ACTIVE TRAVEL STUDIES

Egan, R, et al. Situating the E-Cargo Bike in an Emerging Cycling Network: A Qualitative Study. *Active Travel Studies: An Interdisciplinary Journal*, 5(1): 4, 1–18. DOI: https://doi.org/10.16997/ats.1929

RESEARCH ARTICLE

Situating the E-Cargo Bike in an Emerging Cycling Network: A Qualitative Study

Robert Egan[1], Hannah Julienne[2], Mark Philbin[3] and Brian Caulfield[1]

[1] Centre for Transport Research, Department of Civil, Structural and Environmental Engineering, Trinity College Dublin, Ireland

[2] Behavioural Economics Unit, Sustainable Energy Authority of Ireland, Ireland

[3] School of Nursing, Psychotherapy, and Community Health, Dublin City University, Ireland

Corresponding author: Robert Egan (eganr.research@gmail.com)

In many low-cycling contexts, cycling is routinely marginalised in transport planning practice while, in everyday traffic interactions, cyclists are frequently disregarded as legitimate road users. E-cycling can help to reduce the physical and psychological demands of cycling in such unfavourable conditions, enabling riders to accelerate faster and sustain higher speeds when on the road with motor traffic. Emerging evidence on private e-cargo cycling suggests that e-cargo bikes (ECBs) might additionally improve presence and visibility on the road. However, studies on both cargo and e-cargo cycling indicate that the atypical size and dimensions of these cycles can limit the accessibility and comfort of protected cycle networks. Following the lead of this early (e-)cargo bike research, in this qualitative study, we explored how private ECB owners on the island of Ireland experienced their local and regional cycling networks. Our study reveals the unique effects of cycle network planning, maintenance, and design practices on e-cargo cycling in this context. In particular, we found that e-cargo cyclists (i) may especially benefit from protected cycle networks due to the common use of ECBs for carrying children, (ii) may be more sensitive than conventional cyclists to the surface quality and clearance of cycle networks, and (iii) may be effectively excluded from protected cycle networks that are designed without consideration for atypical cycles and cyclists. On these grounds, our study suggests that inclusive cycle network design practice and robust maintenance regimes are paramount to enable e-cargo cycling to grow as a dynamic variant of cycling.

Keywords: e-cargo bike; e-bike; planning; design; cycle network; infrastructure

1. Introduction

In the face of pressing transport decarbonisation targets across Europe, cycling has been recognised as a mode with considerable potential to reduce car use, as part of a broader shift towards multi-modal mobility practices. In this context, the importance of developing ample protected cycle networks has been noted as a key measure to increase cycling ridership

(European Commission, 2022; European Commission, 2023). While cycling in general has been identified as a valuable means of transport sector decarbonisation within Europe, e-cargo bikes (ECBs) in particular have been proposed as a variant of cycling that could contribute to decarbonisation of urban goods transport (European Commission, 2022; European Commission, 2023). ECBs have equally been considered as potential vehicular substitutes for the private car, a view that is evident in Irish climate policy (Department of the Environment, Climate and Communications, 2023) and has been recently supported by sizeable ECB purchase subsidies for employees in Ireland (Revenue, 2024).

Existing research on e-cargo cycling has primarily examined ECBs as logistics vehicles rather than private vehicles (Narayanan and Antoniou, 2022). However, an increasing number of studies have sought to directly investigate experiences of private ECB use (e.g., Marincek, Rérat and Lurkin, 2024a; Marincek, Rérat and Lurkin, 2024b; Thomas, 2022). Our study contributes to this burgeoning area of scholarship, qualitatively exploring how private ECB owners experienced cycle networks on the island of Ireland. Specifically, our analysis provides an in-depth qualitative account of how e-cargo cycling is experienced across varied and developing cycle networks on an island where cycling presently constitutes a very small proportion of total journeys (Department for Infrastructure, 2023; National Transport Authority, 2023) but occupies a position of considerable policy ambition (Department for Regional Development, 2015; Department of Transport, 2022).

We begin our paper by examining how cycling has been marginalised as a transport mode in Ireland and the UK, how e-cycling might offer a way for greater participation in cycling within unfavourable cycling conditions, and how e-cargo cycling might help people feel more secure and safe when cycling on roads while making protected cycle networks more challenging to access and use. Following this, we present our methodology for the study, detailing the process of interview data collection and data analysis, which was informed by previous analysis of cycling experiences in Ireland (Egan and Philbin, 2021). We then provide the findings of the study, outlining how various aspects of local and regional cycle networks (i.e., their planning, maintenance, and design) were uniquely experienced by private e-cargo cyclists in Ireland. In the discussion section, we situate our findings in relation to extant cycling, e-cycling and e-cargo literature, and conclude with several primary implications of our study.

