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Civil society-led shared mobility for transport equity? An empirical analysis from Berlin

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ABSTRACT

This study explores the potential of community-led shared mobility to achieve equitable transport, using a socially innovative cargo bike-sharing system in Berlin as a case study. The empirical approach combines booking records, survey responses, and spatial data. This approach enables an analysis of transport equity in terms of spatial distribution, as well as user structure and behavior. The results suggest that community-led initiatives may complement commercial shared mobility operators and be associated with more equitable transport system outcomes. In particular, the results show no differences in cargo bike host locations based on social status index groups. Additionally, the gender distribution aligns with that of the general population. Cargo bikes were found to be used for diverse purposes which differed by social status area and gender. The findings suggest that promoting socially innovative, community-led projects may represent a promising governance approach associated with enhanced transport equity.

Introduction

The current car-centric transport sector contributes to a complex and increasingly problematic urban situation by exacerbating the climate crisis, endangering public health, and intensifying pressure on already scarce communal spaces. Among others, Paterson (2007), Sheller (2018), and Brand et al. (2021) have highlighted the unequal impact of the negative externalities of private automobility, as well as the unequal access to mobility in a car-centric transport sector.

Growing awareness of the sustainability challenges posed by private automobility has led to a shift in transportation research and practice (Bertolaccini, 2013). An increasing body of literature advocates for transport equity, which embodies principles of fairness and justice (Pereira et al., 2017; Pereira & Karner, 2021). The concept emphasizes that individuals should be given equal opportunities based on their needs; this, in turn, involves treating people differently according to their (cap)abilities (Pereira & Karner, 2021).

As will be summarized later in this article, shared mobility services are considered a promising pathway to achieve a more equitable and environmentally-friendly transport system. However, previous studies raised concerns regarding the actual impact of profit-oriented shared mobility services (Dill & McNeil, 2021; Henriksson et al., 2022; Shaheen et al., 2014; Singh, 2020).

Alongside car and bike sharing, cargo bike sharing has recently emerged as a new mobility option capable of replacing private car use (Bissel & Becker, 2024b; Marincek et al., 2024a). Notably, a well-established type of operation in Germany and some other European countries is Commons Cargo Bikes, a socially innovative cargo bike sharing system (S. Becker & Rudolf, 2018a,b; Bissel & Becker, 2024b), in the tradition of community-led not-for-profit bike sharing systems (Nixon & Schwanen, 2019). This concept relates to research which argues that interactive governance approaches that actively involve societal actors, such as social movements, are promising as an alternative to classic top-down policy making (Geels, 2019; Karner et al., 2020).

To date, the socially innovative concept involving hosts and personal handovers has been analyzed in multiple studies (S. Becker & Rudolf, 2018a; Bissel & Becker, 2024a,b; Rublack, 2020; Zimmermann & Palgan, 2024). Previous research by Bissel and Becker (2024b) indicated a relatively balanced gender distribution and underscored the potential of Commons Cargo Bikes to reach different geographical regions, including rural areas, which are typically less prioritized by commercial shared mobility services. This finding highlights the potential of socially innovative shared mobility solutions to improve geographical accessibility. However, with the study's focus on different regional types, it remains too broad to offer detailed insights into the spatial distribution and use patterns according to social status indicators (as defined in the methods

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section) at a finer spatial scale.

Against this background, the present study aims to provide a more detailed analysis of geographical accessibility, usage, and equity in the context of Commons Cargo Bikes. In doing so, it addresses the need for research on shared mobility at a municipal level (Shaheen & Chan, 2016). The analysis focuses on cities well suited for testing low-carbon transport alternatives such as cargo bikes (Hess & Schubert, 2019).

In particular, the study addresses two research questions. First, it examines the extent to which the spatial distribution of Commons Cargo Bikes locations and their host characteristics in Berlin contribute towards equitable transport. Second, it evaluates the implications of user structure and behavior for transport equity. By doing so, the study aims to complement existing research on shared mobility and equity by focusing on a less explored transport mode (Hess & Schubert, 2019; Riggs, 2016) in combination with an alternative mode of operation (Nixon & Schwanen, 2019). To the best of the authors' knowledge, the present study is the most comprehensive study on transport equity and cargo bike sharing so far in terms of the empirical approach and level of granularity. In particular, while previous studies analyzed the spread of cargo bike sharing between different regional types such as urban areas compared to rural regions (Bissel & Becker, 2024b), the present study provides a more granular perspective on the distribution within a specific urban area, namely Berlin. The sample size exceeds that of previous studies on cargo bikes with a focus on equity (Riggs & Schwartz, 2018).

Literature review

The potential of shared mobility for sustainable and equitable transport

In theory, shared mobility represents a unique opportunity to address challenges related to environmental and social sustainability in the transport sector, particularly in cities where many of these challenges are pronounced. First, shared mobility could positively impact environmental sustainability; for instance, sharing options can contribute to dematerialization, which is essential for reducing resource consumption (Lange & Santarius, 2020; Liao & Correia, 2020). Second, the concept could help to tackle social challenges by enabling more individuals to access resources. Sharing options theoretically provide access to mobility modes and thus to public and social places, fostering greater transport equity (Dill & McNeil, 2021; Liao & Correia, 2020). Thus, it is not surprising that high hopes have been placed on shared mobility.

