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How do electric cargo bikes fit with real life? A social practice analysis in the United Kingdom

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ABSTRACT

Cycling an e-cargo bike offers key advantages of both car and bike use, and its potential to substitute many car trips offers energy demand reduction benefits. Fulfilling this potential depends on its being routinised in households' lives as a mobility practice. This paper applies social practice theory to interview data from 49 household trials of e-cargo bike use in suburbs of three cities in the United Kingdom to explore what domestic e-cargo biking is as a social practice, and whether it can substitute car use. Households likely to use e-cargo biking to replace car use were purposely sampled to receive e-cargo bikes for free trials. The paper frames its analysis within a specific theoretical understanding of 'mobility practices' which builds on key texts to identify such practices' complex and unique nature and their potential to substitute car trips. This is based on three methods of attracting (or in practice language, 'recruiting') car drivers away from driving: we explore what e-cargo biking has in common with driving; how it can tie together the other activities or social practices of life; and how activities of strong emotional importance can be combined with it. We suggest that domestic e-cargo biking is indeed a distinct social practice with elements shared with both car use and cycling, with particular importance to families with young children. We develop recommendations for policy makers to target such groups with e-cargo bikes ownership and supportive measures to enable multi-modal lifestyles that reduce the need to use or own a car.

1. Introduction

Electric 'pedelec' cargo bicycles (EU 2023), or 'electrically assisted (cargo) pedal cycles' (EAPCs) in the UK¹ (henceforth 'e-cargo bikes' or ECBs) are a relatively new mode of 'electric micromobility (EMM)' [1]. Pedelecs are legal in most countries, allowing ≤ 250 W electric motor power to enhance human pedalling to a maximum speed of 15.5mph. This electric 'boost' helps drive heavier e-cargo bikes and their cargo, especially in hills [2]. ECBs can carry passengers, especially children, and some offer some weather protection. These features replicate key functions of cars, especially their 'cargo function' [3]. Thus ECBs, like e-bikes, have great potential to substitute especially shorter car trips in urban areas, but also car use in rural areas [4,5]; they might enable households and/or individuals to reduce car use and ownership [6–8]. EMM ranges exceed the distances of most car trips; the UK National Travel Survey of 2022 found 71 % of car trips were under 5 miles [9].

ECBs along with other forms of EMM therefore can potentially aid transition from a car-centred mobility system, required for Net Zero and other environmental policy commitments to mitigate the impacts of climate change [10].

Transport research to date has identified the many barriers to use of active modes [11,12], and specifically cycling [13–16], some of which are reduced by EMM [17–19]. ECBs are also known to have specific barriers including their high purchase costs [8], needs for extra (and secure) storage space [20], fear of theft [21] and difficulties in manoeuvring their greater size [22]. EMM has desirable 'co-benefits' beyond car substitution's carbon benefits including health and physical activity [23]. EMM extends active travel to those with mobility issues based on health or age and reduces the fitness required to cycle [24–28], especially in hills.

The grey literature on e-cargo bikes focuses on their urban commercial freight potential [29]. The academic literature mirrors this to a

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¹ <https://www.gov.uk/electric-bike-rules>

large degree, examining service providers [30] and delivery/logistics, with poor weather a key determinant of usage [31]. Reviews of this use mode (e.g. [8]) spell out workforce, organisational, policy, operational, vehicular and infrastructural influences, without addressing users' experiences much beyond a preference for weather protection [32]. Exceptions include qualitative research of freight users [33] and parents/child-carers [34,35], and the SPT analyses reviewed below [36–38]. Studies of non-commercial use have focused on ECB sharing schemes, solely [39], or have been included in studies of sharing modes more generally [40], combined with non-electric cargo bike sharing [41], or other EMM modes such as e-bikes and e-scooters [42]. Using more qualitative social science methods and focusing on household use, as has been done in the present study, promises to identify how and why they are integrated into households' travel patterns in empirical reality, and thus their real-world (rather than theoretical) potential for car substitution and energy/carbon reduction, from the lived perspectives of their users.

The uptake of cycling to replace shorter car trips has been limited: do ECBs in particular hold more substitution potential? How might policymakers and other stakeholders maximise the potential for ECBs to be taken up in households' mobility routines and substitute for car use? To answer these questions, we use Social Practice Theory (SPT) in this paper to examine 'e-cargo-biking (ECB-ing)' as a social practice, which has potential to recruit practitioners from the use of other modes, particularly the car. We draw on data collected from research participants borrowing ECBs in three different cities in the UK in summer 2023 and winter 2023–24; qualitative data from semi-structured interviews. Drawing specifically on the 'mode + activity' SPT model of mobility practices [43–45] and the importance of the integration of affectively valued 'distributed practices' [46] to practice recruitment [47,48], we explore the elements of e-cargo-biking as a practice entity [49] in its integrated performances. We also test whether ECB-ing elements are such that it can link multiple other practices in ways replicating car driving. We first outline the specific approach we adopt and how SPT has been used to analyse diverse cycling mobility practices, before detailing the study and methods employed, outlining the findings, and discussing the implications for substitution policy and for policy making.

2. Literature review

2.1. SPT and mobility practices – outlining a specific approach

This paper combines several strands of SPT to create a specific approach to understanding *mobility* as social practice. Fig. 1 illustrates the following explanation of how we build on earlier work in SPT and on mobility practices specifically to come up with the framework for analysing how ECB-ing might recruit cyclists and 'defecting' drivers; people abandoning the social practice of driving.

We subscribe to a common dual definition of practices as *entities* and *performances*. Entities are patterns, "filled out by a multitude of single and often unique actions" [50:220], or a "nexus of doings and sayings" [46:89], made of linked elements. These actions, doings and sayings are the performances; "practitioners do the active work of integrating the elements of the practice into a contingently effective configuration, in the process of doing" [51:490]. Watson's 'contingently effective configurations' persist across performances as the patterns recognisable as entities. However, individual performances can change how elements integrate, resulting in change in entities.

Different practice theorists use different but overlapping definitions of what the elements of practice are [52,53]. Here, like Watson, we adopt Shove et al.'s [49:14] tripartite definition (see Fig. 1:A) of:

- "materials – including things, technologies, tangible physical entities, and the stuff of which objects are made"
- 'competences – which encompasses skill, know-how and technique'; and

- 'meanings – in which we include symbolic meanings, ideas and aspirations'"

Schatzki [54:10] uses different exact names for the three elements and distinguishes, as a fourth element, *material arrangements*, that "ubiquitously prefigure practices [...] by making some actions, *inter alia*, easier and harder or more direct or circuitous than others" (Fig. 1:B). Roads and cycle-paths are obvious mobility examples. Such materials are considered material-infrastructural elements of practice in three-element models (as Shove does e.g. [55]).

Schatzki [46] also makes a distinction (Fig. 1:C) between *dispersed* practices - building blocks of other practices and common across different contexts - and *integrated* practices, which combine elements and/or dispersed practices with *teleo-affective structuring*: the ends and emotions appropriate to an integrated practice (green in Figs. 1, 2 and 6). To illustrate the distinction, specific performances of 'writing' produce lecture notes, journal entries, novels, or academic papers; it is a practice *dispersed* across many social practices (education, diaries, authoring, or academia) into which it is *integrated* [46,56,57]. Cass and Faulconbridge [43] define *mobility* practices as unique in combining/integrating *mode* and *activity* practices. Mode practices - using a mode of transport 'for-its-own-sake' - substitute the affect of moving by that mode (Fig. 1:D) for the end/purpose or *telos* of the *teleo-affective structuring* that is provided when travelling to fulfil an *activity* practice: e.g. in shopping trips, school runs, or commuting² (Fig. 1:E). The bare activities of shopping and getting to work or school are similarly not fully integrated practices (or even possible) until transport modes (including feet) are utilised, and "as a dispersed practice, travel does not require specific objects" [58:199]. Spurling and McMeekin [59:86] similarly highlight 'practice/mobility bundles', Kent [44], *direct transport* and *facilitated* practices, and Mock [39: 378], *trips* and the *activities* enabled by them. Cass and Faulconbridge [47] also use SPT to point out that transport mode choice is influenced by the possibility of integrating emotionally/affectively valued *dispersed* practices (Fig. 1:F). Their research participants integrated exercise, self-monitoring, active navigation, and listening to music into mobile performances, influencing modal choice over the life course. Illustrating the applicability of the approach, Hampton [48] adapts it to study home energy consumption practices. Focusing on 'ECB-ing' recruiting defecting drivers, we are concerned with how the mode integrates with multiple activities (Fig. 2:G). As Van Eenoo and Boussauw [60:2] state, "it makes sense to explore how mobility practices like car driving connect with other practices and how they shape each other".

Rather than individual choice, SPT analyses processes of recruitment to practices [61]. "Conceptualising transport practices, such as private car use, as an extraordinarily successful process of recruitment (or failed defection)", as SPT does [44:226], means that 'modal shift' requires that the "awareness and allegiance of a relatively committed cohort of car drivers" [ibid op. cit.] must be captured by other modes. Successful *recruitment* to practices involves 'circuits of satisfaction' (the internal rewards of performances: [49: 75]), including the affect from valued and integrated dispersed practices.

As illustrated by Fig. 2:G, we therefore see mobility practices as involving the integration of mode-specific competences and materials with the meanings and 'teleo-affective structurings' of the activities which trips allow (i.e. trip purposes). They may also involve the integration of dispersed practices into performances, both sorts of integrations adding purpose (*telos*) and valued *affect* to individual performances and trips. Performances of mobility practices may also have multiple purposes due to stringing together multiple activity practices, each with their own competences, materials, and meanings, in time and space. This paper's theoretical framework thus combines Cass

² This observation draws on the Activity Based Approach to transport research, and the 'derived' nature of travel demand.