2. Background

Within low-cycling contexts such as Ireland and the United Kingdom, cycling has been an historically marginalised transport mode relative to the private car. This marginalisation presents in two primary ways. First, in the context a dominant system of automobility (Urry, 2004), "cycle traffic" has been largely ignored as an object of transport planning practice and investment (Aldred, 2012; Aldred et al, 2019; Cox, 2020; Egan and Caulfield, 2024; Egan and Philbin, 2021; Hanna, 2015; Parsons and Vigar, 2018). Second, cyclists are routinely disregarded in everyday traffic interactions with professional and private motorists, thereby treated as implicitly inferior road users (Aldred, 2016; Egan and Philbin, 2021; Hogan and Jeffers, 2023; Joshi, Senior and Smith, 2001; Lawson et al, 2013; Mullan, 2013). This disregard can be enacted through close-passing manoeuvres, tailgating, blocking cycle spaces, harassment, and failing to respect a cyclists' right of way (e.g., Aldred, 2016; Egan and Philbin, 2021). In countries where cycling is prioritised as a form of transport, dense and connected cycle networks are commonplace, cycling is normalised, and motorists have greater legal liability in the case of collision with a cyclist (Pucher and Buehler, 2008).

In the context of this marginalisation, a growing body of research indicates that e-cycling can enable more comfortable "vehicular cycling" (i.e., cycling with motor traffic) compared to conventional cycling, potentially offering a way for people who might otherwise be deterred

by hostile cycling conditions to engage in cycling (Dill and Rose, 2012; Johnson and Rose, 2015; Jones, Harms and Heinen, 2016; Melia and Bartle, 2021; Popovich et al, 2014; Thomas, 2022). In particular, e-bikes have been found to assist riders to accelerate more rapidly and to cycle at sustained higher speeds. These improved capabilities appear to help e-cyclists integrate with motor traffic rather than become an "obstacle" to motor traffic (Behrendt, 2018; Dill and Rose, 2012; Dowling and Maalsen, 2020; Jones, Harms and Heinen, 2016; Jones et al, 2022; Popovich et al, 2014; Wild, Woodward and Shaw, 2021). The studies by Wild, Woodward and Shaw (2021) and Dill and Rose (2012) indicate that e-cycling can also facilitate "getting out of the way" faster (Wild, Woodward and Shaw, 2021, p. 10), suggesting that e-bikes enable not only integration with motor traffic but also enhanced avoidance.

E-cargo cycling may further positively reshape the experience of vehicular cycling. In the North American study of Thomas (2022), one participant noted how they felt the sheer size of their ECB led to safer overtaking practices by motorists, as the ECB made their presence amongst traffic so conspicuous that "nobody can miss it" (p. 642); another participant similarly described how "everybody sees you" (p. 642) when e-cargo cycling. Analysing a much larger body of responses from nearly 700 ECB users in Switzerland (87.9% of whom rode ECBs), the study of Marincek, Rérat and Lurkin (2024b) found that 70% of respondents experienced cargo cycling mixed with motor traffic as safe, while 57.7% felt respected by other road users. Marincek, Rérat and Lurkin (2024b) additionally noted that cargo trike riders felt more respected than longtail cargo riders in their study, lending credibility to the claims of the e-cargo riders of Thomas (2022) regarding the positive impact of their ECB size on motorist behaviour.

Despite this early evidence suggesting a potential experiential advantage when e-cargo cycling on roads, several studies indicate that the design of cycling infrastructure can present a major problem for e-cargo cyclists (Melia and Bartle, 2021; Marincek, Rérat and Lurkin, 2024b). In the study by Marincek, Rérat and Lurkin (2024b), the majority of respondents perceived that the current provision of cycle lanes and paths was not appropriately designed for cargo bikes. This finding resembles existing research focused on non-electric cargo bikes (Liu et al, 2020; Riggs and Schwartz, 2018). The North American study of Riggs and Schwartz (2018), for example, found that existing cycle infrastructure provision could be uncomfortably narrow for cargo-cycle users. Liu et al (2020) reported a similar phenomenon amongst cargo cyclists in the higher-cycling contexts of Stockholm and Amsterdam. Cargo cyclists in Stockholm in particular described how overtaking with the cargo bike could be exceptionally challenging on protected cycleways with heavy cycle traffic, with some users even expressing a preference for using bus lanes or unprotected cycle lanes due to the greater availability of space to manoeuvre. Focusing on e-cyclists in the UK, Melia and Bartle (2021) reported that e-cargo cyclists in their study found segregated routes more challenging to access due to gates and other obstructions more easily negotiated with narrow and lighter cycles (see also, Sherriff, Blazejewski and Davies, 2023).

In our study, we explore experiences of e-cargo cycling using existing (and selectively expanding) cycling networks on the island of Ireland, drawing on qualitative interviews with 25 private ECB owners. While the bulk of e-cargo cycling research to date has focused on the logistics applications of ECBs (Narayanan and Antoniou, 2022), this study contributes to the growing body of scholarship that has included (Dowling and Maalsen, 2020; Edberg, 2023; Edberg, 2024; Melia and Bartle, 2021; Wild, Woodward and Shaw, 2021) or centred (Marincek, Rérat and Lurkin, 2024a; Marincek, Rérat and Lurkin, 2024b; Thomas, 2022) the experiences of private ECB users. To our knowledge, our study provides the most comprehensive qualitative inquiry to date exploring how an existing and growing protected cycle network is experienced by private ECB owners in their everyday e-cargo mobilities, building on the survey

research of Marincek, Rérat and Lurkin (2024b) and the qualitative e-cycling study of Melia and Bartle (2021). In doing so, our study offers nuanced insights that can inform more ECB-inclusive cycle network planning, maintenance, and design.