In practice, however, expectations have been somewhat dampened in recent years. Regarding environmental impacts, the success of dematerialization and mode shift varies depending on operational conditions and transport modes, often failing to meet expectations (Creutzig et al., 2024; Liao & Correia, 2020). Consequently, the Intergovernmental Panel on Climate Change (IPCC) concluded that "the effect of shared mobility on transport-related GHG emissions is highly uncertain" (Jaramillo et al., 2022).

Regarding social challenges, prior research has questioned whether shared transport innovations achieve their intended positive impact on equity (Dill & McNeil, 2021; Henriksson et al., 2022; Shaheen et al., 2014; Singh, 2020). A key criticism has been the placement of sharing services predominantly in affluent areas (Nixon & Schwanen, 2019). For example, in an evaluation of 35 'docked' bike-share systems across the US, Smith et al. (2015) found that 53 % of docking stations were located in the top quintile of economically advantaged census block groups. Moreover, as of 2016, four out of five Canadian bike-share systems provided better access for advantaged areas (Hosford & Winters, 2018). Regarding gender differences, Uteng (2019) showed that Oslo's city bike docking stations were primarily located near male-dominated employment sectors.

A closely related equity concern in the sphere of sharing innovations is user structure and behavior. The described distributional observations open up concerns whether this unequal access translates into fewer benefits for different groups. This is amplified by limitations regarding available payment options and the size and shape of bikes (Dill & McNeil, 2021; Henriksson et al., 2022; Nixon & Schwanen, 2019; Shaheen et al., 2014; Singh, 2020). In the case of app-based car sharing, research by Becker et al. (2017) and Kawgan-Kagan (2015) indicated that car-sharing users are predominantly male. In addition, they have typically been well-educated with a higher income than non-users (Clewlow, 2016; Kawgan-Kagan, 2015). This observation about the use of shared mobility innovations poses challenges in terms of equity, especially as there are gendered mobility patterns and growing socio-economic differences in society (Gauvin et al., 2020). In this vein, Joelsson and Scholten (2019) argued that transport planning, including the promotion of social innovation, is inherently a political practice and research in this field must recognize the varied social positions to effectively address equity concerns. Thus, in conclusion, sustainable and equitable shared mobility is a complex challenge that may require different approaches, including civil society-led sharing services, whose potential is examined in this study.

Cargo bikes and civil society-led cargo bike sharing

Cargo bikes, in general, are positioned between cars and bikes. Therefore, they play a special role in the provision of active mobility, contributing to both equitable and sustainable transport (Marincek et al., 2024a). Cargo bikes have the potential to be an environmentally friendly alternative to cars, as they do not produce any local emissions (Gruber et al., 2014; Marincek et al., 2024b). Furthermore, they take up less physical space than private cars and are flexible modes of transport that do not require a driving license. This theoretically makes them accessible to more people, which may contribute to improved transport equity. Carracedo and Mostofi (2022) further stress that the key purposes for electric cargo bike use are child transportation, leisure, and shopping. Thus, cargo bikes mostly replace private car trips for purposes other than commuting. This underlines their potential for additional CO_2 emission savings compared to other transport modes. In line with this identified potential, an evidence synthesis indicated that electric cargo bikes accounted for the largest share of car trip substitution among all electric micro mobility modes (Liao & Correia, 2020).

In principle, cargo bike sharing presents a promising opportunity for transport equity by improving access to cargo bikes, which would otherwise be costly to acquire (Dorner & Berger, 2020; Zimmermann & Palgan, 2024). Nonetheless, commercial cargo bike sharing may be subject to the same equity concerns as other sharing options, particularly regarding spatial distribution and use as outlined above. This raises the question of how civil society-led cargo bike-sharing options perform in this regard.

A socially innovative form of cargo bike sharing is Commons Cargo Bikes. This concept describes civil society-led local initiatives that organize cargo bike sharing in collaboration with local hosts, such as shops that facilitate personal handovers. Cargo bikes are available for free, with users encouraged to donate to support the initiative. The operations of local initiatives, as well as the overarching organization of the Commons Cargo Bikes network, are run by volunteers. Over the past decade, the number of initiatives has grown to 170 across multiple countries, particularly in Germany, with more than 90,000 registered users cumulatively (S. Becker & Rudolf, 2018a; Bissel and Becker, 2024b).

The largest Commons Cargo Bikes initiative is located in Berlin, Germany (Bissel, 2024; Bissel & Becker, 2024b). This initiative, called fLotte Berlin, provides approximately 230 cargo bikes and facilitates 14,000 borrowings per year for 25,000 registered users (Bissel & Becker, 2024b). Between 2018 and May 2022, 38 % of trips made with a fLotte Berlin cargo bike replaced a car trip, leading to an estimated reduction of 70 tons of CO_2 emissions (Schmidt & Sikora, 2022; Zimmermann & Palgan, 2024).

Materials and methods

To address the research questions outlined in the introduction, the empirical analysis of this study drew on multiple large-scale datasets, including booking data, survey data, and location data. More precisely, datasets provided by fLotte Berlin were geocoded and combined with publicly available data retrieved from the Berlin city administration. Following previous studies (Smith et al., 2015; Uteng, 2019), host location data were analyzed alongside external datasets - specifically official data on social status - to assess equity implications. Booking and survey data were then used to generate further insights. All data analyses and interpretations were conducted independently by the authors of the study.

