RESEARCH ARTICLE

Scooter Stories: User and Non-user Experiences of a Shared E-scooter Trial

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E-scooters are the fastest-growing form of micro-mobility, riding a wave of popularity in recent years; in many cities, they have sparked something akin to an urban personal mobility revolution. Despite their popularity, e-scooters raise several challenges for policymakers and transport providers, and are a divisive mode on the streets. Reports of conflict and tension around e-scooters' safety are common. In addition, there are questions about what mode trips e-scooters are substituting. However, to date there remain few academic studies into user and non-user experiences. This study focused on a UK e-scooter trial, using a mixed methods approach to collect data from 222 participants. The focus of this paper's analysis is on participants' qualitative "scooter stories", supported by quantitative data that provides broader insight into the scooters' use and demographic patterns.

We find that on the positive side, e-scooters are useful, affordable, enjoyable, and flexible; they provide a viable alternative to some urban car trips and can be linked to active travel. However, whilst scooters are sometimes replacing car trips, they are more often substituting for walking or cycling, a challenging finding from a health and sustainability perspective. E-scooters exacerbate conflicts between users of urban space: we explore legality, safety of riders and non-riders, impacts on pavement and road space, intoxicated riding, and more. We present our findings in the context of sustainable urban mobility policy, making recommendations for policymakers and other stakeholders seeking to mitigate the impacts of e-scooters, and harness the sustainable mobility benefits of this popular new mode.

Keywords: E-scooters; mobility; perceptions; safety; conflict; sustainability

Introduction

Transport is rapidly becoming the most problematic global sector for greenhouse gas (GHG) emissions. As countries across the world make progress with reductions to GHG emissions in sectors such as energy and industry, motorised transport modes remain a stubbornly difficult emissions source to address (Green and Parkhurst, 2017). For example, in the UK, transport emissions are estimated to have reduced by only around 3% between 1990 and 2018 (BEIS, 2020), and transport now contributes 28% of the UK's total domestic GHG emissions (Morris, 2020; BEIS, 2020). Therefore, to mitigate climate change, a rapid and radical switch away

from the dominance of fossil fuel–powered motorised vehicles towards more sustainable alternatives is necessary (Mögele and Rau, 2020). The global coronavirus (COVID-19) pandemic has offered a rare glimpse at what a less auto-centric future might look like, with an increase in many places of the use of active and micro-mobility modes, coinciding with a global wave of popularity for e-scooter use, particularly in urban areas. This paper's exploration of e-scooter use is set within this context of the potential significant environmental and social benefits that might be created through the transition to such alternative urban transportation options (Khoo, 2020).

E-scooters have become popular with urban transport authorities for being an enjoyable and (more) sustainable form of transport than the private car, which might help cities address some of their congestion and public health issues (Tuncer and Brown, 2020). However, issues of road safety and the rising number of road accidents involving e-scooters have made this mode of transport controversial (BBC News, 2021a). Laws and regulations around e-scooter use have been suggested to be ambiguous and a source of confusion (Christoforou et al., 2021; BBC News, 2021c), and as-such, there have been campaigns to end rental schemes due to increasing incidents and safety issues (BBC News, 2021a). This paper explores these important issues.

There are three main themes in this paper: (i) what modes e-scooter trips are replacing (relevant to understanding their potential contribution to more sustainable transport options), (ii) conflicts between scooter and other road/pavement users, and (iii) specific issues of safety of both scooter users and those with whom they share space. The literature review sets out what existing studies have found on these themes, explains the methodology used for this study, presents results and discussion on the three core themes, and finishes with conclusions and recommendations around future e-scooter use for transport policymakers and other stakeholders.

Literature review

E-scooter use

E-scooters as a modern phenomenon first emerged in China, with sales booming in 2015 (Hardt and Bogenberger, 2019). They gained widespread popularity in the US in 2017, and within five months, e-scooter usage had tripled in multiple American cities (Christoforou et al., 2021). The surge then extended to Europe with trials conducted in the UK, Germany, Ireland, Sweden, France and Spain (Hardt and Bogenberger, 2019). As a new mode of powered transport which can be used on roads, e-scooters are subject to local and national regulations according to where they are used. The UK is currently the only European country where the use of private e-scooters is *illegal* on public roads, meaning an organised trial is the main way the public will have access to the mode (Jacobs, 2021). This paper focuses on the use of e-scooters that are part of a trial public hire scheme in the UK. At time of writing, 52 UK cities and large towns have set up such a scheme where users usually access a scooter via a smartphone app and pay either by time of use, by distance travelled, or by subscription. A trial of one such scheme in the UK has been led by the West of England Combined Authority (WECA) (Travelwest, 2021; WECA, 2021). The trial was launched in Bristol and the West of England in autumn 2020 (Travelwest, 2021). The e-scooters available in this area are issued by Voi, a Swedish company that aims to improve accessibility and reduce congestion and pollution in cities (Voi, 2022).

Research by Sanders, Branion-Calles and Nelson (2020) found that 42% of all trips completed by e-scooter were purely for leisure and enjoyment purposes. Similarly, e-scooters are popular with younger generations, particularly when used for exploring, seeing friends and family (Christoforou et al., 2021). Further research by Hardt and Bogenberger (2019)

found that most daily urban trips are suitable for e-scooter journeys, and scooters are ideal for commuting because there is limited effort required to move them. However, it is worth noting here that due to the COVID-19 pandemic, subsequent lockdowns and restrictions and increase in working from home, there has been a reduced need to travel for work for many people, so perhaps there is a reduced utilisation of e-scooters for commuting to date.

Research suggests that there may be an important case for e-scooters at universities, given this is a new phenomenon and their relatively high levels of use amongst younger age groups for the purposes of accessing education sites such as university campuses (Maiti et al., 2019). Research investigating e-scooter use at universities has focused predominantly on the US (Maiti et al., 2019; Sanders, Branion-Calles and Nelson, 2020). One article conducted by Maiti et al. (2019) focused on e-scooter use at two campuses at the University of Texas. This research demonstrated the importance of e-scooters for students and on-campus, with journeys being made to get to lectures and for leisure (Maiti et al., 2019). This paper provides an important UK perspective to this area, addressing a current gap in the literature (Tuncer and Brown, 2020). Interestingly, regarding gender, Wray (2021) found a notable gender imbalance first in cycling and more recently in scooting, with men being more likely to engage in both.

Benefits of scooters

A transition to electric mobility in both private and public transport is one of the main available approaches to reducing air pollution and greenhouse gas emissions in densely populated urban areas (Liberty et al., 2017, cited in Nigro et al., 2021). Recently, shared e-bikes and e-scooters have entered cities on a wide scale with positive outcomes because they provide an alternative travel mode that can contribute to sustainable urban mobility (Gössling, 2020). This is discussed in relation to trip replacement in the following section.

E-scooters can be an exhilarating form of transport which provides users with the freedom to travel without having to rely on a car (Sanders, Branion-Calles and Nelson, 2020). E-scooters have been hailed by some as a greener, more sustainable mode of transport that can reduce traffic congestion (Mercer, 2021). E-scooters appear to be an environmentally friendly solution to reducing the number of cars on the road (Christoforou et al., 2021). Sanders, Branion-Calles and Nelson (2020) suggest that e-scooters have the opportunity to improve accessibility within cities and towns; providing an alternative form of mobility can grant those with limited access to the typical transportation modes access to more opportunities. They found that e-scooters are enjoyed for many reasons, but particularly for speed, convenience, the ability to replace car trips, and being fun and relaxing. However, whilst studies have identified significant benefits to e-scooters, they have also found barriers and challenges.

What are e-scooters replacing?

Key questions from a sustainability perspective are what modes e-scooter trips are replacing and the extent to which they are generating new trips. From an emissions perspective, it is desirable that e-scooters replace a high proportion of private car trips, whereas from a public health perspective, it is hoped that e-scooters are not substituting for *more* active modes such as walking and cycling (given e-scooter use has been found to require substantially less physical activity in comparison with these more active modes) (Sanders, da Silva Brum-Bastos and Nelson, 2022). Concerns have been raised that e-scooters displace active travel, which may exacerbate a public health crisis (Gibson, Curl and Thompson, 2021; Sanders, da Silva Brum-Bastos and Nelson, 2022). It has also been argued that e-scooter use will never replace cycling and may always remain a more limited active mode in terms of both distance and utility (Hosseinzadeh et al., 2021). Research shows that e-scooters have been more often replacing

walking and cycling use rather than reducing car trips, which is the opposite of one of their intended purposes (Sanders, Branion-Calles and Nelson, 2020).