3. Study context

Ireland is a country with high levels of private car use and walking, and low levels of cycling. In 2022, cycling was estimated to account for 2% of total journeys nationally, in stark contrast to journeys by car (69%) or walking (19%) (National Transport Authority, 2023). While overall cycling levels are low, cycling participation is even lower amongst women in Ireland, accounting for only 1.3% of women's total trips in 2021 compared to 3% for men (Central Statistics Office, 2022). Levels of cycling vary considerably within Ireland, depending on context; for example, cycling constituted 5% of journeys in Dublin City and its suburbs compared to only 1% of journeys within urban towns (National Transport Authority, 2023). Overall, Ireland has a low provision of segregated urban cycling infrastructure (Conway et al, 2019), which deters the inclusive growth of cycling (Aldred, Woodcock and Goodman, 2016).

However, increased ambition and investment in developing protected cycle networks is evident at both national (Department of Transport, 2021; National Transport Authority, 2025) and local authority levels (Cork City Council, 2022; Dublin City Council, 2025) to grow cycling mode shares (Department of the Environment, Climate and Communications, 2023). In the Cork City Development Plan (Cork City Council, 2022), for example, 100 km of new or upgraded cycle facilities are planned for delivery by 2028. This expansion of cycle infrastructure aims to help increase cycling modal share from 1% of journeys in 2022 to 10% of journeys by 2040. The Dublin City Council (2022) Development Plan, on the other hand, aims to increase cycling/micromobility mode share from 6% in 2019 to 13% by 2028, supported by the longer-term rollout of 314 km of infrastructure for active transport from a baseline of 10 km (Dublin City Council, 2025).

While national cycling participation is recorded in Ireland, specific rates of e-cycling and e-cargo cycling are unknown at the national, regional, and local levels, as these are not measured through official data gathering channels and are instead subsumed as "bicycle" trips. However, e-bike ownership is recorded: 2% of households are estimated to own an e-cycle of some kind nationally, compared to 44% for non-electric bicycles (National Transport Authority, 2023). Irish market data indicates that the share of households in Ireland that own an e-bike of some description is likely growing, with e-cycles constituting 18% of total cycle sales in 2023 (Statista, 2024). The growth in e-cycle sales is likely aided by Ireland's "Cycle to Work" scheme, which awards a €1,500 subsidy for the purchase of a new e-bicycle and up to €3,000 for a new cargo/e-cargo cycle (Revenue, 2024) as a means to promote greater uptake of cycling for commuting journeys.

As our research has focused primarily on experiences of e-cargo cycling in the Republic of Ireland, our context section reflects this. For more information on the status of cycling ridership and policy in Northern Ireland, we direct readers to the Bicycle Strategy for Northern Ireland (Department for Regional Development, 2015), the Northern Ireland Travel Survey (Department for Infrastructure, 2023), and the Belfast Cycling Network Delivery Plan (Department for Infrastructure, 2022).

4. Methodology

Our analysis in this paper originates from a broader study exploring how private e-cargo cycling is experienced and integrated as a mode of everyday mobility in Ireland, with attention to competing modes of everyday mobility such as car-driving and conventional cycling.

Initial data were gathered with a broad interest in practices relating to ECB purchase, use, and parking. In this paper, we examine how private ECB owners participating in this study experienced cycle networks in their everyday e-cargo cycling use, with particular attention to how these networks might be experienced differently when using an ECB relative to a conventional bicycle or e-bike. Data collection and analysis to investigate this topic were guided by the study of cycling in Dublin carried out by Egan and Philbin (2021). This study identified how the spatial and temporal design and planning of dedicated cycle spaces – and the (insufficient) regimes of maintenance for such spaces – could shape an insecure experience of conventional cycling in the Irish capital, compounded by disregard from motorists and a lack of police protection. This attention to cycle network planning, maintenance, and design is reflected in our findings, where these three dimensions of Ireland's existing (and slowly growing) cycling network are explored qualitatively, focusing on the perspectives of private ECB owners.

Data for this study were gathered using semi-structured qualitative interviews with adults based in Ireland who owned an e-cargo cycle of any kind. As indicated above, participants were asked about their experiences of accessing and using available cycle networks with their ECBs. Follow-up questions explored the experienced connectivity, condition, and design of these networks as an ECB rider in greater depth. Data analysis involved selectively coding interview transcripts to identify how the planning, maintenance, and design of a given cycle network were experienced by ECB owners, and how the qualities of a given network might uniquely affect e-cargo cyclists relative to conventional (e-)bicycle users. This analysis can be read as an account of how, from the perspective of ECB owners, the (variable) "technologies" and uses of the ECB interact with mobility "environments" designed for cycling (Cox, 2019) on the island of Ireland.