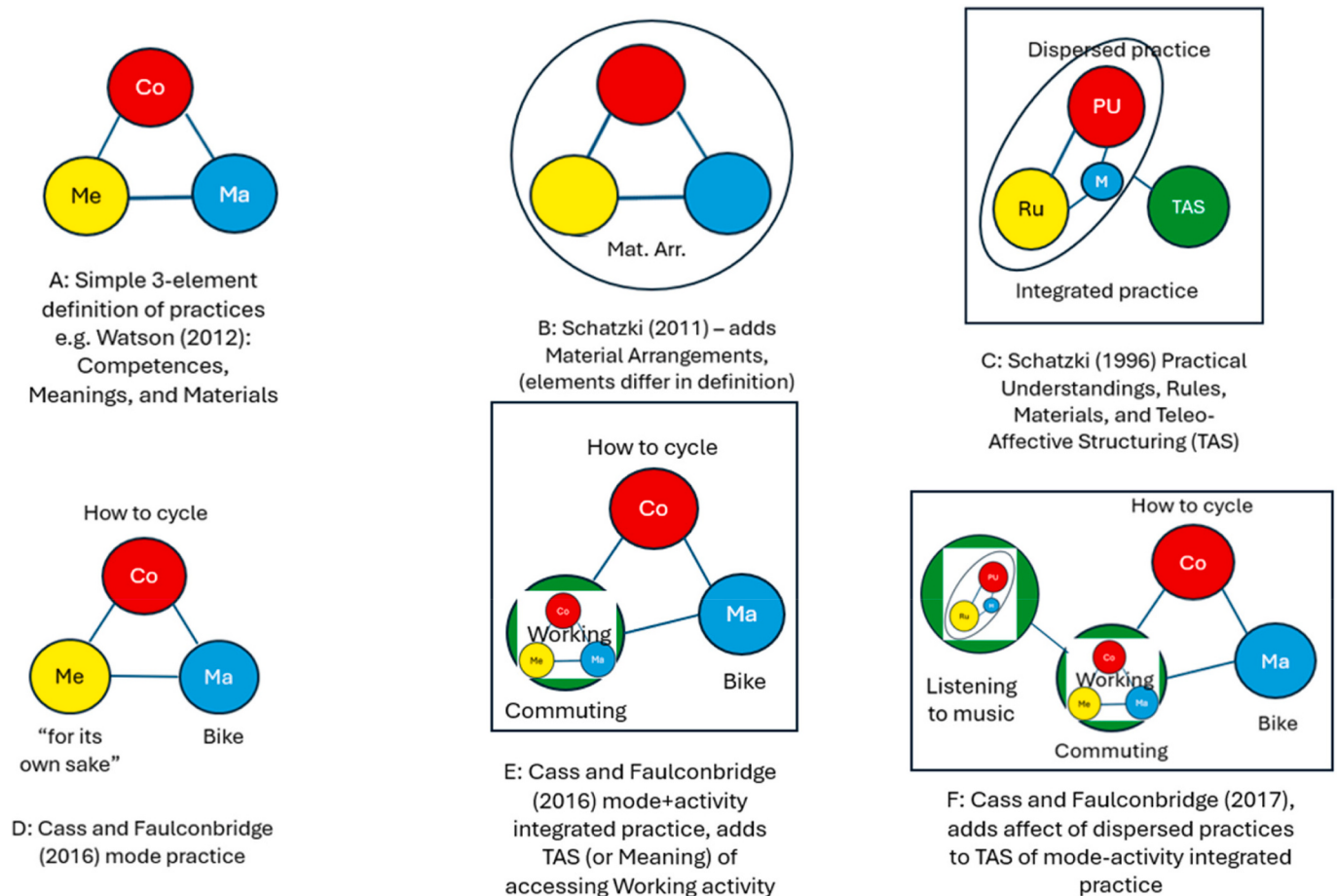


Fig. 1. Development of a theoretical framework of mobility practices, building on earlier literature.

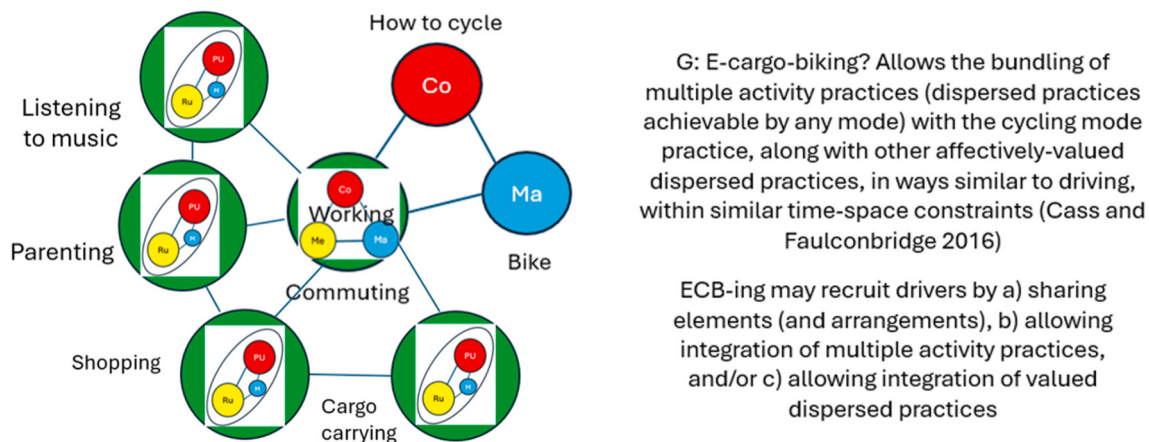


Fig. 2. Combined theoretical framework applied to e-cargo biking, with implications for recruitment to the practice.

and Faulconbridge's 'affectively satisfying' integrative performances [47] with Watson's 'contingently effective configurations' of practices [51].

Fig. 2:G thus illustrates how this theoretical framework of dispersed and activity practices integrating with mode practices combine and are thereby important for ECB-ing's potential to recruit drivers in three ways. A transport mode practice may share important *elements* of car driving practices that help cement its recruitment. Although roads are a material element (or material arrangement) shared with cars, are there other elements (e.g. of meaning and competences) which ECB-ing

shares, facilitating car drivers' defection? Second, "car commuting recruits easily because of the commonality of its elements with most other driving practices" [43:6], therefore a transport *mode* practice must effectively integrate with multiple *activity* practices, to have greater driver recruitment potential. Third, the affective satisfactions of ECB-ing, found in its *meaning* elements and in the *dispersed* practice integrations possible in performances, could compare or compete with those of car driving, cementing and stabilising the new practice through 'circuits of satisfaction' into a routine.

2.2. SPT analyses of (e-)(cargo-)biking

Having outlined the unique approach to mobility which SPT allows, and the specific approach we take, we now review the SPT literature on relevant different cycling practices, as ECB-ing studies alone are rare. The most straightforward form of SPT analysis is of *elements*. Some basic elements of cycling are illustrated in Fig. 3, which omits some common elements such as the rider's body, a bike, clothing, and a road surface (materials), and associations with environmentalism, health and exercise (meanings). Fig. 4, also from Schneider's 2022 thesis [37], illustrates "themes [i.e. elements] which are central to the difference between riding pedelec and cycling" [37:65], colour coordinated as in SPT orthodoxy with blue materials, red competences and yellow meanings. Table 1 then combines elemental analyses of different (e-)(cargo-)biking³ practices from 6 key texts, illustrating the degrees of agreement and difference in the literature.

SPT studies of **non-electric cycling** are understandably most numerous. Some focus on practice-oriented (urban) design [62] and on material arrangements/infrastructure, while others see the 'system of practice' of *vélomobility* [51,63] competing for road-space and the time of travellers against the dominant automobility system [64]. Key to this competition is recruitment to cycling, and (the focus of Shove [65]), defection from driving practice - based on the availability of elements, and their ability to bundle practices together. Larsen [66:878] analyses how a 'cycling city' (Copenhagen) is made "through normalizing and mainstreaming cycling", by political alliances but also by everyday mobility through which "everyday users co-produce cycling practices by performing cycling and by enlisting and passing on knowledge to new practitioners". Bruno and Nikolaeva [67] similarly focus on the established *vélomobility* of the Netherlands, but focus on *maintenance*, i.e. avoiding defection of existing, rather than recruitment of new, practitioners. Cass and Faulconbridge point out that unique elements required of non-driving commuting practices and difficulties squeezing multiple practices into tight time-spaces cause problems in recruiting [43], and that integrating dispersed practices into cycling performances can be key to recruitment [47]. Scheurenbrand et al. [68:229-30] outline cycling sub-practices, "such as braking, parking, storing, ringing the bell, and reacting in traffic" and "how elements intersect both within the practice [...] and [with...] other related practices (e.g., driving, schooling, policing)" [68:228]. Finally, Spotswood et al. [69] offer a seminal analysis of cycling practice elements (see Table 1) through datasets from cyclists and non-cyclists.

An SPT account of (domestic) **cargo-biking** by Pearce [22:iii] sees electrically-assisted cargo-biking as a subset of "domestic load-carrying [...] transporting children, shopping, and other domestic goods, and achieving other daily mobility needs". She sees cargo-cycling as "a competing and overlapping practice-variant of cycling which has the potential to meet need for load-carrying in urban environments," [22:94] (Table 2). Boterman's study of cargo-biking links *inner city* cargo-biking to middle-class parenting practices and gentrification, as a 'time-space practice': cargo-biking functions as "a symbol of the interdependence of specific residential, employment, consumption and mobility practices" [70:245]. Mock's study of cargo-bike and car-sharing practices suggests cars have an advantage due to "temporal and material-spatial links between social practices" [39:375].

E-biking has been compared to car-driving as a 'vehicle-based' practice "in relation to infrastructure" [20:1] and declared as less 'multi-functional', although this study suggests that ECBs "have the potential to offer the same solutions [as the car]" [20:5] in tying multiple practices in tight timescales. Schneider [37,38] provides an extensive element analysis of e-bike *commuting* practices (see Figs. 3 and 4), noting that the commute "is often combined with shopping, parenting or other activities that require transporting cargo [...] the possibility to load cargo

becomes essential" [37:3,64]. He decides that e-biking is "a variant of riding (cycling) rather than driving (motoring)", despite "substantially different characteristics" [37: 90] to non-electric cycling, and requires "a ground level parking facility" [37:73].

Finally, SPT accounts of **ECB-ing** see it as a subset of cargo-cycling [22], e-biking [35] or shared e-biking; combining "established elements: a cargo bike, an electric motor, and sharing infrastructure" [36: 153]. The latter study suggests recruitment is aided when infrastructural elements are shared, or if "specific competences and meanings [...] can be transferred among practices" [36: 155]. Thomas' study [35] outlines links with childcaring practices and ECBs' need for ground floor storage because of the bikes' weight [35:642].

Thus, SPT analyses of (e-)(cargo-)biking go beyond elemental analyses, analysing different variants [22], sub-practices [51,68], and genres [[65] of cycling practices: "the proliferation of manifestations of the practice of cycling" [51: 495]. These are compared to cycling and other mobility practices, and are bundled with, integrated into, or linked to other non-cycling practices in ways that explain their recruitment of different carriers. They stress that competitor practices seeking to recruit drivers must rival driving's ability to bundle multiple practices in compressed times and spaces. Whilst numerous studies have addressed commercial/freight uses of e-cargo bikes, where they might substitute for a van [8,31,33], our study uniquely focuses only on *domestic* ECB-ing, and on *new* (or potential) recruits rather than committed practitioners, allowing identification of what enabled and frustrated recruitment, in the study context.

3. Methods and study

The data used below is drawn from: 51 semi-structured interviews of ~60mins, conducted with members of the public after a free, summer, ~4-week trial loan of an e-cargo bike; and 10 interviews with participants who borrowed the ECBs again for 4-6 months in winter 2023-4, which were conducted after their second trial loan. Interviews were conducted by researchers in each city: Leeds, Brighton and Oxford, using Teams software or voice recorders. The recordings were transcribed by data protection compliant professional transcribers.

