Safer streets with shared micro-mobility

Voi's Annual Safety Report
June 2021, updated in August

voi.

Content

CEO STATEMENT

Let’s build our cities for people and not cars

As an operator for shared micro-mobility, we take responsibility for the crashes and road injuries that our service contributes to. We have a Vision Zero target, meaning that we are working on eliminating all severe traffic injuries and fatalities by 2030.

“If we work together, then shared micro-mobility can provide significant benefits to the people in our cities.”

Fredrik Hjelm, CEO of Voi Technology

THE SAFETY OF SHARED MICRO-MOBILITY and particularly e-scooters, has led to heated debates in recent years. This is one of the main reasons for producing this report.

We want to bring as much transparency to the industry as possible. This means educating ourselves, our riders and those involved with urban transport so that we all can make our cities safe for everyone.

Voi exists because we want to create cities for people and not cars. It has been a personal journey for me. I was inspired to start Voi after spending time in Moscow where I became dismayed with the traffic chaos and air pollution that residents had to endure there. It was time for a new way to look at transport.

Of course, anytime something new arrives on the scene, it gets questioned. Safety is one of the areas where we feel those questions have been very relevant.

WE KNOW THAT E-SCOOTERS are just as vulnerable as pedestrians or cyclists in traffic and that the primary source of danger on our streets comes from heavier vehicles. We also know that if more people opt for shared micro-mobility services, then there would be less cars on the road and this results in less crashes and better air.

At the same time, we know that our service is involved in incidents causing injuries for our users and other road users. Sometimes these incidents are directly related to irresponsible user behaviour. Neither I nor any of our more than 500 employees think this is acceptable. Our company was founded after all with a vision to create cities for living.

It’s important then, that we understand the true cause of all crashes and the best ways to solve them. What gets measured gets done and this report is the first step for us to measure and report our findings. It’s helping us already in understanding where to focus our energy.

This also puts us in line with the Stockholm Declaration from last year's global ministerial conference on road safety. The declaration calls on businesses to contribute to the road safety-related Sustainable Development Goals and report the progress.

LIKE MANY OF OUR CITY PARTNERS, we have a Vision Zero target. That means we want to eliminate all severe injuries and fatalities by 2030. We know this can be achieved if we all work together. This is why we started a global safety advisory council, helping us identify the best ways for us to improve safety on the streets we operate in.

We have also implemented several concrete measures like educating our users on safe riding and rewarding them for doing so. We have launched a string of new in-app safety features to improve riding behaviour, such as our reaction test to prevent drinking and riding. In addition, we have released two new e-scooter models designed to increase safety.

WHEN EVERYONE OPENLY REPORTS their safety footprint, we can together find solutions. Transparency is key for us to work well together with cities and government authorities to build safer streets. If we work together, then shared micro-mobility can provide significant benefits to the people in our cities and make it easy to choose alternatives to cars, making spaces not just safer, but healthier and easily accessible.

We hope this report can add new insights into safety issues not just with e-scooters but all traffic and we look forward to continuing the journey to safer travels and healthier cities. **V.**

Taking action to create a safe service

At Voi, we take a data-driven approach to improve the safety of our service, and help cities achieve Vision Zero. Here are some of the safety initiatives that we have implemented.

Report highlights

Some of the facts and figures you can learn more about in this report.

31%

...of Europeans find the lack of dedicated lanes to be a key issue for e-scooters. Eurobarometer

80%

...of fatal bicycle and e-scooter crashes are caused by heavy motor vehicles. ITF-OECD

70%

...of city authorities believe that fewer car trips and more micro-mobility are good for safety. Voi's City Survey

16%

...of all crashes resulting in personal injury occur on the first ride. Voi's crash data

60%

...of e-scooter riders ended their trip in a parking spot when available. Transportøkonomiskt institutt

REPORT FINDINGS AT A GLANCE

A roadmap for our journey to Vision Zero

We pledge to be transparent and factual on our safety track record and what we're doing to prevent crashes. This annual Safety Report is another step in this direction.

“This Safety Report is our first but won’t be our last. We will publish a new one every year from now on and report on the measures we’re taking.”

NEARLY THREE YEARS have passed since Voi pioneered shared e-scooters on European streets. Since then, thousands of shared e-scooters and other lightweight vehicles have been deployed in cities. In this short period, we have learnt that road safety is one of the most significant risks for the shared micro-mobility industry.

At the same time, micro-mobility can substantially improve road safety and help us reach ’Vision Zero’. Shared micro-mobility has proved to be an enabler for reducing car dependency, helping cities achieve social and environmental goals while also contributing to increased road safety.

As our company matures, we need to manage our safety risks and opportunities in order to realise the potential of making streets safer with shared micro-mobility. This Safety Report is our first but won’t be our last. We will publish a new one every year from now on and report on the measures we’re taking and the progress we’re making year on year. Our target is zero severe injuries and fatalities in our value chain by 2030.

For this first report, we have looked at available research and gathered input from a wide range of stakeholders to help us get new insights into safety risks and opportunities for shared micro-mobility, and e-scooters in particular. We share these insights throughout the report so that everyone can benefit. We aim to foster a dialogue on how Voi and the shared micro-mobility industry can contribute to cities’ and governments’ Vision Zero goals.

The key causes of crashes and injuries

We believe that the right approach to creating a safer service is to learn from previous crashes and other research to identify the safety performance factors that significantly impact e-scooter safety. By focusing our efforts on finding solutions to mitigate the critical crash risks, we aim to reduce the road injuries attributed to our service.

We have talked to several international road safety experts and looked at research from external sources. These findings have been coupled with internal data to identify the leading causes of crashes for shared e-scooters, and to a large extent micro-mobility in general.

WE HAVE IDENTIFIED the following seven factors that substantially impact the risk for incidents leading to personal injury and fatalities:

A. Heavy, fast-moving vehicles present the greatest road safety risks.
B. Lack of safe road infrastructure is a significant risk for lightweight travellers.
C. The first rides with e-scooters have an increased crash-risk.
D. Inadequate knowledge of traffic rules increases risky riding behaviour.
E. Riding under the influence of alcohol and drugs is a critical risk factor.
F. Lack of helmet usage increases the head injury risk.
G. Wrongly parked scooters and pavement riding increases the risk for other road users.

These risks impact road safety for shared e-scooters to varying degrees. The risks also differ between countries and cities because of disparities in infra-structure, social norms, and previous experience with micro-mobility. It's also likely that the extent to which these factors impact safety will change over time as social norms evolve and road infrastructure becomes adapted for lightweight travellers.

We believe that it's essential to look at this list from a holistic perspective since actions targeting one factor may negatively influence another. For example, a mandatory helmet requirement might decrease the risk for head injuries but at the same time negatively impact the opportunity to reduce car dependency in cities with shared micro-mobility.

At Voi, we believe that these seven factors are all areas that we can impact directly or indirectly to help make streets safer. Improvements in vehicle design, product development, rider education, data sharing, and lobbying and investing in better infra-structure are all actions that can help to increase road safety. These are all measures that Voi is already working with.

However, it's clear that measures also need to be taken from cities, governments, and public authorities to fulfill the thinking around Vision Zero. We hope that sharing this research will foster a dialogue on how Voi can help improve road safety in partnership with the public sector and other partners.

In the following chapters of this report, you can learn more about the safety risks for shared e-scooters and how Voi works with preventing these.

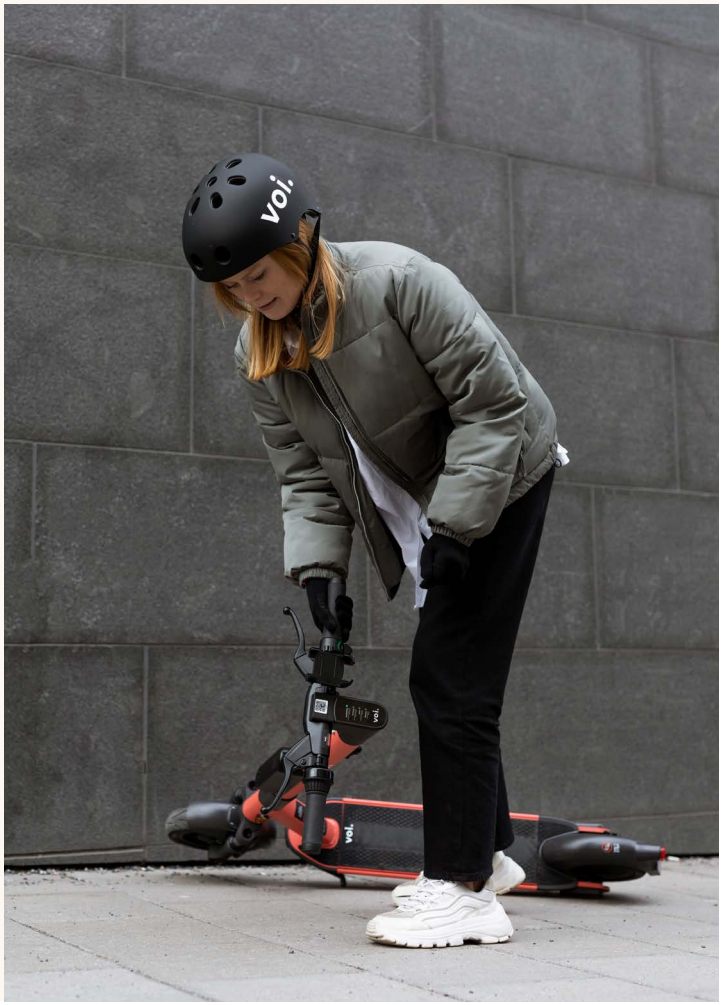
Safety priorities

Voi is committed to building a safe service together with our riders and partners. Since shared e-scooters are still a relatively new phenomenon, we believe there's a particular need to focus safety efforts on beginners.

Data suggests that beginners are more likely to end up in a crash, indicating a continuous need for training, education and safety campaigning. Safety concerns are also stopping people from trying e-scooters and blocking the potential shift from car dependency.

Increasing efforts for training, education and safety campaigning is also likely to reduce the number of intoxicated riders and increase awareness of the risks associated with riding without a helmet. Enhanced efforts in educating and incentivising riders to park

"We hope that sharing this research will foster a dialogue on how Voi can help improve road safety."



"Voi believes that many key safety risks will decrease over time as social norms evolve for e-scooter riding."

correctly and not ride on pavements is also likely to improve road safety for riders and other road users.

We believe that many key safety risks will decrease over time as social norms evolve for e-scooter riding, and people adapt to the new vehicles on the streets. However, we also think that the lack of safe road and parking infrastructure for lightweight travellers contributes to these risks. We will not only target our users with safety measures but also our partnering cities. We will enhance our efforts in sharing data that serves this purpose and continuously lobby for better road infrastructure for all lightweight travellers.

In the meantime, we're pledging to design the safest e-scooters on the streets and leverage our products and technology to incentivise safe riding behaviour. We will also implement measures to improve the safety performance of our operations. We're using internal data as well as external research to iterate, learn and improve.

Next step: Reporting our progress to zero

As a provider of shared micro-mobility, we take responsibility for the crashes attributed to our service. Every road crash is one too many, and we are putting a lot of effort and resources into mitigating risks for our riders and other road users to end up in incidents causing personal injury or death.

Safety is one of our biggest sustainability risks. Thus, a critical step towards a strategic safety approach – as with all areas of corporate sustainability – is to measure, report and set targets for our safety work. As a maturing company, we understand that this is expected from us since this will help inform our stakeholders about our safety risks and opportunities.

There is no standard today for reporting companies' impact and contribution to road safety. The micro-mobility industry also lacks a standard for measuring crashes. We pledge to drive the dialogue for developing an industry standard for crash reporting. In addition to this, we are committed to spearheading the development of safety reporting for the shared mobility industry.

While working with this report, we have evaluated the opportunities to develop a framework to report our safety footprint and progress towards our Vision Zero target. We have developed an initial draft of a framework and shared it with our Global Safety Advisory Council. Thanks to this, we learned that the FIA Foundation is currently developing the world's first framework for companies to report on road safety, together with the Swedish-Finnish engineering consulting firm AFRY.

The work we have done to date resembles FIA's framework, and we have received encouragement to continue these efforts. As a data-driven mobility service provider, we benefit from owning our vehicles over the entire lifecycle and having access to data to inform decision-making. We will now make sure to

Why report on road safety?

What gets measured gets done. As with any kind of sustainability issues, reporting helps drive improvements and accountability.

THE STOCKHOLM DECLARATION, the outcome document from last year's global ministerial conference on road safety, called upon businesses to contribute to the attainment of the road safety-related Sustainable Development Goals, and report on safety in their sustainability reports.

The FIA Foundation is currently developing the world's first road safety index, for businesses to report their impact and contribution to road safety. This will help the financial sector to estimate business risks and opportunities, while also contributing to the societal Vision Zero goals.

FIA states that reporting for road safety directly contributes to these three targets in the Sustainable Development Goals:

- **3.6** Reduce Road Injuries and deaths.
- **11.2** Affordable and sustainable transport systems.
- **12.6** Encourage companies to adopt sustainable practices and sustainability reporting.

present our Safety Footprint reporting framework that will allow stakeholders to follow the progress towards our Vision Zero target in the coming months.

Engaging with external experts

On a high level, the framework that we aim to present will include reporting on our safety footprint and safety performance factors that we monitor and report on regularly.

The safety footprint is the number of road fatalities and severe injuries attributed to our service. It's the lead indicator for our Vision Zero target. The initial data we have gathered on this can be found on the next page. However, we understand that the process for gathering this data might need to be refined in the future.

The safety performance factors are conditions that have a significant impact on the number of road fatalities and injuries. For example, an indicator could be the share of our riders who have completed our virtual traffic school, how many car trips our service has helped to avoid, or the number of user reports about malfunctioning vehicles.