Participants were recruited using an online interview volunteer advertisement. This was widely shared on platforms including LinkedIn and X by the researchers and by the social media accounts of their respective organisations. In addition, the call for volunteers was shared by a prominent cycling news website (Ginty, 2024). In total, 23 interviews were carried out, involving two (heterosexual) couples, and 21 individuals (*N*: 25). Interviews had a duration of 40 to 73 minutes. All participants provided signed informed consent forms. Thirteen women and 12 men participated in the study. This approximate participant gender balance contrasts with the cycling gender gap in Ireland (Central Statistics Office, 2022). The majority of participants lived in Dublin (*N*: 12) were between 30 and 39 years of age (*N*: 12), had at least one child (*N*: 24), and had years of experience cycling for everyday purposes. There was a reasonably balanced mix of ECB types: 11 participants used a box-bike – which has a cargo box situated to the front of the bike – while 12 used a long-tail bike – which generally has a seating area for passengers situated to the rear of the bike. Only two participants used a box-trike. **Table 1** presents various demographic information relating to participants, including interview information. This research was ethically approved by the university ethics committee.

5. Findings

5.1. Cycle network planning

Private ECB users in this study described their sense of vulnerability cycling on roads and unprotected junctions, where cycle lanes or tracks were either not present or had suddenly "disappeared". In particular, participants were often uncomfortable cycling with motor traffic – sometimes travelling at high speeds – when cycling with their children on board their ECB. Muireann described how she almost exclusively used roads

Table 1: Basic participant and interview information.

Age	Gender	Settlement	Bike Type	County	Interview (IV) Type	IV Duration	IV No.	Pseudonym
30–39	Man	City Suburb	Box-trike	Dublin	In-Person	53 min	1	Damien
30–39	Man	City Centre	Box-bike	Dublin	Zoom	1 hr 12 min	2	Gerald
40–49	Woman	City Suburb	Long-tail	Galway	Zoom	1 hr 4 min	3	Sinéad
30–39	Man	City Suburb	Long-tail	Belfast	Zoom	1 hr 6 min	4	Ian
30–39	Woman	City Suburb	Long-tail	Belfast	Zoom	1 hr 6 min	4	Ruth
30–39	Man	City Suburb	Box-bike	Dublin	In-Person	1 hr	5	Jack
30–39	Woman	City Suburb	Box-bike	Dublin	In-Person	1 hr	5	Elaine
30–39	Woman	City Suburb	Long-tail	Dublin	In-Person	52 min	6	Aisling
40–49	Man	City Suburb	Box-bike	Dublin	In-Person	1 hr 13 min	7	Seán
40–49	Man	City Suburb	Box-bike	Dublin	Zoom	1 hr 4 min	8	Craig
30–39	Man	Town/Village	Box-trike	Kildare	Zoom	40 min	9	Patrick
40–49	Woman	City Suburb	Box-bike	Cork	Zoom	1 hr 3 min	10	Jennifer
40–49	Man	City Centre	Long-tail	Dublin	In-Person	46 min	11	Killian
30–39	Man	Town/Village	Box-bike	Antrim	Zoom	54 min	12	Dara
50–59	Man	City Suburb	Box-bike	Dublin	Zoom	33 min	13	Richard
50–59	Woman	City Suburb	Box-bike	Waterford	Zoom	50 min	14	Niamh
40–49	Woman	City Suburb	Long-tail	Cork	Zoom	1 hr 7 min	15	Muireann
30–39	Woman	City Suburb	Long-tail	Dublin	Zoom	50 min	16	Catherine
40–49	Woman	City Suburb	Box-bike	Dublin	In-Person	54 min	17	Anna
30–39	Woman	Town/Village	Long-tail	Wexford	Zoom	1 hr 12 min	18	Éireann
40–49	Woman	City Suburb	Long-tail	Dublin	Zoom	55 min	19	Amy
40–49	Woman	City Suburb	Long-tail	Galway	Zoom	40 min	20	Emma
30–39	Woman	City Suburb	Long-tail	Cork	Zoom	43 min	21	Laura
40–49	Man	City Suburb	Long-tail	Belfast	Zoom	52 min	22	Conor
40–49	Man	Town/Village	Box-bike	Kerry	Zoom	1 hr 5 min	23	Mark

when cycling her long-tail ECB around North Cork City with her child on board. While some cycle lanes did eventually become available closer to the city centre, a limited network meant that such spaces were not relevant for the routes that Muireann regularly travelled.

> We don't get to a bike lane until we go to town. There's one very, very small bike lane locally that makes no difference to us whatsoever because it's nowhere near where we're going. So that's it. So, everywhere we go, we're on the road, we're in traffic. (Muireann, Cork)

Seán, on the other hand, described how he could generally cycle his ECB on the "bits" of dedicated cycle space "that they give ya" in Dublin. However, he noted that this provision for cycle traffic often ends at junctions, leaving one to "fend for themselves" to reach the other side of the road.

> The bits that they give ya are grand. I think the…em…my general complaint (laughing) has always been around the junctions. The bike lane seems to just disappear as you get to a junction. You're left to fend for yourself to get to the other side. (Seán, Dublin)

Similarly, in the context of Belfast, the capital of Northern Ireland, Ruth described the typical piecemeal composition of cycle lanes within the city, where dedicated spaces for cycle traffic at junctions were often unavailable.

