Analysis of naturalistic cycling data: Do cyclists on e-bikes behave differently than cyclists on traditional bikes?

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ABSTRACT

Cycling is a healthy, environmentally-friendly and enjoyable activity, which unfortunately also claims more than 2000 lives every year in Europe. Many municipalities across Europe are waging successful campaigns to increase cycling and, as a consequence, reduce pollution and congestion. Despite some simulation-based research claims that the increased cycling will not result in a proportional increase in road accidents, safety concerns are still legitimate. In fact, in the short term, a surge in cycling will challenge existing infrastructure, regulations, and the interaction among different road users. Further, cycling is changing as new electrified bicycles (e-bikes), able to maintain a constant 25km/h speed independent of road gradient or wind, become more and more prevalent. E-bike sales in 2012 were between 700,000 and 1,200,000 in Europe, twice as many as in 2009 and 8 times as many as in 2006. The extent to which e-bikes and their increasing prevalence impact safety is currently unknown and very hard to simulate with statistical models. In 5-10 years, accident databases may have some answers; however, waiting so long may incur significant costs.

Naturalistic data, i.e. data collected from road users while performing their daily routines in traffic, may be able to give timely answers to our safety questions while still anchored to the real world. In 2012, the BikeSAFE and BikeSAFER projects collected 1500 km of naturalistic cycling data from traditional bicycles. In 2013, the e-BikeSAFE project collected 1200 km of naturalistic data from e-bikes. All studies took place in Göteborg in the same period of the year, and as much as possible involved the same participants. While these naturalistic data are limited and possibly not representative of the cycling situation in all of Europe, they are also the most advanced data today available for comparing how traditional and electrical bicycles behave in traffic, thus offering a promising test bed for developing data analysis methodologies.

Since previous analyses in BikeSAFER indicated that interaction among road users is a key component for cycling safety, this study's analysis focused on how the cyclists interacted with other road users, including at intersections. Five random video clips were extracted for each participant from the data collected in BikeSAFE and e-BikeSAFE, forming an overall analysis database of 150, 30-s long, full HD, video clips. Video reduction identified which road users were involved in the interactions with the traditional and electric bikes. During the analysis, potential influencing factors (e.g. bike lane width, gradient, and curvature) were also taken into account. Intersections were also coded for presence of traffic lights, light status at the time of crossing, and intersection type. The coded information for e-bikes and traditional bikes was compared by means of odds ratios.

Results show that e-bikes and traditional bikes are ridden differently: cyclists riding e-bikes experience more and different interactions with other road users, and conform differently to regulations than cyclists riding traditional bicycles, possibly because of their higher average speed. These results suggest that e-bikes, especially if their popularity continue to increase, may create new challenges for infrastructure, regulations, and education to preserve and improve cycling safety.

Keywords: cyclist behaviour, naturalistic data, e-bikes, electrical bicycles, bicycle dynamics.