The work that goes into this report has provided us with a foundation for our understanding of the safety performance factors that are vital for us to measure and report on. We will continue this effort in the coming months by researching and engaging with external experts to come up with reliable and trustworthy indicators for measuring our progress towards Vision Zero.

We hope you enjoy the report and we encourage you to challenge us and provide input for our continued work to develop the world's first safety reporting framework for shared micro-mobility operators. V.

A data-driven approach for our Vision Zero target

This model illustrates how we will monitor, report and set targets for our progress towards Vision Zero. The model has been developed based on the FIA's feasibility study for a Road Safety Index.

Our commitment

Voi's Vision Zero target: Zero fatalities and injuries in our value chain by 2030.

Safety Footprint

? The footprint is the rate of fatalities and severe injuries, caused by crashes attributed to our service.

! The safety footprint will be the lead indicator for us to measure progress towards our Vision Zero target.

Safety Performance Factors

? Safety Performance Factors are conditions of road traffic safety that significantly impact the number of fatalities and road injuries. FIA states that a company must present a definition, targets, and ways of monitoring for each safety performance factor.

! We are in the process of defining our safety performance factors, and the opportunities to report these over time. For Voi, the safety performance factors include our impact on rider behaviour, vehicle performance, operations and how we contribute to making streets safer.

Voi's Safety Footprint

A crucial part of safety reporting is to disclose data for the rate of fatalities and injuries in the value chain. The Safety Footprint is the lead indicator for our Vision Zero target that we will track relentlessly until it reaches zero.

When one of our users is involved in a crash, we receive information about the incident through our in-app support channels. After this, one of our customer support agents reaches out to the user to get additional information about the crash. All agents are trained on how to handle these cases responsibly.

The crashes are classified in several factors, for example severity level, to help us understand and prevent further crashes. In the past months we have made a push to improve the classification of our crash data. This gives us more reliable data and a better understanding of the severity and causes of crashes.

The chart to the right shows Voi's crash data for the period January to June 2021. The chart includes all crashes leading to major and severe injuries. This is the baseline for our continued reporting on the progress toward zero fatalities and injuries.

We have had more than 21 million rides in total across the 10 countries we operate in during this period. Our internal crash data shows that our service was involved in zero fatal crashes and 105 incidents causing major or severe injuries during the period. This means that 0.0005% of all rides between January and June resulted in a crash with major or severe injury. In total, we have had 717 crashes with personal injury, when we also include milder injuries.

Numbers are one thing but every number is an injured person and a personal tragedy. All of these personal tragedies are one too many.

IT'S IMPORTANT TO EMPHASISE that this is self-reported data, meaning that it might not give a complete picture. We can't be sure that all riders who have been involved in a crash decide to report it to us or provide us with a correct picture of what happened. The potential impact on insurance claims and the fact that it can be hard to remember a critical situation correctly can have an impact on the data.

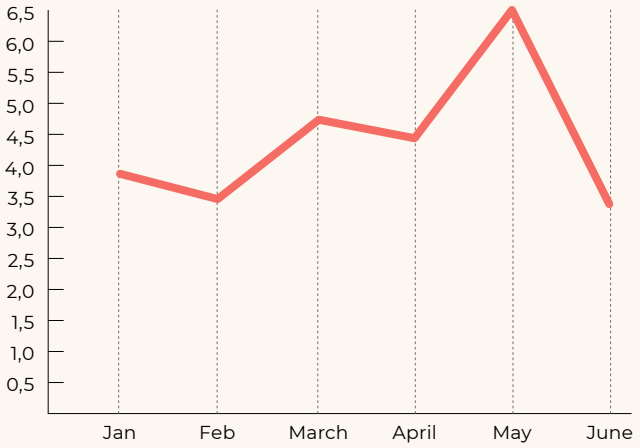
This is however the most reliable data we have for now, and we strive to be as transparent as possible. For this reason, we are disclosing this data and pledge to continuously improve our processes for gathering data to get a complete picture of the road injuries in our value chain. We will further investigate the opportunities to improve crash data collection through our insurance companies and other external data sources such as the police and hospitals.

OUR ADVICE IS to be cautious in comparing these figures with data from other shared micro-mobility operators, due to the fact that there is no industry standard for collecting and reporting crashes resulting in personal injuries. We believe such a standard would be desirable to enhance the opportunities for researchers and public authorities to understand the risks with shared micro-mobility.

That's why we're committed to starting a discussion with others in the shared micro-mobility industry to align on principles for a standardised approach to measuring crashes resulting in personal injuries.

Crashes per million ridden kilometers

The chart includes all crashes leading to major and severe injuries from January to June 2021. No fatal crashes have occured in this period.



Our pledges for Vision Zero

In August, we announced ten pledges to guide our journey towards our Vision Zero target. We want to emphasise this commitment by reiterating that Voi pledges to:

01. Relentlessly work to have the safest fleet and riders on the streets.
02. Continue using technology to find innovative ways of increasing road safety.
03. Be transparent and collaborate with academia and research institutes to increase knowledge on road safety and key challenges.
04. Continue collaborating with local authorities and police in all Voi cities.
05. Continue campaigning against riding under the influence.
06. Collaborate with vulnerable groups.
07. Be proactive advocates for a zero-vision of micro-mobility crashes.
08. Help cities reach their ambitious sustainability targets.
09. Continuously evaluate commercial partnerships that aim to increase the safety of riders and other road users.
10. Frequently seek the advice of external experts.

In the following chapters, you will learn more about how we are guided by these principles in our commitment for Vision Zero.

Creating safe streets through modal shifts

Shared micro-mobility can be a catalyst for less car-centred cities and lead to improved road safety. This however requires road infrastructure that is safe.

"That means protecting all those people who are on the outside of those medieval armors called cars," says Pedro Homem de Gouveia, road safety expert at POLIS Network.

SHARED MICRO-MOBILITY has entered the streets of European cities and become a new topic for discussion among city dwellers and politicians. Scooters are a hot topic.

Early adopters have found a new flexible travelling mode in urban areas, while others are concerned about the new vehicle's impact on road safety and risks associated with misparked scooters.

European citizens think that the dangers to riders and the safety of other vulnerable road users such as pedestrians are key challenges to address for e-scooters in urban areas, as indicated in a special Eurobarometer on mobility released last summer.

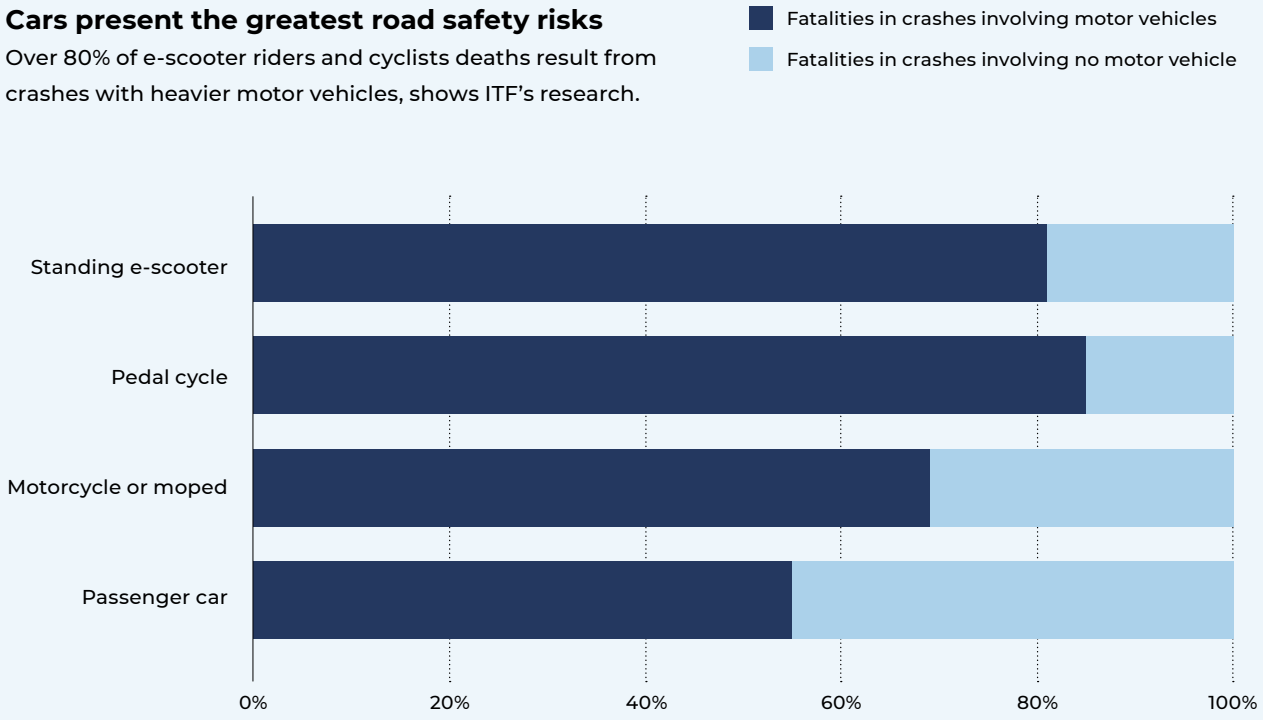
WITH THE ROLL-OUT of shared e-scooters available for all citizens, a new cause for injuries has made its entrance into the statistics. There is an increasing interest to investigate the safety risks associated with e-scooter crashes. Meanwhile, a structured and comparable approach to reporting injuries related to e-scooter riding is still missing in most countries.

Early reports have indicated an increasing number of crashes associated with the new transport mode, making headlines in the media and opinions about its road safety

"This is something that the cycling world is used to. Before e-scooters arrived, journalists would pick on the dangers of cycling," says Alexandre Santacreu, who is in charge of policy analysis for road safety at the OECD associated think tank International Transport Forum (ITF). Journalists and politicians are falling into a trap when saying that bikes are dangerous since there is no evidence for this claim, according to Alexandre Santacreu. "It's the same with e-scooters."

Cars present the greatest road safety risks

Over 80% of e-scooter riders and cyclists deaths result from crashes with heavier motor vehicles, shows ITF's research.



Source: ITF-OECD (2020). Safe Micromobility.

Heavy vehicles the source of danger

A trip by car or motorcycle in dense urban areas is much more likely to result in a road user's death than a trip by bike or e-scooters. This was a conclusion from the ITF in a report about micro-mobility safety released a year ago in conjunction with the third global ministerial conference on road safety.

ITF calculated that motor vehicles are involved in about 80 % of crashes that result in the death of bicycle or e-scooter riders. The conclusion, however, comes with some caveats as it builds on media reports due to a lack of statistics for e-scooter crashes in most countries.

Alexandre Santacreu, the principal author of the report, says that the ITF has calculated the fatality risk for e-scooters and found that it was the same for cycling and well below that of riding a motorbike.

"Here I'm only talking about the risk to yourself as

a rider. The risk to others, such as pedestrians, is much lower than when driving a car or riding a motorbike," says Alexandre Santacreu.

He explains that ITF's conclusions build on a safe system approach, the dominant form of safety management, which considers that the focus should be on eliminating severe and fatal crashes.

DATA INDICATES THAT the first ride with e-scooters is the most dangerous and that people will make more mistakes before they learn to ride, which makes scooters appear less safe than they are, according to Alexandre Santacreu.

"People will always make mistakes and take risks. You just need to design a system in which they never get seriously hurt or killed," says Alexandre Santacreu. "We have the argument now to say that micro-mobility is not dangerous; the challenge for the industry is to carry the message that the streets need to be safe."

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Alexandre Santacreu,
Policy Analyst Road Safety,
International Transport Forum

The central message on micro-mobility safety is shared by Pedro Homem de Gouveia who leads the work on road safety at POLIS, a network for European cities and regions working with transport innovation.

"There is no risk-free transport mode, and it's a big mistake to treat all kinds of injuries together. You miss the big elephant in the room, which is the car," says Pedro Homem de Gouveia. "There is one mode that is a source of danger: Vehicles that weigh around a ton or more, that can go around at the speed the driver wants – that's the source of danger."

Modal shifts for safer cities

Modal shifts can play an essential role in increasing road safety, as acknowledged at last year's global ministerial conference on road safety. The ministerial meeting culminated with the Stockholm Declaration, stressing the need to speed up the shift towards safer, cleaner, more energy-efficient and affordable modes of transport as well as integrating these modes with the use of public transport.

Car-replacement is also a vital pillar for making cities more sustainable and reaching climate targets. This however requires that other mobility options are available for people to move around in the city.

In its recently presented Sustainable and Smart Mobility Strategy, the European Commission emphasises the importance of making sustainable alternatives widely available in a fully integrated and seamless multimodal transport system.

"The EU cannot rely exclusively on technological solutions: immediate action to adapt our mobility system is necessary to tackle climate change and reduce pollution," the Commission wrote, while adding that

The elephant in the room – air and noise pollution

It's not directly a matter of road safety but certainly a public health issue; air pollution from road transports is a significant source of premature mortality and a long list of adverse health conditions.

A STUDY PUBLISHED in the Lancet journal estimates that reducing air pollution to levels recommended by the World Health Organisation would prevent more than 50,000 annual deaths in European cities.

The report concludes that cities are generally hotspots for air pollution and disease, and the burning of fossil fuels for road transport is a significant contributor. Another study published in Cardiovascular Research found that 19 % of the deaths from Covid-19 could be attributed to long-term exposure to air pollution.

ROAD TRAFFIC IS also the most dominant source of environmental noise. A report from the European Environment Agency estimates that 113 million people are affected by long-term noise levels considered harmful to human health and well-being. The European public authority estimates that the number of people exposed to road traffic noise in urban areas is set to increase even if targets for switching to electric vehicles are met.

video-conferencing, e-commerce and shared mobility services contribute to an ongoing transformation of mobility.