> There's cycle lanes all over Belfast which I call, "Oh! You're on the road again." They just like end, and you're spat out…into the road. Yeah, that was on a road nearby. So, there's this *lovely little cycling lane* that protects the cyclists for all of…two hundred metres, really. And, then (makes surprised face)…it just ends. You know, you have to… look behind you but while you're looking in front of you cos you're coming up to a junction as well. So…yeah, it's not great. So, you turn a corner and yes, there's another painted cycle lane. But then I have to turn right. But, again, it's a busy road so how does the cyclist get from the painted lane into turning right? (Ruth, Belfast)

However, depending on the geography of participants, several commended local authorities for a greatly improved cycle network, especially in Dublin and Cork City, where considerable progress has been made in providing segregated, physically protected spaces for cycle traffic. This contrasted with the widespread dissatisfaction of conventional cyclist participants based in Dublin in Egan and Philbin (2021), who primarily navigated unprotected, on-road cycle lanes and bus lanes – prior to a considerable improvement in protected cycle network provision in the city. Nevertheless, many participants in this study called for more priority for cycle traffic in planning practice, noting issues such as having to yield to motor traffic at crossings when travelling on off-road cycle tracks and diverging levels of priority for cycle traffic at particular streets, leading to an experience that was far from "cohesive" (National Transport Authority and Department of Transport, 2023).

> Cycle infrastructure, in my opinion – like, I'm not an engineer – I do think it's come on leaps and bounds. Even since I've moved back to Cork several years ago, it has just improved so much. There's so many more cycle lanes. But the infrastructure is not cohesive in a lot of places. So, like, a cycle lane will just *stop*, or…there'll be a counter-directional cycle lane which will end up…*in a junction* and it *doesn't continue on the other side of the junction.* (Jennifer, Cork)

> My main pain points are like going from just a lovely separate space to, like, nothing. (Laughs.) So, I go across Samuel Beckett Bridge. I don't know if you've ever cycled that but it's just like you go from this really nice space, and then I have to turn right and you're just back into mental…you're into mental, like… You either have to come off the footpath into the traffic or…stay in the traffic and not be in the space you're supposed to be. So, it's improved but it could be much better. It's better than it was. (Catherine, Dublin)

5.2. Cycle network maintenance

While the provision of connected and protected cycling networks was a concern for many participants, the quality of existing cycle infrastructure was also problematised in relation to e-cargo cycling. In particular, the compromised physical condition of painted and segregated cycle spaces encountered by participants rendered these spaces risky or uncomfortable to use when e-cargo cycling – concerns that were evident in previous non-cargo cycling studies (Cox and Bartle, 2020; Lawson et al, 2013; Mora et al, 2024; Popovich et al, 2014). Wet leaves, puddles, potholes, and broken glass were all considered detrimental to using dedicated cycle spaces on an ECB. The sheer mass of the cargo bike and the precious cargo often carried by participants (i.e., their children) exacerbated this sense of risk – particularly of destabilising, which several participants had experienced with their children on board. Jennifer described how potholes were particularly uncomfortable when cycling the ECB because of its heavy weight, noting how such "rattles" contribute to "wear and tear" of the vehicle:

> Dutch cycling infrastructure is really smooth and even and… Whereas, like, road surfaces here are ridiculous. So, you know, if you hit a pothole, it will r*attle* you, like, because you're on this huge, *heavy* piece of kit. So, there's a fair bit of wear and tear. (Jennifer, Cork)

Anna, who was from the Netherlands and based in Dublin, commented on how cyclists in Dublin often cycle in the "middle of the road", which she found somewhat irritating as a driver. However, reflecting on her own experience of cycling in Dublin, she noted how road surfaces can often be poorly maintained, necessitating full use of the road, especially with the ECB.

> As a cyclist, I know that…it's cos of the maintenance of the road are also quite bad. So a lot of the time there are holes, so you also need to avoid them as well. And then, with the cargo bike, that's even more true because you're having a bit, you know, more of the bumps. (Anna, Dublin)

The implications of glass debris on cycle spaces were particularly consequential for an e-cargo cyclist. Catherine described the logistical challenges of having a wheel punctured on her way to work, where wheeling the bike on foot or independently fixing the puncture was out of the question.

> That's the one thing…a puncture on the e-cargo is…you're done for, you know. I got one five minutes from work…just even pushing the bike. You couldn't even push it to a shop. I had to get one of those…em…like, on-the-go bike repair people. They had to come to the bike as opposed to me being able to get to the shop…and it was 50 quid! (Laughs.) I knew it was going to cost a fortune but it was like, "Sure, you know…what can I do (raises hands up)?" And also, sorry, it's got a cage. It's not like I can kinda flip it upside down and do anything, you know. It's painful, yeah. (Catherine, Dublin)

Overall, participants indicated that local authorities responsible for maintaining segregated or on-road cycle spaces often failed to do so to an adequate standard. This neglect, as argued, was prevalent in the proliferation of leaves, puddles, glass, and other obstacles in spaces where cycle traffic was intended to travel through, suggesting a treatment of cycle lanes or tracks as "left-over" spaces of transport (Cox, 2019, p. 182).