Existing studies have found mixed results on modal substitutions. Research in Paris has found that more than 16% of private car use amongst participants was replaced by e-scooters (Christoforou et al., 2021). Sustrans, a major UK walking and cycling charity, showed substantially lower replacement of car trips through research in France, which asked 4,000 users of public e-scooters how they would have travelled if scooters weren't available: 44% said they would have gone on foot, 30% would have used public transport, 12% would have cycled, and just 3% of respondents would have used a private car if no e-scooters had been available (Sustrans, 2021). Existing studies therefore suggest that scooters are predominantly replacing not car trips but rather active travel (mainly walking) and public transport trips.

However, initial studies of the West of England Voi scooter trial show that the e-scooters have already replaced more than 370,000 car journeys in the region since the trial began in October 2020, removing over 200 tonnes of CO_2 emissions (WECA, 2021). Ultimately, there is evidence of both the sought-after displacement of motorised vehicles by e-scooters alongside the much less desirable and unintended displacement of active and public modes.

Looking at scooters and their contribution to providing access for people where none previously existed, a study conducted by Hollingsworth, Copeland and Johnson (2019) found that 7% of trips made on e-scooters would have not been made if a scooter was not available. Although this figure is relatively small, e-scooters do appear to be an important form of micro-mobility that provides an alternative option that can increase transport equity through expanding travel choices (Basky, 2020). The modal replacement theme is returned to in the results section, where this paper explores the extent to which e-scooter use is replacing car travel, public transport, and active modes in the UK context.

Challenges and conflicts

Sustainability

Despite e-scooters' widely touted green credentials, their positioning as a fully "sustainable" mode has been challenged in several studies. Hollingsworth, Copeland and Johnson (2019) identify relatively high life-cycle emissions associated with their short life span, as well as unnecessary recharging and the use of a fuel-inefficient vehicle fleet (often diesel vans) for pick-up and drop-off, decreasing the sustainability of this mode. In addition, e-scooters that are available for renting commonly use lithium-ion batteries, which are damaging to the environment in their production (Tuncer and Brown, 2020). Overall, evidence suggests that e-scooters are not as sustainable as they are portrayed to be (Hosseinzadeh et al., 2021).

Inclusivity

In terms of their use, e-scooters have been held responsible for creating new conflicts between users and non-users by adding an additional mode to the already overcrowded shared space of public roads and pavements (Tuncer and Brown, 2020), with e-scooter riders generally being seen as a danger to non-users and all those with whom they share the urban space (Wallius et al., 2021). A lack of properly designed and designated scooter infrastructure has been suggested to increase tensions amongst users and non-users including pedestrians, motorised vehicles, and cyclists in public spaces, as they compete for already limited available capacity (Hosseinzadeh et al., 2021). In addition, as a public mode, e-scooters can be exclusionary of disabled people with mobility impairments because they require a certain level of mobility, balance, and strength to be mounted, dismounted, and ridden safely (Tuncer and Brown, 2020).

Legality

E-scooters can move freely between the road and pavement, and they can also be walked by a pedestrian to perhaps jump red lights or avoid riding on the roads (Tuncer and Brown, 2020). Although this "hybridity" of e-scooters is viewed as a positive by some, it also further exacerbates the conflict for public space. The ability for scooter riders to change roles and infrastructures in a single trip—for example, moving from road riding to pavement riding to walking through crowds of pedestrians—places them in a grey area in terms of people's perceptions of them and the dangers scooter riders pose to both themselves and other road users, particularly pedestrians (Tuncer and Brown, 2020). Although there are bans on pavement riding in the UK, this is often ignored by riders (UK Parliament, 2020). This may have negative implications for both users and pedestrians, especially concerning safety, and it also leads to negative perceptions of scooters and their riders amongst non-users, particularly where they are seen to be ignoring the rules of shared road and/or pavement use by which others must abide. The scooter stories presented in the results and discussion of this paper shed more light on these conflicts.

E-scooters and safety

Collisions and injuries are becoming commonly associated with e-scooters (Sanders, Branion-Calles and Nelson, 2020). In the year ending June 2021, 931 casualties in accidents involving e-scooters were recorded in the UK (GOV UK, 2021a), and of these, 732 were e-scooter users. Three fatalities were also recorded during this period, all of whom were e-scooter riders (GOV UK, 2021a). The high number of accidents recorded for such a recent addition to urban mobility highlights the vulnerability of this mode (Hyde, 2022). Sanders, Branion-Calles and Nelson (2020) found that there is a slight gender disparity within e-scooter users, with more women being concerned about falling off an e-scooter or being hurt than men. Another safety concern is that because rental schemes for e-scooters are often paid for by the minute, some riders may feel compelled to scoot quickly to make the most of their money (Tuncer and Brown, 2020).

Frequent users of e-scooters are seen to develop more risk-taking behaviours such as partaking in drunk riding and using their phones whilst riding (Basky, 2020; Christoforou et al., 2021; BBC News, 2021b). In London, the Metropolitan Police issued fines for riding on pathways, with a £100 fine and six penalty points added to driving licences for using a phone whilst riding, as well as for riding through a red light (BBC News, 2021c). There are similar implications recognised in Bristol, the site of this present study, with a man disqualified from driving for 18 months for riding a scooter whilst inebriated (BBC News, 2021a). The legality of e-scooters is a complicated issue, and laws and regulations around e-scooter use are being regularly updated in light of incidents that occur; for example, a recent injury claim from a rider illegally using a private e-scooter on the roads and who was hurt when overtaken by a bus may result in tougher laws for riders (Hyde, 2022). There are additional safety concerns about the scooter vehicles themselves, particularly their relatively large batteries. Transport for London (TfL) has banned e-scooters on its transport network as a result of an e-scooter catching fire on its premises due to a supposed defective lithium battery (TfL, 2021). Consequently, reports about the safety and legality of e-scooters may be damaging the mode's public image.

Finally, some literature has suggested that the use of helmets when riding e-scooters has become a somewhat controversial issue. Despite helmets being suggested by rental companies (see **Figure 1**), research has suggested that most customers renting an e-scooter did not wear a helmet and found carrying one around irritating (Tuncer and Brown, 2020). This taps into existing debates about safety equipment and active travel, in particular the promotion

Figure 1: Voi poster on a bus stop located in Bristol City Centre (Taratula-Lyons, 2021).

of helmet use for cyclists, for which there remains conflicting evidence and opinion, both public and academic (see, e.g., Hoye, 2018 for an overview). Helmets emerge in our analysis as an important feature in people's scooter stories, and this is explored in the results and discussion.

Existing international research literature has identified important issues relating to e-scooter use and some potentially valuable benefits to be realised. But there remain substantial gaps in our understanding of e-scooter use, in particular international data on what modes scooters are replacing, accounts of actual user and non-user experiences of scooter use, more detailed perspectives on scooters' contributions to conflicts in urban mobility spaces, and insight into scooters' applicability in different urban mobility/journey contexts (commuting, accessing education, leisure trips, etc.).

The findings we report in this paper help address these research gaps, using both quantitative survey responses and qualitative scooter stories from students and staff at a large university campus to explore the perspectives of both users and non-users of e-scooters.

