

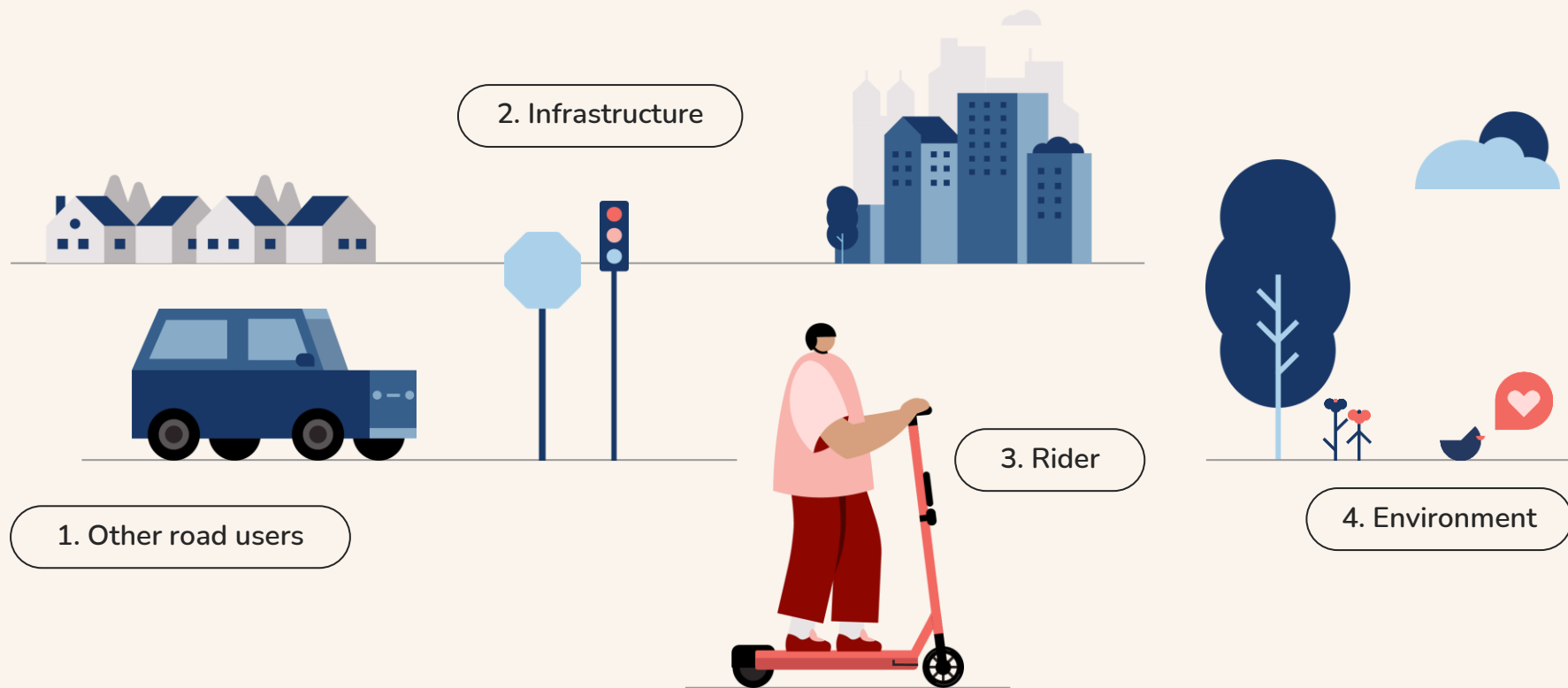


# Session 2.D – Road Safety in Practice

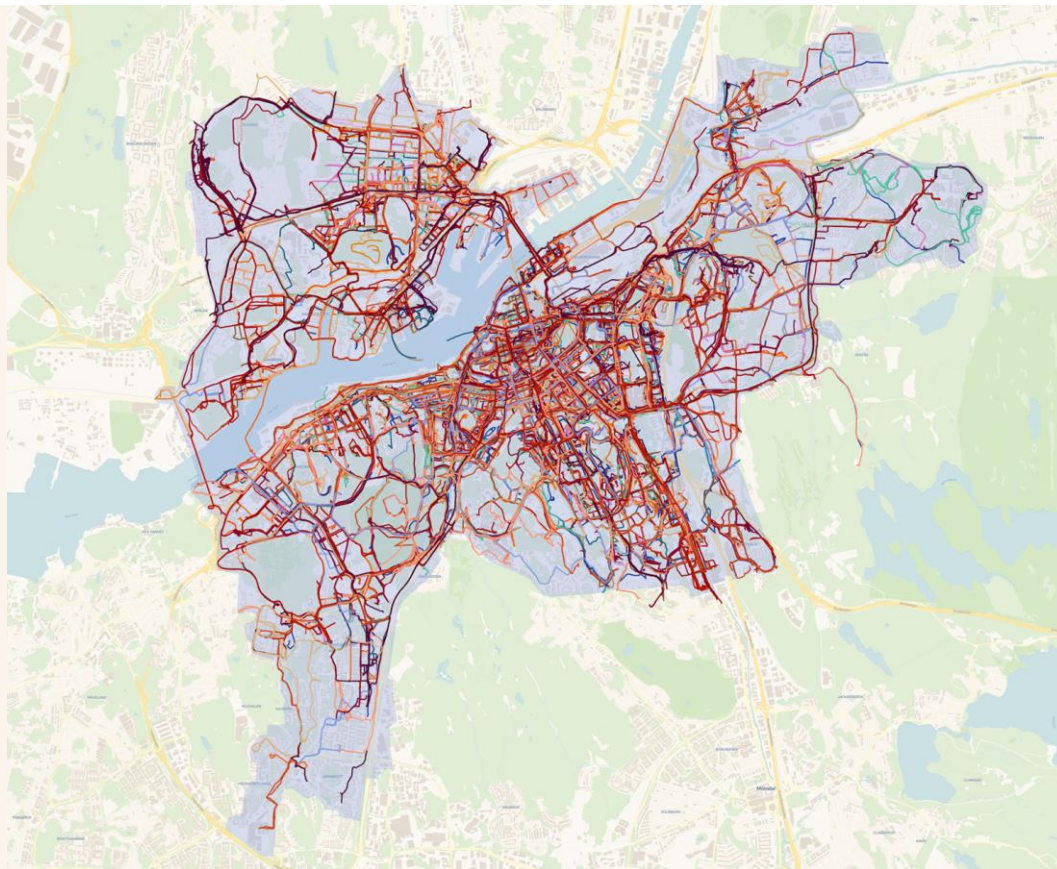
What's actually safe, and what isn't? Learnings from a camera-based behaviour analysis