5.3. Cycle network design

Although several participants in this study attested to the value of the growing segregated cycling networks, a common experience was that sections of these segregated facilities were simply not accessible with e-cargo cycles. Instead, many facilities were designed with individual conventional cyclists in mind, overlooking the infrastructural needs of ECB or trike users. The effect of these bicycle-centric infrastructures was that such spaces were either wholly inaccessible or riskier to use for e-cargo cyclists, undermining their purpose as mobility spaces designed to protect cyclists from danger.

In this study, nearly all cases of cycle network inaccessibility and risk were raised by participants living and cycling in Dublin. This may be explained by the proliferation of segregated cycling spaces in highly trafficked locations within the county. Gerald, for example, found some of the design widths of segregated cycle spaces constructed in recent years in Dublin as "very tight", particularly for turning his box-bike, leading Gerald to cycle on the road instead of the cycle network for certain sections.

> The infrastructure – even the stuff they're putting in, the segregation – some of it is very tight. It's very hard to manoeuvre some of the turns on anything that isn't a... like, a normal, pretty normal... But even with the normal bikes... So, I don't know if you know...they've put in some segregation around Heuston Station going over the river towards the Northside from Heuston, and there's a turn on it, it's insanely tight – even on a regular bike, it's very, very tight. So, I tend to skip it. I tend to go into the lane of traffic, (laughs) out of the segregation, to avoid that turn and then I'll jump back in. (Gerald, Dublin)

Damien, on the other hand, described how he was forced to use a bus lane for particular sections of his route to work, as parts of the cycle lane protected with orca bollards were "too narrow" to access with his wider e-cargo trike.

> There's one or two bits, again, where it's...the bike lanes haven't been designed thinking about any kind of cargo bike. So, there's actually one bit where, coming along one section of bike lane where it's too narrow for the cargo bike to fit in, and they have the plastic bollards (laughs). So, you have to go out into the bus lane. And, it's OK...it's still a bus lane, so its fine, but there's...one or two bits like that. (Damien, Dublin)

Both Gerald and Damien's accounts demonstrate how the design of particular sections of their everyday cycle network was effectively unusable with their ECBs, further fragmenting an already disconnected existing network.

Others described how narrowly designed protected cycle infrastructure could impede overtaking in the cycleway when e-cargo cycling. Seán, who rode a box-bike, found the width of segregated cycleways in Dublin problematic for situations where faster cyclists wanted to overtake him or when he wanted to overtake slower cyclists. Interestingly, while such segregated cycle spaces could prevent close passing from motorists, they seemed to result in close passing from other cyclists.

> Sometimes, you know, there's someone who wants to go faster than me but there's probably not enough room for them to get past, and they don't realise the length of the bike. I've been clipped a couple of times by people trying to squeeze past. And, similarly, like, if there's someone cycling a bit slower than me...like, the e-bike goes 20,

> 25 kilometres an hour. So, if there's somebody going 15-ish, you're like, "Right, I'd like to get…I'd like to get past." But you can't find the opportunity, so you're kinda, like… you're slowed down for a while. (Seán, Dublin)

Outside of the context of Dublin, Éireann described how the narrow design of a proposed cycleway in her area resulted from local opposition over reduced car parking. While originally more "universal" cycling spaces were planned in the original proposals, these were "watered down" to preserve existing car parking, thereby creating minimal cycling spaces that could be incompatible with ECBs.

> There's supposed to be…there is a big redevelopment of a street, and it went from being one-way with cycle lanes and wider footpaths, to really…em…you know, backlash over the loss of parking. And it just got watered down and watered down and watered down to…they ended up just keeping all of the on-street parking, and they're somehow gonna wedge in a two-way cycle lane. And we've seen the drawings and it's horrendous…and it's not gonna be used…cos it's tiny and it's wedged in and the entrance is behind parked cars. It's just kind of doing the bare minimum that they have to do […] it's still total prioritisation of cars… (Éireann, Wexford)

For several participants based in Dublin, "kissing gate" infrastructure along dedicated greenways for walking and cycling prevented access for e-cargo cyclists, many of whom had a strong preference for segregated spaces to cycle with their children on board. Designed to prevent access to people on scramblers, these kissing gates effectively rendered greenways and parks as bicycle spaces rather than "cycle" spaces (Hickman, 2016).

> We can't use that route through the park in our cargo bike because the cargo bike doesn't fit through the kissing gates […] we can't go through a park which would be a much quieter, nicer, safer route for us to the school. It's just not available to us because of a silly gate. (Aisling, Dublin).

> With the canal as well, you know those kissing gates – is that what they're called? The anti, kind of, scrambler stuff. The bike just doesn't fit through them. I've got caught… There's a new local…really nice bike space there, but I came up the other side of it and the…and I couldn't fit it through those gates. I ended up having to go back down… (Catherine, Dublin)

Alongside protected cycleway widths, turning radii, and greenway gates, the design of road and cycleway surfaces was described as an important consideration to the accessibility of spaces for e-cargo cycling. This finding resonated with the comments of Hickman (2016) and Cox and Bartle (2020) regarding the importance of designing smooth cycleway surfaces for disabled cyclists. In particular, participants described how navigating cobbled streets and "hand-laid" (versus "machine-laid") cycle lanes was very uncomfortable with an ECB, especially for child passengers.