Covid-19 has reinforced changing mobility and behavioural patterns, and many cities are reinventing themselves for post-pandemic recovery. C40, the global network of cities taking action to address climate change, has touted the idea of the 15-minute city as a blueprint for post-covid-19 recovery. C40 emphasises that the 15-minute city concept builds on walking, biking and public transport as the future means of transportation, enabling car-free access to all needs, including jobs, shopping and meeting friends.

SHARED MICRO-MOBILITY services such as Voi are helping reinvent public transport by enabling access to affordable shared lightweight vehicles. In the longer term, shared micro-mobility can be integrated into the public transport system to build a seamless multimodal mobility network. Some cities are already taking steps in this direction.

A systematic shift of urban mobility could empower people to move around in cities without a car. This could lead to redistribution of space to make streets safer and build thriving cities. Voi's user surveys indicate an increasing rate of e-scooter trips that replace car trips, and 63 percent of the riders reported that they combined e-scooters with public transport before Covid-19.

"Reversing car dependency is the core of our sustainable impact strategy, and it contributes to making our streets safer," says Sarah Badoux, head of sustainability at Voi. Voi's user surveys show that scooters are

Sustainable and safe operations

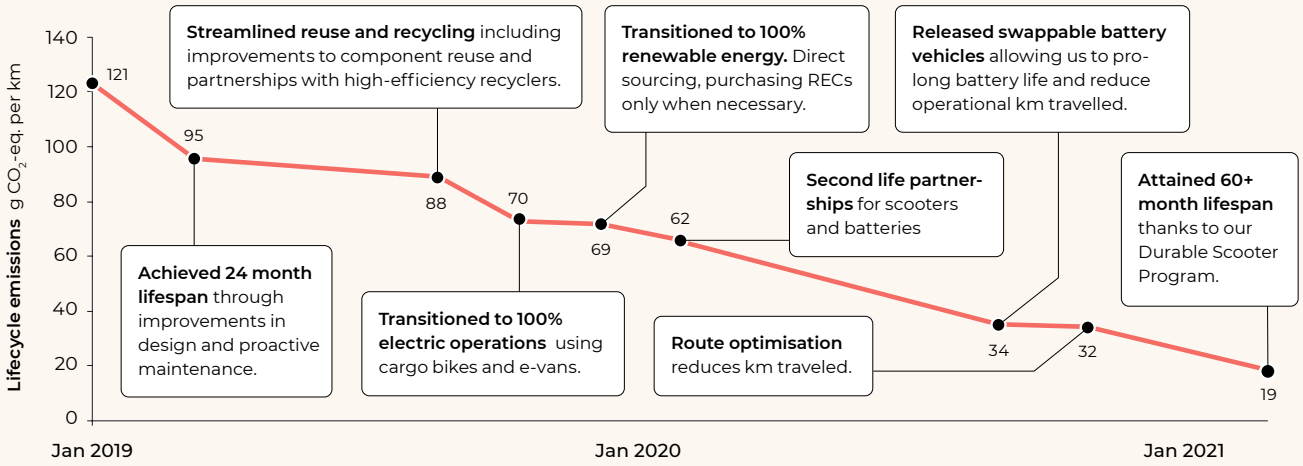
From November 2019 a substantial majority of our scooters have swappable batteries, enabling us to perform 70-80 % of in-field tasks with cargo bikes that are powered with renewable energy.

THIS IS NOT only important for reducing the emissions from our operations but also for improving our safety footprint by reducing the traffic with heavier vehicles that our service generates. Swapping batteries on the spot has enabled a 70 % reduction in daily transport load and volume.

Voi's e-scooters are bespoke and modular, enabling repair and maintenance to extend the lifespan to an estimated five years. An ongoing switch to in-field maintenance operations will increase our capacity to proactively maintain and repair the whole vehicle fleet, ensuring that no user starts a ride on a malfunctioning scooter. We have estimated that 80 % of repairs are quick fixes that could be performed in-field.

We have no gig-economy workers at Voi. We are committed to providing living wages and safe working conditions for all employees in the value chain. This means that we take environmental and social responsibility seriously throughout our supply chain, both upstream and downstream. We have taken several actions to ensure transparency and responsible practices during the production of our e-scooters, the sourcing of materials and all the way to recycling.

Voi's Climate Action Plan has reduced carbon emissions per trip by 85% in many cities



14%

...of Voi's users reported replacing car trips with scooter rides in 2020. This is a 27% increase on the year before.

63%

...of Voi's users users reported that they combined e-scooters with public transport before Covid-19.

already replacing car trips, even though the full potential has not been reached yet. "Car-replacement is not a static phenomenon, but increases as the service matures and is perceived as a more reliable transport option."

The perception that micro-mobility is good for overall safety is something that Voi shares with the cities it operates in. Voi commissioned a survey with its cities in May, and it showed that 70 % of respondents believe that fewer car trips and more micro-mobility are good for overall safety. The survey shows that seven out of ten cities have included shared micro-mobility in their vision for a more sustainable city.

The safety in numbers effect

E-scooters can be a catalyst for this mobility transformation, together with other lightweight transport modes such as e-bikes. The adoption rate of shared e-scooters has been four times faster than bike sharing in Paris, indicating that the new transport mode can act as a catalyst towards behavioural change and alternative mobility uptake.

Assuming that e-scooters are here to stay, the increasing uptake would by itself lead to improved safety because of a mechanism called safety in numbers. The mechanism designates that the number of crashes per user go down as traffic volumes goes up.

"If there is one scooter and there are lots of cars around, it's a big hazard," says George Yannis, an international road safety expert and professor at the National Technical University of Athens. "But if there are several scooters, the perception of car users and other road users is totally different because they perceive that e-scooters are moving, so they behave differently. It's an excellent automatic training for traffic at a lower speed."

He points to the fact that a fundamental factor impacting road safety is speed. Even more important is the difference in speed between vehicles, influencing both the frequency and severity of crashes. The

"Car-replacement is not a static phenomenon, but increases as the service matures."

Sarah Badoux,
Head of Sustainability,
Voi Technology

Safety in numbers – a case study of e-scooter crashes in Oslo

The safety in numbers effect shows that crashes per travelled distance decrease as traffic volumes increase.

A SYSTEMATIC REVIEW and meta-analysis of studies about the safety in numbers effect concluded that it does exist. The review was conducted by Norwegian researchers in 2017 and was looking at safety in numbers studies for motor vehicles, cyclists and pedestrians.

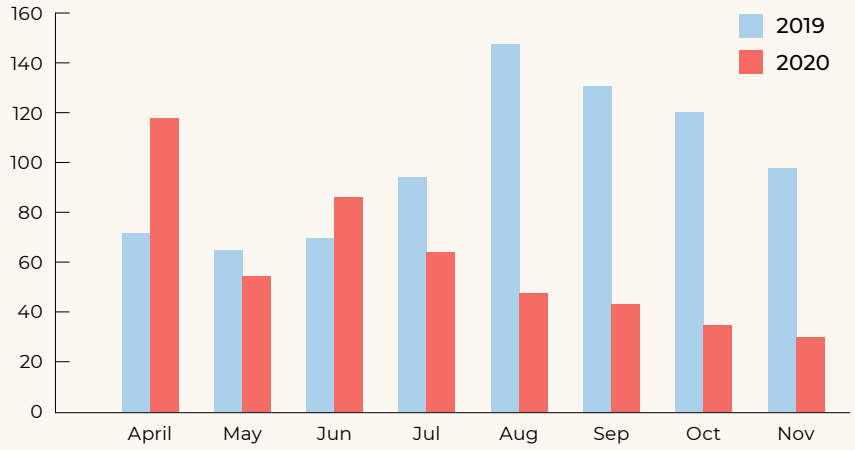
The Norwegian researchers found that the causes of the safety in numbers effect are not completely known. However, one of the studies reviewed – a study about safety in numbers for walking and biking in the US – concluded that a motorist is less likely to collide with a person walking and biking if more people bike and walk: "It appears that motorists adjust their behavior in the presence of people walking and bicycling".

Since e-scooters are a new phenomenon it's hard to find academic studies and long-term data to confirm that the effect exists for this vehicle mode, even though that's likely to be the case. However, Voi's research on e-scooter crashes in Oslo, Norway, indicates that the crash risk decreases over time.

The analysis builds on injury data from the Oslo University Hospital and e-scooter traffic data from Fluctuo, an independent third-party data specialist focused on shared-mobility services. It shows that the injuries per million kilometres travelled decreased by 45 % between 2019 and 2020, and the injuries per kilometre travelled decreased by 73 % from April to November 2020.

Decreasing crash rate

Voi's research indicates that the crash rate has declined for e-scooters in Oslo, Norway. The chart shows the number of injuries registered at Oslo University Hospital per million travelled kilometres from all e-scooter operators. Overall, the crash rate has reduced by 45 % between 2019 and 2020.



Source: Total number of rides based on Fluctuo tracking data, competitor intelligence & Voi management estimates.
We believe we are well within 10% error margin. Number of e-scooter injuries based on data from Oslo University Hospital.

dangers of differing speed already exists between cars, cyclists and pedestrians, and the e-scooter is a new vehicle to take into account.

"Downtown where the traffic is slow and comparable to the speed of e-scooters, one could say that they are as safe as cyclists and most road users because the speed is slow," says George Yannis. "If we go semi-urban or into the suburbs – outside of the city centres – the speed of scooters and other vehicles might be different, which leads to more danger."

The increased dangers regarding different speeds are, however, not a reason to prohibit e-scooters. George Yannis says that the new transport mode contributes to the environment and public health, and therefore it needs to be organised and protected. For him, it's about focusing on the points where most crashes occur.

Need for dedicated road infrastructure

The special Eurobarometer on mobility indicates that the cause for safety concern regarding e-scooters is the lack of dedicated lanes to use them and dedicated traffic rules. The shortage of road infrastructure dedicated to micro-mobility is also a significant cause of worry for the scooter riders themselves, as shown by Voi's survey with users across Europe last year.

Another survey Voi made with non-riders across European cities found that nearly half of respondents said that they would try e-scooters if it was safer to ride them, highlighting the opportunity for a reversal of car-dependency in cities by making streets safer.

THE ITF REPORT on safe micro-mobility recommends that micro-vehicles should be banned on pavements

Cities limit speed for motor vehicles to 30 km/h

The ITF report on micro-mobility safety recommends that all motor vehicles should have a maximum 30km/h speed limit in places where motorised vehicles and vulnerable road users share the same space.

THE RECOMMENDATION WAS reiterated in the Stockholm Declaration, in which ministers committed to mandating a maximum road travel speed of 30 km/h in areas where vulnerable road users and vehicles mix in a frequent and planned manner. The ministers agreed that speed reduction is vital to reduce road traffic deaths and injuries and positively impact air quality and climate change.

FOLLOWING THE recommendations, several cities in Europe have taken steps to reduce speed in urban areas. Brussels introduced a 30 km/h speed limit across almost the entire region from the start of 2021 for all vehicles except for trams, emergency vehicles in blue-light mode and snowploughs. Data suggests that already after a few weeks the measure has led to a 9 % decrease in speed without impacting the travel time.

Examples of other cities that are taking steps in the same direction include Barcelona, Paris and Bilbao.

“70 % of cities say that they will likely significantly expand micro-mobility infrastructure in the next five years.”

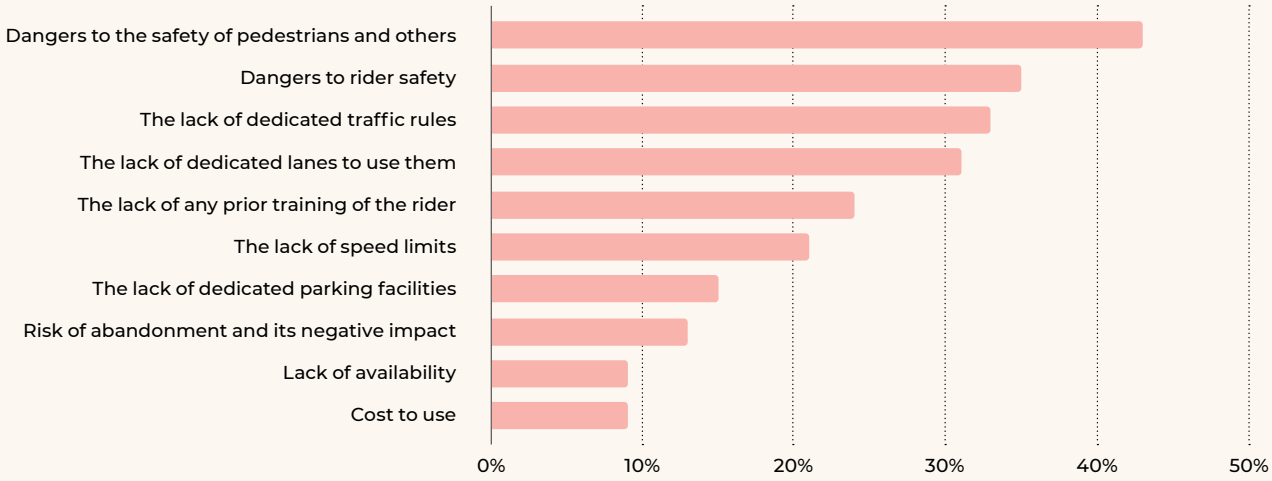
Source: **Voi's City Survey**

or subject to low-speed limits. It also says that authorities should create a protected and connected network for micro-mobility by calming traffic or redistributing space to physically protected lanes. The recommendation is at the top of a longer list, together with the advice to concentrate on addressing car drivers’ risky behaviour. The placing is not a coincidence, says Alexandre Santacreu: “Think about it: When you hear about a crash, a driver running over an e-scooter rider because of a blind spot. That blind spot could have killed a biker or pedestrian as well.”