Rahul Pai, Chalmers

Christy Pearson, Voi







Toppled  
scooter



Braking  
scooter



Swerving  
scooter





30%



19%



16%



5%



28%

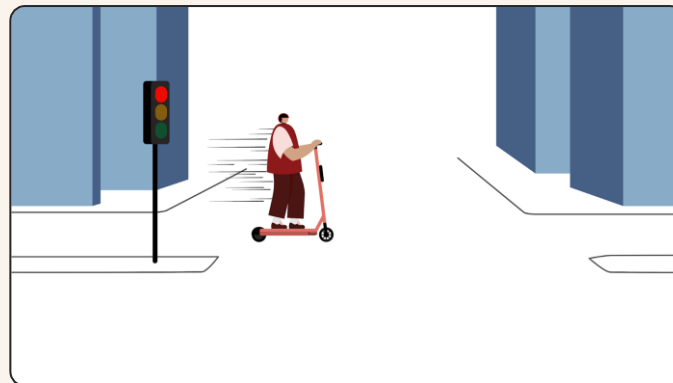


2%

## Critical Event



## Baseline Event



# Inexperience

Crash risk ↑  
**2.23<sub>x</sub>**



# Phone usage

Crash risk ↑  
**2.67<sub>x</sub>**



# Single handed riding

Crash risk ↑

**6.51<sub>x</sub>**



# Pack riding

Crash risk ↑  
**2.68x**



# Object on handlebar

Crash risk ↑

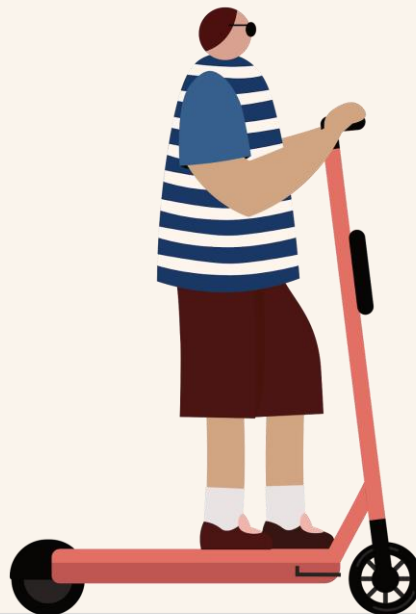
**1.61<sub>x</sub>**



# Leisure activity trips

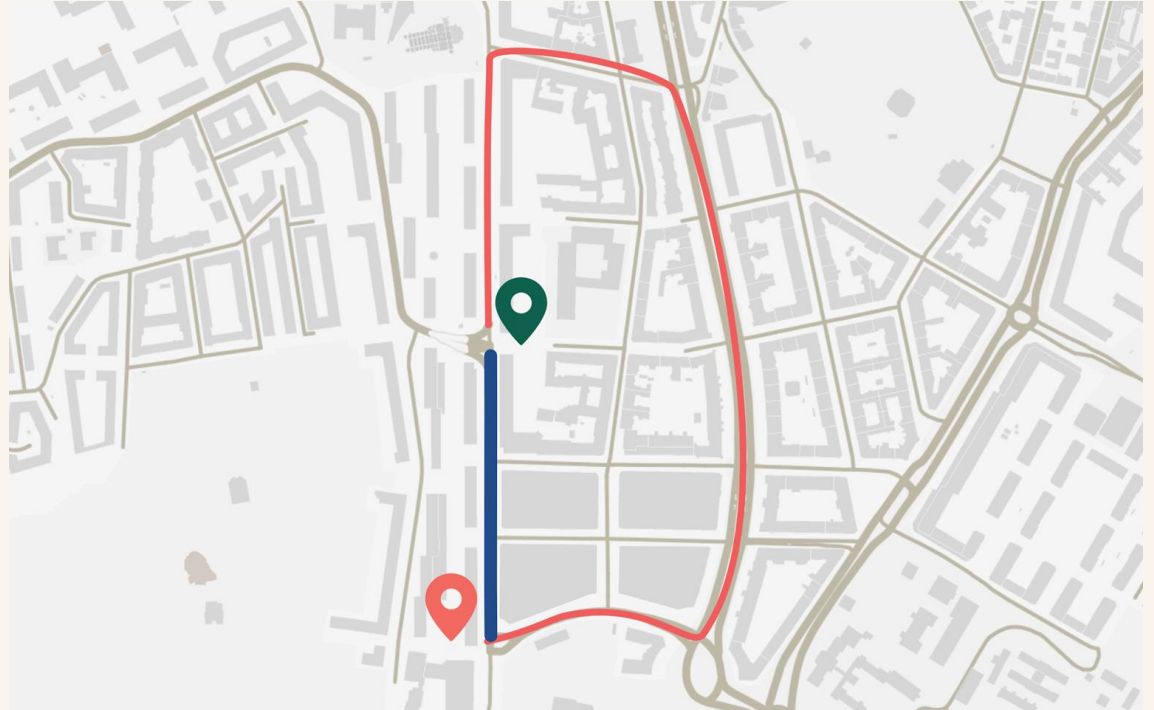
Crash risk ↑

**2.40<sub>x</sub>**



# Detour trips

Crash risk ↑  
**4.93<sub>x</sub>**





# Understanding factors influencing e-scooterist crash risk: A naturalistic study of rental e-scooters in an urban area

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## ARTICLE INFO

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E-scooter Safety  
Naturalistic Data Analysis  
Micro-mobility Crashes  
Rider Behavior  
Electric Scooter

## ABSTRACT

In recent years, micromobility has seen unprecedented growth, especially with the introduction of dockless e-scooters. However, the rapid emergence of e-scooters has led to an increase in crashes, resulting in injuries and fatalities, highlighting the need for in-depth analysis to understand the underlying mechanisms. While helpful in quantifying the problem, traditional crash database analysis cannot fully explain the causal mechanisms, e.g., human adaptation failures leading to safety-critical events. Naturalistic data have proven extremely valuable for understanding why crashes happen, but most studies have addressed cars and trucks.