Methodology
Case Study
This study is focused on an e-scooter trial operating in WECA, a combined authority area comprising three local authorities in the south-west of the UK (see **Map 1**). WECA is one
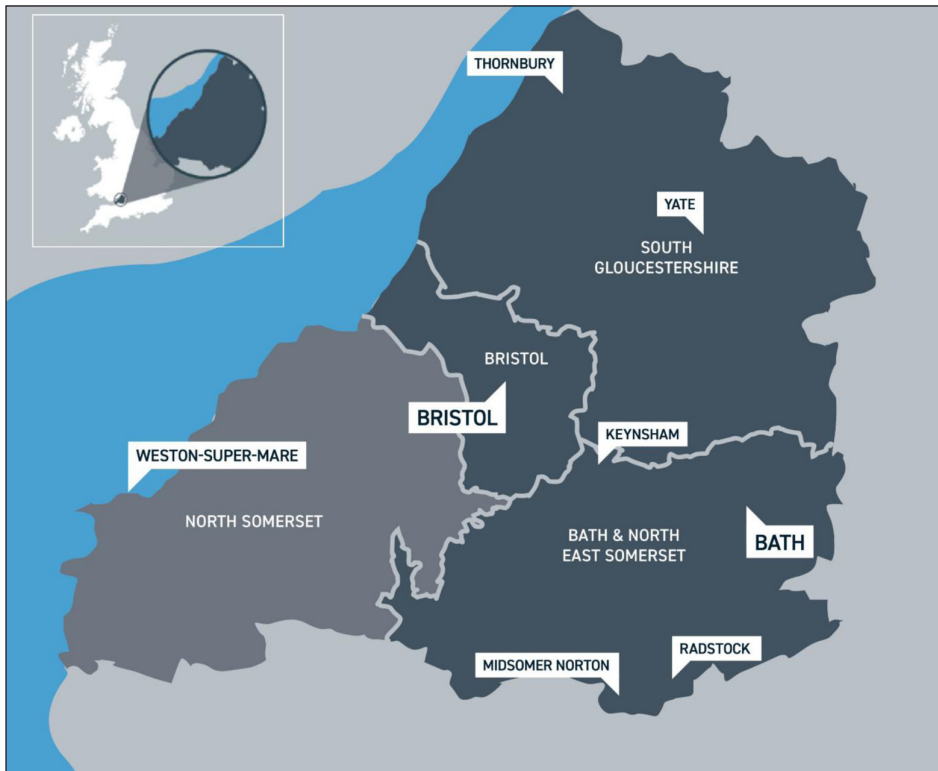
Map 1: Map of West of England Combined Authority. (Main map: WECA, 2022. Inset: BEIS, 2019).

of four Future Transport Zones established by the UK government and set up to trial new transport technologies to cut congestion, improve air quality, and reduce carbon emissions (Travelwest, 2021). The WECA Voi scooter scheme is the largest in the UK outside of London, with approximately 3,000 scooters being used in the trial. The e-scooters were first introduced to the region in October 2020 during the height of the COVID-19 pandemic, with the trial running through November 2022. One reason for this trial was to provide an alternative to public transport which can accommodate social distancing (Travelwest, 2021); e-scooters became popular in many urban areas during the pandemic by supporting social distancing and helping cities to not rely solely on private cars to replace public transport rides, counter to sustainable urban transport objectives (Dias, Arsenio and Ribiero, 2021).

Scheme and transport policy context

To provide context for the study, it is necessary to understand a little about the Voi scheme and the policy setting within which it has operated. Voi e-scooters can be unlocked by downloading the Voi app; however, a valid UK driving licence or provisional licence must be uploaded and approved before a scooter can be ridden (Voi, 2022). An option to join Voi's "Traffic School" appears on the app and can be accessed online, which provides guidance on how to ride safely and tips that promote responsible riding (Voi, 2022). Once a scooter is unlocked, its costs vary, with day and month e-scooter passes available to purchase on the app; a pay-per-minute option is the basic tariff (Voi, 2022). Before the start of the trial, Voi predicted that based on a 2,400-scooter fleet, it could expect a 12–16% private car replacement rate (Voi,

2022). This study examines this aim in light of the survey findings presented in the following section.

Voi's ambitions to contribute to more sustainable mobility options in WECA urban areas are set within the broader policy context of the combined and local authorities' own sustainable transport policy objectives. WECA and the local authorities which comprise it each have stated policy objectives to reduce private vehicle trips and encourage the use of active modes and public transport (WECA, 2020). This policy context is important in terms of the extent to which the e-scooters can be seen to be contributing to these objectives, particularly in light of the previous discussion about what modes the scooters are replacing. This is explored further in the results and discussion sections.

Study site

The University of the West of England (UWE) is a large university in Bristol. UWE has three campuses, more than 30,000 students and more than 3,800 staff (UWE, 2021). All three campuses are within the Voi WECA operating zone. UWE is aware of the potential impact its staff and students can have on congestion around its campuses Bristol, with the potential for tens of thousands of trips to and from its campuses each day. UWE campuses have provision for access by car, bus, bike, and foot. There are regular bus services to campuses, and there are dedicated cycle routes and storage facilities. **Table 1** below outlines the mode share totals for both staff and students at UWE, with a comparison between 2012 and 2019 data, showing the university's aim to progress towards more sustainable access to its campuses (UWE, 2022a).

Table 1: UWE mode shares for campus access.

Mode	2012	2019
Car on own	40%	22%
Bus	26%	32%
Walk	10%	27%
Car share	16%	8%
Cycle	6%	7%
Rail	1%	1%
Motorcycle/moped	1%	1%
Park and walk	–	2%

UWE has a stated carbon-neutral goal of net-zero emissions of greenhouse gases by 2030, and it has made several sustainable travel commitments to reduce travel-related emissions; these include the prioritisation and promotion of sustainable travel options (including e-scooter hire) as well as a 20% decrease in available car parking spaces by 2030, which could further contribute to a demand for micro-mobility options in Bristol (UWE, 2022b). As is familiar in many urban areas, Bristol has high levels of air pollution, contributing to approximately five deaths every week (Laville, 2021). As with the transport authority context, this paper examines the contribution of the e-scooters to the university's sustainable mobility ambitions.

E-scooter stories

The qualitative data in this paper are accounts of people's perceptions and experiences of being a user or non-user of the Voi public scooter scheme. Participants were asked to tell their

"scooter stories", with an open prompt to provide an account of whichever experience(s) of the scooters they felt most relevant/important to share. The intention behind the scooter stories was to collect data that could provide insights into the benefits of public rental schemes for user, whilst also illuminating any tensions experienced between users and non-users.

This research used two methods to collect the scooter stories: via social media and a quantitative survey. First, the social media approach was designed to get engagement from university students, and it involved the creation of a Facebook group to which participants were recruited as described in the sampling section below. Second, a section of the questionnaire was devoted to getting scooter stories from both students and staff, in the form of an open written response section asking for users and non-users' experiences. In the survey, this open response was limited to 250 words to encourage engagement by giving an idea of the amount that participants might write for their stories and to keep it manageable. In total, 124 qualitative scooter stories were collected.

Questionnaire

A questionnaire survey was developed based on the earlier literature review of current e-scooter research. **Table 2** gives an overview of the survey questions. The survey was hosted and distributed using the Qualtrics online survey platform. The survey was distributed to the university population following the approach described in the sampling section below.

Sampling

Participants for both the social media group and the survey were targeted from the staff and student population using a combination of purposive and snowball sampling. For the distribution, we purposefully chose approaches which were likely to achieve a good response. For students, links to the Qualtrics questionnaire form and the e-scooter stories Facebook group were promoted and distributed onto six UWE student society pages, which were selected for their high engagement rates and substantial membership, and also via internal university communications, which aimed to reach a broad demographic of the student population. For staff, the links were distributed through university and staff channels on the university's internal communications and also via university-related LinkedIn professional pages. Participants who found the link through any of the social media distributions were asked to also share it themselves, to increase reach.

Sample size and demographic

The survey was undertaken by 236 respondents, but following data cleaning for both incomplete and unconsented survey responses, 222 complete participant responses were included for analysis.

In terms of gender and age (**Table 3**), the sample was 53.6% male, 45.4% female, and 0.9% non-binary, and it was relatively well spread across the age categories, with the largest response from the 18–24 category (34.2%), followed by those aged 35–44 (19.8%) and 25–34 (16.2%).

In terms of occupation at the university (**Table 4**), the sample comprised staff (57.3%) and students (42.7%). As expected, the staff/student split in the sample closely aligns with the age composition of the sample.

Previous studies have focussed on age as an important factor in e-scooter use/experience and also suggested that university campuses are useful sites of enquiry when exploring e-scooter use (Sanders, Branion-Calles and Nelson, 2020; Maiti et al., 2019). This study has collected data on both age and student/staff experiences of e-scooters, and these dimensions are explored throughout the analysis.

Table 2: E-scooter survey questions.