Datasets

This study analyzed and integrated three comprehensive datasets of the Commons Cargo Bikes provider fLotte Berlin. The first dataset covered booking data over six years, from January 2018 to December 2023, providing insights into usage patterns. It included the cargo bike ID, host name, and booking period. In total, the dataset comprised 66,315 bookings. Secondly, the study analyzed survey data collected through a short questionnaire sent to all users after each booking. The survey included questions on socio-demographics (age, gender, and children) and user behavior (trip purpose and substituted transport mode), based on previous research on Commons Cargo Bikes (S. Becker and Rudolf, 2018a). All users who borrowed a cargo bike were invited to participate and repeat users received multiple invitations. Survey data were collected continuously over five years (January 2019 - December 2023), yielding 7,082 responses - equivalent to 12.5 % of all bookings during this period. Fig. 1 provides an overview of the number of bookings over time, along with absolute and relative survey participation. Thirdly, the study analyzed a dataset of local hosts, including their names, addresses, and the cargo bike assigned to each location; in total, 295 hosts were identified. For more detailed analysis, location data were combined with booking data.

Procedure

After data cleaning (e.g., removing outliners beyond three standard deviations for the "distance to host" item and correcting addresses in the location dataset), the datasets were processed using two publicly available datasets and an inductive coding system. In a first step, location and booking data were geocoded and mapped onto the most granular geographical categorization system used in city planning in Berlin. Specifically, locations were mapped onto 542 lifeworld-oriented spaces, which divide the city into small areas designed around the daily needs and living environments of residents (SenStadt, 2020). The shapefiles were created and provided by the Berlin-Brandenburg Statistics Office. Secondly, this spatial structure was combined with social status data from the official Social Urban Development Monitoring. This monitoring system included a social status index that classified the 542 lifeworld-oriented spaces based on four key indicators. The indicators are as follows:

- Unemployed citizens: The share of residents aged 15 to below retirement age who are registered as unemployed and receive basic income support
- Children and adolescents in single-parent households: The proportion of minors under 18 living in households with only one parent
- Recipients of transfer payments: The percentage of non-working residents who rely on state transfer payments for subsistence, excluding those classified as unemployed
- Children affected by poverty: The proportion of children under 15 living in households receiving unemployment benefits

All four indicators are statistically standardized using z-transformation to ensure comparability. These transformed values are then

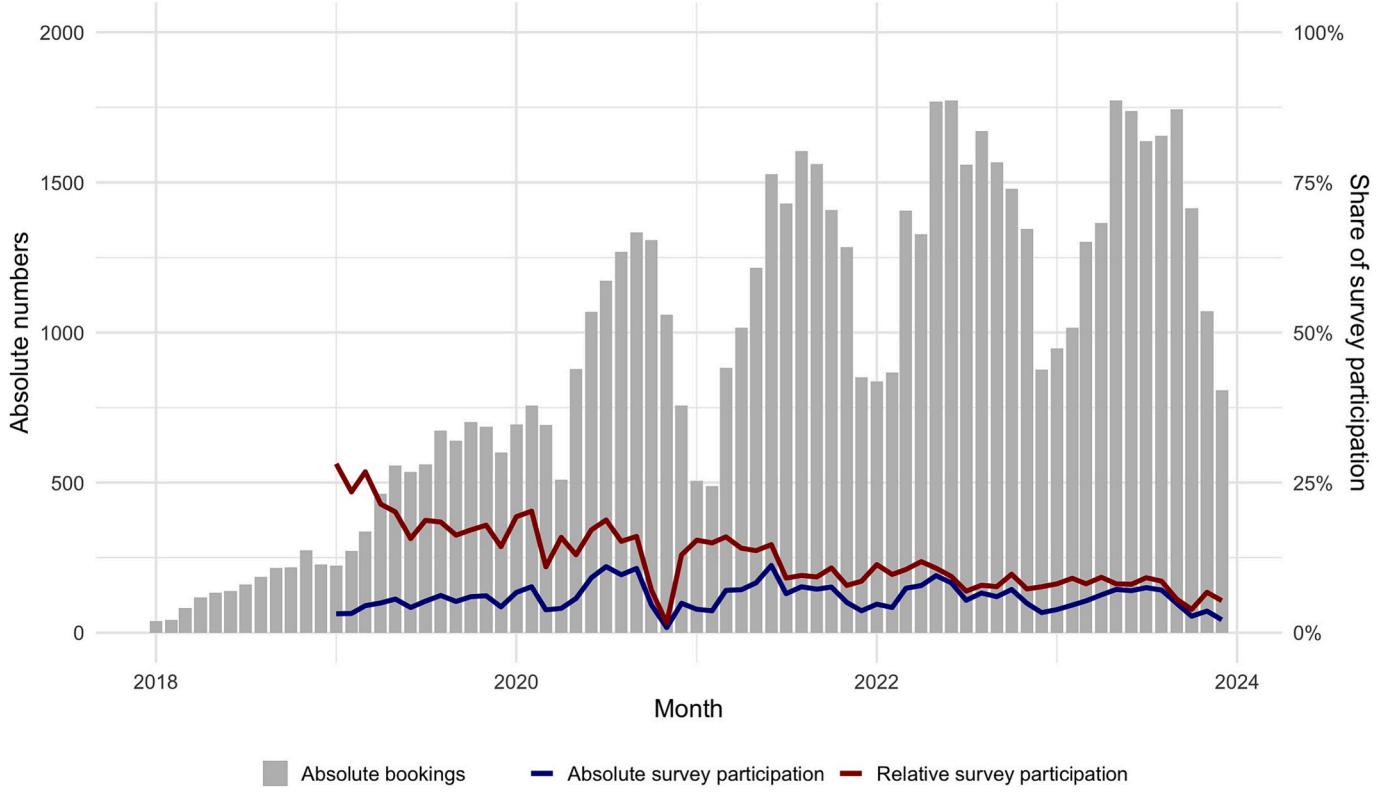

Fig. 1. Booking data and survey participation over time.

averaged to create a composite index value for each lifeworld-oriented space. The resulting values are classified into four ordinal groups: high, medium, low, and very low (SenStadt, 2023). These data were openly available from the Berlin-Brandenburg Statistics Office. Of the 542 planning areas, 16.0 % were classified as high social status, 65.3 % as medium, 10.0 % as low, and 9.0 % as very low.

