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Conflicts between bikes and trucks in urban areas—A survey of Norwegian cyclists

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ABSTRACT

Several challenges accompany the current growth of bike and truck volumes in urban areas, with traffic safety being one of the most critical concerns. Bike-truck accidents present a direct measure of the safety; however, these are rare events. Furthermore, accident records are subject to several shortcomings. Thus, safety studies should not rely solely on accident analysis, and conducting the additional methods is advisable (e.g. surveys or conflict analysis). This paper discusses the results of a retrospective survey of Norwegian utilitarian cyclists, which collected data about their involvement in conflicts with trucks in urban areas. An online questionnaire was disseminated within major cities in Norway, and 631 valid responses were analysed. The results revealed large numbers of conflicts experienced by cyclists, with the most frequent types of conflicts being (1) truck overtaking bicyclist and (2) right-turning truck vs. straight-riding bicyclist and. Visibility issues were frequently mentioned as the important risk factors. Almost all cyclists blamed truck drivers as the party responsible for the conflict. The distribution of conflict categories differed between major Norwegian cities, which corresponds with the findings of a previous accident analysis. Insights developed are useful to local policy makers both in Norway and abroad, when considering how to plan for increasing numbers of cyclists and trucks in urban areas.

1. Introduction

Urban cycling has been gaining significant political support in Norway. Policies have been introduced to encourage and motivate people to cycle, as it contributes to improving health, reducing the negative effects of car traffic, and creating liveable and vibrant cities. The current Norwegian National Transport Plan 2014–2023 has introduced a "zero-growth objective" referring to the use of private motorised vehicles (Norwegian Ministry of Transport and Communications, 2013). It states that the expected growth in urban passenger transport is to be made by public transport, cycling and walking. The Government aims to increase the cycling share from 4% (year 2013) to 8% by 2023, and set aside significant annual funding of NOK 0,82 billion (≈EUR 87 millions) towards implementing measures for cyclists and pedestrians. Given such objectives and funding, it is possible to expect a growth of cycling in urban areas, as described e.g. by Pucher et al. (2010).

Meanwhile, the number of kilometres driven by heavy trucks in Norway increased by 5.3% in the period 2011–2016 (Statistics Norway, 2017a), and further growth is expected, particularly on short distances (Norwegian Ministry of Transport and Communications, 2013). Although numerous innovative city logistic concepts (e.g. urban consolidation centres, off-hour deliveries, bicycle deliveries, crowdshipping) that could reduce freight traffic in the cities, the structure of urban areas is such that trucks are highly likely to be the dominant delivery mode for the foreseeable future (Jaller et al., 2013). Moreover, longer and heavier vehicles are expected to be more frequent on the road network (Norwegian Ministry of Transport and Communications, 2013). One of the consequences of this development is that cyclists and trucks are sharing urban roads more than ever, which increases the risk of potentially fatal accidents (Davis and White, 2015).

Based on several road safety indicators, Norway is considered one of the safest countries in Europe (ETSC, 2016). The Norwegian safety policy is grounded on Vision Zero approach, which implies that all the traffic safety work should be based on a vision of no fatal or serious injury accidents. Nevertheless, cyclists are facing considerably higher risk in traffic than passengers of motor vehicles (Elvik, 2009). According to the Norwegian Public Road Administration's accident database, STRAKS, 65 cyclists were killed and 6032 suffered an injury in road accidents in urban areas between 2000 and 2014. The frequency and characteristics of accidents between cyclists and motor vehicles are influenced by variety of risk factors and their combinations. These

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factors relate to humans, infrastructure, environment and vehicles. The most common are age, gender, type of infrastructure and intersection, mass and speed difference between a cyclist and other vehicle/s, visibility, weather, inattention, unpredictable behaviour, errors in decisions, reactions or observations (Kim et al., 2007; Bjørnskau, 2005). The frequency of cycling, particularly the number of encounters between cyclists and motor vehicles have an effect on accident rates, too, because of the negative relation between exposure and risk (Elvik, 2015).

Focusing on truck-bicycle accidents (referred as TCA further in the text), a total of 271 occurrences were recorded by the Norwegian police in the period 2000–2014, with 27 cyclists fatally injured. Further, the majority of TCA (80%) and TCA fatalities (85%) were recorded in urban areas. The share of fatal TCA in all fatal cycle accidents in urban areas in Norway (35%) is one of the highest in Europe (Evgenikos et al., 2016). Urban TCA in Norway typically occur at intersections, under low-speed manoeuvres of trucks, during working days and working hours, under good weather-visibility conditions (Pokorny et al., 2016). Existing literature has highlighted that numerous characteristics of TCA are different from other types of bicycle-motor vehicle accidents, particularly regarding the environment of fatal accidents, accident scenarios, severity of consequences, the role of speed, visibility, age and gender of cyclist. While the majority of fatal cycle accidents occurs in rural areas, most of the fatal TCA were recorded in urban areas. TCA are typically very severe – the fatality rate of urban TCA in Norway is more than ten times higher compared to other urban bicycle accidents (Pokorny et al., 2016). This corresponds with findings from the UK, Germany, Denmark or China (Niewoehner and Berg, 2005; Ming et al., 2014; Kaplan et al., 2014). The high severity level of TCA is usually attributed to the mass differences between a vulnerable bicyclist and a truck (Kim et al., 2007), while the speed of a truck is not considered as a significant risk factor (Volvo Truck, 2013). Turning accidents, and particularly those associated with limited visibility around a truck (so-called blind spot accidents), are regarded as the most serious and frequent type of TCA (Johannsen et al., 2015; Seiniger et al., 2015). Female cyclists were found to be overrepresented in TCA (Niewoehner and Berg, 2005; Frings et al., 2012). Specifically in Norway, females were involved in 48% of fatal TCA in urban areas in the period 2000–2014, while regarding other fatal urban cycle accidents, the percentage was 20%. The significant difference was also found for non-fatal accidents (40% vs. 20%). Frings et al. (2012) suggest that gender differences in risk perception could explain this phenomenon. Cyclists involved in TCA are spread over all age groups (Niewoehner and Berg, 2005) and this is true for Norway as well (Pokorny et al., 2016). However, Norwegian data show that older cyclists (over 60) were involved in 10% of urban TCA, while their share in fatal TCA was 26%. This difference suggests the well-known effect of older age on accident severity, mainly because of the human body's increasing vulnerability. Furthermore, age has been shown to affect cyclist behaviour, as older cyclists appreciate pedestrian crossings, signalized intersections and cycle paths significantly more than do younger cyclists (Bernhoft and Carstensen, 2008).

