International Transport Forum | CPB Corporate Partnership Board

Project workshop
March 7-8, 2023

Micromobility: "Back to the Future"
Session 4: Safety & health performance of micromobility

George Yannis, Professor
Katerina Deliali, PhD
Virginia Petraki, PhD student

National Technical University of Athens

Outline

- ➢Introduction
- ➢Literature review findings
    1. Micromobility crash and injury data
    2. Safe Vehicles
    3. Safe Users
    4. Safe Infrastructure
    5. Safe Trips
    6. Safe System & Health
- ➢Open Issues
- ➢Next Steps

Micromobility safety

- Micromobility safety results are not black and white
  They depend on infrastructure, traffic volumes & speed and safety culture

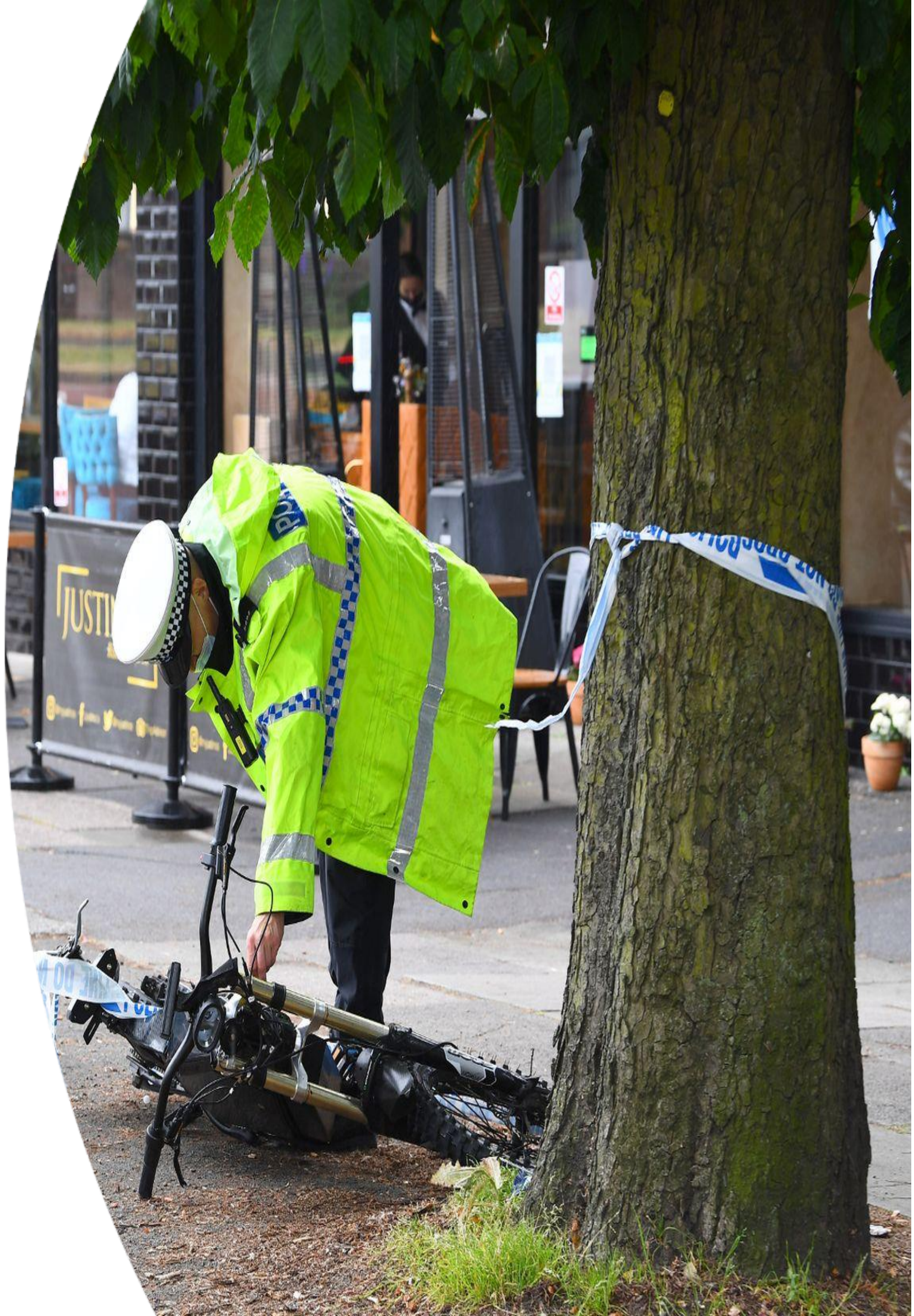
- <u>Various risk factors</u>
    - with or without dedicated infrastructure
    - road infrastructure (segments, junctions, connectivity, etc.)
    - inadequate road surface (cycles / e-scooters)
    - common infrastructure (cycles / e-scooters)
    - time of the day, day of the week
    - riders shorter learning period
    - inherent vehicle safety
    - shared / private micromobility modes
    - individual versus collective risk
    - collision matrix

Micromobility crash and injury data

- The literature (scientific & grey) were reviewed to capture trends about the safety of micromobility.