Lastly, the list of hosts was coded by the authors using an inductive coding system to analyze host characteristics. This system classified the hosts along two dimensions: first, hosts were categorized by sector: public (e.g., public libraries), social (e.g., youth centers), and private (e.g., supermarkets); secondly, they were classified by domain into seven categories: education, social and cultural, mobility, sustainability, gastronomy, shopping, and 'other'. This second categorization helped to explain why certain hosts might agree to host a cargo bike and, more importantly, provided insights into the host structure, which might explain the diversity or absence of certain target groups for the socially innovative cargo bike-sharing system.

Results

The following section summarizes the results of the empirical analysis in line with the research questions. First, it presents findings on the spatial distribution of cargo bike hosts and bookings, as well as host characteristics, primarily based on location and booking data combined with public data sources. Next, insights into user structure and behavior were derived mainly from survey data. For a more detailed analysis, survey data are linked to location information and supplemented with public data sources.

Spatial distribution of cargo bike hosts

Fig. 2 presents a geographical overview of cargo bike hosts in Berlin in relation to the social status index of the surrounding lifeworld-oriented areas. As shown on the map, host locations covered most of the city and included areas from all social status categories. While they extended to the outskirts, their density was higher in the city center.

To provide a more detailed analysis, Table 1 summarizes key indicators on the number of residents, hosts, and bookings across different social status categories. As shown in the table, the distribution of hosts and bookings closely aligned with the distribution of residents. Moreover, there was no clear linear relationship between social status and the number of hosts or bookings. Specifically, the share of hosts and bookings was lower than the corresponding share of residents in high and very low social status areas but higher in medium and low social status areas.

Table 1
Distribution of key indicators among Social Status Index LORs.

Social Status	Residents		Hosts		Bookings	
	N	%	N	%	N	%
High	520,438	13.5	34	11.5	5,337	8.0
Medium	2,542,025	66.0	203	68.8	49,837	75.2
Low	416,993	10.8	33	11.2	7,623	11.5
Very low	369,853	9.6	25	8.5	3,518	5.3

To test for significance, analyses of variance (ANOVA) were conducted based on the 542 planning areas categorized by social status group. This analysis found no significant difference in the number of hosts per resident, $F(3, 532) = 0.610$, $p = 0.609$. However, for the number of bookings per resident, an ANOVA indicated a statistically significant difference, $F(3, 532) = 3.09$, $p = 0.027$. Post-hoc comparisons using the Tukey HSD test revealed a significant difference between high social status areas ($M = 0.009$, $SD = 0.02$) and medium social status areas ($M = 0.019$, $SD = 0.04$), $p = 0.049$. This suggested that the number of bookings per resident was lower in high social status areas compared to medium social status areas.

One potential confounding factor was the borrowing of cargo bikes by residents from adjacent areas. To assess how shifts in resident locations might have affected the results, survey and location data were combined to analyze whether the average distance travelled to borrow a cargo bike differed by social status category. If hosts in lower-status areas had higher average borrowing distances, this could suggest that residents from higher-status areas borrowed more frequently in these areas than vice versa.

However, the results showed the highest average distance to hosts in high social status areas ($M = 3.89$, $SD = 4.41$), followed by medium ($M = 2.98$, $SD = 3.54$), very low ($M = 2.96$, $SD = 3.68$), and low social status area ($M = 2.88$, $SD = 3.7$). An ANOVA indicated a statistically significant overall difference between social status groups, $F(3, 6{,}509) = 9.99$, $p < 0.001$. A Tukey HSD post-hoc test revealed a statistically significant difference between high social status areas and medium and low ($p < .001$), as well as very low ($p < .01$) social status areas.

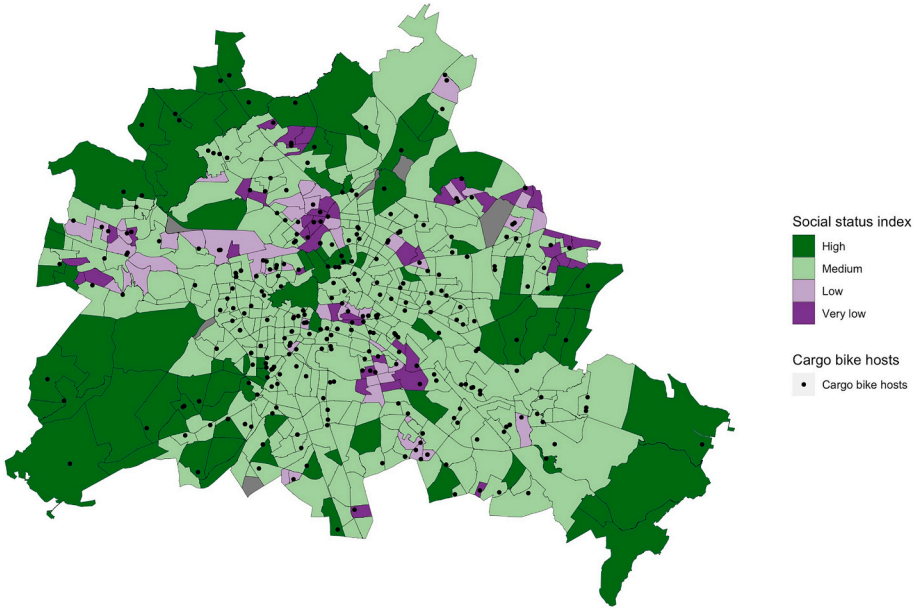

Fig. 2. Locations of Commons Cargo Bikes hosts in Berlin and geographical distribution of social status index.