This study is the first to systematically analyze factors contributing to crashes and near-crashes involving rental e-scooters in an urban environment, utilizing naturalistic data. The collected dataset included 8668 trips, covering 850 km over 70 h with 4894 unique participants. We identified 61 safety-critical events, including 19 crashes and 42 near-crashes, and subsequently labeled variables associated with each event according to the textbook using video data.

Our exploratory analysis identified that rider experience and behavior (e.g., phone usage, single-handed riding, and pack riding) significantly increase the crash risk. Given the accessibility of rental e-scooters to individuals regardless of their experience, our findings emphasize the need for rider training in addition to education. Influenced by their experience with bicycles, riders may anticipate a similar self-stabilizing mechanism in e-scooters. We found that single-handed riding, which compromises balance, poses a heightened risk, underscoring the crucial role of balance in safe e-scooter operation. Furthermore, the purpose (leisure or commute) and destination (point-to-point or dismount) of the trip were also identified as factors influencing the risk, suggesting that user intent plays a role in safety-critical events. Interestingly, our analysis underscores the importance of adapting the crash and near-crash definitions when working with two-wheeled vehicles, especially those in the shared-mobility system.

## 1. Introduction

Micromobility, characterized as a light and sustainable transport alternative to traditional means, has grown in popularity due to its potential to reduce emissions, traffic congestion, and parking constraints. Dockless electric scooters, or e-scooters, have become popular among young adults, primarily due to the convenience and accessibility of sharing services (Gao and Zhang, 2021). However, the unprecedented growth has brought challenges, including increased crashes and, consequently, deaths and injuries involving e-scooters. Research indicates that e-scooters, often perceived and regulated similarly to bicycles (Transportation, 2021), exhibit distinct behavior (Dossa et al., 2023; Li et al., 2023), and usage patterns compared to bicycles,

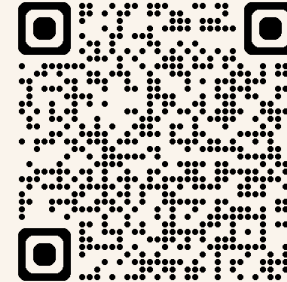
with e-scooter riders facing ten times higher risk of crashes (Fearnley et al., 2020). The distinct characteristics inherent to e-scooters necessitate specific research to understand the mechanisms and factors underlying the e-scooter crashes, as extrapolating findings from bicycle crash studies may not yield accurate insights. Despite the growing body of literature on e-scooter safety, there remains a significant gap in understanding the specific mechanisms and factors leading to e-scooter crashes. For instance, most existing studies rely on police and hospital reports, which often lack detailed insights into the behavioral factors leading to crashes. The lack of nuanced behavioral data and risk factors in e-scooter crash data hinders the ability to develop targeted interventions to improve e-scooter safety.