- The most common data sources especially for e-scooters (and other emerging modes) are medical records (e.g., emergency department registries, trauma centers) & surveys (the respondent is asked about their collisions/falls history).

- For bikes and e-bikes, the above sources as well as police crash reports are analyzed.



e-scooters safety (1/3)

Through the synthesis of the literature, it is evident that when a crash involves an e-scooter then:

- It is quite rare not to have an injury (6-27%)
- Most of the times (61-76%) it results in a minor injury (e.g., scratch) while severe injuries correspond to 18 to 33% of the times
    - Injuries mostly affect the upper body and the head
- Fatalities correspond to 9% of reported injuries

For **shared** e-scooters:

- Incidents with personal damage: 84.6% of all incidents
- Incidents that required medical treatment: 15.3%
- Fatalities: 0.07%

e-scooters safety (2/3)

- It is important to note that in their majority (93%) e-scooter reported injuries are due to single-user crashes (*Toofany et al. 2021*).
- Single-user e-scooter injuries mostly involve the rider and secondly, pedestrians who either are hit by a moving e-scooter or they trip over one.
- Falls specifically account for a significant number of crashes (~80%) and injuries (64-85%).
- While e-scooter & motor vehicle collisions account for a relatively small portion of injuries (8-19%) they are mostly responsible for e-scooter fatalities (~85% of fatalities).

e-scooters safety (3/3)

- E-scooter exposure cannot be directly measured due to lack of relevant demand data.
- It is easier to observe the demand of shared e-scooters through sources like Fluctuo & NACTO and make estimations.
- Injury numbers are going up, but demand increase is higher (e.g., number of trips, number of shared vehicles).
- Therefore, it is hypothesized that e-scooter risk is decreasing (based on exposure estimation).

This will be further explored in the coming months with an effort to analyze newer data & synthesize demand/ exposure sources to estimate risk.

Bikes & e-bikes safety

- Crash and injury data as well as exposure data for bikes are much more abundant and reliable compared to e-scooter data.
- Bikes are still disproportionally affected by crashes in relation to other vehicles.
- About e-bikes safety:
    - Safety data exist from earlier (e.g., before 2018) implementations of e-bikes; there are mixed findings of the safety of e-bikes compared to bikes, especially between EU and US studies.
    - These earlier data do not capture e-bike great post-pandemic expansion (e.g., use in logistics).

Crashes Under-reporting

The listed issues are relevant to all micromobility modes:

- Differences in the total number of recorded injuries and crashes among different databases
  - Injury-related crashes are more likely to be recorded in medical databases, especially when they involve one user or no property damage.
- Under-reporting of non-injury or mild injury crashes/falls
  - This is evident through surveys, where respondents report higher rates of non-injury crashes.
- Crash reports do not include terminology for all micromobility modes (e.g., e-scooter vs e-moped) and professionals are not always familiar with those to correctly record them.

Safe Vehicles

- The following design features of micromobility modes have been found to positively affect micromobility safety:
  - max speed limit,
  - larger wheels and tyres,
  - brakes,
  - back and front lights,
  - bells.
- Shared micromobility modes benefit from periodical safety/ maintenance checks (e.g., brakes condition) & additional app-based features such as: geofencing, drun driver detection.

For these features there is no crash data to support safety analysis and so, the findings rely more on experiments that are designed to specifically assess a feature.

Safe Users

- For both bicycles and e-scooters (it is assumed that this is extended to other micromobility modes) the following behavioral factors have been associated with injuries and crashes.
- Speeding
  - Excessive speeding has been found as a risk factor for e-scooter injuries (~30% according to CDC)
- Riding under the influence of alcohol/drugs
  - 7-53% of all injuries for e-scooterists
  - 6-13% of all injuries for cyclists
  - 37% of cyclist fatalities involved alcohol (NHTSA, 2021)
- Helmet use
  - 0-3% of all injured e-scooterists wore a helmet
  - Survey data & video data show that helmet use is very low & is more likely for e-scooter owners
  - ~16% of all injured cyclists wore a helmet
  - For cyclists helmet use is higher, depending on local regulations

Safe Users

- Double riding
  - 4-17% of injured e-scooterists were double riding
  - Double riding affects the kinematic energy during the collision
- Visibility
  - Both e-scooter and (e-)bike crashes occur during low visibility conditions. Dark clothes, lack of lights, etc. deteriorate safety in those conditions.
- User experience
  - There are different analyses (before-and-after, comparisons between owned and shared e-scooter) supporting the argument that the more a person users micromobility the more their skills and safety regarding that mode improve:

Safe Infrastructure

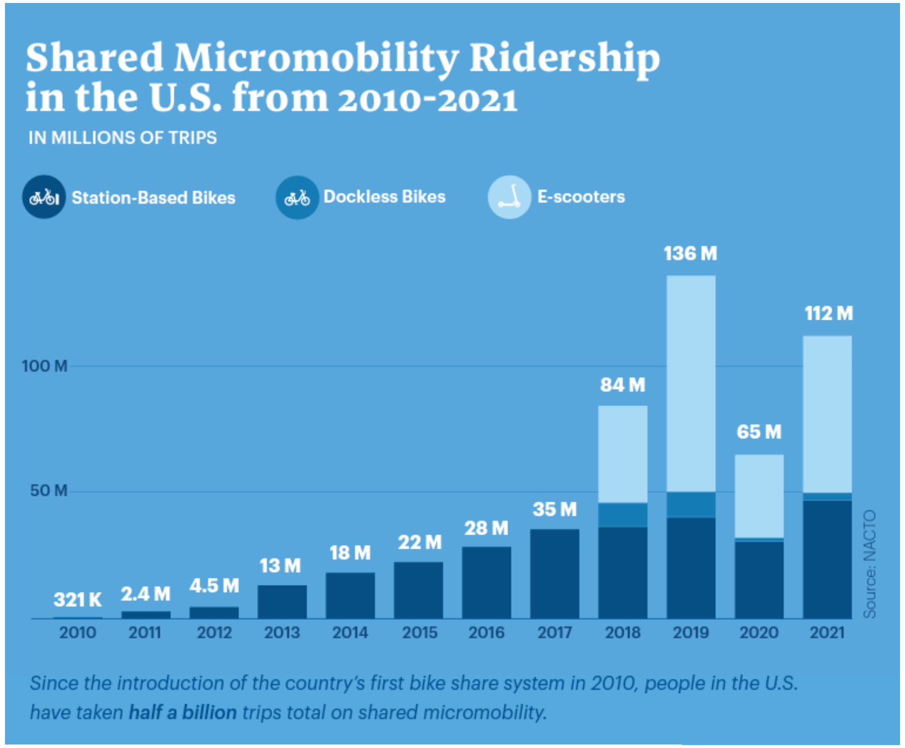
- Several studies have demonstrated that riding a bike on cycling infrastructure instead of the road improves cyclist safety. Safe & convenient cycling infrastructure can attract road users to micromobility.
- Safety is further improved when (a) cycling infrastructure is physically separated, (b) is connected and easy to navigate, (c) exists on both segments and intersections, & (d) driving speeds are reduced in the case of shared/ non-physically separated infrastructure.
- The pavement quality of the cycling infrastructure is important too as poor quality has been found associated with single-road user crashes – particularly for e-scooters.
- Cycling infrastructure and parking infrastructure are important for pedestrian safety & comfort, too.

Safe Infrastructure – new needs

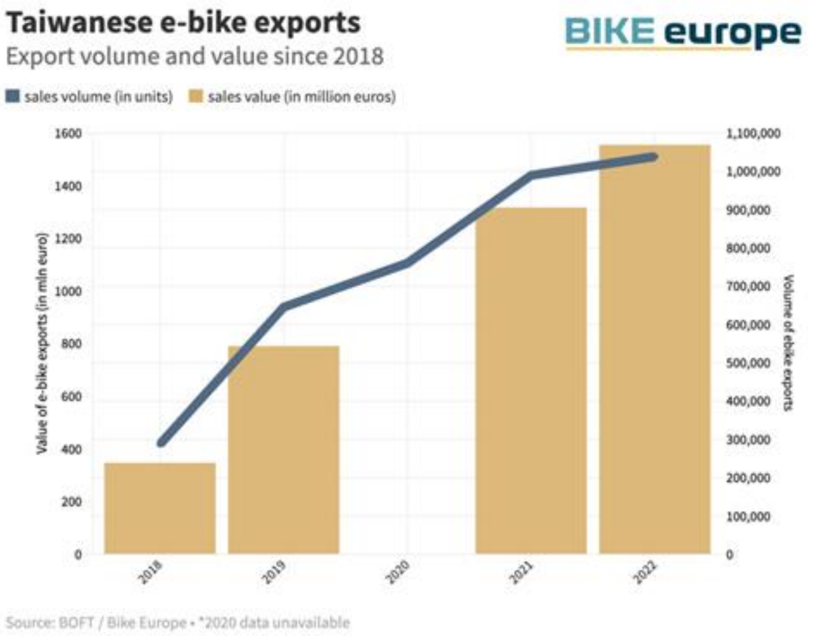
- Cycling is increasing and sometimes existing cycling lanes are experiencing congestion & is likely that people use the traffic lane
- It is unclear whether modes with higher traveling speeds (e.g., e-bikes) use the cycling lanes or prefer traffic lanes as they can move faster.
- There is evidence that safe infrastructure is not equitably allocated (due to its cost).
- There is a new range of modes who are expected to use cycling lanes but due to their size and traveling speeds, they cannot be fully accommodated by the existing cycling infrastructure.