Survey question	Overview
Demographics	Gender, age, staff/student, main campus used
E-scooter use	Used/not used
Frequency of use	Hardly ever to every day
Reasons for use	Cost, environmental impact, reduced public transportation options (COVID), fun/relaxing, active travel, safety, other (text entry)
Statements on e-scooter experience (Likert 5 point, strongly agree to strongly disagree)	"E-scooters are fun to ride." "E-scooters are safe to ride." "E-scooters are inexpensive to rent." "E-scooters are easy to use." "E-scooters are convenient to use."
Journey purpose	Socialising/leisure, commuting, education, shopping/personal business, exploring the city, other (text entry)
Mode of transport that would have been used if scooter not available	Would not have made trip, car, car share, bus, train, cycle, walk, taxi, other (text entry)
Length of most recent e-scooter trip	Selection scale up to 10 miles
Barriers to e-scooter use	Happy with current transportation/not interested, road safety concerns, lack of experience, not feeling in control, lack of helmet, can't transport goods/passengers, impractical for longer trips, weather, availability/proximity, battery levels/range anxiety, concerns over breakdown/malfunction, other (text entry)
Likelihood of using an e-scooter in the next year	Very unlikely to very likely
Preference for purchasing own scooter	Already own one, purchase own in future, rent (short term: min/hr/day), rent (long term: week/month), unsure, do not want to rent or own e-scooter
Conflict and safety statements (Likert 5 point, strongly agree to strongly disagree)	"Pavement riding by e-scooter users is a nuisance to pedestrians/non-users." "E-scooters should be allowed to use pavements as well as roads and cycle paths." "E-scooter parking is a nuisance to pedestrians/non-users." "It is sometimes acceptable/necessary for scooters to ride on the pavement for safety." "People often ride the e-scooters whilst intoxicated." "Helmets should be mandatory for e-scooter use." "E-scooters will continue to be used into the future."
Scooter stories	Open response (max 250 words)

Data analysis

The qualitative data were analysed using thematic analysis, to identify and explore important themes in the participants' experiences (e.g. Kiger and Varpio, 2020). We conducted an iterative coding process, and the resultant themes have been structured into the sections of the results and discussion. The initial themes were informed and influenced by the literature

Table 3: Gender and age.

Gender and age		Male	Female	Non-binary	Total
18–24	**N**	37	38	1	76
	%	31.1	37.6	50.0	34.2
25–34	**N**	23	12	1	36
	%	19.3	11.9	50.0	16.2
35–44	**N**	25	19	0	44
	%	21.0	18.8	0.0	19.8
45–54	**N**	19	9	0	28
	%	16.0	8.9	0.0	12.6
55–64	**N**	11	19	0	30
	%	9.2	18.8	0.0	13.5
65+	**N**	4	4	0	8
	%	3.4	4.0	0.0	3.6
Total	**N**	119	101	2	222
	%	100.0	100.0	100.0	100.0

Table 4: Occupation (staff/student).

Staff/Student	N	%
Staff	125	57.3
Student	93	42.7
Total	218	100

review, subsequent to this, and additional themes were identified during the iterative thematic analysis.

Statistical analysis of the quantitative data was preformed using the SPSS software package. The quantitative analysis involved descriptive statistics for scooter use, mode replacement, and demographics, as well as significance testing to identify relationships between variables, with a particular focus on scooter use and experience by demographic.

Ethical considerations
Before the research commenced, an ethical review and risk assessment was conducted, and it was approved by the University Research and Ethics Committee.

The questionnaire was designed in such a way that required informed consent to be provided before the participant could begin answering the questions. The data collected from the questionnaire was anonymous and was held securely.

Similarly, the social media discussion group was also designed in a way that required the participants to read, understand and agree to several rules before being accepted into the group. Within these rules, which also included recommendations for etiquette in the group, participants had to provide their informed consent for the research by agreeing to several statements

which outlined their right to withdraw, confidentiality and anonymity and data handling. The data collected from the social media group was downloaded and anonymised and then integrated with the collection of stories that were collated from the questionnaire. Once data collection was concluded and data was extracted, all of the data was manually deleted from the scooter stories Facebook group, and then the group itself was closed and deleted.

Results and discussion

This section explores the scooter experiences and perceptions of users and non-users, what journeys and modes e-scooters are replacing, and the new conflicts and safety concerns that are emerging in urban spaces. The discussion is guided by results from the qualitative scooter stories, which this paper uses to expand upon the insights from previous studies (Sanders, Branion-Calles and Nelson, 2020; Maiti et al., 2019) to provide unique and personal narratives of both users and non-users. The qualitative themes are supported by the quantitative data from the questionnaire survey.

What are e-scooters replacing?

E-scooters are promoted as a sustainable form of transport and a more efficient option than a car (Hosseinzadeh et al., 2021). Despite this, both the quantitative data (**Chart 1**) and the scooter stories (**Table 5**) indicate that e-scooters often displace other sustainable modes such as walking, cycling and public transport modes such as buses. We find that 37.8% of e-scooter trips replaced walking, and a further 25.6% replaced bus trips, with only 8.9% of respondents stating it had replaced a journey by car. It is important to note that our study sample already had a relatively low modal share of car use in terms of it being a younger demographic of scooter users, and the university has lower levels of commute by car than the city more generally; in 2019 prior to the e-scooter trial, only around 30% of the staff and student population travelled to campus by car (UWE, 2022a). However, our findings also align with existing research, in which 44% of respondents in a recent study in France said they would have previously gone on foot, with 30% using public transport and 12% cycling. Interestingly, just 3% of respondents to that survey suggested they would have travelled by private car had an e-scooter not been available (Sustrans, 2021). Our finding adds to a growing body of evidence that scooters are mainly replacing walking and public transport trips, with much lower proportions of trips replacing car journeys.
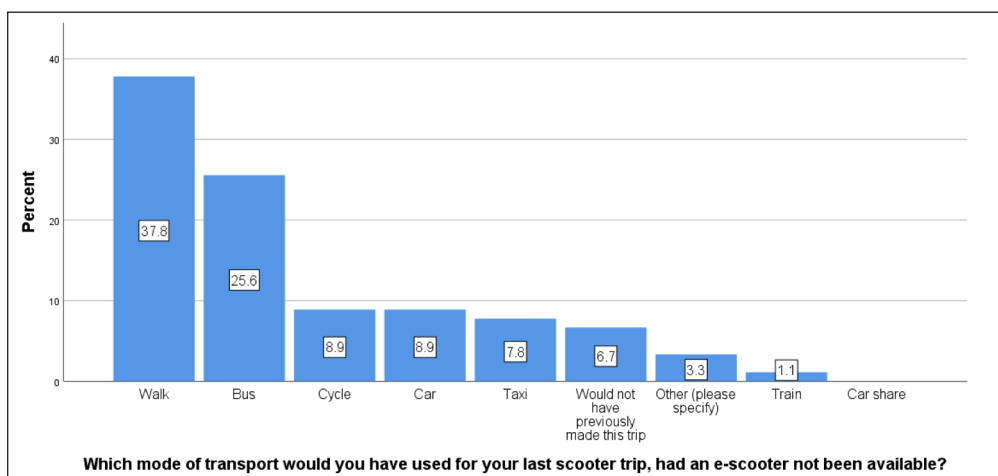

Chart 1: Modes scooters are replacing.

Table 5: Scooter stories discussing what e-scooters are replacing.

"I rented a scooter to travel back from a friend's house instead of getting the bus as a bit of fun. My house was conveniently close to a drop-off point, so when finished, I didn't have far to walk back. I will most likely rent again as I enjoyed using it."	18–24	Female	Student
"I cycle and walk. Why would I replace these modes of exercise with a passive experience that contributes to climate change?"	45–54	Male	Staff
"It could be argued that they don't actually stop people using cars, as I have found the people who mainly use the scooters would be walking anyway."	18–24	Male	Student

   Whilst it is encouraging that e-scooters have been successful in replacing *some* car journeys, this finding demonstrates that more needs to be done to encourage people out of their cars and onto scooters for short urban trips. As explained in the context section, it is a stated sustainable transport policy aim of the combined and local authorities, and the university, to reduce car trips, and it appears as though there is more that scooters could be doing in this regard. Indeed, these findings for car replacement show that the Voi scooters are falling short of Voi's own target of 12–16% car replacement (Voi, 2022), at least in the university context. Overall, the modal replacement statistics and scooter stories challenge whether e-scooters' introduction to urban areas does successfully displace car use, with the issue illustrated succinctly in a participant's scooter story:

> You also have to question how many people using e-scooters would have been using the bus, cycling, or walking if e-scooters weren't available. I highly doubt there is any noticeable modal shift away from cars to e-scooters, and if there isn't a shift, then what's the point of them? (Male student, 18–24)

Despite the scooters having the potential to contribute to sustainable travel to campus and supporting the movement to net-zero greenhouse gas emissions, currently, they are predominantly replacing walking and PT trips, not car journeys.