The sample was to some extent self-selecting. Another aspect of the overarching project [71,72] involved surveys about e-micromobility with a nationally representative UK sample ($n = 2000$) and residents of our target suburbs' neighbourhoods ($n = 996$: 312 in Leeds; 422 in Brighton; 262 in Oxford). After the latter, people expressing an interest in a free trial loan of an ECB ($n = 515$, 52 %) were sent another survey to check their suitability for a free trial loan (e.g. time availability, having suitable storage, intending to replace as many car trips as possible) with 154 responses. Participants (i.e. those receiving a free ECB bike loan for ~4 weeks) in 49 households were selected from this sub-sample with further skewing towards households most likely to be able to substitute car trips: this was purposive, not representative sampling [73] (details of the sample in Table 3). The findings from the sample were not intended to be generalisable because participants were unrepresentatively keen to try using an ECB to substitute for car use: 95 % of our participants who drove were trying to minimize their car use compared to 65 % of drivers in our national survey [72]. The aim of the project was to discover who, with what lifestyles, in what contexts, could make the most use of ECBs. The sample size of 49 households is comfortably large for a qualitative study, with comparable social practice studies of (e-)(cargo-)biking reviewed above having sample sizes of:

- Spotswood et al. 2015 ($n = 60$)
- Pearce 2016 ($n = 46$)
- Edberg 2023 ($n = 25$)
- Schneider 2022 ($n = 9$)
- Schneider 2023 ($n = 8$)

The sample was disproportionately of middle to late middle age, with

³ This somewhat clumsy abbreviation indicates cycling, e-cycling, cargo cycling and e-cargo cycling.

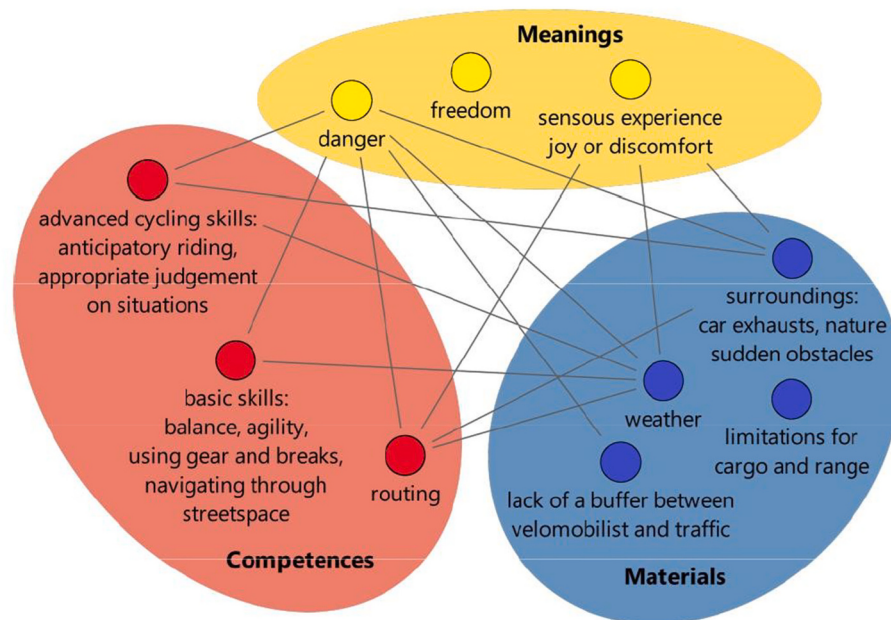


Fig. 3. Practice elements of vélomobility, taken from Schneider 2022: 60.

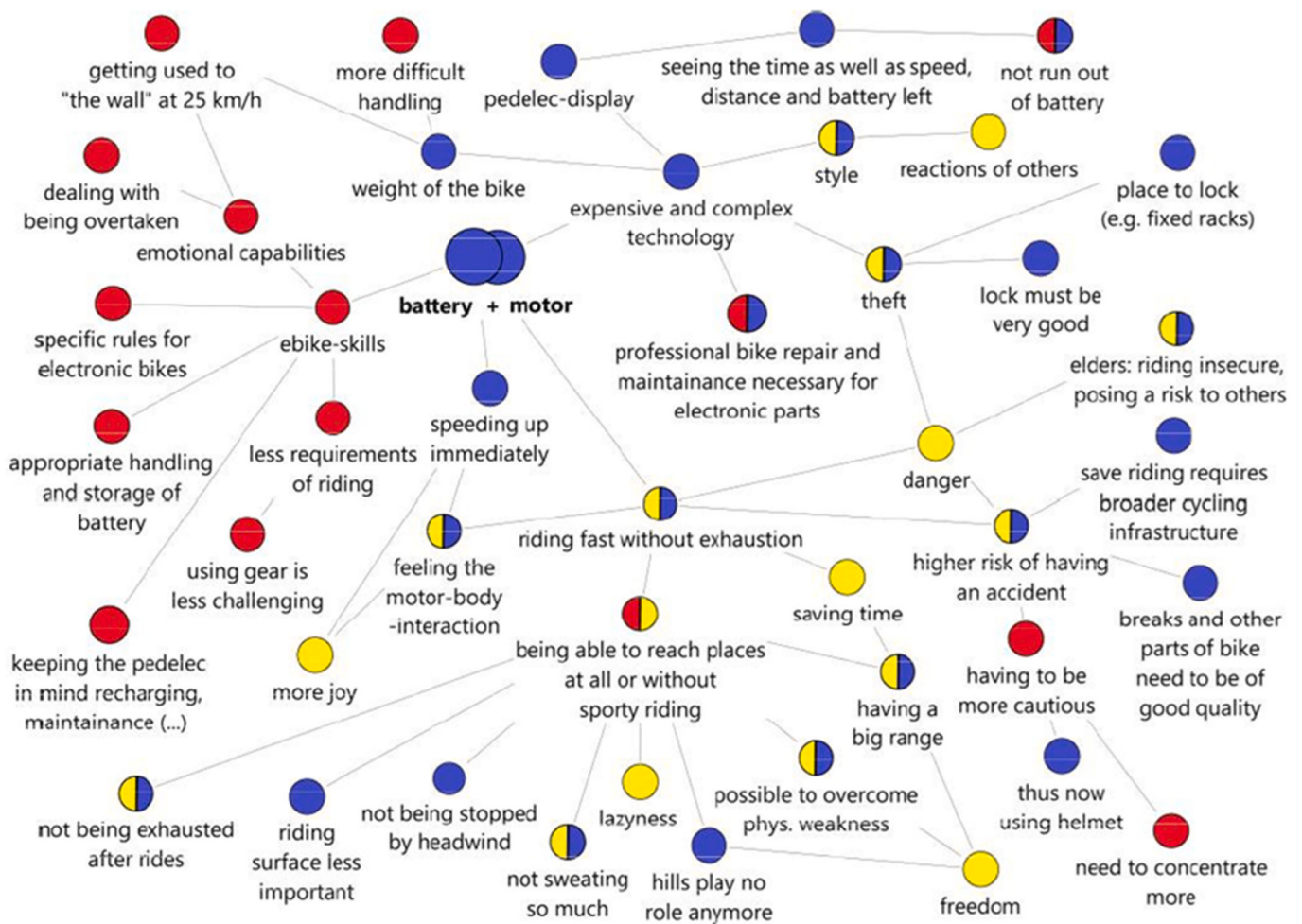


Fig. 4. Elements different in ECB-ing/pedelec use from cycling, taken from Schneider 2022: 54.

Table 1
SPT elements of (e-)(cargo)biking practices, in selected literature.

Materials	Competences	Meanings
Body of rider ^f Weather, ^f hills ^{b,d,e} and road conditions ^b Bike ^a or (heavier or more cumbersome ^{d,e,f}) e-bike ^{b,c,d,e,f} e.g. longtails, front-loaders, recumbents, trailers and E-assist bikes, ^b with high quality brakes ^e Bike carrier (for bundling with driving ^f) Cycle paths ^{a,c,d,e} ('roads are for cars' ^a), any road surface, ^f obstacles and traffic lights ^f Other road users ^f Showering/vanity facilities ^a Clothes for cycling: normal ^a or expensive e. g. lycra, clip-in cycling shoes, ^a rain or cold gear. ^f E-biking specific clothing: functional, chic or work ^f Rucksack ^{a,f} or panniers/ storage space ^{b,c,d,e,f} Helmet ⁵ , accessories and repair gear ^f Passengers or cargo ^{b,c,d,e,f} Ground level ^e parking space ^{c,d,e,f} and racks, ^{d,e} high quality ^e locks ^{d,e} Sharing infrastructure for shared bikes ^c Electricity networks, ^d plug socket to charge, ^f batteries ^{e,f} Expensive and complex technology ^{a,f} Display tech for speed, battery level etc. ^f	Cycling skills ^{a,b,c,d,e} including e.g. confidence in negotiating 'dangerous' roads, managing and storing cycling gear, ^a steering, braking, gear changing, pedalling, observing, ^b balance, quick reactions, staying attentive, maintaining flow, cyclist sign language, adjusting clothing, dealing with rain, first aid, and maintenance ^f Specific to e-biking: alternative cycle handling, ^b navigating safely ^c and digitally, ^f including more caution and concentration ^{c,f} Managing personal hygiene (cycling ^a) Knowing what to wear ^{a,f} Knowledge of using a sharing platform ^c Manoeuvring a heavy bike ^d Protecting electric elements in bad weather, ^d handling and storage of battery, ^e (anticipatory ^{e,f}) recharging, connecting phone, bike, apps, ^f knowing where to charge ^f Planning alternative parking options and securing to different objects ^d Scheduling errands for security, ^d and splitting large shopping trips into multiple trips ^f Getting used to 'the wall' at 25kmh, dealing with being overtaken ^{e,f} Knowing specific rules for e-bikes ^{e,f} Basic fitness, not overestimating capabilities ^f Empathy for other road users, ^f and their reactions ^f with anticipatory riding ^f Adjusting bike to body ^f using gears and boost ^f	Fast, efficient, ^a comfortable ^f allowing time-efficient ^{a,f} trip-linking, ^{b,d} increasing range without sporty riding, ^e and space efficient when (easily) parked ^d Cost-effective ^{a,b,f} or expensive ^f Avoids congestion, ^a ^d although involving traffic danger ^{a,e,f} , using cycle paths and roads ^d Carrying heavy loads, ^c children and goods ^b Extends cycling when aging, ^b although increasing risk to others ^e Emotions of stress, relaxation, adventure, ^a sociality (with cyclists), ^b joy, laziness, ^{e,f} freedom ^{a,f} , community ^f Mental well-being ^{a,b} from outdoor contact with nature ^f exposed to weather ^d Fitness, ^a health ^f and exercise ^d Self-monitoring ('fastest time') ^a Environmental benefits ^{a,b,c,f} Being perceived as arrogant, dangerous, disrespectful, uncool, different, brave, committed, adventurous, ^a or trendy ^{a,f} Enables hills, coping with headwinds ^{b,d,e} , over greater distances, ^{d,e} without exhaustion (even if weak), feeling motor-body interactions ^e arriving not sweaty ^{d,e} Avoiding parent-car lock-in ^b , bundling chores with leisure ^f Second car substitute ^b with good acceleration ^e but range anxiety ^f

- ^a Spotswood (2015) on utility (commuter) cycling.
^b Pearce (2016) on e-cargo cycling.
^c Hess and Schubert (2019) on cargo bike sharing.
^d Edberg (2023) on e-biking (focus on charging and parking).
^e Schneider (2022 thesis) on e-bike commuting.
^f Schneider (2023) on e-biking commuting.

children, and disproportionately wealthy, owning more cars and cycles than their neighbourhood, on average, and cycling more [72].