Safety implications of modal shift (1/2)

- Several sources such as sales of micromobility modes, travel demand data (sensors, bike-sharing systems), survey data, indicate that there is an **increasing trend in micromobility.**
  - Higher micromobility demand → "Safety-in-numbers"
- Additional points to consider:
  - induced traffic (new trips) not being possible without micromobility modes
  - annual change (usually increase) of mobility demand



- **Modal shift** studies focus mainly on survey data (also from operators).
- Depending on the area and the available modes micromobility modes **might replace car trips** (most likely in the US) or **public transport trips** (most likely in Europe).
- However, in some cases, modal shift does occur between micromobility modes (e.g., bike → e-scooter).



Safety implications of modal shift (2/2)

- Car/taxi trip replacement can improve road safety as exposure to motor vehicles decreases.
- More micromobility modes on the road improve “safety-in-numbers”.
- Shifting from walking/cycling to micromobility should not be seen as a negative trend as this shift can result in either more frequent users & longer trips.

- Cities with existing cycling infrastructure are more likely to ensure safer shared micromobility deployments.
- Combined measures like MaaS, mobility hubs, allowance of bikes/e-scooters on public transport are found to encourage modal shift from car to other modes and improve road safety.

Safe Trips – Identified data needs

- More data on modal shift across the different modes such as shared/owned e-scooters, shared/owned bicycles and e-bikes.
- Disaggregated by time of the day, trip purpose, trip duration, trip frequency, location (urban, peri-urban, rural & high- vs low-income communities).
- For shared micromobility modes these data from time to time are available through the operators (e.g., NACTO 2022 report) & these are the most valuable data.
- Data from cities are also needed: bike lane network availability & quality, presence & spatial dimension of other measures to enhance sustainable mobility.
  - US cities tend to be more "open"
- Data from transport/logistics providers & delivery companies who have shifted from motor vehicles to micromobility.

Safe System & Public health

- The relationship between cycling & public health is straight-forward; the same cannot be said for the other micromobility modes for which public health benefits & impacts depend on the broader settings.
- Personal safety is often deteriorated (for the riders) whereas collective safety might be improved (slower traffic)
- Pedestrian safety is likely to be negatively affected.
- E-assisted modes have the potential to improve local air quality & noise levels → physical & mental health benefits.
- With the exemption of e-bikes, physical activity is marginally affected.
- Depending on the context & the operation micromobility might affect (positively or negatively): stress levels for the riders, drivers, and pedestrians, congestion levels, air pollution, accessibility.

Safe System & Public health

- The Safe System Approach (shifting responsibility to Authorities and Operators) have the potential to eliminate the externalities of micromobility and improve public health.
- Some limited evidence from studies that have assessed the **overall effect** of combined measures (e.g., safe vehicles, safe infrastructure, safety campaigns) indicates that Safe Systems Approach policies can be effective for micromobility.
- In terms of data, it was found that the use of **surrogate safety metrics** (e.g., metrics to assess speeding, compliance, helmet use, interactions between road users etc.) can support the understanding of crash/injury occurrence mechanisms.

Open Issues

Data needed

- Crash & injury data
- Exposure for all users & micromobility modes
- Safety Performance Indicators (Surrogate Safety Metrics) of user behavior, infrastructure, vehicle
- Comparability - Time Series

Analyses needed

- Specific Risk Factors
- In depth crash investigation per mode
- Safety performance of different business models
- Policies/measures effectiveness assessment

Next Steps

- Analysis of real-world micromobility data
  Operators' data, ITF-Safer City Streets, Statistics, Assumptions, etc.
- Identification of best practices for safe and sustainable micromobility
  Modal share, Legislation, Operators, Technology, etc.
- Overall micromobility safety synthesis
  Key risk factors, Fusion of data and results sources, etc.
- Combination with the broader impacts of micromobility
  Crashes, Public health, Climate
- Recommendations
  Safe System Approach, Behaviour change, Data needs and standardization, etc.

Plan to disseminate: Two Questionnaire surveys:
a) Authorities b) Operators (data, analyses, practices, proposals)

International Transport Forum | CPB Corporate Partnership Board

Project workshop
March 7-8, 2023

Micromobility: "Back to the Future"
Session 4: Safety & health performance of micromobility

George Yannis, Professor
Katerina Deliali, PhD
Virginia Petraki, PhD student

National Technical University of Athens