To reduce the risks involved in encounters between trucks and cyclists, it is necessary to have the sufficient knowledge about those encounters, their types and the risk factors involved. Studying TCA is an obvious approach to obtain such knowledge, as accidents are a direct measure of safety and the data are relatively accessible. However, relying solely on accident analysis cannot provide sufficient knowledge (Juhra et al., 2012), as accident data suffer from several constraints. First, TCA are rare events, which makes their statistical analysis challenging (Pokorny et al., 2016). Second, data about accidents involving cyclists suffer from a significant level of underreporting, which depends (amongst others factors) on accident severity (Kaplan et al., 2017). Regarding Norway, it was estimated, that the probability of reporting a bicycle accident is 12% for minor and moderate injuries, 33% for serious injuries, 71% for severe and critical injuries and 100% for fatal injuries (Veisten et al., 2007). As TCA are typically more severe than other bicycle accidents, their level of reporting is probably higher; however, a proportion of TCA is certainly missing in official statistics. Third, the absence of certain data and inconsistency of reporting of TCA were identified within the Norwegian police database (Pokorny et al., 2016).

To compensate for these limitations, the analysis of surrogate measures of safety, including conflicts, has been recognised as an alternative to accident analyses. A conflict is understood here as "an observable situation in which two or more road users approach each other in space and time to such an extent that there is a risk of collision if their movements remain unchanged" (Amundsen and Hyden, 1977). The impact of conflicts are associated not with physical harm but can act as a significant psychological deterrent for future cycling (Jachyra et al., 2015; Sanders, 2015), as cyclists are experiencing conflicts in traffic on daily basis and the involvement of trucks in those conflicts is associated with a significant increase of fear (Aldred and Crosweller, 2015).

The current knowledge about traffic conflicts involving cyclists and other vulnerable road users (also referred to as near-accidents or near-misses), was recently summarised by Johnsson et al. (2016). Several methods exist to collect and analyse conflicts, i.e. recording (observing) road users' behaviour and consequently identifying the conflicts based on different criterions, using traffic diaries or conducting face-to-face interviews and surveys. Only a few studies have focused on bike-truck conflicts specifically. For example, an observational study from the US (Conway et al., 2013) analysed conflicts on three different configurations of parking and cycle lanes in commercial areas of New York City. During 92 h of observation, 35 conflict events were recorded.

This paper explores truck-bicycle conflicts from a cyclist perspective within the context of Norwegian urban areas through using a retrospective questionnaire survey. The objectives of this study were to identify the types of conflicts cyclists are experiencing in Norwegian cities; to explore the associations between the conflict types and various background variables, and, more generally, to contribute to filling the knowledge gap regarding truck-bicycle encounters, particularly conflicts.

2. Methodology

A retrospective questionnaire survey was performed focusing on cyclists' involvement in conflicts with trucks, as this type of study design is considered to be appropriate for assessing the interrelation between bicycle safety and infrastructure (Vanparijs et al., 2015). A conflict between a cyclist and a truck was described to respondents as any situation where a cyclist almost collided with a truck, but due to the reactions of the cyclist and/or driver (braking, suddenly changing direction etc.), no accident occured, the cyclist having merely been threatened. This "user-friendly" definition is a modification of the classical Amundsen and Hydén definition mentioned previously. Referring to the survey, a truck was defined as a large road vehicle used for carrying or pulling goods or materials.

2.1. Design of the survey

The survey "*Interactions between bicycles and trucks from a cyclist's perspective*" was designed as an online questionnaire with nationwide coverage. The target group included the adults cycling regularly in Norwegian cities for utilitarian purposes, as those were identified from an accident analysis as being the most common type of cyclists involved in TCA (Pokorny et al., 2016). The questionnaire consisted of four sections. Section 1 contained compulsory questions about background variables. Section 2 collected data about conflict types experienced with a truck during the previous 12 months. Depictions of 18 conflict types were presented here and accompanied by their written description. Respondents could mark numerous conflict types they had experienced within 12 months, describe their most recent conflict type in more details or note that they had not experience any conflict at all. Section 3