Host characteristics

Collaboration with local hosts, as described above, is a key element of the socially innovative Commons Cargo Bikes concept (S. Becker & Rudolf, 2018a; Bissel and Becker, 2024b; Egermann, 2022). Since previous studies suggested that local hosts are an important first point of contact for Commons Cargo Bikes (Bissel & Becker, 2024b), it is valuable to investigate these hosts in Berlin in greater detail.

Regarding sectoral distribution, coding of the host dataset shows that most hosts (60 %) were social institutions, such as NGOs, youth centers, or cultural organizations. Additionally, more than a quarter (26 %) belonged to the private sector, including restaurants, cafés, and local shops. Lastly, 14 % were public institutions, primarily universities and libraries. Aligned with this diverse range of sectors, hosts covered various thematic areas. Most notably, 58 % had a social and cultural focus, such as neighborhood centers. Additionally, 13 % focused on education (e.g., universities), 11 % were linked to sustainability (e.g., organic shops), and 6 % shared a mobility focus with Commons Cargo Bikes (e.g., bicycle associations). Other hosts were associated with shopping (6 %), gastronomy (3 %), or other topics (4 %).

User structure and behavior

Beyond contributing to transport equity at the spatial and host levels, the survey data provided deeper insights into user structure and behavior:

User structure

The survey results showed that Commons Cargo Bike users had an average age of 39.8 years (SD = 13.8), slightly younger than the Berlin average of 42.4 years (Berlin-Brandenburg Statistics Office, 2022). In terms of gender, 43.3 % of participants identified as female, 48.9 % as male, 6.0 % preferred not to say, and 1.8 % selected another gender identity. This distribution closely aligned with public data from Berlin, which also reported a 48.9 % share of men (Berlin-Brandenburg Statistics Office, 2022). Regarding children, 46.7 % of survey participants reported having children in their household, compared to 17.4 % in the general Berlin population (Berlin-Brandenburg Statistics Office, 2022). Finally, regarding mobility behavior and car ownership, 28.0 % of Commons Cargo Bike users reported having a car in their household, slightly lower than the Berlin average of 31.9 % (Berlin-Brandenburg Statistics Office, 2022). Notably, only 3.8 % of users identified the car as their primary mode of transport, while 68.8 % primarily used bicycles.

Transport purposes

As outlined in the introduction, cargo bikes served various transport purposes. Fig. 3 provides an overview of these purposes for all users, along with a comparison between male and female participants. The results showed that transporting bulky goods was the most common reason for borrowing a cargo bike (53 %), followed by child transportation (31 %) and curiosity/testing (29 %). Notably, the latter is a core aspect of the Commons Cargo Bikes concept (Bissel, 2024; Bissel & Becker, 2024b). Moreover, the comparison of transport purposes between male and female participants revealed notable differences. Most strikingly, transporting goods was found to be more prevalent among male participants, with a Chi-square test indicating a significant difference, X^2 (1, N = 7,082) = 108.81, $p < 0.001$. In contrast, borrowing cargo bikes to transport children was significantly more common among female participants,X^2 (1, N = 7,082) = 139.01, $p < 0.001$. In addition, female survey participants indicated a higher frequency of borrowing cargo bikes for testing purposes, (X^2 (1, N = 7,082) = 5.99, $p = 0.014$), as well as for leisure purposes, X^2 (1, N = 7,082) = 32.96, $p < 0.001$. Meanwhile, male participants reported a higher proportion of shopping trips compared to female participants, X^2 (1, N = 7,082) = 24.13, $p < 0.001$.

In addition to the gender-based comparison, combining survey data with location data enabled an analysis of transport purposes by social status categories. Specifically, a comparative analysis of the five most frequently mentioned transport purposes by category of the social status index revealed statistically significant differences. As shown in Fig. 4,

