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Editorial

Safety Science Special Issue on Cycling Safety

This Special Issue of Safety Science is dedicated to Cycling Safety. In Europe, and in many other countries all over the world, bicycle use is growing. An increasing number of commuters choose to ride a bicycle instead of driving a car, because of health benefits and fuel savings, environmental awareness, or simply a shorter travel time. Public authorities at all levels foster this new trend by promoting cycling as a solution to mobility and pollution concerns. Regardless of the reasons for its renewed popularity, cycling is a relatively risky mode of transportation, so cycling promotion should also include interventions for crash-risk reduction. Scientific research is needed to better understand the crash risks and design appropriate interventions. This research can benefit from decades of research on motorized vehicle safety. Thus, research on cycling safety can advance very rapidly if enough funding is made available.

Across Europe, cyclists account for 10–15% of all urban road fatalities every year, showing a relative increase in bicycle crashes in the last few years. In addition, crash databases show that cyclists are among the most frequently injured road users. Although a safety-in-numbers mechanism (by which the number of crashes increases less than proportionally with traffic volume) may lower the relative risk of bicycle crashes, concerns about the future of cyclists' safety are legitimate. Furthermore, the European cycling population is aging, so that the same type of crash could result in more severe consequences over the years. In addition, new bicycle types, propelled electrically or testing new geometries, are increasingly popular. These new bicycles may change cycling itself, challenging the safety-in-numbers assumption and creating new potential hazards for cyclists, especially in their interactions with other road users.

Today, research on cycling safety is responding to growing societal concerns. Even in the Netherlands, which has a long history of cycling and a low crash risk for cyclists compared with other countries, the increased number of seriously injured cyclists in traffic has raised serious concerns about cycling safety. Municipalities and provinces, supported by the initiatives of the Ministry of Infrastructure and the Environment, are increasing their efforts to improve cycling safety. However, to support these efforts, research on cycling safety needs to address a substantial number of research questions, especially in light of the new safety solutions enabled by intelligent technologies. Research on cycling safety is being increasingly undertaken across the world, including in countries such as China, where cycling is actually decreasing but still creates major safety concerns. Not only does cycling safety research lag behind vehicle safety research, but it has perhaps even been hampered by it, because vehicle safety research prioritizes risk reduction for car occupants and does not always consider other road users. Since mass motorization started, urban infrastructures have been modified to facilitate motorized-vehicle mobility, sometimes at the expense of pedestrians and cyclists.

Although bicycle crashes are largely underreported in official statistics (more so than any other mode of road transport), crash databases provide some very interesting insights into the prevalence and possible causes of bicycle crashes. In many European countries, single-vehicle crashes (i.e. crashes in which the cyclist did not collide with any other road users) are the most common crash type; nevertheless, it is in crashes with motorized vehicles that cyclists experience the most severe consequences. Unfortunately, crash databases provide very little information about cyclists behaviour and their interactions with other road-users, especially just before a crash happens.

Rider control and other aspects of cyclist behaviour are still poorly understood and scientific knowledge plays little part in the decision-making on infrastructure design and policy. Nevertheless, naturalistic studies are very promising for describing and understanding the behaviour of cyclists (and other road users). For instance, the effects of passive safety solutions such as helmets can only be assessed if we know whether cyclists actually wear them (properly). Furthermore, current research suggests that cyclist impairment (e.g. alcohol, drugs, and fatigue) and distraction (e.g. using mobile phones while cycling), which are not well documented in police and hospital records, are a growing concern. Finally, although single-bicycle crashes are the most common crash type, the extent to which poor interactions with other road-users contribute to these crashes is still unknown. These are three areas of cycling safety where we lack scientific knowledge.

Research on cycling safety is not a mature field nor does it have a strong tradition, with the possible exception of traditional "cycling countries", such as the Netherlands and Denmark. Perhaps as a result, the research framework for cycling safety research is, generally speaking, not well established. To foster and improve this research field, research groups composed of some excellent (experienced) researchers must be identified, research programmes must be defined, and communication between researchers and other stakeholders must be increased in order to provide new, ongoing funding opportunities. Furthermore, it is not yet well established what road safety data would be most useful for cycling safety research and which tools should be used for their analysis. Quantitative and qualitative data on bicycle crashes and normal cycling are necessary for modelling cyclist behaviour and determining how cyclists can safely interact with other road users and the infrastructure. Data from instrumented bicycles and infrastructure may be particularly important because they record cyclist behaviour in a naturalistic fashion. On the other hand, data from

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a bicycle simulator would be crucial for repeatedly testing critical situations, as well as assessing new infrastructure solutions without having to build them. More traditional crash data from police reports could be combined with hospital data, exposure data, and other sources, to provide a reliable estimate of crash risk and its contributing factors.