Use and experience of scooters
Table 6 shows proportions of participants that had either tried or not tried the Voi scooters at the time of taking the survey. A larger proportion of respondents had not used the Voi scooters before (58.4%) compared with those that had (41.6%). The survey also asked how frequently the participants used the e-scooters (see **Table 7**). The most common response was "Hardly ever—one or two trips" (47.2%) followed by "Once or twice a month" (21.3%). Smaller proportions of respondents were very regular scooter riders, with 16.8% of scooter-using respondents using the scooters once or twice a week or more.

Users by demographic
Scooter use varied by demographic, with age being the most significant determinant of use. **Table 8** shows the analysis of use by age, with a Chi-squared test finding that a significantly higher proportion of younger people have used the scooters compared to people in the older age categories ($p < 0.01$). Looking more closely, there is evidently a general trend of decreasing use with increasing age; however, there appears to be a particularly notable divide between the youngest age category in our survey (18–24) and all the other age categories above this (25+).

Table 6: Scooter use.

Scooter use	N	%
Yes	92	41.6
No	129	58.4
Total	221	100

Table 7: Scooter use frequency.

Scooter use frequency	N	%
Hardly ever—one or two trips	42	47.2
Once or twice a month	19	21.3
Three or four times a month	13	14.6
Once or twice a week	10	11.2
Three or four times a week	5	5.6
Total	89	100

Table 8: Scooter use by age.

Scooter use by age		Used Voi e-scooters		
		Yes	No	Total
18–24	N	56	20	76
	%	73.7	26.3	100.0
25–34	N	13	23	36
	%	36.1	63.9	100.0
35– 44	N	15	29	44
	%	34.1	65.9	100.0
45– 54	N	6	21	27
	%	22.2	77.8	100.0
55– 64	N	1	29	30
	%	3.3	96.7	100.0
65+	N	1	7	8
	%	12.5	87.5	100.0
Total	N	92	129	221
	%	41.6	58.4	100.0

χ^2 (5, N = 221) = 58.702, p = 0.000.

Our results show that a large majority (73.7%) of respondents aged 18–24 had used the scooters, with only about a quarter (26.3%) not having tried them; however, in the next age category up (25–34), this pattern is almost reversed, with 36.1% of this group using the

scooters and 63.9% not using them. This finding supports previous research that e-scooters are most popular with younger age groups (Christoforou et al., 2021).

As previously mentioned, this age divide aligns with the student/staff divide in the sample. **Table 9** shows the analysis of scooter use by university occupation and finds a significant difference in use between students and staff (p < 0.01). Amongst students, a large majority (64.1%) had used the scooters, whereas for staff it was the opposite, with almost three-quarters of that group (74.4%) having not used them.

Looking at other demographics, for gender, there was some evidence of a smaller disparity between men and women (**Table 10**), but the analysis found that this was not significant to the 95% confidence interval (p = 0.099). Nevertheless, it is useful to observe that whilst there is no significant relationship present, it is evident that there is a disparity in the proportion of men and women who have used the scooters, with a higher proportion of men having used them (47.1%) compared with women (36.0%). This aligns with Wray (2021), who found a similar gender imbalance in cycling and more recently scooting, with men being more likely to engage in both.

Table 9: Scooter use by university occupation.

Scooter use by staff and students				
		Used Voi e-scooters		
		Yes	No	Total
Staff	N	32	93	125
	%	25.6	74.4	100.0
Student	N	59	33	92
	%	64.1	35.9	100.0
Total	N	91	126	217
	%	41.9	58.1	100.0

χ^2 (1, N = 217) = 32.311, p = 0.000.

Table 10: Scooter use by gender.

Scooter use by gender*				
		Used Voi e-scooters		
		Yes	No	Total
Male	N	56	63	119
	%	47.1	52.9	100.0
Female	N	36	64	100
	%	36.0	64.0	100.0
Total	N	92	127	219
	%	42.0	58.0	100.0

χ^2 (1, N = 219) = 2.728, p = 0.099.
*Note: For this analysis the "non-binary" category was removed due to a low count (n = 2).

Scooter users' experiences

Amongst the scooter users, both positive and negative experiences were discussed. Users of e-scooters often stated that they were useful, affordable, and enjoyable and that they broadened mobility options. There was also regular reference made to the COVID-19 context within which they were introduced.

> During the pandemic, it presents far less risk of catching COVID which is a plus. Overall it's great as a practical means of transport, with the added benefit of being fast, fun and exciting. (Female student, 18–24)

The scooter stories in **Table 11** below demonstrate a range of different benefits that users experienced.

Overall, users and advocates of the e-scooters portray a new and exhilarating way of travelling which is free, fun and affordable, and which allows mobility without having to worry about the threat of COVID-19, which may be experienced on alternative shared modes such as public transport.

The survey found that convenience was the most popular reason for using a scooter, which is consistent with existing studies (e.g., Sanders, Branion-Calles and Nelson, 2020). Convenience was followed by finding it fun or relaxing and then the environmental impact (**Table 12**). It is an interesting point to note that almost a third of people are using the scooters simply because they are fun and relaxing, which is a purpose largely absent from utilitarian transport policy objectives, but it is arguably no less important to users from a health and well-being perspective. Most participants agreed that e-scooters are convenient (30.2%), are fun or relaxing (29.3%), and have a low environmental impact (17.1%). However, the statements that e-scooters are safe to ride and inexpensive to rent appeared to be more contested, with only 0.9% of participants listing safety as a feature of the scooters, which could be related to avoidance of contracting COVID-19. This demonstrates that there are significant safety issues attached to e-scooter use as acknowledged

Table 11: User experiences of e-scooters.

"I've generally had very good experiences with scooters; they're a good, fun way of getting around the city, particularly fun for showing family around."	18–24	Male	Student
"I found scooters are nice when I'm running late, I can't arrive to a place sweaty, and I don't want to worry about leaving the bicycle to be stolen. It serves its purpose, but it's not a game changer for me."	35–44	Male	Staff
"I like the idea of having shared transport, easy to use and personal, so mobility around the city is increased and car pollution is reduced."	35–44	Female	Staff
"They are pretty cheap for 24-hour hire, there are lots of them around my local area, and [they are] super simple to use for your A–B trips. The Voi app is nice to use and well mapped out, with good notifications and customer service if you go out of line or need help. I really enjoy using them especially with friends, they're so fun."	18–24	Male	Student
"Having used the scooters only a few times in Bristol, I can do nothing but praise them! Not only do they provide an exciting and fun way to travel, they are also extremely efficient!"	18–24	Male	Student

by Tuncer and Brown (2020) and Hosseinzadeh et al. (2021), and this is explored further in later sections.

When participants selected "other" in response to their reasons for using the e-scooters (8.9%), there were a variety of reasons attributed to them—for example, to "see the city in a different way." Interestingly, several users within this subset also noted "trying them out" as their primary cause for utilising the mode. Several participants referenced various poor qualities of public transport as their reasoning, with one respondent stating, "Faster than public transport, with more start/finish points." Similarly, another participant mentioned "bad public transport services", with a further respondent referencing being able to avoid the mandatory use of wearing face coverings on public transport during the pandemic.

In addition, the cost in comparison to other public transport appeared to make e-scooters a more desirable choice. Most participants' most recent scooter trips were undertaken for socialising or leisure purposes (**Table 13**). Importantly, relatively few of the participants (6.0%) noted travelling to or from the university as their last trip, which links back again to the alignment of the scooters with the policy objectives of the places in which they are being used (UWE, 2022). In this case, whilst evidently *some* trips by students and staff are for the purposes of accessing the university, there is an opportunity to substantially expand on this access to help reducing car trips to campus, which is one of the university's sustainable travel aims.