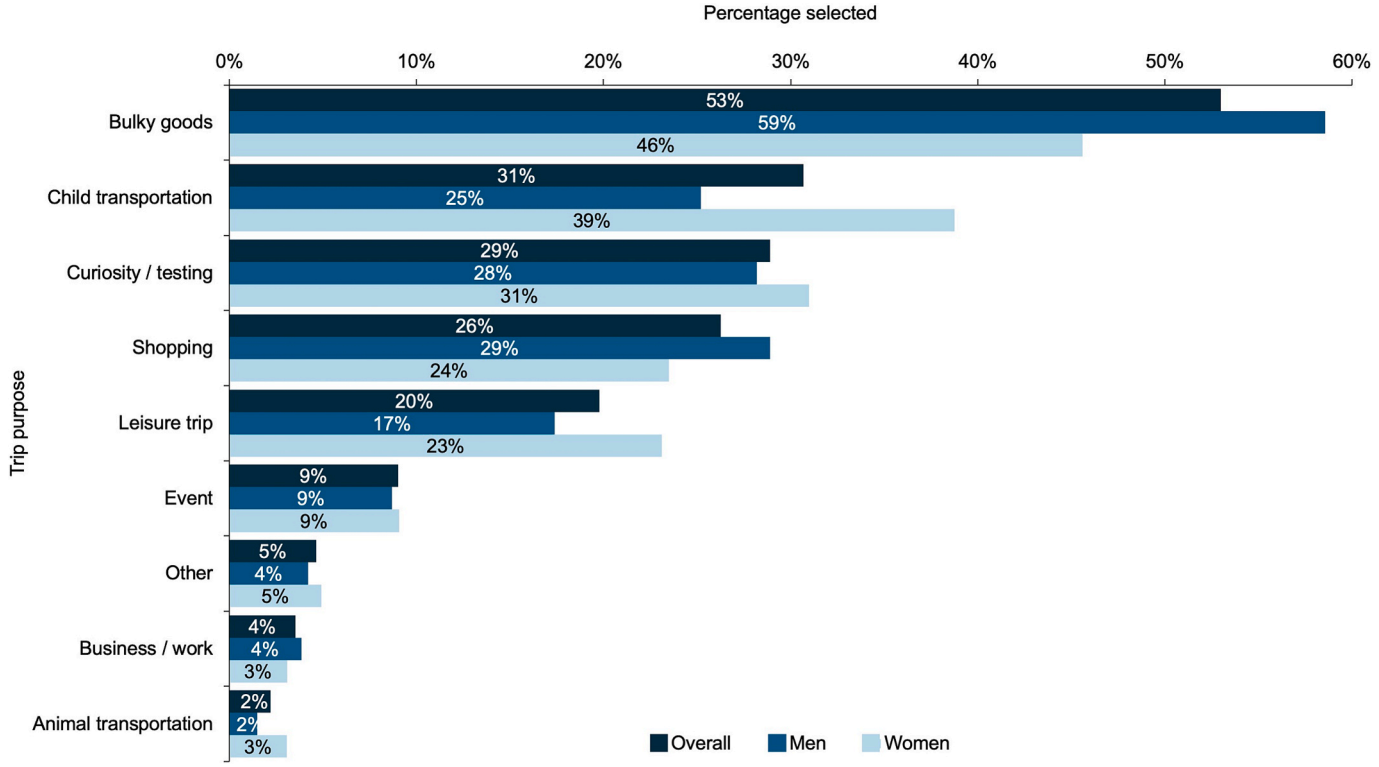

Fig. 3. Transport purposes overall and by gender.

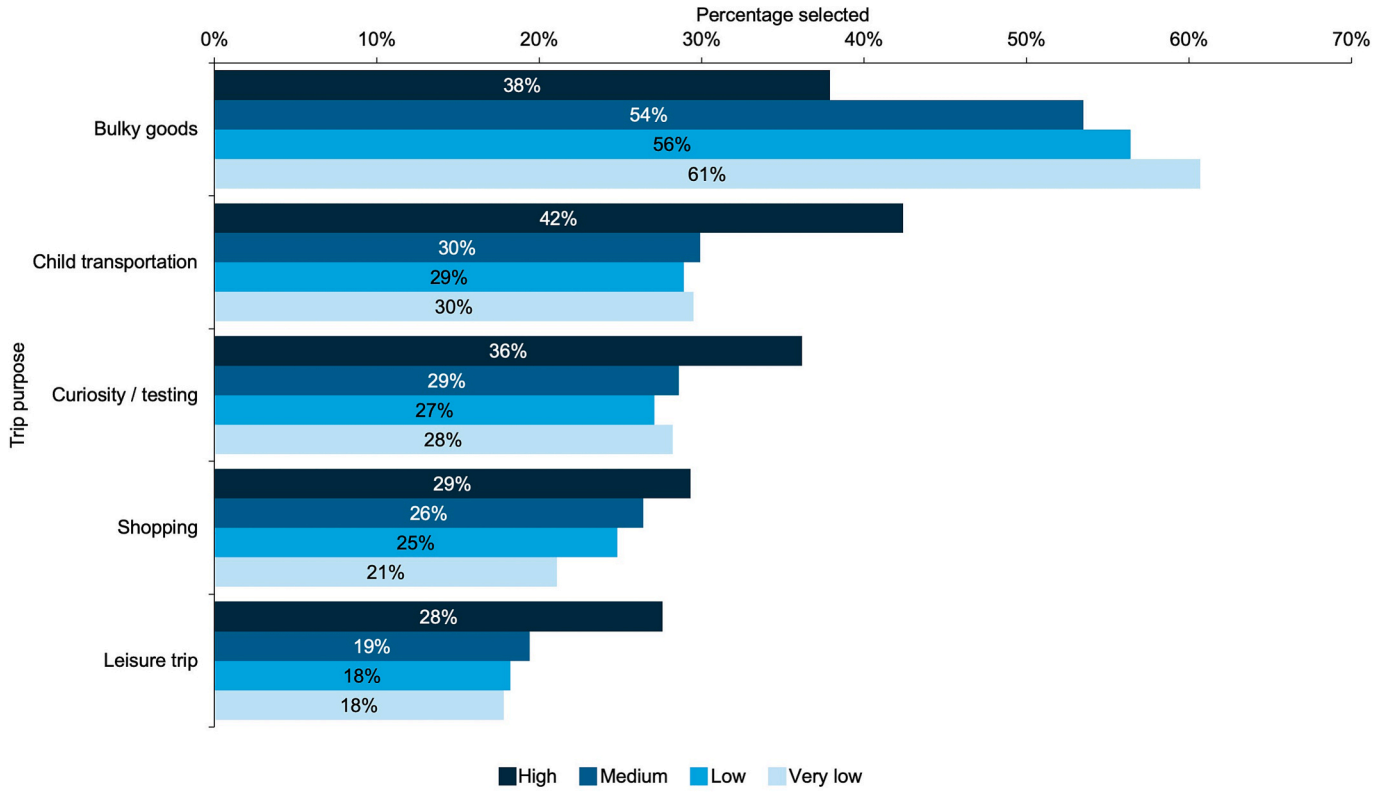

Fig. 4. Transport purposes by social status.