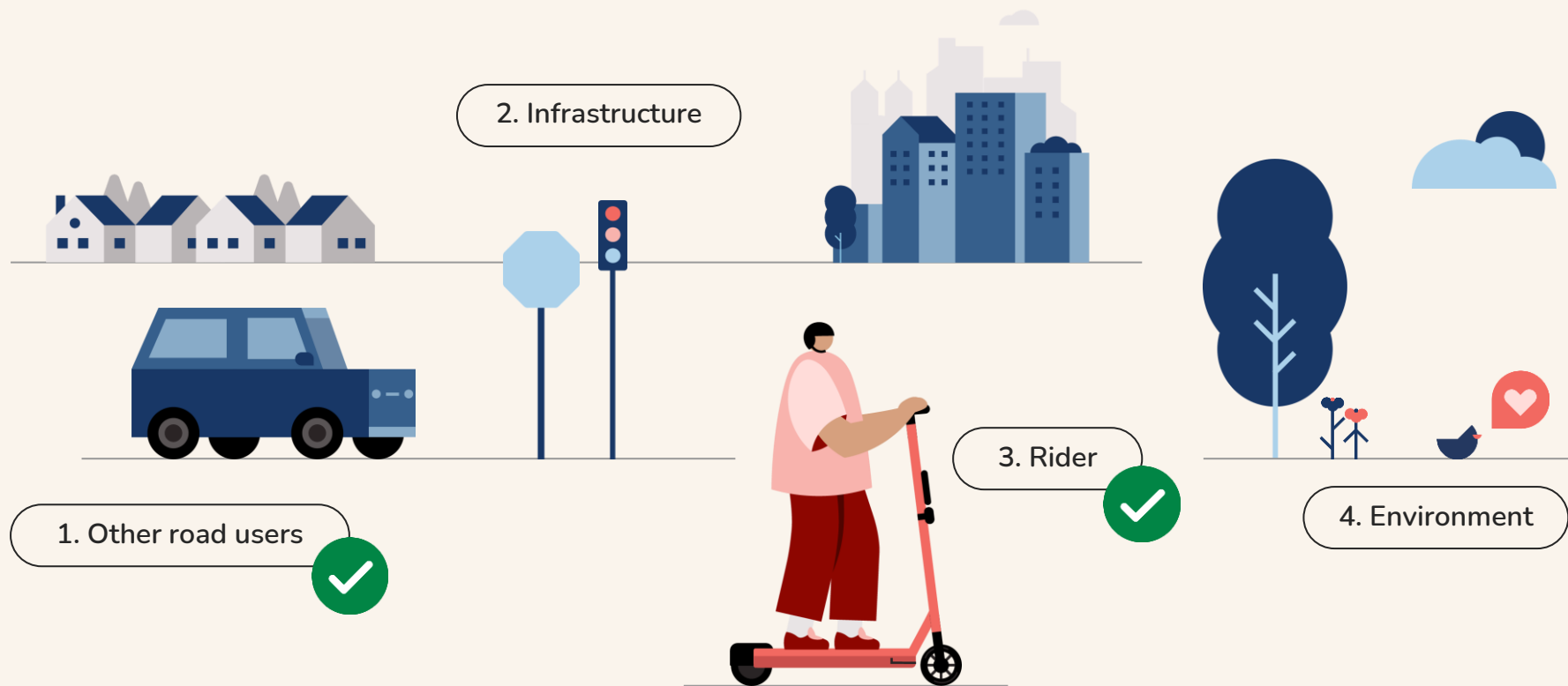
This paper presents the first study of shared e-scooter usage in an