The transcripts of the interviews were thematically coded in NVivo, from a coding structure created deductively (from issues drawn from literature) and inductively (from thematic coding of early interviews), by 4 coders including one not involved with the data collection and

Table 2
Bike-based, load-carrying practice elements, taken from Pearce (2019: 111–120).

Type of bike-based 'cargo-carrying practices'	Materials (bikes)	Competences	Meanings
Functional two-wheeled load-carrying practices	Longtail cargo cycles, conventional cycles with panniers or trailers	Normal 'pedal cycle handling'	Appearing 'normal' – like a conventional cyclist
Child-focused cargo cycle practices	Longtail but preferably longjohn cargo cycle, not recumbents	Manoeuvring unwieldy bike	Combining practices, car avoidance, safer than conventional bike for children
Recumbent car-free retirement practices	Recumbent cycles, sometimes with trailer and/or e-assist	Recumbent cycling, significantly different to upright cycling	Extending cycling into older age comfortably, utility cycling
Conventional child-carrying cycling practices	Conventional cycles with carriers or trailers, some with weather-proofing. Longtails	Cycling with weight	Safety for children, enabling some shopping/gear portage
Stable riding practices	Upright trikes, bikes with trailers, longjohns	Less confidence and balance required than two-wheeling	Health/exercise, energy-saving and environmental benefits of cycling
Electrically assisted practices	All types potentially	Using electrical assist	Defeating hills, weather and wind, less effort and exercise, looking normal

inter-coder consistency was checked iteratively to avoid bias. Segments of data relevant to a social practice analysis were identified through a combination of Text Searches, and Coding Queries in the qualitative data analysis software. The data selected for inclusion in this article was therefore the product of a second level of thematic analysis across the whole corpus and the results of earlier thematic analysis.

The neighbourhoods used for the trial loans were suburbs of Leeds, Brighton and Oxford (the sites of the three main collaborating universities in the project), and selected after examination of data on census Lower Super Output Areas to represent ideal characteristics for domestic e-cargo bike usage from the literature: suburban and peri-urban areas with high car ownership and use with a high proportion of middle-class parents. The Leeds suburbs were satellite towns to the north of the city, some distance from the centre, while the Oxford site was a village/suburb on the edge of the city, and the Brighton locations were high density and closer to the city centre, with e.g. a higher proportion of flat-dwellers. This captured experiences of a variety of suburban living contexts. Oxford has an established cycling culture and extensive cycle path provision and use compared to the other areas, and surveys identified higher cycling behaviour. Leeds had the lowest amount of cycling infrastructure and usage rates. Segments quoted use initials of trial city and anonymised numbers as identifiers, e.g. L[Leeds]18. For full details of the methods and methodology, please see [71].

4. Findings

4.1. Elements of the social practice entity of e-cargo biking

In the following we discuss the ways in which ECB-ing, as described by our participants: a) maps onto and differs from elements identified by reviewed studies; b) shares aspects of the social practices of car driving and (e-)(cargo)cycling; and c) provides evidence of the integration of affectively valued dispersed practices. The bracketed letters refer to

Table 3
Selected socio-demographic detail of lead participants and household characteristics.

ID	Ages in household				Income (HH)	Lead participant								Housing			
	<10	10–18	18–64	65+		Dis-ability	Daily Exercise	Age	Gender	Sex'ity	Eth'ity	Employed?	HE+	Housing type	Storage	Issues	Area type
L18	0	0	1	0	£50 k+	No	2.5 h+	35–39	Male	Hetero	White	Employed	Yes	Terraced	Shed	Yes	Urban
L45	2	0	2	0	£50 k+	No	2.5 h+	40–44	Female	Hetero	White	Employed	Yes	Detached	Garage	Yes	Suburban
L57	1	1	2	0	£50 k+	No	2.5 h+	55–59	Male	Hetero	White	Employed	No	Semi-d	Shed	Steps	Suburban
L73	0	0	2	0	£50 k+	No	2.5 h+	60–64	Male	Hetero	White	Retired	Yes	Semi-d	Shed	Yes	Suburban
L82	0	2	2	0	N/A	No	30 m-2.5 h	50–54	Female	N/A	N/A	Employed	Yes	Terraced	Shed	Steps	Urban
L138	1	0	1	0	£50 k+	No	<30 min	40–44	Male	Hetero	White	Employed	Yes	Semi-d	Shed	Steps	Rural
L180	2	0	2	0	N/A	No	2.5 h+	40–44	Female	LGB+	White	Caring	Yes	Detached	Garage	None	Rural
L203	0	0	2	0	£50 k+	No	2.5 h+	40–44	Male	Hetero	White	Employed	Yes	Terraced	In house	Yes	Suburban
L208	0	1	2	0	£50 k+	No	30 m-2.5 h	40–44	Female	Hetero	White	Employed	Yes	Semi-d	Garage	Distant	Suburban
L241	2	0	2	0	£50 k+	Yes	<30 min	40–44	Male	Hetero	White	Employed	Yes	Detached	Shed	None	Rural
L258	0	2	2	0	£50 k+	No	2.5 h+	40–44	Female	Hetero	White	Employed	Yes	Detached	Garage	Yes	Suburban
L289	0	0	1	1	£20-50 K	No	2.5 h+	65–69	Male	Hetero	White	Retired	No	Semi-d	Garage	None	Suburban
L293	0	0	3	0	£50 k+	No	2.5 h+	55–59	Male	N/A	N/A	Employed	Yes	Detached	Garage	None	Rural
L295	0	0	2	0	£50 k+	No	30 m-2.5 h	40–44	Female	Hetero	White	Employed	Yes	Terraced	Garage	None	Urban
L300	0	0	2	0	£50 k+	No	2.5 h+	30–34	Male	Hetero	White	Employed	Yes	Terraced	Kitchen	Steps	Urban
L303	2	0	2	0	£50 k+	No	2.5 h+	40–44	Male	Hetero	White	Employed	Yes	Semi-d	Garage	None	Suburban
L323	1	0	2	0	N/A	No	30 m-2.5 h	40–44	Female	N/A	White	Employed	Yes	Caravan	Lean-to	Slope	Rural
L329	1	0	2	0	£50 k+	No	2.5 h+	30–34	Female	Hetero	Asian	Employed	Yes	Semi?	Garage	None	Suburban
O7	1	0	2	0	£50 k+	No	2.5 h+	35–39	Female	Hetero	White	Employed	Yes	Detached	Garage	Narrow	Suburban
O11	0	2	2	0	N/A	No	2.5 h+	45–49	Male	Hetero	White	Employed	Yes	Semi-d	Garden	Narrow	Suburban
O12	2	0	2	0	£20-50 K	Some	<30 min	40–44	Female	Hetero	White	Employed	No	Detached	Garage	None	Suburban
O23	0	0	1	1	£20-50 K	Some	2.5 h+	60–64	Female	Hetero	White	Employed	No	Semi-d	Garage	Slope	Suburban
O24	0	0	0	2	£20-50 K	No	2.5 h+	75–79	Male	N/A	Asian	Retired	Yes	Detached	Garden	None	Suburban
O61	1	0	2	2	£20-50 K	No	2.5 h+	65–69	Female	Hetero	White	Employed	No	Semi-d	Passage	Narrow	Suburban
O72	2	0	2	0	£50 k+	No	30 m-2.5 h	40–44	Female	Hetero	White	Employed	Yes	Detached	Garage	Slope	Suburban
O85	0	0	2	0	£50 k+	No	30 m-2.5 h	40–44	Male	Hetero	White	Employed	Yes	Semi-d	Garage	None	Suburban
O563	2	0	2	0	£20-50 K	No	2.5 h+	40–44	Female	Hetero	White	Caring	No	Detached	Garage	None	Suburban
O581	1	0	2	0	£50 k+	No	2.5 h+	35–39	Male	Hetero	White	Employed	Yes	Detached	Garage	Narrow	Suburban
O589	0	0	2	0	£20-50 K	No	2.5 h+	35–39	Male	Hetero	White	Employed	Yes	Terraced	Garage	None	Suburban
O595	4	0	2	0	£50 k+	No	2.5 h+	35–39	Female	Hetero	White	Employed	Yes	Detached	Garage	None	Suburban
O646	1	0	2	0	£50 k+	No	30 m-2.5 h	45–49	Male	Hetero	White	Employed	Yes	Semi-d	Garden	None	Suburban
O660	2	0	2	0	£50 k+	No	30 m-2.5 h	30–34	Male	Hetero	White	Employed	Yes	Semi-d	Garage	None	Suburban
O692	1	3	1	0	£50 k+	No	30 m-2.5 h	40–44	Male	N/A	N/A	Employed	Yes	Detached	Garage	Distant	Suburban
O700	2	0	2	0	£20-50 K	No	2.5 h+	30–34	Male	Bisexual	Mixed	Employed	No	Semi-d	Garden	None	Suburban
B10	0	2	2	0	£20-50 K	No	2.5 h+	40–44	Female	Hetero	White	Unempl'd	Yes	Detached	Garage	None	Suburban
B38	3	0	2	0	£50 k+	No	30 m-2.5 h	35–39	Female	Hetero	White	Caring	Yes	Terraced	Hallway	Yes	Urban
B55	2	0	1	0	£50 k+	No	2.5 h+	35–39	Female	Hetero	White	Employed	Yes	Detached	Yard	None	Urban
B107	0	2	2	0	£50 k+	No	2.5 h+	45–49	Female	Hetero	White	Employed	Yes	Detached	Garage	None	Suburban
B131	0	0	0	2	£50 k+	No	2.5 h+	70–74	Female	Hetero	White	Retired	Yes	Detached	Garage	None	Suburban
B153	0	0	1	0	£50 k+	No	2.5 h+	25–29	Male	Hetero	White	Employed	Yes	Flat	Garage	None	Urban
B171	1	0	2	0	£50 k+	No	2.5 h+	35–39	Female	LGB+	White	Employed	Yes	Terraced	Yard	Yes	Urban
B172	6	2	2	0	£20-50 K	No	2.5 h+	40–44	Female	N/A	White	Employed	Yes	Semi-d	Garage	None	Suburban
B182	1	0	1	0	£50 k+	No	2.5 h+	45–49	Male	Hetero	White	Employed	Yes	Semi-d	Garden	None	Suburban
B247	2	0	2	0	£20-50 K	No	2.5 h+	25–29	Female	Hetero	White	Employed	Yes	Flat	Garage	None	Urban
B261	1	0	2	0	N/A	No	30 m-2.5 h	40–44	Female	Hetero	White	Other	Yes	Terraced	Garden	Steps	Urban
B277	3	1	2	0	£50 k+	No	30 m-2.5 h	40–44	Female	Hetero	White	Employed	Yes	Semi-d	Hallway	None	Urban
B354	2	0	2	0	£20-50 K	Some	30 m-2.5 h	30–34	Female	Hetero	White	Caring	Yes	Semi-d	Garage	None	Suburban
B357	4	1	2	0	N/A	No	2.5 h+	35–39	Hetero	Hetero	White	Employed	Yes	Semi-d	Yard	None	Urban
B400	0	0	2	0	N/A	No	30 m-2.5 h	45–49	Male	Hetero	White	Employed	Yes	Terraced	Hallway	Yes	Urban

Table 4
Illustrative quotes from research participants.