Table 12: Reasons for using an e-scooter.

Reason(s) for using an e-scooter	%
Convenience	30.2
Fun or relaxation	29.3
Low environmental impact	17.1
Inexpensive	11.7
Reduced PT capacity (COVID)	4.5
Exercise (active travel)	1.4
Safety	0.9
Other	8.9

Table 13: Purpose of last scooter trip.

Purpose of last scooter trip	N	%
Socialising/leisure	49	58.3
Commuting to/from work	13	15.5
Transportation to/from education	5	6.0
Shopping/running errands	7	8.3
Exploring the city	7	8.3
Other	3	3.6
Total	84	100

Non-user perceptions

The majority (58.4%) of survey participants had not ridden an e-scooter before (**Table 6**). The previous discussion on gender in our survey established that 64% of women and 52.9% of men had never ridden a scooter. The predominant perceptions of e-scooters coming through non-users' scoter stories were negative.

Safety was a key theme for non-users, with many stories mentioning the possibility of injuries, the risks from dangerous riding, and being scared of e-scooters. Interestingly, some of the non-user e-scooter stories were written specifically from the perspective of car owners and drivers, which highlights the modal tensions which form an important theme in our findings.

> As a car driver, I do not feel that they are safe whatsoever.... They often swerve around because the roads are not good enough for their small wheels.... Additionally, they also ride two abreast or in a huge cluster which blocks the entire road. They also often do not stop at red lights and will cut in front, meaning a sudden stop is required risking someone going into the back of my car. (Female student, 18–24)

Riding e-scooters whilst intoxicated was mentioned frequently in non-users' scooter stories. The stories often implied a stereotype of students as being inebriated and irresponsible, which is consistent with broader media representations and reports (e.g. BBC News, 2021b). This perception of e-scooters users is suggested to have been exacerbated by the media's representation of e-scooters, and portrayal of users in a negative light (Basky, 2020).

> Witness drunks riding on the road, crashing at night and finding it "hilarious", not caring about the criminal damaged being caused.... They are death traps waiting to happen, being a menace to pedestrians and other road users, who will get the blame for their stupidity. (Male staff, 45–54)

Riders having a lack of equipment (particularly helmets), not using the scooters properly (including the use of indicators) and not riding responsibly on the roads were all issues mentioned in the stories of non-users. This interlinks with the idea of e-scooter riders being seen as a general danger to non-users with whom they share the space (Wallius et al., 2021). Some non-users suggested the need for e-scooter training to be mandatory before riding. The scooter stories in **Table 14** below show a number of different concerns that non-users have in relation to the scooters.

Interestingly, these stories highlight the topic of legality. Many non-users appear to see e-scooter users as operating outside the law, with a general feeling of users being subject to fewer or less-enforced rules. Statements from non-users raise a question the fairness of road use in relation to regulations. E-scooter riders are seen as disobeying the rules of the road more frequently, yet being penalised less often than car drivers, which some non-users see as unfair. This highlights the need for a review and update of legislation and policies surrounding rented and private e-scooters to try to manage these conflicts.

These stories highlight the negative image of e-scooter users in the minds of non-users, as well as the safety issues and the reality of riding them on UK roads. The issues of safety identified here are explored in more detail later, in the safety section.

As is evident throughout, there is a strong pejorative element to many of the statements in the scooter stories, particularly those of the non-users. Blame for e-scooters' perceived road and pavement transgressions is almost always placed firmly and only with the scooter riders. And yet, conflicts in urban space are the result of complex relationships and interactions between a whole range of different actors, human and non-human. For example, from an

Table 14: Non-user perceptions of e-scooter safety.

"I am very scared and nervous about using e-scooters so have chosen not to use them. I think if I was to use them, I would need someone to teach me how to properly use them."	18–24	Female	Student
"My daughter (18) fell off one and needed hospital treatment—they are very unsafe and open to abuse."	45–54	Female	Staff
"Inexperienced non drivers, riding on the road, leaving their signal lights on, indicating to turn left and carrying straight on. Excessive speed on the pavements in crowded areas, not a great combination when young children are about. Riding at night without lights."	45–54	Male	Staff
"People do not wear helmets, and I have had to stop and provide first aid to people who have fallen off. They are often driven by drunk people and have multiple people riding them. I also think that the police aren't doing enough to stop the use of privately owned scooters."	18–24	Female	Student

Actor Network Theory perspective (see Callon, 1986; Latour, 1992), the e-scooter is just one part of a large network of actors, including other road users, their vehicles, and the material infrastructure (surfaces, kerbs, lanes, lines, lights, ramps, paths, signage, etc.). E-scooters are currently seen as "out of place" because they are a new mode disrupting long-established urban networks and practices and interacting in novel, conflicting ways with existing users and infrastructures. Whilst e-scooter riders themselves are of course important actors in this disruption, they are not solely and only to blame for conflicts which arise.

Conflicts in urban space

The introduction of e-scooters in the UK has added more strain on road, path, and pavement infrastructure, which (perhaps unsurprisingly) has resulted in conflicts in urban settings (Hosseinzadeh et al., 2021), and our scooter stories illuminate these tensions. The majority of the stories related to conflict come from the non-user perspective and often display annoyance for e-scooters taking up space on the road. Furthermore, e-scooters also dominate pavements (illegally, in the UK), which causes issues for other pedestrians, particularly for those who are less mobile and/or elderly.

> E-scooters compete for space on the roads and in cycling infrastructure. In Bristol, more needs to be done to make segregated space for these vulnerable road users. There is a significant differential in speeds between pedestrians and scooter riders and scooter riders and motorised traffic. If they are to be promoted for use, these groups need to be kept separate for their own safety/perception of safety. (Male staff, 35–44)

The underlying trend of the scooter stories calls for the implementation of better cycle lanes and road infrastructure, which can be utilised by e-scooters. **Table 15** shows a range of stories with links to issues around the safety, legality and equity of e-scooters.

   Developing the earlier point about the pejorative moralisation of e-scooter riding, most often by non-users, there is a strong narrative of them being a dangerous annoyance being used by young people for trivial (or even criminal) purposes. Many non-users described the road as not being a place for scooters (even if being ridden legally) whilst also suggesting the same of the pavement. Despite arguably being one of the most vulnerable groups of road users, non-user stories often focussed on the need for e-scooters to be removed from the road space to improve safety, as opposed to any changes or restrictions made to driving practices

Table 15: Scooter stories discussing conflicts in urban space.

"See illegally used by young riders and two riders at a time (which is a very efficient use of space). Drivers can react angrily to them even when they are used sensibly as they are slow. Good to see more variety of modes using the carriageway."	55–64	Male	Student
"The infrastructure in Bristol isn't built for them, much the same for cycles too. If the council fully invested and built proper lanes for cycles and scooters, it would be far more safe."	25–34	Male	Staff
"As a community carer, I work with elderly and disabled patients. Conversations with them have highlighted how scared they are to go out into their area due to the scooters. They are scared of being knocked over, because of slow walking."	25–34	Female	Student
"They block the footway in the village where I live. This is inconsiderate, to say the least, and may adversely affect visually impaired people and wheel-chair users."	55–64	Male	Staff
"I often see buses not being able to use bus lanes and being stuck in traffic because the bus lanes are full of people riding e-scooters, often riding two or three abreast so it is impossible for anyone else to use the bus lane. E-scooters are the perfect vehicle for various crimes, especially drug- and theft-related crimes."	18–24	Male	Student

or private car access. These points are important as they contrast with the scooter users' perspective, which highlights the easy, affordable access e-scooters provide and the pleasure that riders get from their use when exploring the city.

The stories are important for illuminating broader issues of legality such as fairness of road use, with other road users seeing scooters as not having the same rules despite having the same freedom. There appears to be a perceived grey area around scooter operations for some participants because they do not require the same Vehicle Excise Duty (often known as road tax) as motorised vehicles, and they are not seen by some as being policed in an equal way compared to other road users. This has become a point of tension between e-scooter users and non-users, exacerbating the perpetual battle over shared spaces between those on foot and those on wheels.