borrowing cargo bikes for child transportation (X^2 (3, N = 7,082) = 37.27, $p < .001$), curiosity (X^2 (3, N = 7,082) = 15.32, $p = 0.002$), and leisure purposes (X^2 (3, N = 7,082) = 23.06, $p < 0.001$) were found to be significantly more prevalent in areas with high social status. While a similar trend was observed for shopping purposes, this difference did not reach statistical significance, X^2 (3, N = 7,082) = 7.53, $p = 0.06$. In contrast, transporting bulky goods (e.g., purchasing furniture or moving) was found to be significantly more prevalent in areas with relatively

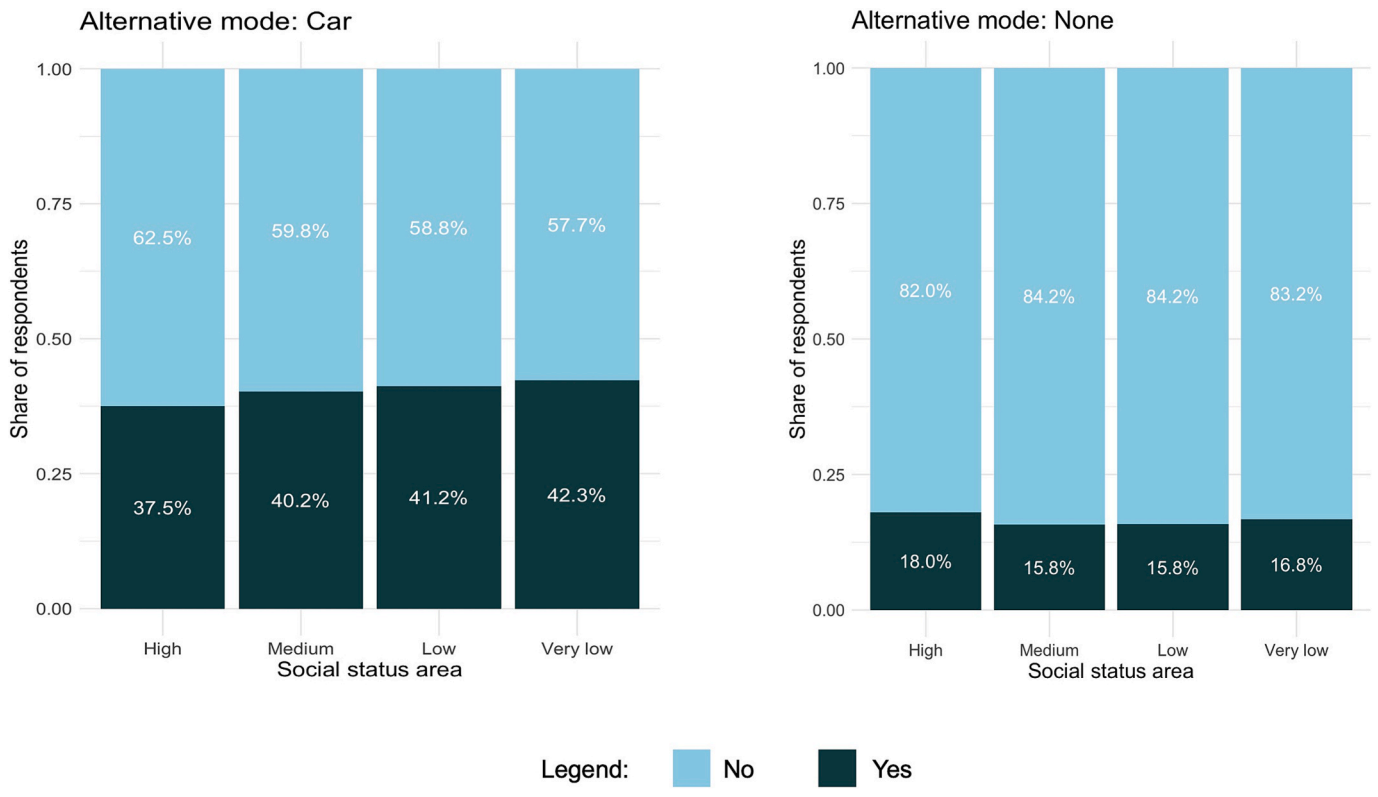

Fig. 5. Alternative modes of transport of cargo bike sharing would not have been available.

low social status, X^2 (3, N = 7,082) = 60.36, $p < 0.001$.

Mode substitution

The substitution of other transport modes, particularly motorized individual transport, is a key area of interest in the context of cargo bikes, given environmental and social challenges (Marincek et al., 2024a). Overall, 40.2 % of survey participants reported that cargo bike sharing replaced car trips. This includes different forms of car trips such as private cars, taxis, or car-sharing. In addition, 16.0 % stated they would not have made the trip at all without Commons Cargo Bikes.