Analysis level	Data code	ECB user code	Data
Comparisons with driving practices	A	B182	Nearly every school pick-up, drop-off we used the bike, apart from a few rainy days
	B	L303	So the benefits of it have been transporting the kids [...] I can put two kids in there with all their bags from whatever they're doing, if it's nursery
	C	B357	We met up with some friends who we haven't seen all summer and I took the bike and it was the kind of novelty factor and took their kids for rides around the park
	D	B38	It's just really useful for stuff like chores, you know, like to kind of, oh, we'll go and sort that out, then we'll do some shopping, then we'll come back, you know, it just feels like you can achieve a lot more in a day
	E	B131	Went to the usual, RSPCA and back, and then today I did a lot of running around, collecting stuff and delivering them to the shops, so I was sort of all, buzzing around all over the place, all over town
	F	L45	So it was two big bags of shopping and then on the front of the bike in the basket section, yeah, is a plant pot full of more shopping. But we've had guitars strapped to it, we've had, yeah, we've had hamster cages, we've had all kinds of stuff strapped to the bike and just transporting things and people it's wonderful
	G	L289	I went down to music club [...] weather was fine, and didn't really want to use the car [...] but it's just a little bit further [...] when you want to walk if you're carrying an instrument, a music stand and an iPad."
	H	O595	The kids' Christmas presents, I picked them up on Facebook Marketplace and were dotted around Oxford.
	I	L289	So I cycled the bike up to the top of the hill [...] did some litter picking [...] bring the bike down past the bag, litter pick a bit more. [...] I was able to take three full bag-fuls off, which [...] would have been very difficult with the car. [...] that was the first time I thought, this is [...] absolutely perfect for this type of work.
	J	B153	Yesterday I went up to the Recycling Centre [...] trip to the dump, basically, and wanted to take a bike instead of a car [...] I was carrying like two old paint cans and a, like some electric, old speakers that had broken, so really heavy stuff
	K	L323	I think I was surprised that I dr... I rode it to work when I was at, working at Roundhay Park, I don't know that I would have expected to have driven it, to have ridden it that far
	L	L329B	I think on Week 3 I realised that I could even do what I used to do before, that I would go to the south of Leeds, John Charles Swimming Centre and have a swim before I start work

Table 4 (continued)

Analysis level	Data code	ECB user code	Data
	M	L138 L258	Went to the library to pick up that a glances for the idea of, the house where you could get the first of the day the door janked and right to be wanted to go on for a bit to be consistent and then I was just all this stuff's not so much easier, if it, like the days when he's been working at home you know, it is a little bit like oh, like reverse his car out, get the bike out, put his car back on the drive
	O	L138	Okay, that genuinely is going to reduce our other transport costs, and that directly transferable kind of capital expenditure is kind of like well, you know, why wouldn't we have one of these, it has all these other benefits [...] and it doesn't cost you anymore. Why wouldn't you do it?
	P	L73	My wife would have needed the transport to get the kids around, do the shopping, etc., etc., and i can see that a cargo bike [...] would have fulfilled most of those needs [...] and, of course, all the environmental concerns that we try to comply with
	Q	B354	It's, yeah, definitely made a big difference to being able to get out and about, like and for me exercise and feeling like I'm actually doing something with my body
	R	B357	Anything that you can do to tackle the climate emergency helps to alleviate some sort of anxiety and stress
	S	O660 O23	[...] and i think this is a really, really good example. You know, we're not going to tackle the climate emergency on our own, but it's these little actions that will eventually make the big difference.
			I decided, rather than taking the normal road back home I'd go down the Cycle 5 route that takes through Abbey Park and Abbey fields and then round the back of Radley Lake, [...] and doing that just changed my mood, it just put me back in a good mood again and that's something that's really difficult when you suffer with depression
	T	L323	It kept me nice and fit and the sunshine always makes you feel better, yeah, and being outside is a boost to your mental wellbeing so that's always good, yeah.
			The unrelaxing part of the public transport is making sure you're there on time because it won't wait for you type of thing, getting to the stop early [...] whereas when you're on a bike there's no timescale other than you go when you're ready [...] you're in control of that completely yeah.
	U	L18	The main struggle was the junction at the top, which is the one where all the traffic queues are at, I had to basically treat it like a motorbike rather than a bike, I couldn't weave through traffic like I normally would
	V	O24	It would have been twice the distance in a car whereas on a cycle path I

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Table 4 (continued)

Analysis level	Data code	ECB user code	Data
	W	B182	would make a shortcut, so that was economy and convenience for me. You feel safer because it's a larger road presence, it's a more dominant road presence [...] it doesn't get under, in the way of traffic so much.
	X	O24	A lot of people see it and they say oh, this is just another bike coming towards me, but you need to just be conscious that it's a big vehicle compared to a normal bike.
	Y	L258 L295	So advantages probably both the hybrid and the e-bike over the car is it's probably quicker just because the traffic in Leeds in just awful and you know, the bike lanes along the A65 you know, basically mean you know, you're not stuck in traffic too much. Can see the benefits of using it in the city traffic where you can zip past the queues and things like that, the traffic jams.
	Z	B38	And I was kind of stuck in traffic then [...] I think in those situations you almost realise you are a bit more like a mini car than a bike a bit, you know, because it sometimes, sometimes you can't manoeuvre around in the same way, but yeah.
	AA	L57 O85	Safety largely from car drivers and having to be very, very road savvy to prevent careless or aggressive driving. I'm not that confident with the wobble, and the cars going past. And that kind of stuff, feeling a little bit that it, yeah, that it, that i could tip, or crash.
	AB	O11	People often talk about when they're driving cars the fact that there's a lot of metal around you so you feel safe, for some reason I feel the same on that bike, it's a lot of bike so it makes me feel a little bit safer, I think.
	AC	L303	The steering is very different to a normal bike when you're, you know, you're steering in front of you but your wheels right up the front, that takes a lot of getting used to. The way you lean and use your weight on the bike is very different, just the size in terms of manoeuvring.
	AD	B247	It was all really easy. I think because we've got the underground car park it was really simple to kind of just that was that routine. We'd go downstairs, we'd get it out, it wasn't a hassle.
	AE	O692	There is space like in the Westgate car park for example, like that's undercover and reasonably secure, that I guess there's motorcycle parking in there, never occurred to me to go and park in that sort of area.
	AF	L203	I had to move the trays of plants that they've got for sale so I could actually get to one of the Sheffield stands to lock my bike up. I'm quite comfortable doing that, however
Comparisons with cycling practices	AG	L293	...couldn't just drive it out of the garage, I had to go up the garden and under the tree [...] I think that was the only inconvenience really to, to get it to the top of the drive, open the gate, take it through the gate, close the gate.

Table 4 (continued)

Analysis level	Data code	ECB user code	Data
	AH	B247	When I first used the bike [...] I was quite nervous going on the roads. Now I would cycle anywhere and everywhere with the children on the bike [...] I mean I'd never even been on a roundabout, now I'm like flying through them.
	AI	L239	That was the novelty aspect of it, [...] I was just literally riding around with the baby on it, as opposed to putting him in the pram [...] I'd just be riding around these little back streets, just basically exploring, but also just because I liked it.
	AJ	B247	Oh we've had loads and loads of comments and you also get to know other cyclists so everyone ends up waving at each other in the mornings, which is nice [...] i've had so many questions about the bike [...] people definitely noticed it and been intrigued by it.
	AK	L303	I feel really passionate about these things, but it doesn't make sense, like financially it just does not make sense.
	AL	B107	Yeah, because you were putting [...] next to no effort in [...] I don't think the e-bike's been good for my fitness to be honest, I think I've put on weight since I had the e-bike.
	AM	L258	Before I probably wouldn't have ever considered it now I would consider it and I think it's more about seeing the bike as a form of transport as opposed to exercise.
	AN	L329	If for example my wife needs to go somewhere else, she can do it, with the car, and I can just rely on the Cargo. Because for these sort of short journeys I can do everything with it, as if I had a second car basically. So playground, shopping, swimming, whatever, picking something up.
	AO	L247	Especially when it's raining you want to get from A to B quite quickly and the bike is the perfect thing for that.
	AP	L45	I'd like to live in the Netherlands where everybody, there's a greater culture of just hiring a car when you need one [...] but other than that [...] I'm going to use it for my commute, I'm going to use it to take the kids to school, to nursery and shopping and just any other journey where I have to carry things.
	AQ	L203	Quite often on my normal bike [...] I would feel the need to have to stand up and swing from side to side occasionally [...] whereas I never got the feeling, the need [...] quite comfortable just to sit down and pedal and sort of get on with it.
	AR	L208	Wednesday I commuted to the office, and it was a really hot day, and I was wanting to experiment with, can I go to the office, fully in an office dress, not even in trainers? So I had some sandals on, full office dress.
	AS	L293	I like the idea of turning up somewhere on a bike and people raising an eyebrow really and just sort of challenging the status quo and people's, you know, perceptions about how things have to be done,

(continued on next page)

Table 4 (continued)