The bicycle-centric design of cycle parking spaces for ECBs and trikes also emerged as a major barrier to using existing cycling infrastructures for e-cargo cyclists in this study (see Egan, Julienne and Caulfield, 2025). A detailed discussion of this phenomenon is beyond the scope of this particular paper but, overall, many participants described how formally provided cycle parking – generally the "Sheffield Stand" – was primarily designed with conventional bicycles in mind. Kerbs, narrow entrances, steps, and steep ramps could all prevent

access to on-street or off-street cycle parking for e-cargo cyclists to a far greater extent than for those travelling with conventional bicycles.

To conclude, the ECB-inaccessible design of cycle networks forced e-cargo cyclists in this study to engage in more vehicular cycling, despite the added concern of cycling with children on board. In this way, the design of (protected) cycle infrastructure appeared to exert a similar effect for e-cargo cyclists as cycle lane car parking produced in the study of Egan and Philbin (2021). In this former study, conventional cyclists were forced to use the road in response to frequent car parking in the unprotected cycle lanes of Dublin, which were a more widespread component of the cycle network at the time.

6. Discussion

In pursuit of a transformative "shift" in nationwide transport behaviour, Ireland has undertaken a major programme of investment in segregated cycle infrastructure to enable greater use of cycling for everyday mobility (Department of Transport, 2021). Concurrently, substantial subsidies have been made available for employees to purchase private e-cargo cycles (Revenue, 2024), which have been identified as a mode of transport that could feasibly substitute private car journeys (Department of the Environment, Climate and Communications, 2023). In this study, we qualitatively explored how private e-cargo cyclists primarily based within the Republic of Ireland experienced cycle networks in their local and regional areas, analysing the interview accounts of 25 ECB owners. Our exploration offers a unique analysis of how two sustainable transport policy measures – namely, the development of protected cycle networks and the subsidised expansion of the private ECB fleet – may interact with one another. We found that e-cargo cyclists, particularly those in counties with growing cycling networks (i.e., Dublin and Cork), experienced unique effects of cycle network planning, maintenance, and design practice relative to cycling such networks with a conventional bicycle.

First, the piecemeal provision of protected cycle networks by local and national authorities, in which cycle traffic priority and cycle network connectivity are compromised, presented a major problem for e-cargo cyclists in this study – many of whom travelled with child passengers. Being forced into vehicular cycling with children on board the ECB, especially at junctions, was experienced as significantly riskier than cycling without children (see also Melia and Bartle, 2021; Sersli et al, 2020). Being unable to trust in the connectivity of segregated cycle networks was experienced as frustrating. These findings concur with previous studies exploring experiences of conventional cycling in low-cycling contexts (Aldred et al, 2017; Egan and Philbin, 2021; Hogan and Jeffers, 2023; Latham and Wood, 2015; Mora et al, 2024). They also resonate with the work of Sabelis (2022), who highlights how cycleways in the Netherlands offer piecemeal connectivity for longer-distance cycling transport journeys, and the work of Hickman (2016) and Cox and Bartle (2020), who argue that piecemeal cycle networks can limit the ability of disabled cyclists to use cycling as a primary mobility aid.

In this respect, our findings indicate that people engaging in e-cargo cycling experience a similar aversion to cycling amongst motor traffic and desire for protected cycling as people engaging in conventional, electric, or unconventional cycling. This aversion is, however, intensified when e-cargo cycling with child passengers – the predominant function of most private ECBs. Such aversion was widely expressed by participants in this study, who enacted practices of restraint when cycling with their children relative to cycling their ECB alone. These practices included a refrain from "filtering" through static motor traffic; taking circuitous routes to their destinations to avoid areas of heavy motor traffic; sticking to segregated cycling facilities as much as possible; and avoiding travel to certain areas altogether with the ECB. Expanding the provision of (ECB-accessible) protected cycle networks could thereby enable ECB owners to make shorter, safer, and faster everyday child-carrying journeys. This

could, in turn, improve wider public perceptions of ECBs as a safe and convenient vehicle for providing child-related mobility relative to the private car.

Second, practices of official neglect – where local authorities failed to adequately maintain cycle spaces – were a major issue encountered by participants when e-cargo cycling. The mass of the ECB compared to a conventional bicycle or e-bike made uneven surfaces much more uncomfortable and potentially destabilising for both riders and passengers when e-cargo cycling. This contrasted somewhat with the study by Popovich et al (2014), where e-cyclist participants felt that poorly maintained cycle surfaces were primarily uncomfortable and hazardous due to the greater speeds achievable with an e-bike. Along with a greater sensitivity to mobility surface quality, cycling over glass and sustaining a puncture on an ECB was considered a more severe risk than with a conventional bicycle. In particular, wheeling an ECB to a cycle shop for repair or attempting to fix a puncture independently could present major logistical challenges. As a result, puncturing the wheel of one's ECB could leave the rider (and their children) "stranded", echoing the findings of Cox and Bartle (2020), who explored the experiences of disabled cyclists in a large UK town. With these sensitivities in mind, improving standards of routine cycle network maintenance is required to ensure that existing cycle networks can be safely and comfortably accessed by ECB riders year-round.