ITF’s conclusions were echoed by the end of last

Lack of dedicated lanes and traffic rules causing a perception of unsafety

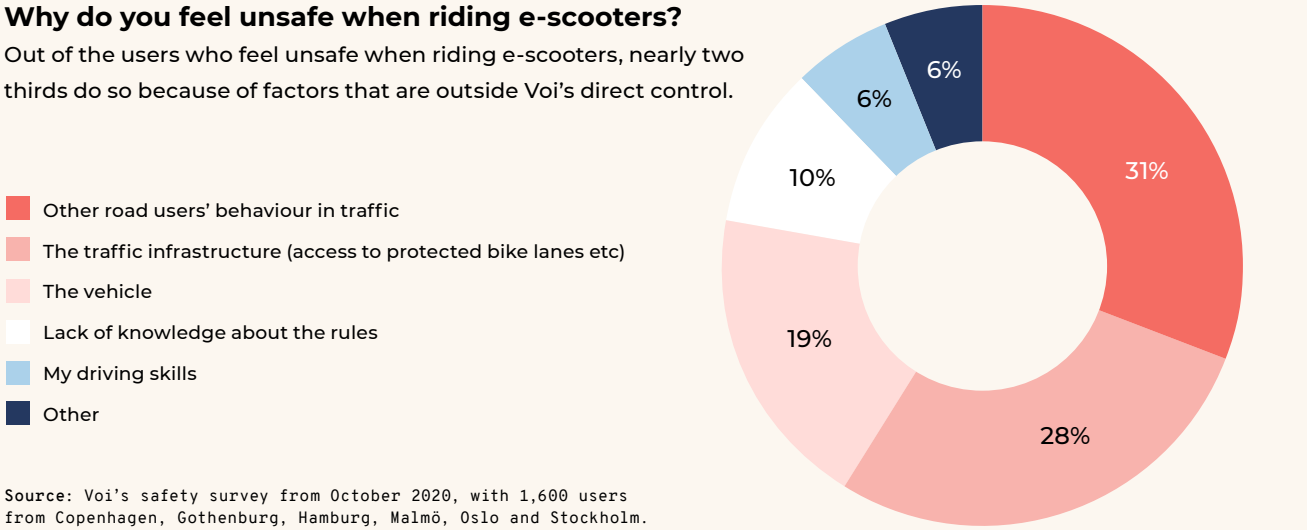
The European Commission conducted a survey with citizens in all member states to explore a range of factors relating to mobility. When people were asked about the key challenges to address regarding e-scooters in urban areas, safety-related issues top the agenda.



Source: European Commission (2020). Special Eurobarometer 495: Mobility and transport.

Why do you feel unsafe when riding e-scooters?

Out of the users who feel unsafe when riding e-scooters, nearly two thirds do so because of factors that are outside Voi's direct control.



Source: Voi's safety survey from October 2020, with 1,600 users from Copenhagen, Gothenburg, Hamburg, Malmö, Oslo and Stockholm.

"Micro-mobility operators should actually deploy with higher intensity along these bike lanes."

Pedro Homem de Gouveia,
Senior Policy Manager and Safety Coordinator, Polis Network

year in a report about safety for lightweight electric vehicles from the Swedish Transport Agency, which has analysed data compiled from hospitals and the police. The Swedish public authority concluded that the risk for a minor, moderate and severe injury is equal between bikes, e-bikes and e-scooters.

"A conclusion from this is that it's important to work for improved safety for biking in general, not only for electric single-passenger vehicles", said the lead author of the report in a press statement.

In February, the ITF published a report on reversing car-dependency, noting that space needs to be redistributed to micro-mobility to make streets safe and perceived safer.

This would make micro-mobility more attractive than cars. Cars tend to take up disproportionately more space than their modal share. "The emergence of shared micromobility has increased demands for redistributing space," the ITF writes.

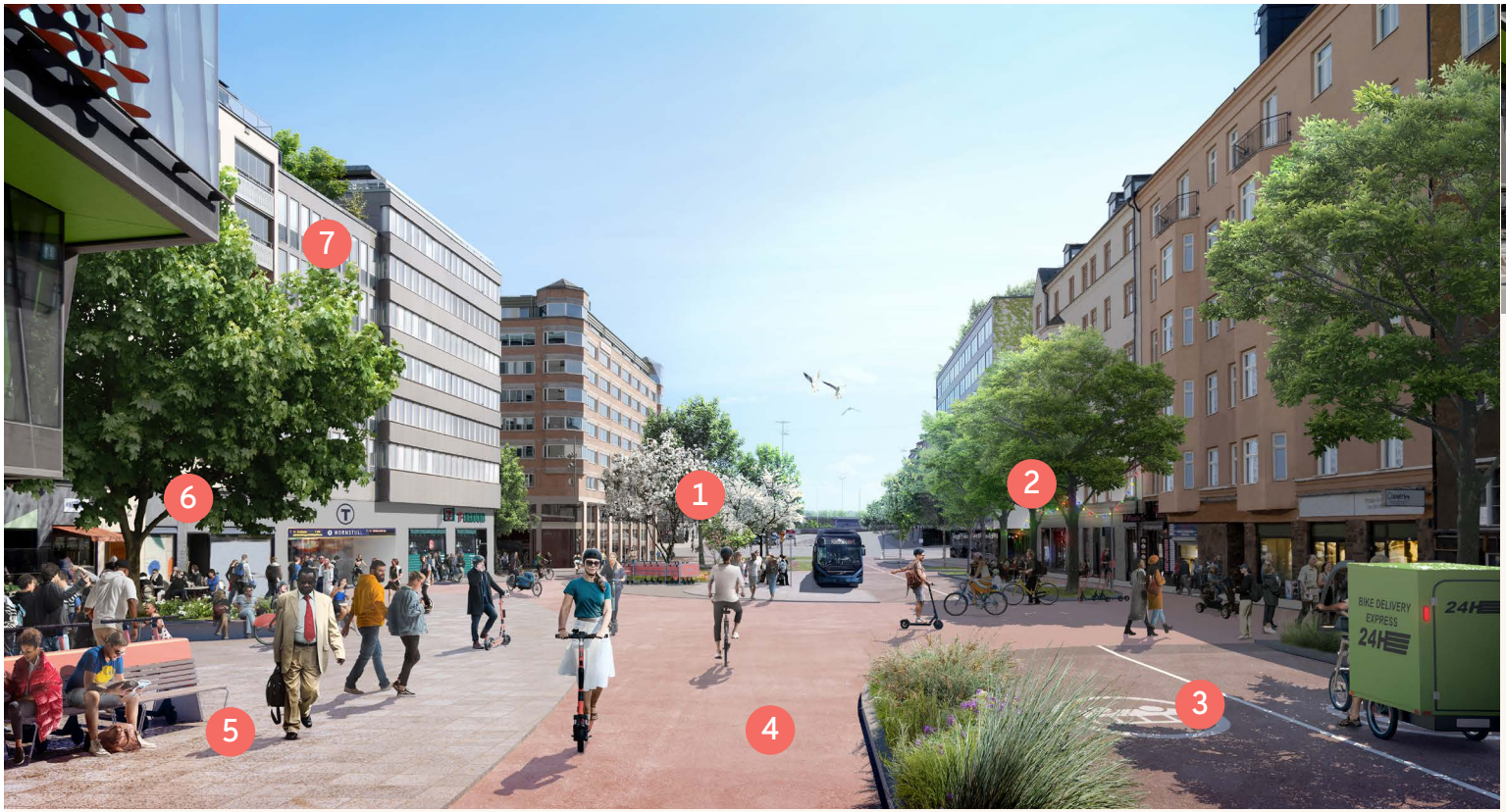
Pedro Homem de Gouveia from the POLIS Network stresses the importance of changing the infrastructure to improve safety for all lightweight travellers and says that it's not the victims that need to be fixed. He emphasises that the tendencies for a single-minded focus on helmet usage distract from the crucial sources of danger for pedestrians, bikers and scooter riders.

"We often get obsessed with 'catchy' but secondary details and miss the main source of problems, and the fact is that we need to create safe spaces for everybody. That means protecting all those people who are on the outside of those medieval armors called cars," says Pedro Homem de Gouveia, adding that companies such as Voi should lobby for road safety, speed reduction and sustainable mobility.

It seems like more dedicated road infrastructure is coming in many cities. In the survey Voi compassed among the cities it operates, 70 % of respondents said that their city is likely to expand micro-mobility infrastructure in the next five years significantly. Three out of four respondents believe that protected infrastructure is vital for keeping cyclists and scooter riders safe.

DE GOUVEIA BELIEVES it's important city officials aren't left alone in promoting bike lanes. When it's only left up to them, there is often criticism that the bike lanes are not used.

"Micro-mobility operators should actually deploy with higher intensity along these bike lanes. For example by making sure every morning that their vehicles are widely available along these lanes," says Pedro Homem de Gouveia. V.



1. Mobility hub connecting micro-mobility with the metro and bus station.
2. Outdoor seating for cafées and restaurants.
3. Bus lane for buses, delivery services and other prioritised transports.
4. Bike lane that is wide, safe and protected from heavier vehicles.
5. Parking rack integrated into benches and other existing infrastructure.
6. Social areas with a mix of commercial and non-commercial outdoor spaces.
7. More urban greening for human well-being, climate adaptation and biodiversity.

A glimpse of your future city

Hornstull is one of the most polluted and noisy areas in Stockholm and a hazard for lightweight travellers. We decided to reimagine the area together with the architect firm CF Møller.

Voi believes in the idea of 15-minute cities that are built to foster travelling with public transport, micro-mobility and feet. This will not only make cities more sustainable but also safer and more liveable. By reversing car dependency in cities, space can be redistributed for micro-mobility infrastructure, social areas, urban greening and other activities that support human well-being.

We live in a decade when carbon emissions need to fall steeply, which requires bold thinking from all parts of society. At Voi, we strive to push this dialogue forward by nudging people and policymakers to reimagine our cities. We believe that transforming urban mobility is critical for reaching climate targets and Vision Zero. This also means building cities for people – not cars.

We partnered up with the architect firm CF Møller to reimagine Hornstull, one of the most polluted areas in Sweden. The street currently has four car lanes and lacks protected bike lanes, making it a hazard for lightweight travellers and a hotspot for air pollution and noise. The reimagined street might seem dramatic, but it does in fact make sense for several reasons.

The development of new roads around the city makes the reduction of traffic in Hornstull possible. It's also a place with good access to both metro and busses. By building out safe infrastructure for lightweight travelling, it's possible to enhance mobility access for all while reversing car dependency.

At Voi, we think it's time to call for a new paradigm for urban development and build cities made for living.

New transport mode, new risks and opportunities

With a new vehicle mode on the streets comes new risks that need to be prevented. But shared micro-mobility also offers unique opportunities for improving road safety.

"There are many lessons to be learned from studies about e-scooter crashes, and we think it's important to have a research-led approach to improve safety," says Soffi Razavi, program manager for Voi's safety task force.

ON A WARM summer day in late August 2020, the Swedish insurance company Folksam published a study about e-scooter related injuries. Leading national newspapers published alarming articles about an increasing number of injuries, causing a heated debate about the safety of e-scooters.

Folksam had studied insurance claims and compared them with public data from Swedish hospitals and the police. The insurance company found that most of the injuries were minor skin or soft tissue damages, followed by fractures and damaged teeth. The head and face were the most frequently injured parts of the body, followed by arms and legs.

FOLKSAM'S TRAFFIC SAFETY researcher Helena Stigson, who is affiliated with the Karolinska Institute, says that it's crucial to study and prevent crashes with minor injury outcomes since the injuries can cause long-term consequences for the injured rider. Only focusing on fatalities and severe crashes leads to a less rigorous road safety approach.

"Depending on what injuries you focus on, there will be different preventive measures that should be in focus," says Helena Stigson. "Thanks to the focus we have today, we also work with safety for bicycles and other types of vehicles."

She says that Folksam's study should not be interpreted as a reason to prohibit shared e-scooters but as an essential step to understanding the risks with a new vehicle that most likely will stay on the streets.

"What we have seen is that the crashes with e-scooters are similar to bikes, but the injuries are a bit different," says Helena Stigson. "E-scooters will most likely stay on the streets, but certain measures need to be taken to fulfil the thinking around Vision Zero in society."

She concluded that measures need to be taken from micro-mobility operators, public authorities and cities to prevent e-scooter crashes.

VOI'S CEO Fredrik Hjelm agrees that it's not enough to focus on preventing fatal and severe crashes, meaning that a more extensive toolbox of preventive actions needs to be implemented.

"E-scooters can help with improving road safety by being a catalyst for modal shift from cars. However, we believe it's important to prevent all kinds of crashes causing injuries to riders and other road users," says Fredrik Hjelm. "We need to work together with other stakeholders to build intelligence and put the right measures in place to mitigate these risks."

The increasing evidence that e-scooters bring new sorts of risks led Voi to formulate the Vision Zero target, focusing on eliminating all traffic injuries and fatalities. A safety task force, spanning across all business units, was established to focus on improving the safety of Voi's products and service.

"This is a long-term commitment. We see that this is the way to work strategically with increasing our contribution to road safety," says Soffi Razavi, program manager for Voi's safety task force, adding that previous safety initiatives are included and developed under this umbrella.

New vehicles with bigger wheels

While we at Voi are also offering e-bikes in some cities, the debate has increasingly focused on the safety performance of e-scooters. For example, the smaller

"E-scooters will most likely stay on the streets, but certain measures need to be taken to fulfil the thinking around Vision Zero in society."

Helena Stigson,
Traffic safety researcher,
Folksam

“We co-develop our scooters with Segway, global leaders in design and manufacturing of light electric vehicles, and own the entire stack of R&D for the IoT hardware.”

Shahin Ghazinouri,
VP Hardware Development,
Voi Technology

wheels may increase the risk of falling over hurdles on the streets. Folksam concluded that a third of all crashes occurred due to poor maintenance of road infrastructure or e-scooter riders driving into pavement curbs.

