phones as the majority of the population is using one, and mobile network coverage is extensive in most countries. Such mobile positioning data features much better geographical and temporal coverage than traditional surveys and counters. Traditional travel diaries and surveys cover only a few days or weeks and provide information about locations related to certain activities. Earlier research showed that traditional travel diary data inherently underreported mobility (see for an overview Schönfelder and Axhausen, 2010) as short-distance and infrequent trips were not reported. Passive GPS and GSM data avoids this bias and covers all of one's activities and can involve months or even years. The majority of such databases cover significant portions of population and longitudinal time periods.

However, this geospatial tracking data also have several shortcomings. For example, typical CDR (Call Detail Record) data include sparsely and irregularly collected points, which are not sufficient for determining the route, speed, and transportation mode. Smartphone-based data contain more information; however, the samples are smaller and the studies cost more. Dedicated smartphone apps can form an alternative data collection method to replace or assist traditional trip diaries. Dedicated apps are also becoming increasingly intelligent in providing user-specific travel advice and feedback, using data science techniques. This opens up opportunities for new research methods in which travelers can be asked for underlying motives and/or personalized incentives can be given while monitoring the choices.

Mobile phone-based data collection has developed quickly and despite the shortcomings involved it is used increasingly in science and practice. The trends here are similar to online surveys in sociology: even if traditional data are better and more reliable for the end-user, an increasing number of end-users require new and lower-quality data sources due to cost efficiency and data collection speed. This has resulted in the rapid development of the methods and tools related to space-time tracking data.

The biannual Mobile Tartu conference organized by the University of Tartu, Estonia, since 2008 focuses on theoretical, methodological, and practical aspects of mobile positioning-based applications. The NECTAR (Network on European Communications and Transport Activities Research) cluster ICT organized special sessions during the conference edition of 2016 on mobile phones, travel, and transportation. Seven of the 14 papers presented were selected for this special issue. Calabrese et al. (2014) gives an overview of the different data types available from mobile phone networks and the variety of studies using these data. These data offer possibilities to better understand mobility patterns. This has the potential to fundamentally change how insights about the use of a transportation system can be discovered. Research is still in development and currently two major streams of research can be distinguished: Using mobile phone location data to gain better understandings about (aggregated) mobility patterns and the use of (dedicated) applications for individual travel patterns. The selected papers show a similar distinction in these two streams.

Puura et al. show in their paper in this special issue that there is a significant relationship between individuals and their social networks and their spatial mobility and transport needs. Using Estonian mobile phone call graphs and CDR data, this research indicates that the larger one's network of calling partners using mobile phones and the larger the geographic area within which the calling partners live, the more an individual moves around. Research from van Vanhoof et al. (this issue) also investigates the use of mobile phone data to better understand travel patterns, although in this case focusing on the development of a methodology. In their paper the authors propose a correction of the Mobility Entropy indicator (ME) used to describe the diversity of individual movement patterns as can be captured by mobile phone data. They argue that a correction is necessary because standard calculations of ME show a structural dependency on the geographical density of observation points. Using this corrected ME revealed the role of car use in relation to land use, which was not recognized when using non-corrected ME values. The presented solution enables a better description of mobility at large-scales, which has applications in official statistics, urban planning and policy, and mobility research.

Two other papers in this special issue related to understanding mobility patterns focus on the use of mobile phone data to determine travel demand patterns and resulting link flows. Wismans et al. used CDR data to improve *a priori* demand estimates of transport models. They present an approach where mobile phone data are used and analyzed to enrich the transport model of the region of Rotterdam, and show that combining the strength of traditional methods with mobile phone data improves the demand estimation. Breyer et al. specifically focused on a method that aims to reconstruct routes through a transportation network from CDR data. Next to testing the validity by comparison with individual routes, the impact of different route estimation methods is investigated when employed in a complete network assignment for a larger city. Using an available CDR dataset for Dakar, Senegal, they show that the choice of the route estimation method can have a significant impact on resulting link flows.

Van Dijk and Krygsman investigated the use of a mobile phone app to collect individual activity spaces and the relationship to available opportunities for activity destinations and whether smartphone-based activity spaces can be used as a proxy for spatio-temporal accessibility. Conducting a case study with 150 participants at the University of

Stellenbosch, South Africa, they showed that smartphones potentially hold much promise to collect accurate individual-level data and that the incorporation of individual activity spaces may aid future travel behavior change interventions by considering opportunity densities. The research of Esztergár-Kiss et al. can be seen as a possible extension of this research in which actual personalized travel advice can be determined. They developed a method for the optimization of daily activity chains which can be used for personalized travel advice. By using flexible demand points, the method is capable of finding possible combinations and choosing the optimal set of activities. Simulations showed promising results for all transportation modes. The application of the extended method produced shorter activity chains and a decrease of travel time for the users. Thomas et al. performed research similar to Van Dijk and Krijgsman, but investigated the performance and use of a smartphone app for travel survey purposes. They compared the performance with traditional travel diary methods. Their findings show that there is strong evidence that smartphone-based trip detection helps to reduce underreporting of trips which is a common phenomenon in travel surveys, in particular for business and leisure trips which are often irregular. The rate of reporting also hardly decreased during the four week period, which is a promising result for the use of smartphones in long-duration travel surveys.

The use of mobile phone data in transportation research and the application of that research is still developing. Much research is being conducted to find proper ways of using these mobile phone data. The papers selected for this special issue provide interesting results relevant to the research community. The next direction this research might take is to integrate the two independent streams and then integrate them with other data sets. Such research might allow us to better understand the travel behavior of individuals and aggregations of travelers. For this purpose interdisciplinary research is needed, combining domains such as computer science, geography, communication, traffic engineering, and behavioral sciences. The NECTAR community welcomes new initiatives and is certainly willing to collaborate on organizing future workshops on this topic.

Finally, and sadly, in the final stages of the preparation of this issue, one of the guest editors, Rein Ahas, died unexpectedly at the age of 51. It is to him that we dedicate this special issue.

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