Survey respondents were asked to respond to a series of statements on the topics of safety and shared space. Two of these statements were related to users' and non-users' perceptions of pavement riding, in addition to roads and cycle paths.

The majority of both users (58.6%) and non-users (73.0%) disagreed with the first statement related more broadly to pavement riding (**Chart 2**). This suggests that most people would prefer that pavements remain a space for pedestrians only; non-users were stronger in their feelings about this, with twice as many strongly disagreeing compared with users.

However, a further statement that focussed on the necessity of *sometimes* scooting on the pavement specifically for safety demonstrated that differences in opinion by use remain (**Chart 3**). In this analysis, a significantly higher proportion of users (72.9%) than non-users (50.0%) agreed or strongly agreed with the statement that it was sometimes necessary for scooters to use the pavement for safety reasons ($\chi2$ (4, N = 203) = 22.704, p < 0.001), with almost a third of non-users disagreeing or strongly disagreeing that it should ever be reasonable to ride scooters on the pavement, even if the roadway option is unsafe for the scooter rider.

The findings support previous research in which a similar result was identified in a discussion regarding pavement riding: the majority of users rode on a pavement to manoeuvre
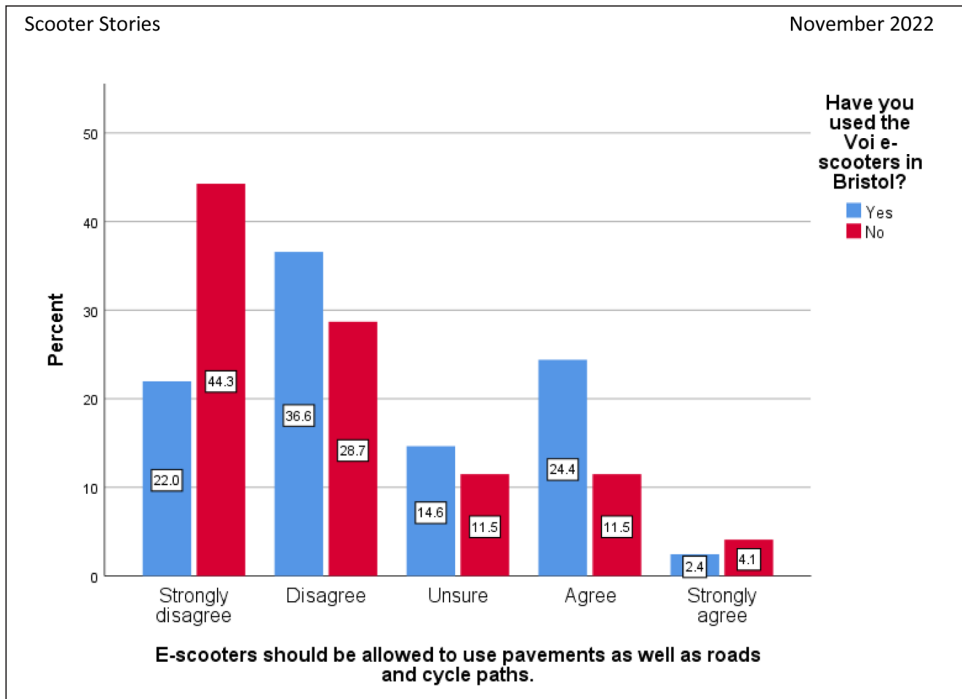
Scooter Stories   November 2022

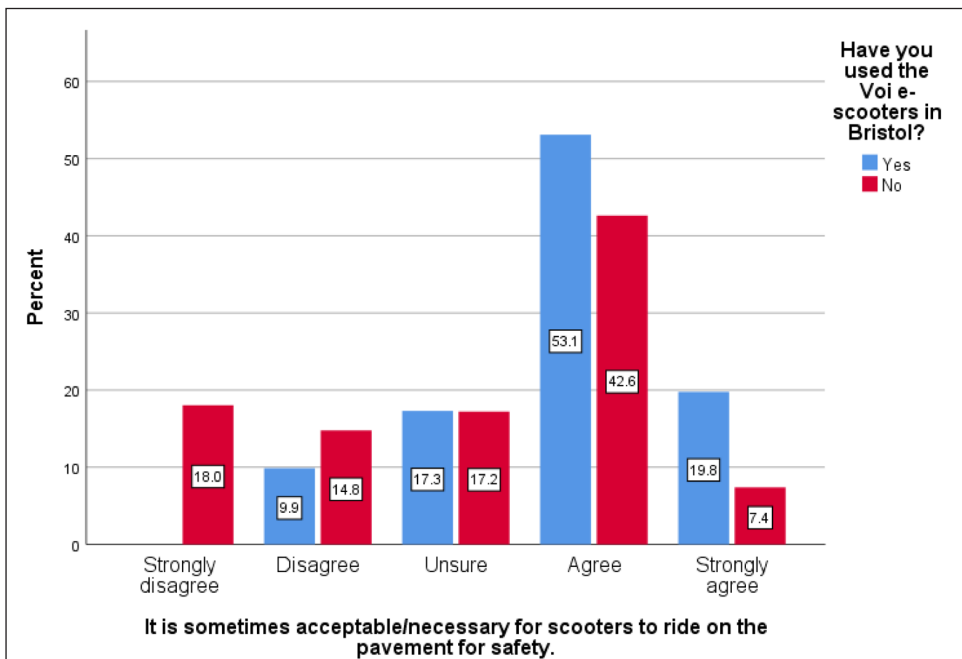**Chart 2:** Opinions on pavement riding between users and non-users.

Chart 3: Opinions on the necessity of occasional pavement riding between users and non-users.

around obstructions in the road, presumably to improve the safety of their ride. A respondent from the study provided some insight to this: "On an e-scooter you're not exactly a pedestrian, and you're not exactly motorised. You end up in a grey area, and in the absence of strict legislation, you allow yourself some things you wouldn't normally" (Tuncer and Brown, 2020, p. 8).

These results are again likely to be influenced by experience, with scooter users experiencing the necessity of sometimes using pavements when traversing a road and cycle path network on which the infrastructure is not of a safe design or standard for scooter riding. At the same time, this necessity may not be so apparent to non-users, who are focussed on the outcome of this, which can be negative interactions between scooter riders and pedestrians on the pavements onto which they have diverted.

E-scooters and safety

The safety of e-scooters is an issue for both users and non-users. The scooter as a powered vehicle is particularly vulnerable as it is almost completely unprotected (Tuncer and Brown, 2021). In addition, roads in the UK can be very dangerous for vulnerable road users such as cyclists and scooters, which must often share the infrastructure with cars and other large vehicles, and the safety of the vulnerable users is dependent on their interactions with other road users (Sanders, Branion-Calles and Nelson, 2020).

The scooter stories demonstrate that users of e-scooters have to be cautious of other road users and be aware of the dangerous events that may occur. Furthermore, although both female and male participants discussed e-scooter safety, there was a notable gender trend, as female participants appeared to be more anxious about the safety of e-scooters, with many stating that e-scooters are not safe to ride. In comparison with the male participants, females were less likely to use an e-scooter frequently and confidently.

> I am very scared and nervous about using e-scooters [and] so have chosen not to use them. (Female student, 18–24)

> Even if you as a rider are following the rules and guidelines, an accident can happen out of your control. So stay safe and be extra careful! (Male student, 18–24)

Interestingly, one scooter rider discussed how she had adapted her trip timings to respond to the safety concerns she had about sharing the roads with cars and other motorised vehicles, particularly in times of high traffic.

> I chose to ride in the later evening as the roads were quieter, which made me feel a bit safer away from large quantities of traffic. (Female student, 18–24)

One other participant touched upon an equity issue in relation to scooter use on the roads, identifying cars and other heavy motorised vehicles as being substantially more dangerous to the scooters and their riders than vice versa, whilst scooter riders in the UK must nevertheless continue to share this sometimes dangerous road space with motorized traffic due to their illegality on most pavements and other shared pedestrian spaces.