“The infrastructure is not adapted to the vehicle,” says Helena Stigson. “As with the bike, the e-scooter is a quite unstable vehicle meaning that it’s easier to fall over potholes and other hurdles. If you drive into a pothole with a car, it will affect the car, but you will never be injured.”

FOLKSAM RECOMMENDED e-scooter operators to make the wheels bigger and improve the hydraulic suspension – measures that Voi has implemented for all e-scooter models released since July last year.

The insurance company also urged municipalities to improve the road environment for e-scooter riders,

Safety at the heart of vehicle R&D

Shahin Ghazinouri and his team of more than 20 engineers ensure that the vehicles that Voi puts on the street are safe, sustainable and user-friendly. Voi’s e-scooters are co-developed with Segway, global leaders in designing and manufacturing light electric vehicles. The IoT hardware in the vehicles is fully developed inhouse. This allows a holistic approach to safety and flexibility to implement new features.

THE LATEST ADDITION to the vehicle fleet is Voiager 4, the most advanced e-scooter that Voi has developed to date. It includes a string of features improving safety, such as hydraulic suspension and large, higher-quality tyres that increase shock absorption and ease the impact from cobblestones and potholes.

“The ability to ride over hurdles has improved massively since our first model which had smaller wheels and no hydraulic suspension. However, for this kind of vehicle there is also a risk with introducing even larger wheels since it will impact the ability to drive at slower speeds, and it increases the distance to the ground which makes it harder to jump off the scooter,” says Shahin Ghazinouri.

ONE OF THE most important new features is the new turn indicators that offer 360° visibility and ensure riders can safely communicate their intended manoeuvres. These also illustrate the strength of owning the full stack of vehicle R&D. The surveys that Voi has made with users shows that the ability to indicate which way you are turning was the number-one feature that impacts a user’s perception of safety.

“Turn indicators offer a safe way for riders to show other road users what their intentions are, so they can avoid collisions and other crashes,” says Shahin Ghazunouri.

THE IOT HARDWARE in the scooters is fully designed in-house, with some significant improvements in the Voiager 4. One of them is the highly accurate positioning that combines information from various sensors to calculate the scooter’s current position to the metre. With the high-accuracy positioning, Voi can slow down scooter speeds or even prevent users from riding in certain areas and streets. The Voiager 4 also includes a dedicated slot in its hardware for extra sensor devices, expanding the IoT’s future capabilities.

“Rather than producing a new e-scooter model every time we want to introduce a new feature, the flexible IoT gives us more flexibility to add and swap out features, depending on requests, regulations, or new requirements. This is truly a more sustainable development model that offers opportunities to keep improving their safety,” says Shahin Ghazunouri.

which means improved maintenance and adapting streets to protect lightweight travelers.

The fact that a significant share of the injured e-scooter riders fall over pavement curbs, highlights the issue with pavement riding seen in many countries. Driving e-scooters on the pavement is not only a risk to the riders themselves but also for pedestrians.

MANY COUNTRIES HAVE therefore prohibited pavement riding, for example, France and Germany. The Swedish Transport Agency recently announced national e-scooter regulation recommendations, which included a proposal to ban pavement riding.

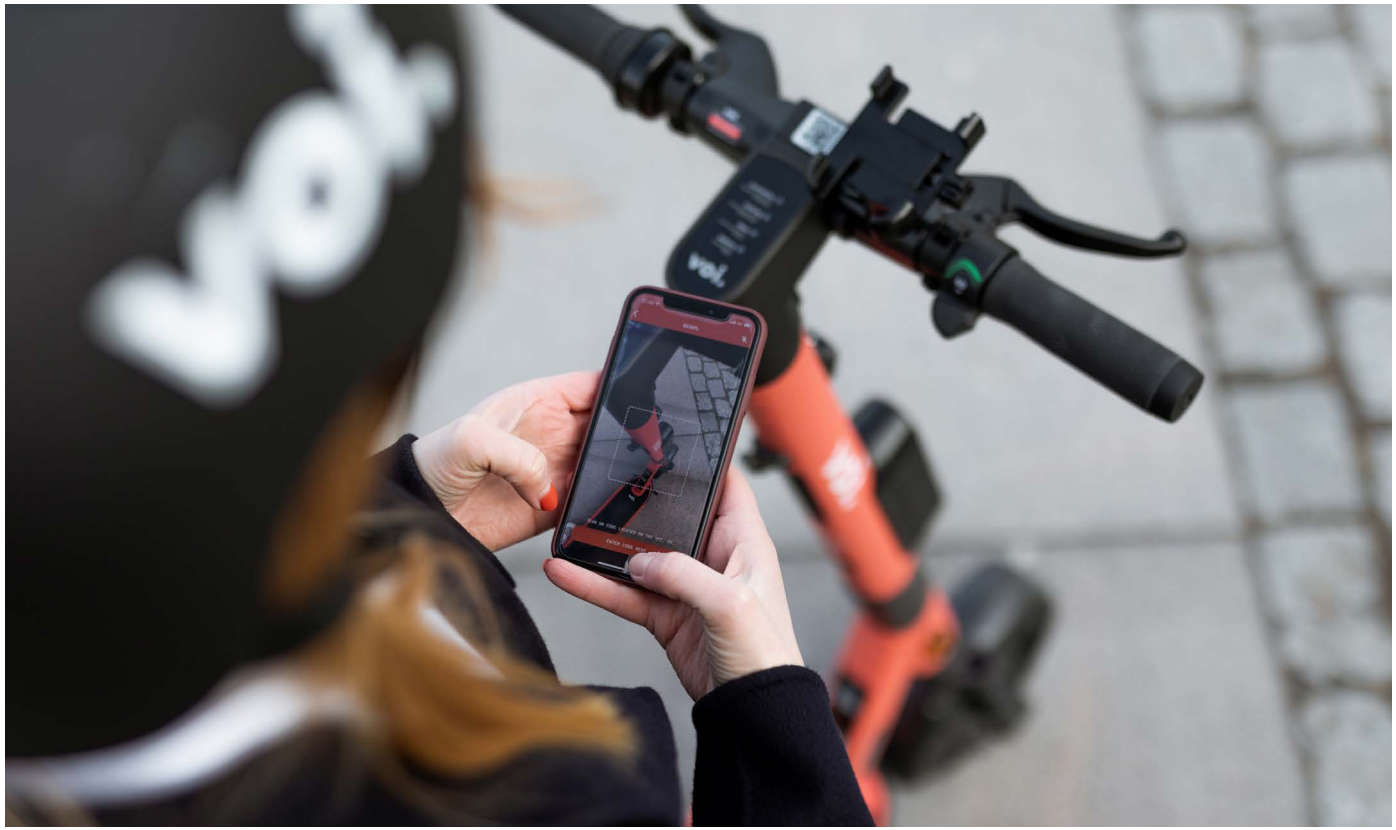
"An expectation is that this change could speed up the development of road infrastructure for pedestrians and bikes," wrote the Swedish public authority.

While dedicated road infrastructure for micro-mobility is critical for mitigating these risks, it's also important to decrease the vehicle risk by developing the design. For Voi, this is an in-house process building on internal research and input from external stakeholders.

"When we launched three years ago, we used off-the-shelf scooters. Today, we co-develop our scooters with Segway, global leaders in designing and manufacturing light electric vehicles, and own the entire stack of R&D for the IoT hardware," says Shahin Ghazinouri, vice president of hardware development at Voi. "We put a lot of effort and resources in improving the safety and user experience of our vehicles and service."

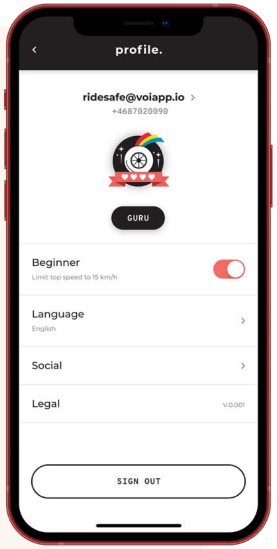
IN JULY 2020, we released the first e-scooter model fully developed inhouse, the Voiager 3X, with increased wheel size – from 8 to 10 inches – and improvements in tyre grip, hydraulic suspension, brakes and other features making the vehicle safer. The most recent addition to Voi's fleet, Voiager 4, has taken further steps to improve safety (see box on page 25).

For the newer e-scooter models, Voi has carried out several safety studies using independent third



Beginner Mode

Beginner Mode is an in-app feature enabling users to reduce the maximum speed of their scooter.



ONCE THE USER activates the Beginner Mode setting in their user profile, the scooters they ride will travel at a reduced speed of 15 km/h instead of the maximum speed set in their city. By enabling novice riders to practice riding at a reduced speed, Voi hopes to build riders' self-assurance on the scooter and prevent crashes. Beginner Mode took effect in all cities in September 2020.

parties before deploying the vehicles on the street. One of these studies was conducted with Traffic Research Laboratory (TRL), a UK independent transport research service.

"They compared our e-scooters with other vehicle types and concluded that there is not a significantly higher risk for accidents with our scooters than a bike," says Shahin Ghazinouri. "It depends on how big the hurdle is, but TRL concluded that the risk is similar to a bike in typical road conditions."

Mitigating risks of the first ride

There are many examples of reports indicating that the first ride with an e-scooter is the most dangerous. One of them is a report from Austin Public Health, published in 2019, which found that 33 % of 190 injured riders injured themselves during their first ride. The author of the report suggests that the risk for crashes decreases when riders become more used to riding the scooter.

A survey Voi made with non-riders across Europe found that speed is one of the biggest hurdles to e-scooter adoption, especially among women and people in the 30+ age bracket. Almost a third of respondents said that the ability to limit the speed during the first rides would convince them to try scooters.

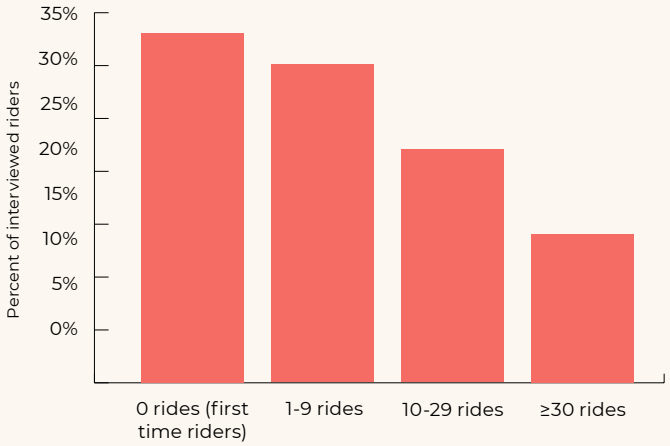
The findings, paired with internal data insights show that 16 % of all personal injury incidents occur on the first ride. This has led to us developing an in-app feature enabling novice riders to practice at a slower speed.

"With Beginner Mode, we want to make sure that people feel safe riding our scooters, especially when they're just starting," says Soffi Razavi. "We really believe that e-scooters should be for everyone."

However, speed is not the only hurdle, as our

The first ride is the most dangerous

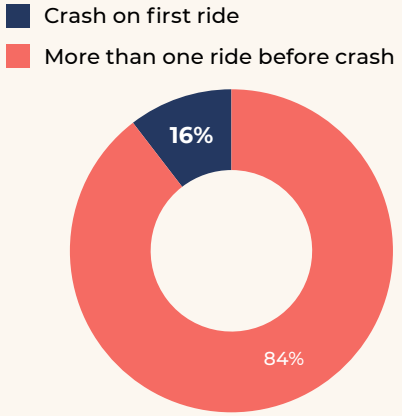
Austin Public Health's review of 190 injured e-scooter riders shows that most crashes occurred on the first rides.



Source: Austin Public Health (2019). Dockless electric scooter-related injuries study.

Share of crashes on the first ride

Voi's crash data verifies that many crashes occur on the first ride.*



*The chart includes Voi's crash data from the period January–June. More than 21 million rides occurred in this period, and 8 % of all rides were a user's first ride.

“With Beginner Mode, we want to make sure that people feel safe riding our scooters, especially when they are just starting.”

Soffi Razavi,
Program Manager for
Voi’s safety task force

survey with non-riders revealed. Almost half of the respondents would prefer trying scooters in a secluded area, while a third would prefer having someone personally teaching them how to ride.

FOLKSAM ESTIMATED THAT 18-26 % of all crashes occurred due to errors in handling the e-scooter. The insurance company found that balancing difficulties and issues with jumping on and off the scooter tend to increase the first ride’s risk.

This highlights the importance of arranging demo days and activities for people to learn how to ride scooters in a secluded environment. Over the past years, Voi has arranged numerous such events in cities across Europe while also remaining present in communities in conjunction with launches to teach people how to ride safely.

An assessment of e-scooters’ impact on traffic safety made by the Finnish Transport and Communications Agency, Traficom, concludes that the vehicle is likely to be safe if the user is adequately familiar with it, follows traffic rules and the relevant instructions. Among the measures recommended to improve safety, the Finnish public authority emphasises the importance of traffic safety courses and opportunities to practice riding in a safe environment.

WHILE PRIVATELY-OWNED e-scooters are on the rise in many countries, shared micro-mobility operators benefit from reaching the early adopters, says Dagmara Wrzesinska, mobility project manager at Vias Institute, the independent Belgian road safety institute.

“Education is key to everything. Companies like Voi have the right tool to reach the community and facilitate the transition,” says Dagmara Wrzesinska.

Research shows that younger generations, particularly people in their 20’s living in urban areas, tend to have lower rates of driving license possession than previous generations at the same age. Younger individuals in their 20’s are also the group who most frequently ride e-scooters.

With this in mind, we decided to develop a virtual

Voi’s virtual traffic schools

In September 2019, we launched the world’s first traffic school for e-scooters, Ride Like Voila. It was developed in collaboration with NTF (The National Society for Road Safety in Sweden) and certified by Vias Institute (Belgian knowledge centre for road safety).