Analysis level	Data code	ECB user code	Data
	AT	L57	you know, challenge why does it have to be done that way. It is enjoyable in that I can have a conversation while we're doing it, we can talk about road safety, we can natter and we have... We see things we wouldn't see in a car because we've got a kind of a 360 degree and we're going slower.
	AU	L18	Yeah, so it's a shed at the end of the garden for all intents and purposes it's the easiest thing to get in and out, well it's relatively easy, if we had the door on the other side it would be super-duper easy but then you're looking at security, but you're pulling it out and even my husband was saying to me this morning, he said, "I do worry about you with, about you putting your back out because it's so heavy"
	AV	L203	The only real challenges were storage and getting it in and out of the house, which even for me became a little bit of a bind [...] initially, we had two scaffold planks to get up, what, the three steps or whatever
	AW	O12 O7	It's changed my perception of e-bikes. So not 100 %, i wouldn't go and get a cargo bike but it has swayed me to use e-bikes, yes. What it's actually made me think is one of the main advantages of it is the electric assistance so what it's actually made me think is what i think i might want is an electric bike to tow the trailer with, think that, that's been my main takeaway is that the electric-ness, electric assistance is even better than i thought it would be
	AX	L18	I was a bit ambivalent towards them before I actually tried the Cargo bike but I am definitely thinking of, whilst not getting one of these big Cargo bikes, getting a smaller e-bike.
	AY	L323	Completely switch out the car I don't think it really, it hasn't done for us [...] It's more like it could replace up to 90 % of the journeys that you do by car, so yeah.
	AZ	L329B	It would be part of the 'going to the playground', or 'going to the swimming pool', [...] because yeah, I just try to be efficient, so just bundle it together, so that's probably why I didn't mention it.
	BA	O563	To go to Oxford with stuff I need to carry, it was amazing, just like door to door, don't have to worry about times for the buses or parking. Yeah, even quicker, I think sometimes, so easier and quicker.
	BB	B247	Sometimes I'd have to go to about five different shops on the way to work, so to just quickly pull up right outside and park right outside the door, grab your stuff, load it up and onto the next.
	BC	B38	If we'd gone normally it would be say in the car, and we wouldn't do both things [...] or if you did you'd have to pay for two car parks.
	BD	O589	It's allowed us to do more things outdoors than what we would have done previously and to go to places

Table 4 (continued)

Analysis level	Data code	ECB user code	Data
	BE	L82	that we wouldn't have gone to together [...] it's increased the amount of time that we spend together outdoors doing leisure activities. We did a lot before but now we do even more. We want to drag the kids with us because our time's limited and [...] because the priority is to spend time together
	BF	O11	It's a great way of getting your, you know, kids around, [...] how nice it is to be able to chat and point and have a conversation with them [...] You can have a conversation with the person who's cycling really well, instead of having to slow down and catch up
	BG	O12	When we went to the Flowing Well ... I had that bike and you had the bucket bike, we went as a family. Whereas I think normally you'd have probably followed in the car. We were very, very lucky.
	BH	O7	Very specific to having a baby, is that he's sitting in front of you, looking at you, right [...] he was [baby speaks] as you can see, he likes to chat! And this morning he was like babbling away, and it's really nice because he's right there and you can chat to him.
	BI	O646	It was more participatory for everybody [...] for [daughter] to come on the bicycle as well and for [baby son] to enjoy the journey and see things [...] So you can sort of talk to him while you're cycling and sort of see what he's looking at.
	BJ	L323	I'm enjoying riding it to some extent but I still have to have the same level of focus as I do driving a car pretty much [...] whereas if you're sat on a bus you just completely switch off, you know that somebody's taking care of that all for you and I find that far more relaxing.
	BK	O660	It's made cycling an option as a family, essentially and then travelling by bike an option which it wouldn't have been before if we were all going somewhere together.
	BL	B182	She had her whole section of the bike, her whole box, if you like, she could spread out, she could decorate it, she could hang on, she had her comfy cushions, exactly, wave to people, definitely wave to people.
	BM	L45	I love riding because [...] I listen to music always in one ear, I've always got one ear pod in so I can listen to Gilles Peterson or whatever on my ride in or a podcast or whatever, I love it. Cycling just makes me happy
	BN	L329B	With the Cargo I feel like it's almost like, it almost became like jumping in a car, it almost felt like the only difference is you didn't have radio on, and it's sort of less cosy I guess.
	BO	O11	[Child] and I have got into the habit of taking the Wonderboom with us and playing music as we're cycling along [...] both of us being upfront, we could enjoy some music together [...] it was good, good fun.

(continued on next page)

Table 4 (continued)

Analysis level	Data code	ECB user code	Data
	BP	B182	So, on the old bike she would always want music and stuff on, but, no, once she'd got this idea of reading a book, that's the difference, right?
	BQ	B107	I don't think the e-bike's been good for my fitness to be honest, I think I've put on weight since I had the e-bike! [laughs]
	BR	B171	I was thinking it would be an amazing taxi. I'm going to be a service for, you know, safe taxi service for women at night on my bike, you know.

illustrative quotes provided in Table 4, to avoid breaking the flow of the text.

4.2. Overlaps and contrasts with other mobility mode practices

The following refers to quotes given in Table 4 with letters in parentheses thus (XX). It also refers to the illustrative Figs. 5 and 6 which act as a visual summary of (some of the) findings.

4.2.1. Car driving

We found considerable overlaps with car driving practices. The households/individuals that made most use of the ECBs were those who had identified a set of previously car-based trips that they wanted to replace. As anticipated, these frequently involved the (material element) 'cargo function' of the car, i.e. they involved carrying: child passengers (for school (A)/nursery runs (B), or leisure activities (C)); shopping (D), or other bulky loads including: charity shop donations (E), miscellaneous cargo (F), musical instruments (G), Person2Person purchases (H), litter bags (I) and waste going to recycling centres or tips (J). Carrying cargo, as pointed out by Pearce [22], can be seen as a bundled dispersed practice (Fig. 4) like parenting or listening to music: it can be carried out using any mode of transport. Other participants also used the ECBs for longer commutes (K), or leisure and fitness trips (L), where either the cargo function was not necessary or trip-linking (e.g. with a school/nursery run or shopping) was involved (M). Trip-linking in SPT terms is the bundling of multiple activity practices in time and space, represented by dashed lines in Fig. 5, whereas solid lines indicate integration of (dispersed) practices in performances.

Having a material arrangement of domestic architecture suited to a car, specifically a garage and clear driveway, was for some key in making use of the e-cargo bike quick and convenient (N). In other words, storing and deploying it like a car had significant advantages of convenience over treating it like a bicycle (see below). In terms of meanings and understandings, the ECB was compared favourably to the car in

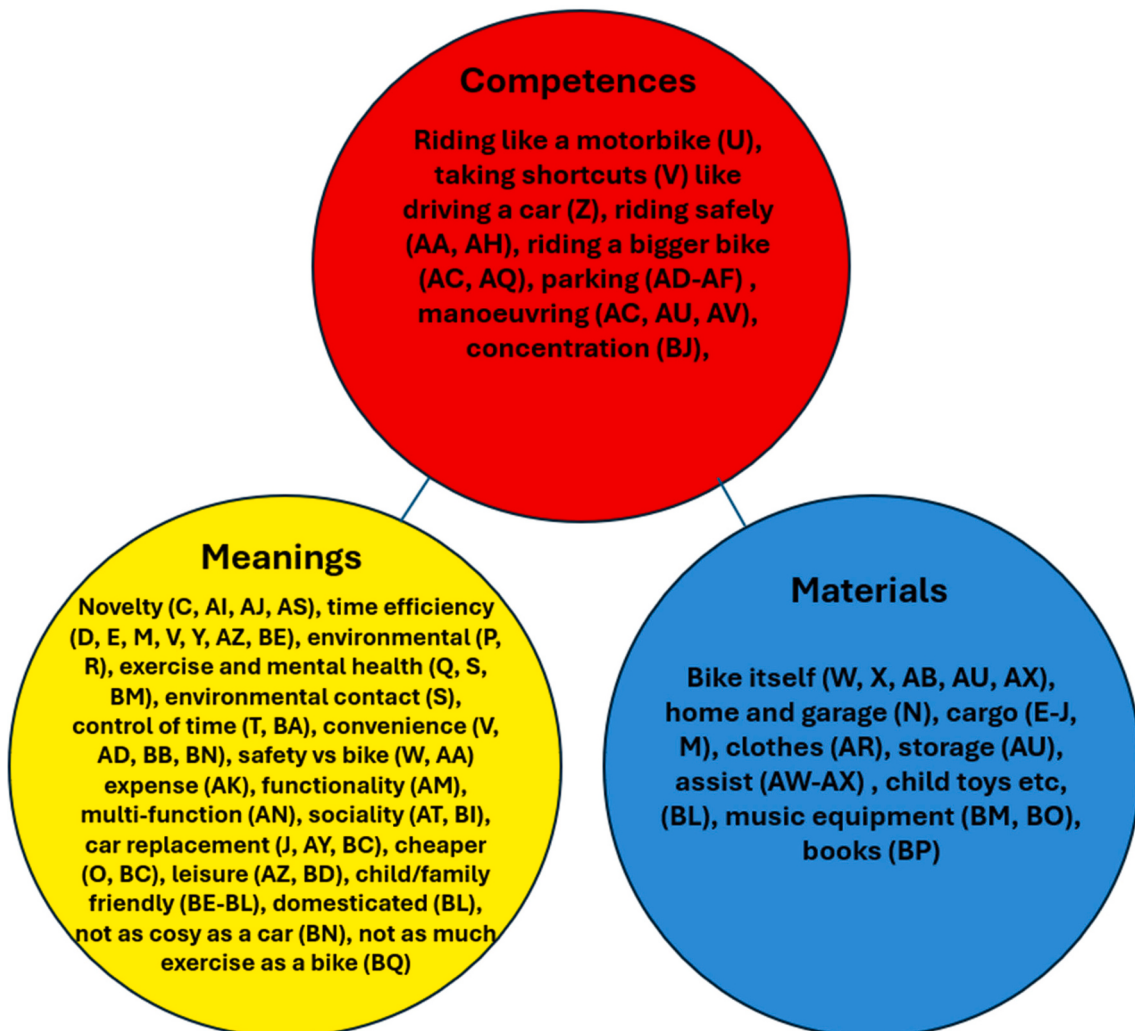


Fig. 5. Elemental analysis of ECB-ing as a social practice, using data from the study.

