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Traffic Safety

Definition: Research on traffic safety is produced across the social sciences, medicine, engineering, and planning. As a consequence of this multidisciplinarity, the type of contributions and the tools and methodologies applied are very diverse. The overarching theme is research into the causes of road traffic injuries (RTI) with the primary goal of their reduction and the creation of a safer transportation environment for all road users, including car & truck drivers, passengers, pedestrians, cyclists, and motorcyclists. Topics include law enforcement, road design, vehicle engineering, driver behavior, and educational campaigns, among others. Traffic safety can be viewed as one of the most important aspects of transportation research.

History: The evolution of traffic safety research is closely tied to the rise of motor vehicles in the 20th century. As the number of cars rose, there was a concomitant increase in fatalities, which in turn put governments under pressure to counteract with safety measures. Initially, the focus was on controlling vehicle speed and improving driver behavior through laws and education. The mid-20th century saw the introduction of seat belts, traffic signals, and strict drunk driving laws. The last decades have been marked by technological advancements in vehicle safety, such as airbags and anti-lock braking systems, and the development of sophisticated road infrastructure to manage increasing traffic volumes.

Theory: Utilizing the concept of Haddon's matrix (1968), road safety interventions can be viewed as the interaction of human, vehicle, and environmental factors with three separate phases: pre-crash, crash, and post-crash. This concept has subsequently been enhanced by the Safe Systems approach, which emphasizes the importance of institutions and policy measures (see, e.g., Goel et al., 2024, and references therein). A classic reference for road safety measures is Elvik et al. (2009).

The crucial element is the correct measurement of accidents. High-income countries have developed appropriate crash reporting systems in the second half of the 20th century. In most low and middle-income countries (LMICs), however, official reports are still largely unreliable. The two major products trying to bridge this gap are the Global Burden of Diseases (GBD) study and the Global Status Reports on Road Safety (GSRRS). Even though there exist large discrepancies

between these estimates, a consensus figure is that around 1.3 Million people die annually due to RTI, more than 90% of which are in LMICs.

Estimates for the annual economic cost for LMICs of road fatalities and severe injuries, including the lost future output of those affected, range between 3 and 7 percent of GDP, depending on the country. These are produced by the World Bank, based on GBD and GSRRS, and rely on assumptions that not all researchers agree with, however.

Conceptualization: A scientific approach to control RTI has been developed in high-income countries over the last several decades (see, e.g., Goel et al., 2024, for a comprehensive treatment). These more conventional studies have recently been complemented by work that applies tools from causal statistical inference. It has been demonstrated, for example, that simple behavioral nudges can be helpful (Habyarimana & Jack, 2015), that traffic enforcement has a deterring effect (DeAngelo & Hansen, 2014), or that the growing vehicle size - especially salient in the US - has detrimental effects (Anderson & Auffhammer, 2013).

Because a large part of RTI are due to drunk driving, strategies for optimal crackdowns have been developed (Banerjee et al., 2019). It has also been suggested that the presence of ride-hailing services can reduce traffic fatalities during evenings and weekends (Anderson & David, 2023).

A big issue is that most studies are conducted in high-income countries, while most deaths occur in LMICs. Results are not necessarily transferable due to a different infrastructure and because the vehicular mix is different in LMICs with a large presence of pedestrians, motorcycles, cycles, and buses (Bhalla et al., 2020).

New Developments: Novel developments in traffic safety research include the integration of advanced technologies to utilize the large amounts of data that are being created by smartphones and traffic surveillance systems. For example, vast data from ride-share trips makes it possible to assess features of road segments (Currier et al., 2023). The even larger flow of data generated by autonomous vehicles will increase possibilities further, including the study of the impacts of these vehicles themselves. Another promising avenue is the usage of sensing technology - e.g., via smartphone cameras - to monitor driver behavior, which has also a promising application in LMICs for the automation of the driver's licensing process (Nambi et al., 2018).

Policy Relevance: Deaths from RTI in high-income countries have steadily decreased and currently hover around 5 deaths per 100,000 inhabitants. An exception is the USA, where pedestrian fatalities have almost doubled since 2010, back to their levels from 1980 (Governors Highway Safety Association, 2022), and traffic deaths overall experienced an unusual increase starting in 2020 to around 13 per 100,000. Road fatalities are thus on par with deaths from gun violence while also being the leading cause of death for young adults. Road safety can, therefore, be classified as a public health crisis in the US.

Also in many LMICs traffic deaths are on the rise. Globally, road deaths are among the top 10 causes of health loss (GBD). The United Nations treat road safety as an explicit Sustainable Development Goal (SDG3.6).

Application Fields: Traffic safety research has wide-ranging applications in regional, national, and global contexts. It informs the design of safer vehicles. In urban planning, it guides the development of road layouts and traffic management systems. Public policy and political science research laws and their enforcement to reduce dangerous behaviors like speeding and impaired driving. The medical sciences do research to improve post-crash care. Recently, there has been an increased interest by quantitative social scientists and urban & transport economists who apply tools from economic modeling and (causal) statistical inference to investigate the causes and consequences of RTI.

Prospect: Given that most traffic deaths are located in LMICs, researchers need to shift efforts in this direction (see e.g., Goel et al., 2024). A necessary condition for this to succeed is the creation of institutional crash-reporting systems (Bhalla, 2020). Going forward, it is also paramount for research to be more effective in convincing policymakers to implement measures that have been proven to work.

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