SINCE TRAFFIC RULES and vehicle classifications vary from country to country, different versions of the test are available to suit all markets in which Voi operates.

Ride Like Voila is free, and users who complete the traffic school get rewarded with free rides. The virtual traffic school consists of traffic rules, signs and signals, scooter knowledge, parking and general information. To date, more than half a million users have educated themselves via our online traffic school.

IN MARCH 2021, Ride Like Voila was complemented with a virtual traffic school targeting both e-scooter riders and other road users. The new UK specific Safety Module was developed in partnership with Drivetech, from AA.

The module addresses other road users to ensure that they are aware of and sensitive to the additional presence of e-scooters on the streets. It covers vital aspects of safe riding and advice on how to understand and accommodate this new on-road vehicle.

500 000

users have educated themselves in Voi’s virtual traffic school.

Teaching users how to ride safely

Our surveys with people who have not yet ridden an e-scooter shows that a third of respondents would be interested in trying if someone personally teaches them how to ride. Over the past years, we have arranged several demo days and other pop-up safety events in the cities we operate in to teach new users how to ride safely. We also remain present in communities in conjunction with new launches to ensure that users ride safely.

Risky riding at night

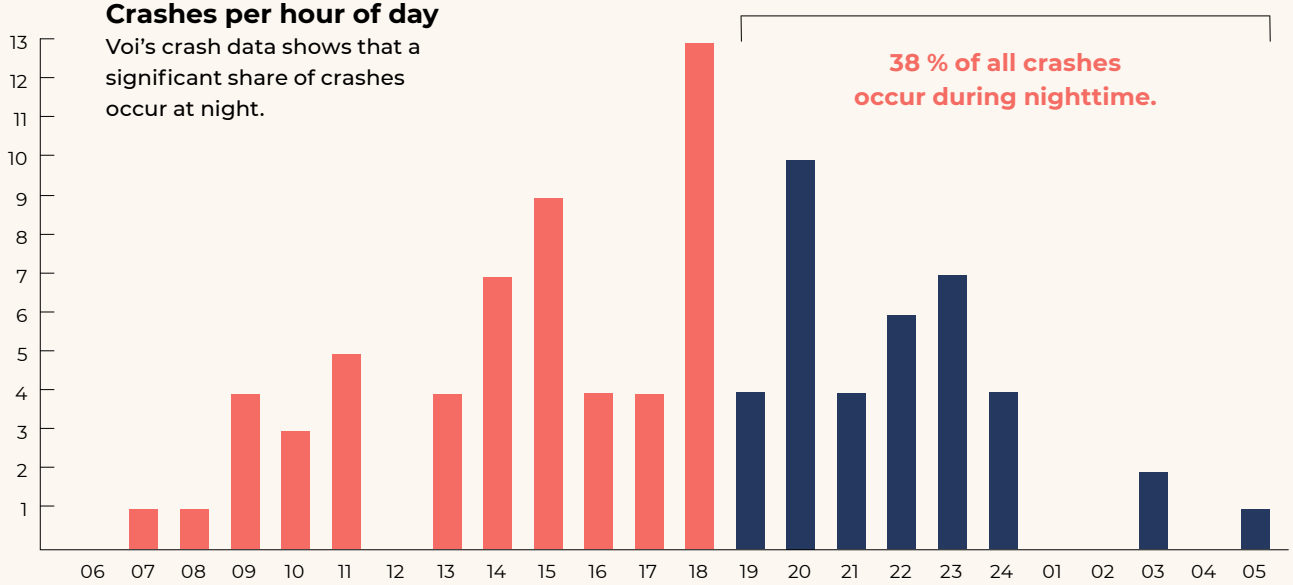
Voi's crash data shows that 38 % of incidents resulting in major or severe injuries occur at night-time.

IT'S HARD TO DETERMINE whether the injured riders have been riding under the influence since other factors such as limited visibility, sight and road conditions can also have an effect. However, it's likely that some of these crashes can be attributed to drinking and riding.

Several research studies show that injured e-scooter riders have been drinking and riding. This means that it's important to focus efforts on changing social norms and prevent people from riding e-scooters under the influence.

Crashes per hour of day

Voi's crash data shows that a significant share of crashes occur at night.



*The chart includes Voi's crash data from the period January–June. More than 21 million rides occurred in this period.

"Ways to control the fitness to drive are excellent means of guaranteeing that the ride is safe."

George Yannis,
Professor in traffic safety and management at National Technical University of Athens, and member of Voi's external Safety Advisory Council

traffic school, Ride Like Voila, for e-scooters in September 2019. Dagmara Wrzesinska and her colleagues helped with ensuring coherence with local legislation for Ride Like Voila, which was developed in collaboration with the National Society for Road Safety in Sweden.

"I admire the commitment to safety from Voi, and I see now that other operators want to follow," says Dagmara Wrzesinska.

VOI'S VIRTUAL TRAFFIC SCHOOL is free of charge, and users are incentivised with discounted rides if they complete the test.

"Traffic schools are usually pretty pricey. While we believe in education as the strongest tool to increase awareness of traffic rules and improve road safety, we also believe in rewarding users for responsible behaviour," says Carro Hjelm, VP Growth at Voi. "Instead of charging for entry into the school, we reward our users with free Voi rides for educating themselves and passing the test."

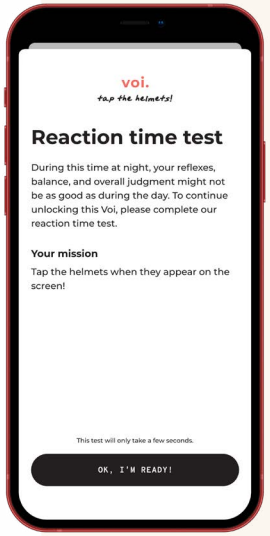
Don't drink and ride

A vital lesson in Voi's virtual traffic school is that people are not allowed to ride under the influence of alcohol and drugs. Several studies indicate that drinking and driving significantly increases the risk of e-scooter crashes as with any vehicle. Finnish Traficom found that riding under the influence of alcohol and other

Reaction Test

To reduce riding under the influence, we developed the world's first in-app reaction test game, in which players need to tap helmets on the screen as they appear in a random sequence.

IF A PLAYER receives a certain score, they pass the test. The reaction test is active on late Friday and Sunday nights and in conjunction with particular events when there is an increased risk for drinking and riding.



The test was launched in September and has been taken 655,000 times since then. Around 10 % of the tests were failed and led the user not to pick up the scooter. This means that approximately 64,000 potentially risky rides have been avoided.

64 000

potentially dangerous rides have been prevented by Voi's Reaction test

intoxicating substances is a primary contributing factor to traffic crashes affecting the riders themselves.

A study from Oslo University Hospital found that 41 % of 815 patients at the hospital had injured themselves when riding under the influence of alcohol or other substances.

In contrast to these European studies, research from Nashville in the US shows that less than 5 % of e-scooter crashes involved drunk riders. Nashville has had e-scooters operating for a couple of years already, which indicates that drinking and riding may decrease as social norms adapt. Another factor at play can be that it's illegal to drink and ride e-scooters in Nashville.

AS WITH ANY MODE of transportation, nobody should drink and ride. Drinking and riding on e-scooters can lead to prosecution under national drinking and driving laws. But in many countries across Europe, it's not illegal to ride on an e-scooter while intoxicated.

Some cities are elaborating measures to limit access to shared micro-mobility at certain times of the day, but this will also affect mobility access for people who are not intoxicated. Vulnerability comes in many forms, and female users have reported to us that they find shared e-scooters to be a safe way to get home on weekend nights to decrease the risk for sexual assault.

This implies that it's essential that shared micro-mobility operators prevent users from drinking and riding. As of today, there is no software solution for determining someone's intoxication. It's however possible to develop software solutions for evaluating the user's reaction time to reduce riding under the influence.

"This applies not only for drinking and drive but also other kinds of impairments like drugs or fatigue, or even some cognitive impairment, which can be temporary or permanent. Ways of controlling the fitness to drive are an excellent means of guaranteeing that the ride is safe," says George Yannis, a professor in traffic safety and management at the National Technical University of Athens.

WE AT VOI RELEASED an in-app reaction test in September last year, which helps prevent driving under the influence of alcohol and other drugs. Since the launch, more than 655,000 users have taken the test. Around 10 % of the tests were failed and led to the user not picking up the scooter. This implies that the test has prevented more than 64,000 risky rides.

Riders can unlock the scooter regardless of whether or not they pass the test, but the test encourages people to think twice about riding.

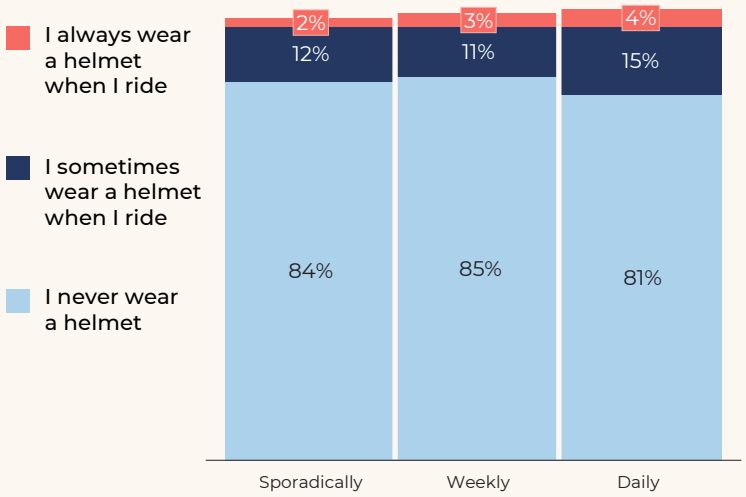
"We want to do our part to help prevent drunk riding while emphasising that the responsibility still lies with the user. However, we are open to taking further actions such as slowing down the speed or completely preventing the user from starting a ride after a failed test," says Soffi Razavi from Voi.

The conundrum with helmets

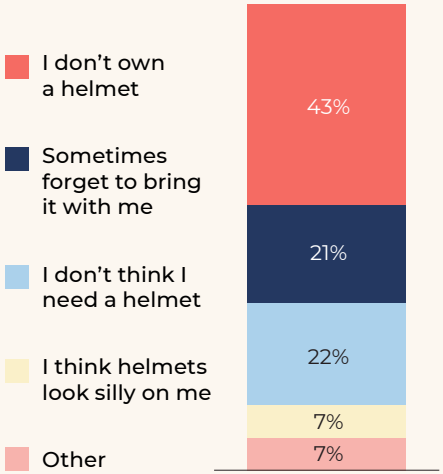
Many studies indicate that head injuries are frequent among the injuries related to e-scooter crashes.

A recent academic study looking at injury statistics from a hospital in Hamburg found that 54 % of the injured e-scooter riders suffered from a head or facial trauma. None of the injured e-scooter riders wore a helmet at the time of the crash.

How often do you wear helmet when riding e-scooters?
Voi's survey with riders shows that helmet usage is higher for users who ride more frequently. The chart is segmented by riding frequency.



Why don't you wear a helmet?
Many users don't own a helmet, but this isn't the only reason for not wearing one.



The Hamburg study also found that alcohol is a risk factor contributing to the high number of head injuries. Out of 25 patients driving under the influence of alcohol, 23 suffered a head or face injury. The authors of the Hamburg study conclude that several other reports show similar results.

The research conducted by Folksam showed that a majority, 44 %, of all reported e-scooter related injuries were damages to the head and face. Meanwhile, a minor share of the injured riders wore a helmet.

BOTH FOLKSAM AND the German researchers stress that e-scooter operators and public authorities should consider a mandatory helmet requirement, together with measures to prevent drinking and riding.

"From a research perspective, when you see the injuries, it's hard to say something else other than that it's important to wear a helmet," says Helena Stigson, the lead author of the Folksam study. "From our point of view, it's hard to say that it shouldn't be a requirement to wear a helmet while driving an e-scooter".

She acknowledged that it can be a problem that the riders will need to carry a helmet. She also says that wearing a helmet reduces head injuries, but it won't address other kinds of injuries.

"I don't think that we should lock ourselves to the perception that a helmet is the only solution. There are so many other measures that help with preventing injuries," she adds. "I think it's a shame that this is the case also with bicycles, that the bicycle helmet is said to be the only solution to getting cycling safer even though head injuries are a minor share of all injuries."

She says that other sorts of measures such as improving the vehicle's stability, identifying and averting risky riding behaviour, and improving road maintenance are essential to prevent the crashes from occurring in the first place.

DAGMARA WRZESINSKA from Vias Institute adds that it's essential to work with education about the importance of wearing a helmet and the risks associated with not wearing one. However, the Belgian road

Take a helmet selfie and get rewarded

In December 2020, we launched the Helmet Selfie feature, which rewards e-scooter riders that are using a helmet during the ride. The Helmet Selfie feature uses an image-classifier AI that can instantaneously detect if a user is wearing a helmet with 95% accuracy.

AFTER SCANNING A scooter to begin their ride, the user will be prompted to take a selfie, which unlocks the scooter. The user's photo is then validated during the ride; if the AI confirms that the user is wearing a helmet, the user will get five loyalty points at the end of their ride. Loyalty points enable users to receive discounted rides. 72,000 riders have taken a helmet selfie since the feature was introduced.

As a further commitment to increasing the riders' helmet usage, we have distributed tens of thousands of helmets to our users.

72 000

users have taken a helmet selfie and been rewarded with discounted rides

safety organisation is not in favour of a mandatory helmet requirement.

"Our official recommendation is that helmets should be recommended but not mandatory. It's hard to enforce a mandatory requirement, and it's also preventing the shift to micro-mobility," says Wrzesinska. "The way helmets are built right now is making it hard for people to carry them all the time. The best way is to make people aware of the risks so that they will think twice."