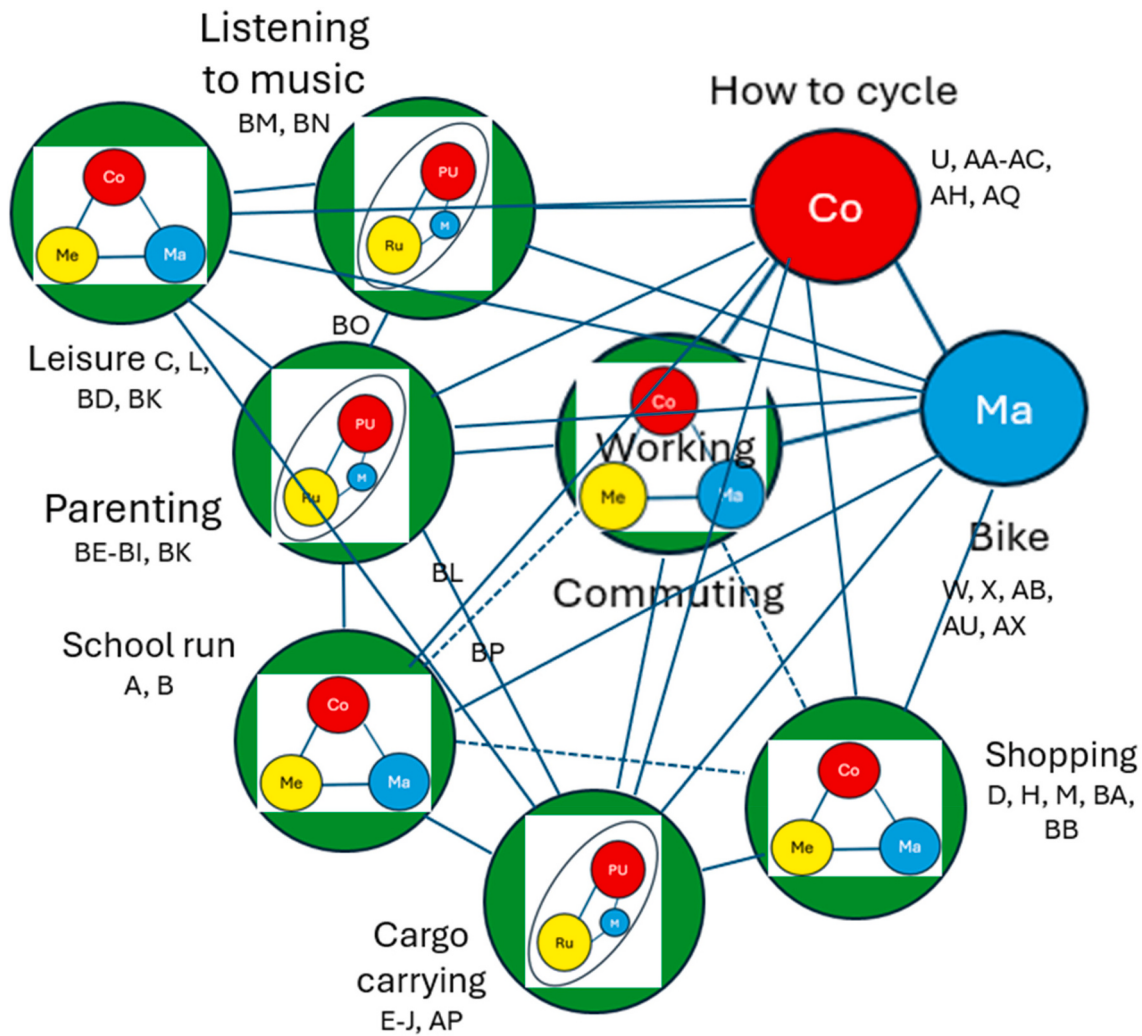


Fig. 6. The practice and performances of ECB-ing in our data, within the theoretical framework.

terms of travel costs (O), environmentally friendliness (P), fitness (Q), and well-being (e.g. from taking action on the environment: R, and outdoor environment contact: S) meanings. However, these meanings are also shared by e-bikes. Their freedom and autonomy of movement was seen as similar to cars (T), but less attractive than the ability to weave through traffic like a (motor)bike (U) or take short-cuts offered by cycles (V). The size of the ECB conferred a meaning of safety for many, who felt justified in taking a safer 'prime position' on the road, compared to cycling (W). Some explicitly described the ECB as a 'big vehicle' (X) – a word not usually used for cycles (see also K), suggesting that its competence element shared much with driving. Speed and convenience were seen as superior to car use when cycle infrastructure allowed them to bypass congestion (Y), but not otherwise, when convenience and speed matched that of traffic: "in those situations ... you are a bit more like a mini car" (Z). On busy roads, perceived safety was less than that of cars (AA), except for the longer and wider 'long-john'⁴ users: "it's a lot of bike so it makes me feel ... safer" (AB). The length of the 'long-johns' however required new cycling competences: "the steering is very different to a normal bike" (AC). Finding suitable parking was again positioned between car and bicycle use due to size, with underground car parks (AD) and motorbike parking spaces (AE) being used, sharing other modes' as well as cycle (AF) infrastructure.

⁴ 'Long-john' cargo-bikes have a large cargo section as opposed to 'long-tails' which have extended parcel-rack storage.

4.2.2. (E-)Cycling

Overlaps with cycling practice undoubtedly helped recruitment to the trial from experienced and competent/committed cyclists who had the competences required, but the unwieldy nature of some ECBs (generally the long-johns) led to new skills being learned to overcome their 'inconvenience' (AG). Experienced cyclists (most of our participants) reported feeling fully competent in their use quickly, or part way into the trials (AH). Positively perceived meanings and understandings included novelty (AI), including enjoyment talking to curious onlookers about the ECBs (AJ). As noted, cycle practice similarities include environmental friendliness, relative cheapness through no operational/fuel costs (although many viewed purchase outlay as prohibitively expensive (AK)), and contributing to fitness or a healthy lifestyle. However, particularly cyclists used to road racing or off-roading felt that using the ECBs slowed them down and reduced desired health and fitness meanings they linked to cycle use (AL). Numerous participants positively identified ECBs with a 'utility' meaning: "seeing the bike as a form of transport as opposed to exercise" (AM). For some, this meant that "I can do everything with it, as if I had a second car" (AN), useful for when "you want to get from A to B quite quickly" (AO), while others associated it with utility meanings attached to cycling abroad in e.g. Amsterdam or Copenhagen (AP), with the 'sit-up-and-beg' sitting position (AQ) and the ability to wear 'normal' clothes overlapping (AR) with cycle use meanings/materials in those places. Some appreciated the opportunity to display an identity as a 'first adopter' of new technology "and just sort of challenging the status quo" (AS), and one used their child's

passenger as an opportunity to educate them in cycling practice: road and traffic awareness, safety, navigating and so on (AT). As noted, long-john ECBs often carried a meaning of being unwieldy and cumbersome, in comparison to cycles. This was raised by participants attempting to use them ‘as cycles’: storing them in sheds outside terraced housing (AU), or in communal indoor spaces, kitchens (AV) etc.

Unexpectedly, several participants already owned e-bikes and were able to compare their usage with the ECBs. Predictably, they saw ECB-ing as carrying all the positive associations of e-biking with the added advantage of cargo-carrying capacity and the problems of additional size and weight:

“to this home ed[ucation] meet up I’d put board games and bits and pieces that she wanted in there and strapping my bike onto the front holder thing, like bungeeing it on [...] it was like we were using it more like a cargo bike, whereas like the first time we had it I felt like we were sort of using it like a heavy, just a very heavy e-bike.”

(L323)

The majority of participants, when interviewed at the end of the trials, stated an increased interest in e-bikes rather than ECBs, appreciating the “electric-ness, electric assistance” (AW), but feeling that the advantages conveyed by extra cargo capacity were outweighed by the disadvantages of size and weight (AX). However, we should be mindful that almost all of these participants had, and intended to retain, access to a car for some trips (AY).

4.3. Limits to links/bundling with other practices

These examples show ECB-ing linking/bundling with a multitude of practices, in some instances where cycling performances would have been inappropriate, for example when turning up at work in normal clothes and not sweaty was facilitated. However, in addition to drawing more links with mobility+activity practices that were previously satisfied by driving, participants acknowledged that many practice bundles were still more normally or exclusively linked with driving, including longer trips (whether in terms of time or distance) beyond the ECB’s range, or where trip-linking was beyond the ECB’s capabilities in terms of speed. Where these things could be accomplished as ECB + activity practices (e.g. quotes D, E and M), participants were often replacing cycling or bus-passenger practices, accomplished with personal time flexibility (e.g. being part-time employed and/or caring). In relatively few cases like litter-picking (I), the ECB was uniquely seen as the perfect vehicle for the job. An identified unique competence of ECB-ing [38] is splitting larger (car-dependent) shopping trips into multiple smaller trips, and integrating them with other practices, as participants “altered their shopping practices and now buy more frequently and at locations that involve fewer detours than when shopping by car” (41). We found evidence of the same being accomplished, almost unthinkingly (a good sign of routinisation) as a competence of efficient trip-linking: “I just try to be efficient, so just bundle it together” (AZ). As with other examples of ‘trip-linking’, this was often achieved through the ability to quickly park at locations easier than is possible in a car or in locations that are not parking-friendly; a form of almost old-fashioned ‘high street shopping’ practice of quickly visiting multiple shops (BA). In some cases, the avoidance of car parking charges itself made linking of multiple practices cheaper and therefore more possible (BC). Another key successful bundling was *collective* (i.e. family) outdoor leisure trips by bicycle (BD), which is addressed below.

4.4. Links with valued practices

We found ECB-ing was repeatedly linked with affectively valued practices. The most important was *parenting*; particularly spending rare quality time with children (BE), especially conversing – difficult with children on bikes (BF). Although for some this replaced bus trips, far more often, quality time together as a family travelling was usually car-

based before the ECB loan: “we went as a family. Whereas I think normally you’d have probably followed in the car” (BG). The families with the youngest children and even with pre-verbal babies particularly valued the direct eye contact made possible by an ECB (BH), but also how parents and children could share talk about surroundings – something that is much less possible when driving (BI), but even more possible on public transport (BJ). This explicitly allowed participants to “make journeys that otherwise I would have used my car for [...] I think it’s brought the family together” (B357), while for others, it allowed cycling practices to be bundled with family leisure trips (BK: and see Fig. 6) and for the most prolific cyclists, it further normalised a lifestyle that they knew was seen as ‘deviant’ family practice:

“the eCargo bike is just family-friendly, [...] it’s just how we go when we go. [...] you just don’t even think about it [...] it’s just like getting in a car [...] it was just how we as a family get around. People think we’re so strange. The other parents at school”

(L45)

For children themselves, being a passenger on the ECB (or ECB-passenger-ing, as a practice) meant that they could integrate *dispersed* practices normally used to turn a car interior into an extension of domestic space, with toys, cushions etc. (BL).

4.5. Dispersed practice integration

Turning to Cass and Faulconbridge’s [47] mobility-related dispersed practices (i.e. exercise, self-monitoring, active navigation, and listening to music), there was evidence that a few participants *monitored* their own performances, if this was an accustomed practice e.g. of monitoring heart rates with a smart watch. The ECBs’ own displays, however, were frequently ignored: “I know I didn’t pay attention to it [boost level, charge left...] regardless of the setting” (L241). For some, *listening to music* could be a lone distributed practice, already used in cycling practice using ear-buds (creating a great affective attachment to it) and extended to the ECB (BM). For others who did not integrate this dispersed practice, “it almost became like jumping in a car ... the only difference is you didn’t have radio on” (BN). However, it was also explicitly mentioned by one family as part of integrating fun and parenting with the ECB (BO), while another had replaced playing music to their child with book-reading, as the long-john ECB’s ‘domestic’ space allowed it (BP).