> Hopefully bikes and e-scooters become a much more normalised way of travelling around the city and getting people out of cars, which are hundreds of times more dangerous. (Male staff, 25–34)

The stories demonstrate the safety concerns e-scooter users have and the precautions that they have to take to avoid danger. These stories highlight users' experiences of e-scooter safety, which are not always considered. Interestingly, when respondents to the survey were asked about their views regarding helmet use on e-scooters, non-users were significantly more supportive of helmets becoming mandatory when riding the e-scooter than e-scooter users themselves ($\chi 2$ (4, N = 207) = 34.087, p < 0.001). As is evident in **Chart 4**, 66.6% of non-users agreed or strongly agreed that helmet wearing on scooters should be mandatory, whereas only 32.1% of actual users said the same; indeed, amongst users, 40.5% either disagreed or strongly disagreed with this suggestion.

This demonstrates an important split in perceptions of personal and generalised road safety between users and non-users; crucially, it appears that non-users perceive a higher need for protection for scooter users than is felt by users themselves. This effect is possibly mediated by experience (or lack thereof), and it is also likely to be linked to broader perceptions of safety in relation to the scooters which underpin people's decisions to be a user or not.

Conclusion

This research has analysed 124 qualitative e-scooter stories and 222 e-scooter survey responses to provide insight into the thoughts and experiences of e-scooters users and non-users. We hope the findings from this paper can be useful in informing transport authorities, providers, and other stakeholders seeking to integrate e-scooters into the modern urban modal mix, with the aim of improving sustainability, access, and health and well-being. This conclusion sets out our main findings, makes several recommendations and considers the limitations of this study.
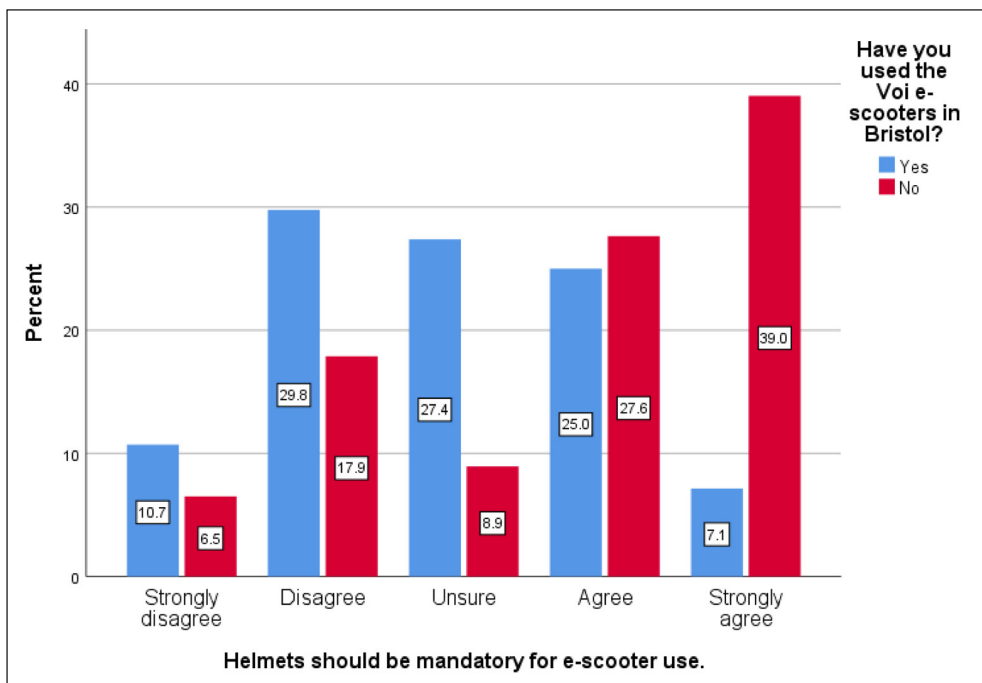

Chart 4: Opinions on compulsory helmet wearing by users and non-users.

E-scooters have become popular as a sustainable alternative to urban car trips, and indeed, the evidence shows that they are; however, at the current time, the e-scooter trips in our and others' studies are predominantly displacing trips by walking, cycling and public transport, often substantially more so than trips by private vehicle (see also Sanders, Branion-Calles and Nelson, 2020; Sustrans, 2022). Our research suggests 37.8% of e-scooter usage is displacing walking and a further 25.6% is replacing bus travel, with only 8.9% of survey respondents stating their e-scooter ride had replaced a journey by car. Linking back to the earlier discussion of combined and local authority sustainable transport objectives (to reduce private car trips whilst encouraging more trips by active modes), the e-scooters are currently at best only partially assisting in this aim and indeed might also be seen to be working against public health and well-being objectives by disincentivising short walking trips, making people less active in their local travel. We recommend that it would be beneficial for transport authorities and providers to focus on promoting e-scooters to a targeted audience of people that could realistically use them to replace short urban car trips, for example to commuters who live and work within an urban area, to university students accessing campuses and to both local residents and visitors for leisure trips around a city or town.

This study finds clear conflicts between non-users and users, mostly associated with safety and urban space. Interestingly, safety is a particularly strong theme for non-users, with many stories mentioning the possibility of injuries, the risks from dangerous riding and being scared of e-scooters. From the users' perspective, conflicts arise when they are faced with the necessity of sharing infrastructure, particularly pavements when these are used to avoid an unsafe piece of road. For non-users, conflicts are evident in a number of issues, including intoxicated riding, illegal use of pavements, disregard for the rules of the road and improper use of the scooter vehicles. An important point from our study, supported by previous research, is that scooters (in the UK context) continue to exist in a sort of grey area between legality and practicality. Scooter riders are arguably amongst the most vulnerable of road users, but currently they are legally allowed to ride only in the most dangerous of contexts—on the road itself amongst cars and other motorised vehicles. Two linked recommendations for transport policymakers and authorities emerge from our findings about e-scooter conflicts. The first is that urgent attention is needed in terms of considering and defining scooters' place in the various pieces of road and pavement infrastructure that make up the shared spaces of towns and cities. And second, leading from this, is that legislation and regulation needs to be reviewed at both the national and local levels, to ensure that scooters are operating in the optimal and safest spaces for both riders and other road users.

Developing this finding, it is evident that road and pavement infrastructures are an important factor in the safety of e-scooter riding. Negative perceptions and narratives of e-scooter riders can often be linked at least in part to infrastructure, for example scooters needing to swerve to avoid potholes which would be especially dangerous to their small wheels. It is evident that current road and path infrastructures are inappropriate for scooter use, and this is contributing to the conflicts we identify. If e-scooters are a personal mobility solution that is here to stay in our urban spaces, then consideration needs to be given to designing for scooter access, and design guidance should be updated accordingly to account for the paving tolerances of e-scooter vehicles.

Although e-scooter use remains contentious, an increase in the use of both private and rented e-scooters is forecasted for the future (Christoforou et al., 2021). E-scooters looks set to retain and expand their new position within the modern urban mobility mix. Therefore, more needs to be done to ensure e-scooter use is safe and accessible for all, and that the potential sustainability benefits of e-scooters are realised without a compromise of health and wellbeing objectives. Policymakers, transport authorities and other stakeholders need to be aware

of the possible negative impacts of e-scooters from both user and non-user perspectives, and they should use this knowledge to find solutions for this new mode of transport to become safe and equitable, maximising the transition from short urban car trips to e-scooters whilst minimising any impacts on active, healthy travel choices.

Limitations and areas for future research

There were several limitations to this study which can help inform future research in this area. This study was conducted on a student and staff population at an urban university campus. This was a useful context to explore, but there are many other urban contexts in which scooters are being used. Future studies might focus on commuter trips in the urban core, or the use of scooters for leisure trips by residents and visitors to an urban area, in different places across the UK and internationally.

Our study focussed on an e-scooter public hire scheme. This was necessary in the UK context because this is currently the only way that e-scooters are legal for use on public roads and paths. However, it would be very interesting to expand our scooter stories approach to get views and experiences from private owners of e-scooters, and/or in places where private use on roads and paths is legal.

Finally, this paper aimed to focus purely on legal e-scooter riding, in the context of the public trial. Through the course of our analysis, illegality became one of the recurrent themes, and it would be valuable in future to go further down this line of enquiry and conduct a study looking principally at illegal scooter riding practices and their relationship with the conflicts and safety issues we identify.

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Competing Interests

The authors have no competing interests to declare.

Author Contribution

Anna Speak and Monique Taratula-Lyons are Co-First Authors on this paper.

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