Our survey with e-scooter riders indicates that between 81 and 84 % never wear a helmet when driving an e-scooter. The share who always or sometimes wear a helmet is larger among riders who take e-scooter trips weekly or daily.

ONE SIGNIFICANT REASON for not wearing a helmet is that a big share of the users don't own a helmet, or if they do so, they sometimes forget to bring it. However, almost a third of the respondents say they don't think they need a helmet or don't use it because they think it looks silly. When asked if they would wear a helmet if it was integrated into the scooter and maintained high hygienic standards, only 39 % said they would consider wearing it.

"We have distributed tens of thousands of helmets to our riders and incentivise them to wear helmets with our helmet selfie," says Voi's VP of communications Kristina Nilsson. "But we believe that a mandatory helmet requirement would impact the adoption of micro-mobility. Our research indicates that we need to tackle the issue with head injuries from different angles together with the cities."

She adds that innovative helmet solutions such as

"It's hard to enforce a mandatory helmet requirement, and it's also preventing the shift to micro-mobility."

Dagmara Wrzesinska,
Mobility project manager
at Vias Institute

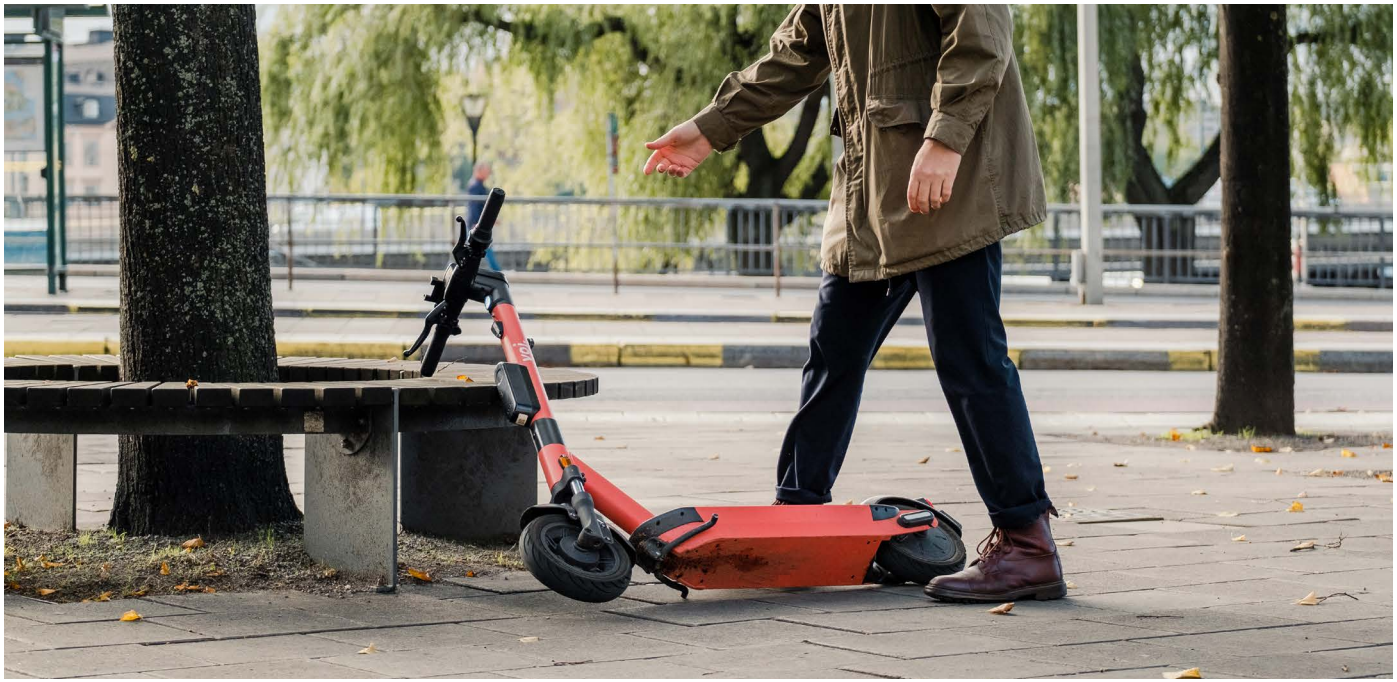
Closca make it easier for people to carry their helmets throughout the day, contributing to increasing helmet usage over time. In the UK, Voi offers free foldable helmets from Closca to all riders who buy a monthly pass to support this transition.

Improving riding behaviour

While crashes involving heavier motor vehicles are a significant source of danger for fatal and severe crashes, it's clear that most e-scooter crashes occur without another vehicle involved when less serious injuries are added to the equation. Our internal crash data shows that only 8 % of the crashes causing personal injury were collisions with other road users.

This indicates that the risks associated with e-scooters are also a matter of riding behaviour, which means that there are opportunities to improve safety by advancing the understanding of the risks and nudging good riding behaviour.

Marco Dozza, a professor in active safety and road-user behaviour at Chalmers University in Goth-



“It’s very interesting to look at statistics of crashes showing the circumstances in which they occurred, but it’s even more interesting to understand why the crash happened.”

Marco Dozza, Professor in active safety and road-user behaviour, Chalmers University

enburg, Sweden, says that there is still a limitation in understanding e-scooter crashes and rider behaviour.

“The problem with crashes is that it’s hard to know why they happened,” says Dozza. “It’s very interesting to look at statistics of crashes showing the circumstances in which they occurred, but it’s even more interesting to understand why the crash happened. If we understand this, it’s easier to find solutions that prevent crashes.”

As an example, several studies show that the first ride is the riskiest one. However, the question is still why this is the case. Is it because riders find it hard to manoeuvre the vehicle or because they can’t control the speed? It might also be the case that a sequence before the crash – a car driving by – made the novice e-scooter rider lose control.

Marco Dozza claims that exposure data is essential to understand the crash risks with e-scooters. However, it needs to be connected to crash data and naturalistic data to enhance the understanding of crash causation. Voi is currently in discussions with Chalmers to perform research to enhance the knowledge of rider behaviour and understand why e-scooter crashes occur.

THE FACT THAT SHARED e-scooters are a new phenomenon means that it’s important to have a research-led approach to the industry’s development. By working together with research institutes and other partners, micro-mobility operators can better understand why crashes occur and use the information to develop safety measures.

Shared micro-mobility comes with a benefit that privately-owned micro-vehicles lack: the opportunity for operators to nudge users to drive safely. George Yannis from the National Technical University of Athens says that telematics, the combination of IoT and vehicle technologies, enables e-scooter operators to target measures to specific users depending on their behaviour in traffic.

“If you have information about a specific user, you can take measures to restrict this person. As an example, you can send personalised messages or put a lower speed automatically on the scooter if a user has been involved in incidents,” says George Yannis.

The micro-level data that operators can collect could be used to build a safety profile for each rider. Voi is developing such a safety profile feature in partnership with a world-leading traffic safety company, to classify

Switch to subscription model contributes to safer riding

We are increasingly focusing on selling time-bound passes to our riders in a move to make our service more inclusive and affordable.

MONTHLY AND DAILY passes were introduced in June last year across all of our markets. Now we are also rolling out yearly passes globally and even more subscription options.

The shifting focus towards a subscription model is also a step to make our service safer. Both the POLIS Network and ITF stress that the pay-per-minute-model, which has been a norm in the industry, may incentivise e-scooter riders to adopt speeds that are not appropriate to the situation or make dangerous manoeuvres. Monthly subscriptions is one of the safety measures recommended by the ITF.

how safe a rider of an e-scooter drives and the risk of ending up in a crash. The safety profile can be utilised to target education and other actions to specific riders.

ANOTHER PROJECT AIMING to understand and influence rider behaviour is Voi's partnership with Luna, a precise positioning and computer vision technology company for micro-mobility. The project aims to improve e-scooter safety by tackling two key e-scooter issues: pavement riding and pedestrian detection.

The solution to these issues lies in improving GPS accuracy and the scooter's understanding of its immediate vicinity and then control where scooters can park and ride. Luna is also developing computer vision technology that uses onboard smart cameras as sensors to govern and control where and how scooters are ridden.

"The whole point is that we instantly should be able to in real-time detect whether a scooter is running on a pavement," says Austin Stout, Voi's project manager for the Luna partnership. "Once the technology is fully developed, it will be possible for us to alert the rider, slow down the scooter or even bring it to a stop."

EVEN MORE OPPORTUNITIES to improve the safety of e-scooter riding will likely arise over time, as more research on the issue is conducted and the industry matures. By working with a data-driven and research-led approach to prevent crashes, we can help unlock the potential to reverse car dependency with shared micro-mobility and create safer streets in the process. V.

Safer streets for all with parking hubs

Improperly parked e-scooters are a headache for both citizens and micro-mobility operators. Research from the Norwegian Institute for Transport Economics shows that dedicated parking space can help solve this issue.

"If you want the biggest impact, the parking measures should be placed where people normally end their trips," says Katrine Karlsen, the author of the report.

THE NEW DOCKLESS shared micro-mobility model provides flexibility for users to find a vehicle and park it at the destination. However, a lack of parking infrastructure has led to clutter in many cities with scooters that are improperly parked. This can negatively impact the accessibility of streets while also being a hazard for other road users who risk falling over e-scooters.

"The way we transport ourselves in cities is rapidly changing, and with that comes challenges connected to the use of public space. Dedicating space for e-scooter parking is important to solve issues with clutter and fully take advantage of the potential that e-scooters represent. E-scooters need a home in cities, just like any other mode of transportation," says Christina Moe Gjerde, Voi's General Manager in Norway.

THE NORWEGIAN INSTITUTE for Transport Economics (Transportøkonomiskt institutt) recently published a study about parking solutions for shared e-scooters, the world's most extensive study to date and financed by several public agencies. The study examined the impact of parking racks on parking behaviour through a combination of GPS data, video analysis and surveys with e-scooter users and non-riders.

The Norwegian researchers conclude that implementing both physical parking racks and painted parking spaces positively affects parking behaviour: over 60 % of the e-scooter riders who ended their trips in the test areas parked in or near the parking solutions.

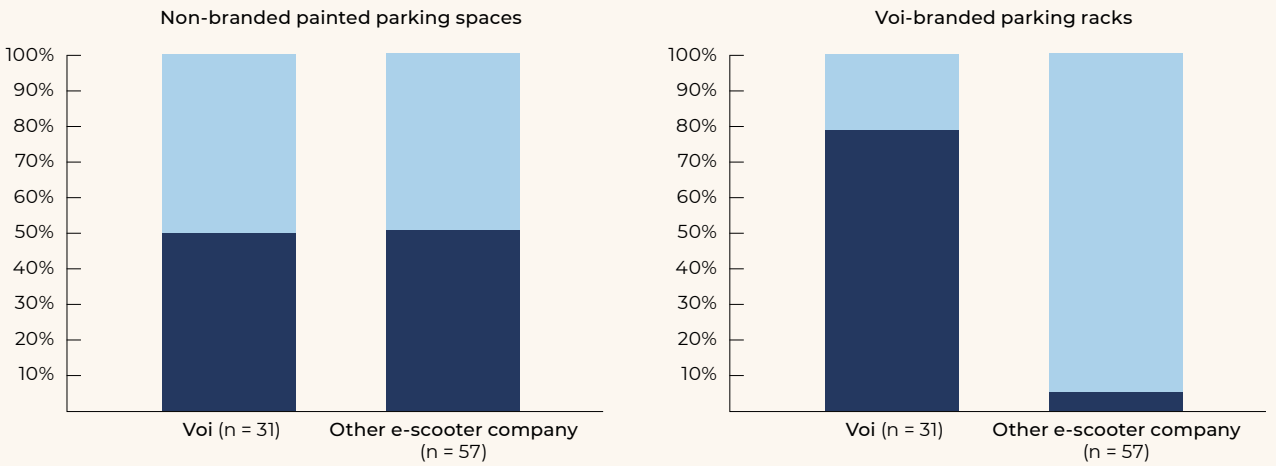
Voi contributed to the study by sharing traffic data and deploying branded parking racks on the streets in Oslo. As a partner to the research project, we also used our geofencing technology to incentivise users to park the scooters in the parking zones.

In Oslo, almost 80 % of the e-scooters from Voi were parked in the racks, compared to 4 % from other operators. In Trondheim, where neutral painted parking spaces were used instead of Voi-branded racks, the distribution was almost identical with 50% for Voi and 50% for other operators.

"This illustrates the impact of having parking measures associated with a single operator. To increase use by riders renting from all operators, one should probably implement neutral parking spaces,"

Dedicated parking space decreases e-scooter clutter

Implementing dedicated space for e-scooter parking improved parking behaviour in the Norwegian cities Oslo and Trondheim. Voi-branded racks had most impact on Voi riders, while non-branded parking spaces decreased clutter from all e-scooter operators.



Source: The Norwegian Institute for Transport Economics (2020). Parking solutions for shared e-scooters

"Dedicated space for e-scooter parking is an important part of the solution to take advantage of the potential e-scooters represent."

Christina Moe Gjerde,
General Manager Norway,
Voi Technology

“Choosing the right location is probably more important than whether one chooses to implement parking racks or painted parking spaces.”

Katrine Karlsen,
Research Officer,
The Norwegian Institute
for Transport Economics

says Katrine Karlsen, the author of the report while adding that the branded racks likely work particularly well for Voi scooters because of the link with their design.

The study also found that convenience and proximity play a role in how effective the solutions are in promoting good parking behaviour. Use of both racks and painted parking spaces decreases with distance from a user’s end destination, so they are most effective when placed in areas where people typically end their trips.

THE SURVEYS SHOW that many users are willing to walk only 1–2 minutes to park in a dedicated spot.

“The frequency of parking measures is important both due to the limited distance users are willing to walk from their end point and due to visibility and awareness. In order to use the parking measures, people need to know they are there,” says Katrine Karlsen. “Choosing the right location is probably more important than whether one chooses to implement parking racks or painted parking spaces.”