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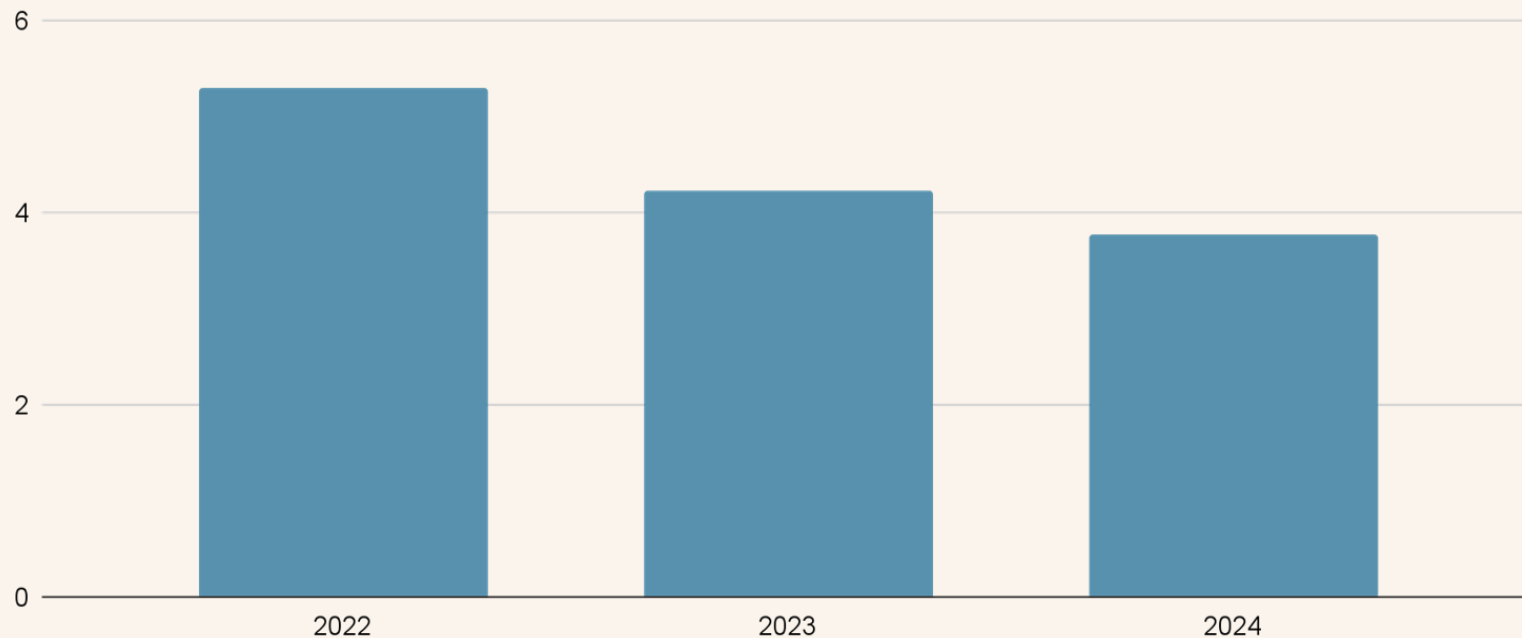
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# Understanding factors influencing e-scooterist crash risk: A naturalistic study of rental e-scooters in an urban area





## Accidents per million kms





## Traffic rules

Traffic rules and laws are there to keep all road users safe. These rules govern riders of bikes and e-scooters, as well as pedestrians and drivers.

Knowing the law is essential for your safety and that of others: it helps prevent accidents, minimises conflicts, and keeps road use consistent.

As a rider, you have a responsibility to learn the law. This course is a great start, but check out your local traffic safety organisations for further information.



Let's start



## Who can ride shared e-scooters and bikes?

In Germany, you must be at least 18 years old to rent an electric scooter. You don't need to hold a driving licence.

Keep in mind that rules can vary from country to country so check ahead if you plan to travel abroad and use e-scooters there.

The RideSafe Academy can be adapted for different destinations on the start screen.



Next



## Where to ride?

In Germany, as in most European countries, cars drive on the right. This means you should always ride on the right side. This applies in bike lanes or and on the road, if there's no bike lane. Stay off roads with speeds over 50 km/h (30 mph).

Remember that you are not allowed to ride your e-scooter or bike in a pedestrian area, on the pavement or on a pedestrian crossing.



Next



## How many people can ride on an e-scooter?

Only one person at a time per vehicle is allowed.

The reason for this is that riding tandem is actually dangerous. The vehicle is designed to carry one rider, and two riders can affect balance, braking and turning.

In some countries tandem riding is illegal and it can have serious consequences such as a fine or a conviction on your criminal record.



Next



## What does the law say about riding an e-scooter or an e-bike under the influence?

Riding an e-scooter or a bike whilst intoxicated is illegal. The legal limit is the same as for driving a car.

You must never ride under the influence of alcohol or any mind-altering substance. It poses a serious danger both to yourself and to your fellow road users.

Violating this rule might lead to fines or even to you losing your driver's license.



Next



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Road safety  
starts with

Always wear a helmet to  
protect your precious head.

Never ride under the influence  
of mind-altering substances.

Only one person at a time per  
vehicle - no twin-riding.



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