However, other participants felt that the ECB took away their bundling of (affectively valued) exercise with mobility practice (BQ) although one participant suggested that there was a choice of how much exercise was received with e-bikes: “you can combine them [...] on an e-bike [...] if you push on you can exercise but if you just sit there and twiddle, you can go somewhere without exercising.” (B182)

A key unique ECB-ing affordance and practice expected a priori was adult passengering. We found little evidence of this (although it was seen as fun when accomplished), despite several participants having imagined they would do it more, in advance (BR). One imagined a larger version of the ECB for this purpose, like a tuktuk, but “a bicycle version of that, that could act as a bus [...] you could perform a journey together, it’s a little bit of a taxi service”, but as they pointed out, “the answer ultimately is, well, just get an electric car.” (L82)

5. Discussion

In terms of the abstracted practice *entity* of ECB-ing, the findings above confirm essentially all of the analyses of previous studies regarding the social practices of (e-)(cargo)-biking including particularly those applying to ECBs (see Table 4). In that sense, we have confirmed the existence of a *distinct* social practice of ECB-ing. Fig. 6 illustrates some of the characteristics of this social practice, allowing the integration of affectively-valued dispersed practices such as listening to music and parenting, and the functionally-valued dispersed practice of

carrying cargo. It also allows the performance of multiple mode + activity trips (the commute, school run and shopping etc.), which can be linked in time and space (represented by dotted links). This practice shares many of the practice elements of car driving *and* nevertheless shares many practice elements in common with the different cycle-based practices previously studied. This is obviously because these practices share the material elements of a bicycle or some form, and the riding environments of roads and bike paths, along with the shared (cycling) competences required [69], and the meanings of e.g. active travel (fitness, health, environmental friendliness). *Unique* practice elements of ECB-ing are therefore unsurprisingly linked to the nature and affordances of powered, usually heavier ECBs. These include the material infrastructures of parking, charging and batteries (as mentioned by Edberg [20]) and their cargo-carrying capacity, electric boost and linked range/terrain benefits as meanings, included in the insights from e.g. Pearce [22] and Schneider [37,38] in Table 1. Some specific competences e.g. of manoeuvring a larger bike and of charging were also predicted and found. See Fig. 4 for the illustration of the practice elements identified in the data used. Note also that driving recruits easily because the material practice elements of driving+different activities are identical, whilst other modes struggle to transport all the material elements required for work, shopping, school runs and leisure [43]. ECB-ing can accomplish this multi-functionality of the mode.

The ability of ECBs to extend the affordances of cycling, particularly with regard to tying together multiple practices over greater distances and/or in tighter times-spaces, was key in enabling participants to replace traditionally car-dependent 'trip-linking' journeys. In addition, the greatly increased cargo capacity of an ECB rather than a bike allowed experimental bundling of cycling practice with traditionally car-dependent practices such as going to a recycling/waste facility with bulky items or picking up large parcels and bought goods.

The integration of affectively valued dispersed practices was clearly evident, but the specific practices involved were not usually those identified in previous study [40]: i.e. exercise, self-monitoring, active navigation, and listening to music. The affective value of bodily experiences of the e-assist [37] was also in evidence: "until you've felt that like power of you pedalling and it going 'whoosh' type thing, you can't really... yeah." (L323). But more foregrounded were a series of dispersed practices such as face-to-face conversion with babies and discussing the surroundings, that enabled ECB-ing to bundle with family leisure or weekendening practices, such that seemingly unique practice bundles such as parenting/familying+leisure/weekending emerged as being facilitated uniquely by ECBs and cars. The data above therefore illustrates that ECB-ing might have a key recruitment advantage over cycling for families; of adding affective value to key performances undertaken together in a family unit, that would usually only be possible (and without the added valued meanings of active, green travel) in a car.

Our data also indicates the *limitations* of ECBs' practice bundling possibilities. Our participants seem to suggest that being a passenger on an ECB, as on a cycle, was viewed as appropriate social practice for a child, but not beyond, with several participants noting that (especially younger) female members of their family had no desire to be seen being transported, e.g. raising "massive embarrassment from being a pre-teen" (L57). This suggests the additional importance of gender as a limit to the family and parenting practices that an ECB could substitute.

In other words, as important as elemental analyses or dispersed practice integration is how ECB-ing's performances allowed bundling with more usually car-dependent practices. As Van Eenoo and Boussauw [60] stress regarding 'car dependent' social practices (cargo- and care-related, visiting friends and family, leisure, commuting, and 'messy' or spatially and temporally complex trips: "there is a persistent connection between car driving and *what* people do and *how*, *when* and *where* they do it" [74:1]. The fact that numerous participants were able to substitute *most* regular trips using the ECB is evidence that the bundling and spatio-temporal coordination and scheduling pressures expected of individuals and families, and usually possible only through car use [34,75], are

facilitated to some degree by ECB-ing. However, some trips remained uniquely bundled to driving, as one participant stressed:

"a lot of people will struggle with [...] you know, 'what happens if it's really raining?' or 'what happens if we've got to go on this long trip?' or whatever. So, I think trying to convince people that it is going to completely switch out the car I don't think it really... it hasn't done for us. I don't know if that's really going to be the way to get it through to people. It's more like it could replace up to 90% of the journeys that you do by car, so yeah."

(L323B)

In terms of policy, this is a key insight: the 90 % of 'easily'-substitutable car trips and the remaining 10 % require different policies in combination. Regarding the 90 %, studies have frequently attempted to explore whether car-dependent practices can be substituted either individually or collectively by other modes [3,60]. Predictably, they have identified urban and shorter journeys, especially commutes, as substitutable [76,77]. These can be seen as 'low hanging fruit' [60:7]; situations where "rebundling with low-carbon or carbon-neutral mobility practices often requires intervening in only one element of mobility practices [i.e. the material of the mode], leaving the facilitated practice untouched". Spurling similarly refers to the 'substituting practices' model of practice change [45,59] which is identified with simple 'modal shift'; these are the easier cases where activities like school runs and commutes can introduce the ECB mode without troubling the surrounding organisation of life.

However, trip-linking and obstinate practices remain (the '10 %') whose spatial and/or temporal characteristics preclude using active modes or public transport, due to the car's ability to tie together disparate and awkward spatio-temporalities of practice, in time [43]. This study highlights some examples where ECB-ing made this possible – for example in quotes D and E, Table 4, on "running all over town" performing different practices - but often this possibility was dependent on the traveller being temporally flexible as a part-time worker, time-rich (co-)parent and/or second car user. This suggests that ECB-ing may play a key role in removing or preventing *second* car use/purchase (see AN), in households with smaller children, which has been identified in the literature as an important life stage or change where car dependency (re)lements [75,78,79]. This offers possibilities for targeting information about ECBs to such people with such characteristics.

The data focuses attention for policy on the remaining ~10 % of car trips mentioned by our most prolific adopters. These "practices that are car-dependent but do not necessarily require private car *ownership*" [60:7] are infrequent, more distant or involve larger cargo. ECBs can potentially deal with larger cargo, especially if a trailer were added for occasional trips. Though infrequent, some are often regular and planned, such as recycling or tip runs which our participants accomplished using ECBs. Others such as occasional purchases or leisure trips might be unplanned and spontaneous, but our data captures instances of ECB-ing for these reasons. The remaining practices that require cars (visiting distant friends and family, work trips, holidays etc.) could be 'mopped up' through membership of local car clubs, or through borrowing larger bikes or (e.g. trailer) accessories, for those committing to car-ownership-free living. Policymakers could therefore promote offering car club membership or public transport discounted passes with ECB purchases.

Seeing ECBs as part of a package of mobility practices that together substitute for all the different car-dependent trips in a household's life thus directs us to multi-modal policy packages. As noted by others, car-free lifestyles are expected to be intrinsically multi-modal [80], or 'flexible' [81], and ECB-ing could certainly, on the evidence of this study, contribute to "ambitious but achievable goals that aim to get more people, travelling by non-car modes more of the time, rather than seeking to achieve complete changes in travel practices all of the time" [ibid: 1].

Further opportunities for research open out from the approach taken here. An SPT analysis has been made of commercial ECB-ing [33], but

similar studies could be applied to other forms of micromobility such as e-scootering. Given the importance of parenting practices to households who feel that a car is necessary for their lives [34,75,79], further SPT research focussing on all cycling social practices in families with children should be pursued, complimenting Kent's work on car-free parenting [34]. Rather than focussing on 'barriers' to car substitution, SPT studies of car-free mobility practices in general should be pursued, along with exploration with car-deserting families (those giving up a (second) car) of how the diverse social practices they perform are successfully accomplished.

6. Conclusions

We have outlined how social practice theory has been applied to *mobility* practices – social practices that involve the use of modes of transport to accomplish other activity practices – and applied the insights from SPT on numerous cycling practices, to e-cargo-biking as a distinct social practice. We confirmed the findings of previous studies which included e-cargo bikes in their application of SPT, however, as far as we are aware, this study is the first to apply SPT only to ECBs. Furthermore, we focussed on domestic rather than commercial use, and on longer-term loans rather than the more commonly researched 'shared' mode. We did this in order to test the hypothesis or generalised assumption that ECBs are uniquely well positioned to recruit car drivers, due to their combining the positive (from environmental and health policy perspectives, particularly) benefits of cycling and other active transport modes, with the cargo and passengering capabilities of cars; particularly in the shorter and urban mobilities that constitute a high percentage of car trips in the UK and elsewhere. This technical potential for energy and emissions reductions has been explored and illustrated through qualitative attention to users' experience of recruitment to the social practice of ECB-ing. This in-depth qualitative focus was applied, uniquely here, not to committed *users* of the newer ECB mode of transport, but to a sample of potential and willing *recruits* to ECB-ing practices, who were lent ECBs for a longer period of time than those in other studies or the shared bike users studied in the majority of previous studies. Thus, we were able to explore the situated, qualitative experiences of potential practice recruits and to confirm and deny the findings of previous studies. We highlighted a number of unique findings including how ECBs enable affectively-valued parenting practices on the move without resorting to car use, as a key recruitment benefit of ECBs over other cycling practices, and also the ability of ECBs to tie together or bundle multiple practices with difficult spatio-temporal requirements in ways that combine e-cycling practices with greater passengering and cargo-carrying capabilities, similarly to cars.

We finally drew out the policy implications for encouraging households for whom ECB-ing is intrinsically attractive to abandon more (including second) car usage. Specifically, the policy implications are as follows. Suburban car-owning families with children where adults are competent cyclists are 'low hanging fruit' or suitable targets for recruitment; targeting them with access to a ECB (perhaps with information or purchase subsidies) would allow them to substitute many (second-)car-dependent practices without much disruption to their lives. However, ECBs cannot alone replace *all* car use for many households. Other options including car-share/hire and public transport are needed for the remaining '10 %'; trip-linking, long distance trips and the most obstinate car dependent trips. Car clubs and sharing, and discounted public transport passes could be advertised/targeted to those interested in buying ECBs. Finally, promoting the ability of ECBs to substitute for cars in combining key affectively valued practices such as parenting and weekend leisure trips with cycling practices may be an important trigger for adoption, and promotion should focus on these aspects.

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CRediT authorship contribution statement

Noel Cass: Investigation, Data curation, Conceptualization, Writing – review & editing, Writing – original draft. **Ian Phillips:** Project administration, Funding acquisition, Writing – review & editing. **Labib Azzouz:** Investigation, Data curation, Writing – review & editing. **Nicholas Marks:** Investigation, Data curation, Writing – review & editing.

Declaration of competing interest

None

Data availability

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