In the near future, we expect that cycling will continue growing in popularity while substantially changing. Novice cyclists will hit the road while the cyclist population as a whole will age, along with the rest of the European population. Moreover novel (intelligent) infrastructures, different bicycle types, (semi-) autonomous vehicles, and intelligent systems will contribute to a new cycling experience. These changes promises huge benefits for society: less polluted, noisy, and congested cities; healthier population; and reduced consumption of non-renewable fuels. The challenge of cycling safety research is to assist this (r)evolution by decreasing fatalities, injuries, and distress.

The Cycling Safety research community is committed to making a substantial contribution to reducing crash and injury risks for cyclists on our roads. The main topics on the research agenda include bicycle-crash causation, cyclist behaviour (including aging, impairments, distraction, and modelling), the design and evaluation of solutions for crash and injury prevention (including protective systems, education, and legislation), urban planning, and infrastructure design and evaluation. Particularly promising are the future opportunities that intelligent technologies offer for cycling safety. Crowdsourcing data collection from small computers and smartphones, which can collect data ubiquitously in real time, promises to increase our knowledge about bicycle crashes (currently underreported in official statistics). Wireless communication will soon connect cyclists to the infrastructure and other road users, offering a new opportunity to investigate and condition road-user interaction. Finally, advances in modelling of the rider-bicycle joint system will enable cycling safety analyses in virtual environments.

The ten contributing papers in this Special Issue were selected from the more than 50 scientific papers and 20 posters that were presented at the third International Cycling Safety Conference (ICSC2014). The conference was hosted by SAFER, the vehicle and traffic safety centre at Chalmers University in Göteborg on the 18th and 19th of November, 2014. The first International Cycling Safety Conference, in 2012 in the Netherlands, was organized to create a forum for researchers in the field of cycling safety (www.cyclingsafety.net). This was a Dutch initiative of the Ministry of Infrastructure and the Environment, TNO, Fietsberaad (Dutch Centre of expertise on bicycle policy), SWOV Institute for Road Safety Research, and Delft University of Technology. In 2013, the ICSC was again organized in the Netherlands. To live up to its international ambitions, the ICSC took place in Sweden in 2014, with the intent to hold the conference in a different country every year. After selection, all papers underwent the regular review process of Safety Science. The papers make use of data from a variety of sources: crash databases (from police, hospitals and insurance companies), field trials, and naturalistic studies. They cover a broad range of topics, including crash causation and its relation to cyclist behaviour, the interaction between cyclists and motorists, single-vehicle crashes, and the historical background of the current goal of a high level of cycle safety. Two papers make use of databases to study crashes, Elvik (2017) conducted a meta-analysis and Isaksson-Hellman & Werneke (2017) exploited registered insurance claims. Ohlin et al. (2017) and Olofsson (2017) both used emergency hospital reports to assess helmet safety. While Ohlin et al. (2017) studied the combined effect of motorized vehicle design and helmet use, Olofsson calculated the number of injuries prevented by helmet use in children. LLorca et al. (2017) investigated the lateral clearance between cyclists and motor vehicles, and motor vehicle speeds during overtaking manoeuvres in the real world and Petzoldt et al. (2017) addressed drivers' gap acceptance when negotiating a crossing with an approaching bicycle in a field study. Using game theory, the discrepancy between cyclist behaviour and traffic rules is researched in the paper by Bjørnskau (2017). The paper by Dubbeldam et al. (2017) addresses single-vehicle crashes by studying the different ways in which young and old cyclists mount and dismount a bicycle. Schleinitz et al. (2017) obtain novel insights on electric bicycles safety and e-cyclist behaviour from a naturalistic study in Germany. Finally, the paper by Schepers et al. (2017) has a more historic approach, and explores how the Netherlands achieved the current high level of cycle safety.

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