Third, what could be described as the "closed design" (Cox, 2022, p. 281) of cycle infrastructures encountered in this study limited where participants could avail of segregated cycle spaces where they – and their children – were protected from motor traffic when e-cargo cycling. Illustrations of closed design included narrow cycleways; tight cycleway turning radii; narrow filtered permeability arrangements (in this study, primarily kissing gates); kerbs, steps, and ramps impeding access to, or egress from, cycleways or cycle parking; and cycle parking designed for the dimensions of a bicycle. These design features have been raised as major barriers that limit the accessibility of public spaces and cycle infrastructure for disabled cyclists, who may use conventional or non-typical cycles for mobility (Clayton, Parkin and Billington, 2017; Cox and Bartle, 2020; Hickman, 2016; Melia and Bartle, 2021), thereby constituting a "disabling environment" with respect to cycling (Aldred and Woodcock, 2008; Cox and Bartle, 2020, p. 10). Narrow cycleway widths have equally been found to compromise the accessibility and comfort of cycle networks for cargo cyclists (Liu et al, 2020; Riggs and Schwartz, 2018), a finding also suggested in the ECB study by Marincek, Rérat and Lurkin (2024b).

In our study, such design features appeared to effectively "close" considerable stretches of already fragmented cycle networks, removing e-cargo cyclists from local and regional cycling networks. This necessitated ECB riders to engage in more vehicular cycling than if they were using conventional bicycles, which presented additional concerns amongst participants when cycling with their children on board, as observed in Melia and Bartle (2021). In this respect, closed design, as articulated in this section, could be seen to contribute to conditions of precarious entitlement (Egan and Philbin, 2021) to the cycle network for e-cargo cyclists in this study. Closed design practices foreclose the possibility of a diversity of cycles, cyclists, and cycling practices that could be enabled through more "open" (Cox, 2022) or "inclusive" (Clayton, Parkin and Billington, 2017; Hickman, 2016) design. To fully open cycle networks to ECB riders and their passengers, cycle networks should be retrofitted to ensure universal accessibility (National Transport Authority, 2022; National Transport Authority and Department of Transport, 2023, p.14).

Although our study offers practical insights into how cycle networks are experienced by ECB owners in Ireland, and how they might be planned, maintained, and designed to enable the growth of this dynamic mode of cycling, there are several limitations. The study was exploratory in nature, involving a relatively small number of participants (*N*: 25). Future research should aim to gather data from more ECB users regarding their experiences of cycle

networks, using methods such as self-report surveys. In addition, the study focused on the anonymised interview accounts of ECB owner experiences of their (primarily local) cycle networks. This limited the extent to which ECB cycle routes and specific cycle route features could be analysed. Future research could explore which types of cycle infrastructure are used (and not used) by e-cargo cyclists, and how, through the use of GIS methods. More detailed case studies of particular cycle infrastructures/routes (e.g., Xie and Spinney, 2018) from a standpoint of ECB-accessibility would also be highly beneficial for research and practice.

7. Conclusion

The key findings of our study suggest that e-cargo cyclists (i) may especially benefit from protected cycle networks due to the common use of ECBs for transporting children, (ii) may be particularly sensitive to network surface quality and clearance relative to non-disabled conventional cyclists (Cox and Bartle, 2020; Hickman, 2016), and (iii) may be excluded from accessing protected cycling networks, due to exclusionary and/or minimalist design practices that fail to accommodate e-cargo cycles. Our study thereby reveals how cycle network planning, maintenance, and design practices on the island of Ireland may produce "systemic sticking points" (Watson, 2013, p.124) to the future growth of e-cargo cycling, in spite of sizeable purchase subsidies (Revenue, 2024). On these grounds, developing integrated and protected cycle networks that are both inclusively designed and intensively maintained is essential to ensure such networks can be easily accessed by a diversity of ECB users, in keeping with broader calls for "inclusive" cycle network design practice (Clayton, Parkin and Billington, 2017; Cox and Bartle, 2020; Hickman, 2016). Alongside these cycle network measures, ECB ownership and use can be further supported by developing an ECB-inclusive cycle parking system (Egan, Julienne and Caulfield, 2025) and by designing grant schemes that enable ECB ownership for care-centred cycling practices rather than solely "Cycle to Work" (Revenue, 2024).

Competing Interests

The authors have no competing interests to declare.

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How to cite this article: Egan, R., Julienne, H., Philbin, M. and Caulfield, B. 2025. Situating the E-Cargo Bike in an Emerging Cycling Network: A Qualitative Study. *Active Travel Studies: An Interdisciplinary Journal*, 5(1): 4, 1–18. DOI: https://doi.org/10.16997/ats.1929

Submitted: 18 June 2025 **Accepted:** 08 September 2025 **Published:** 07 October 2025

Active Travel Studies: An Interdisciplinary Journal is a peer-reviewed open access journal published by University of Westminster Press.