The surveys conducted with users and non-users show that both groups desire dedicated parking spots, but they disagree on whether it should be obligatory to park at these locations.

“While the non-users were positive to forced parking areas, users are a bit more sceptical but perhaps not as negative as one might expect,” says Katrine Karlsen. “However, some users comment that they fear that this would reduce the flexibility of micro-mobility.”

In June 2020, we placed our first parking racks for e-scooters on public grounds in Oslo in collaboration with the district of St. Hanshaugen in Oslo and the Norwegian Institute for Transport Economics.

Parking racks as mobility hubs

A survey we made with cities in May indicates that elected officials and civil servants find dedicated parking space a vital solution to solve clutter with shared micro-mobility. 87 % of the respondents believe that parking racks and corrals would improve the acceptance of shared micro-mobility.

We have invested in developing and deploying parking racks in numerous cities in the past year. Cities are also more frequently deploying non-branded racks by themselves.

Partnership with blind associations

Blind and visually impaired people are particularly impacted by wrongly parked e-scooters, since they are at risk of falling over the e-scooters lying on the pavements.

THE PARKING RACKS that we are deploying in cities have been developed together with the Norwegian Association for Visually Impaired, to ensure that the racks can easily be detected even for those with impared sight. We are also collaborating with the Royal National Institute of Blind People (RNIB) in the UK to understand the needs of blind and partially sighted pedestrians. We have already taken the first steps in implementing the organisation's recommendations looking at key elements, such as rider education, training, e-scooter sound alerts and now the redesign of parking racks.

IN MAY, WE LAUNCHED redesigned parking racks to improve visibility and address mobility issues faced by blind and partially sighted people.

The new parking racks have extended and raised side panels to enclose the whole length of the e-scooter. We also increased the colour contrast on all sides to make the scooter rack more visually distinctive.

ANOTHER PART PART of the partnership with RNIB, is a research project that we initiated together with the University of Warwick. The research project aims to investigate a range of questions related to adding an artificial sound to e-scooters. It will look at what kind of artificial sounds are best for alerting visually impaired people of scooters in the surrounding environment.

In May, Voi launched redesigned parking racks, developed in partnership with RNIB. The racks have already been deployed in several cities, including Birmingham and Corby. This year, we plan to have deployed more than 700 parking racks in cities across the UK.

"87 % of the respondents believe that parking racks and corrals would improve the acceptance of shared micro-mobility."

Source: **Voi's City Survey**

"We are willing to continue investing in parking solutions to solve the clutter situation with e-scooters in partnership with cities," says Erik Bergqvist, head of public policy projects at Voi.

He adds that Voi believes in a hybrid model with a combination of a dockless and station-based systems.

"Parking racks can also function as mobility hubs in the public transport system to foster intermodal travelling and modal shifts away from cars," says Erik Bergqvist. "This means that it's important to ensure access to shared micro-mobility near bus stops and subway stations. But we also think that the flexibility of the dockless approach is important for making people leave their cars at home."

A hybrid model would still imply that Voi needs to prevent improperly parked scooters with technical solutions as well. Geofencing techniques can continuously be used to restrict parking in certain areas and incentivise riders to park correctly. It's also important to educate riders on how to park scooters if they can't find a dedicated parking spot.

“We can leverage our experience in building products to solve these issues with clutter and bad parking behaviour.”

Kristoffer Nolgren,
Senior Product Manager,
Voi Technology

Product development to reduce clutter

Another feature that we have recently rolled out in cities is end of ride photos. The new in-app feature, which was launched at the end of February, requires users to take a picture of their scooters after each ride to encourage them to park their scooters properly. The photos are then reviewed by Voi’s user support team.

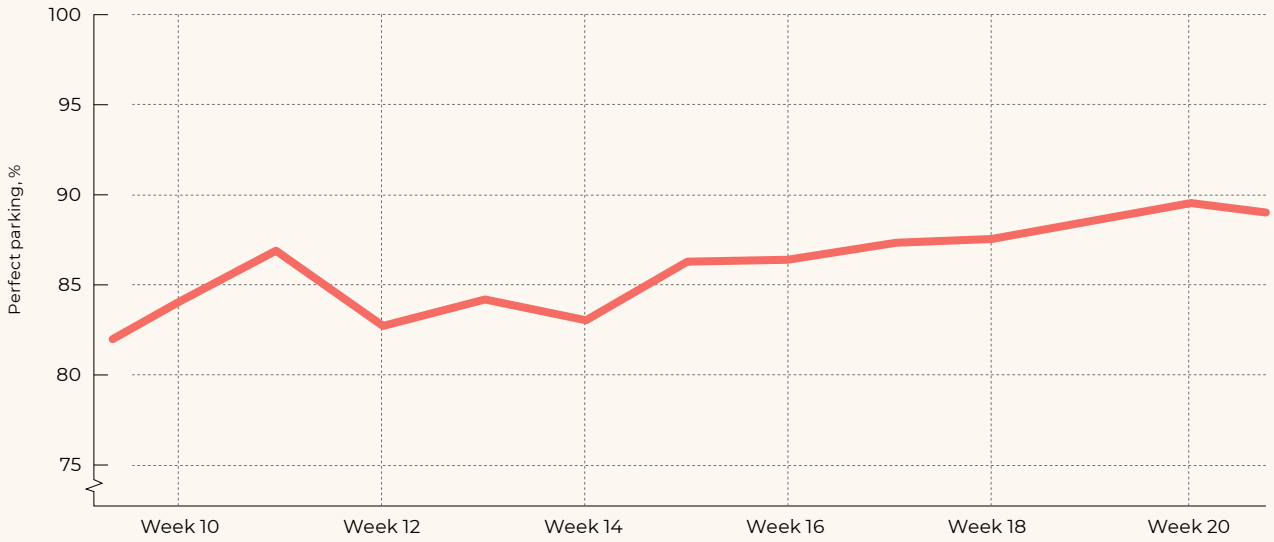
“Users who have parked their scooters improperly will receive an email from us containing a warning, educational message or in worst cases even a fine,” says Don Ingal, head of user support operations at Voi.

The data shows that a clear majority of the riders who have been fined have only been fined once. This indicates that people learn to park if they are told when they misbehave.

Liverpool is one of the big cities where our end of ride photo function was first introduced. It has been live since the beginning of March, and the data shows that it has already had an impact.

Perfecting parking behaviour with end of ride photos

Data from Liverpool shows that the new in-app feature 'end of ride photos' helps improve parking behaviour. Riders who fail to park properly are sent information about how to improve their parking. The chart shows that photos labelled as perfectly parked is steadily increasing since the feature was introduced in March.



Source: Voi data.

WE KEEP TRACK of two kinds of poor parking behaviour with this feature. One is what's called illegal parking, which means that an e-scooter has been parked so that it blocks the footpaths or in other places where it shouldn't be parked. This parking behaviour leads to a fine for users the second time it happens.

"Since the feature was introduced in early March, illegal parking has decreased 45 % in Liverpool," says Kristoffer Nolgren, senior product manager at Voi.

The other parking behaviour that is tracked is called imperfect parking, which means that the e-scooter has been parked in a good place but with room for improvement on the positioning. In this case, we reach out to the rider to explain how they can improve their parking.

"Poor parking behaviour has decreased by 27 % in nearly three months. We can leverage our experience in building products to solve these issues with clutter and bad parking behaviour. We have only just started," says Kristoffer Nolgren. V.

Working together with international road safety experts

At Voi, we frequently seeks advice from external experts on road safety. A new global Safety Advisory Council assists us with further improving the safety of shared micro-mobilty.

SINCE VOI WAS FOUNDED in 2018, the company has frequently sought advice from external experts in the field. In 2019, a group of European experts on road safety was invited to be part of our Safety Advisory Council. The council consists of members working at universities, research institutes, pedestrian societies and former members of national transport authorities.

The Safety Advisory Council helps with driving and influencing improvements and developments relating to safety, ensuring that we have a best practice approach and put plans in place to achieve the outcomes as defined and required.

"The Safety Advisory Council is a forum to consider e-scooter safety strategies and identify ways in which Voi could consider improving the safety of all individuals in the micro-mobility ecosystem," says Kristian Agerbo, VP Public Policy and Market Development. "The council will also seek to inspire and inform other micro-mobility companies to adopt comparable strategies and approaches."

THE SAFETY ADVISORY COUNCIL is a strategic advisory group with expertise in safety, transport and policy. The council's responsibility is to come up with recommendations to Voi. However, the council members are not responsible for any actions taken by us in response to the advice given.

We will host between two to five meetings a year with the Safety Advisory Council. Two meetings have already taken place since the council was founded in 2020. The meetings are held online. This will continue until an in-person event is deemed appropriate.

Voi's External Safety Advisory Council

Professor George Yannis
Professor at National Technical University of Athens

George is an international road safety expert with a thorough understanding of the transportation sector. He has been involved in these issues for more than 30 years as an engineer, academic, advisor and decision-maker in all areas of transportation planning and engineering at national and international level.

Jeannot Mersch
Former President FEVR European Federation of Road Traffic Victims

Jeannot has been doing voluntary work for road traffic victims and road danger reduction for over 25 years. He joined the Luxemburg's Road Victim Association AVR in 1993, after a tragic life event where he lost his 12 years old daughter after she was hit by a speeding hit and run driver when walking to a bus stop.

Bronwen Thornton
CEO at Walk21 Foundation

Bronwen is an international expert, facilitator and trainer on walking and walkable communities. She works with local communities and professionals around the world to promote walking and to develop and deliver innovative and practical projects, resources and tools to support more walking.

Claes Tingvall
Former Director of Traffic Safety, Swedish Transport Administration

Claes has PhD in Epidemiology from Karolinska Institute and is an Adjunct Professor at the Chalmers University of Technology, and a Senior Consultant at AFRY. Claes has published more than 150 scientific articles in traffic safety and has been instrumental in developing Vision Zero from the early beginning.

Kerim Galal
EVP Corporate Strategy & Innovation and CEO DEKRA Digital

Kerim has worked at the global safety company DEKRA over the past 12 years, and has a PhD in strategy & leadership. He is responsible for future strategy, digital transformation and build-up of DEKRA DIGITAL. He leads the development of standards for safe micro-mobility.

Dan Chen
President of 3M's Transportation Safety Division

Dan has a broad and deep business and technical experience in strategy and new product development. He leads 3M's Transportation Safety Division and has more than 17 years experience of working with safety. Dan has a PhD in chemical engineering from the University of Wisconsin and an Executive MBA from INSEAD.

Ellie Wooldridge
Human Insights Team Lead at Connected Places Catapult

Ellie works predominantly in the transport sector, exploring the interactions between people and automated technologies. She has a passion for inclusive design and promotes this mindset when collaborating with transport enterprises and start-ups through her role at the Connected Places Catapult.

Jamie Chan-Pensley
Principal Technologist at Connected Places Catapult

A human factors expert with experience from the defence, engineering, automotive and intelligent mobility sectors. He works across a range of projects applying different skills, methodologies and practical solutions to overcome industry challenges, from working in safety critical systems to advanced technologies.

Sources:

Austin Public Health (2019). "Dockless electric scooter-related injuries study"

6t (2019). "Uses and users of free-floating e-scooters in France"

BMJ Journals (2004). "Safety in numbers: more walkers and bicyclists, safer walking and bicycling"

C40 (2020). "How to build back better with a 15-minute city"

City 30 Brussels (2021). "30 km/h everywhere (at least almost)"

Deutsches Aerzteblatt International (2021). "Accident Mechanisms and Injury Patterns in E-Scooter Users – a retrospective analysis and comparison with cyclists"

ITF-OECD (2020). "Safe Micromobility"

ITF-OECD (2021). "Reversing Car Dependency"

European Commission (2020). "Special Eurobarometer 495: Mobility and transport"

European Commission (2020). "Sustainable and Smart Mobility Strategy – putting European transport on track for the future"

European Environment Agency (2019). "The European environment – sate and outlook 2020"

European Transport Safety Council (2020). "30km/h limits set to spread in 2021"

European Transport Safety Council (2021). "Average speed down 9% in Brussels since launch of city-wide 30 km/h limit"

European Society of Cardiology (2020). "Study estimates exposure to air pollution increases COVID-19 deaths by 15% worldwide"

FIA and Afry (2020). "Fia Road Safety Index – Feasibility Study".

Finnish Transport and Communications Agency Traficom (2019). "Assessment of the impact of electric personal transportation devices on traffic safety"

Folksam (2020). "Kartläggning av olyckor med elsparkcyklar och hur olyckorna kan förhindras"

Oslo University Hospital (2020). "Nye tall for elsparkesykkelskader"

POLIS Network (2019). "Macro managing Micro mobility: Taking the long view on short trips"

ScienceDirect (2017). "Peak Car in Europe?"

ScienceDirect (2017). "Safety-in-numbers: A systematic review and meta-analysis of evidence"

SciendeDirect (2021). "Comparison of motor vehicle-involved e-scooter and bicycle crashes using standardized crash typology"

The Lancet Planetary Health (2021). "Premature mortality due to air pollution in European cities: a health impact assessment"

The Norwegian Institute for Transport Economics (2020). "Parking solutions for shared e-scooters"

The Swedish Transport Administration (2020). "Utredning behov av förenklade regler för eldrivna enpersonsfordon: Delrapport två – redovisning olyckor och tillbud"

The Swedish Transport Administration (2020). "Utredning behov av förenklade regler för eldrivna enpersonsfordon: Slutrapport – slutsatser, förslag och bedömningar"

The Third Global Ministerial Conference on Road Safety (2020). "Stockholm Declaration"

Voi (2020). Safety User Survey. 1 600 respondents.

Voi (2020). Safety Non-rider Survey. 2 200 respondents.

Voi (2021). Safety City Survey. 23 respondents.

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Cities made for living.