Again, the combination of location data and social status information provided valuable additional insights. As illustrated in the left diagram in Fig. 5, there was a linear trend in car substitution across social status categories. In areas with very low social status, 42.3 % of cargo bike trips replaced car trips, compared to 37.5 % in high-social-status neighborhoods. However, the difference between the four categories was not statistically significant, X^2 (3, N = 7,082) = 2.37, $p = 0.480$. Regarding induced traffic, the right diagram in Fig. 5 shows the highest share in high social status areas (18.0 %), followed by very low-status areas (16.8 %). Nonetheless, the overall difference between social status groups was not statistically significant, X^2 (3, N = 7,082) = 1.95, $p = 0.584$.

Discussion

The objective of this study was to examine Commons Cargo Bikes in Berlin from a transport equity perspective. In doing so, the survey contributes to existing research by offering a more granular spatial analysis compared to previous studies (Bissel & Becker, 2024b). To address the two research questions outlined above, the study empirically drew on multiple large-scale datasets, which were integrated with publicly available official data from the Berlin city government.

Regarding the first research question on the spatial distribution of cargo bikes and hosts, results showed no significant difference in the number of hosts per resident across areas of different social status levels. This suggests that hosts were evenly distributed across different areas, without a systematic bias towards more affluent regions. Notably, this finding contrasts with previous research on commercial bike-sharing systems (Smith et al., 2015; Uteng, 2019). While the number of borrowings per resident varied significantly across social status categories, no clear linear trend emerged. Thus, in terms of spatial distribution, the results indicate that this community-led shared mobility initiative operates across a diverse range of locations.

In addition to spatial distribution, the analysis of the host structure highlighted a diverse range of organizations across the social, public, and private sectors - each focusing on different topics such as education, sustainability, and mobility. From an equity perspective, this finding suggests a key strength of Commons Cargo Bikes: the ability to reach a diverse audience by partnering with hosts that cater to different societal groups. However, it should be noted that our dataset does not include non-users. Thus we do not claim that Commons Cargo Bikes are able to reach all societal groups.

Regarding the second research question, which examined transport equity in terms of user structure and behavior, the results suggested that the gender distribution of Commons Cargo Bikes aligned with that of the general Berlin population. Thus, unlike other studies on bike-sharing services, the present data did not indicate a gender imbalance favoring men (Carracedo & Mostofi, 2022). Even more, this observation aligns with Goel et al. (2022), who find that higher overall cycling levels, such as those seen in Germany and Berlin in international and city-level comparison (see also Aldred et al., 2016), are positively associated with women's representation among cyclists and explains more balanced cycling participation.

The findings on trip purposes offer two potential explanations for this pattern. First, people who defined themselves as women in the questionnaire used cargo bikes more frequently for testing purposes. As detailed by Bissel and Becker (2024b), the opportunity to test cargo bikes for free and the personal handover process may contribute to a greater perception of trust as well as traffic safety. Second, female participants reported using cargo bikes more often for child transportation. Statistically, this aligns with previous research on gender differences in transport purposes (Riggs & Schwartz, 2018; Singh, 2020; Uteng, 2019) and particularly for cargo bikes (Bissel & Becker, 2024b; Carracedo & Mostofi, 2022). Notably, the majority of cargo bikes are equipped for child transportation (Bissel & Becker, 2024b). Unlike traditional bike-sharing systems (Singh, 2020), Commons Cargo Bikes appear to be associated with more inclusive usage patterns, potentially supporting transport equity.

In terms of social status, the results revealed interesting and statistically significant differences in trip purposes. Specifically, in high social status areas, cargo bike use was primarily driven by testing and leisure activities. In contrast, in low social status areas, cargo bikes were more frequently used for more essential purposes, such as transporting bulky goods when moving. While this study does not suggest that certain transport purposes are inherently more important than others, the findings indicated that cargo bike usage varied by region based on predominant needs. This underscored the potential role of Commons Cargo Bikes in contributing to more equitable transport outcomes.

With respect to alternative transport modes in the absence of Commons Cargo Bikes, the findings indicated that a substantial proportion of cargo bike trips replaced car trips. This finding corresponds to previous studies (S. Becker & Rudolf, 2018a; Bissel, 2024; Marincek et al., 2024a). While not statistically significant, the results suggested a tendency toward a higher share of substituted car trips in low social status areas, potentially offering additional social benefits by reducing financial burdens associated with car use for less affluent individuals. Additionally, a considerable share of trips would not have been undertaken without Commons Cargo Bikes, underscoring their potential association with increased mobility options that align with environmental sustainability and social inclusion goals.

In summary, the findings of this study highlighted that community-led shared mobility is a viable approach to commoning mobility, a key aspect of transport equity as emphasized by several researchers (Adey, 2021; Nikolaeva et al., 2019; Sheller, 2018).

Limitations

While this study drew on extensive and large-scale datasets, certain limitations should be considered. Despite the high geographic granularity of social status approximation, each area remained socially heterogeneous and the chosen approach does not allow analyses on individual level. In addition, while individuals may book cargo bikes in areas with lower social status categories, an analysis of distances to hosts did not support this concern.

Moreover, our approach does not permit causal conclusions regarding social status differences. Beyond the aforementioned heterogeneity, other potential influencing factors, such as topography or nearby points of interest, may also play a role. Correspondingly, the statistical approach employed in this study relied primarily on analyses of variance and chi-square tests as statistical methods. While these are useful for identifying group-level patterns, they cannot account for confounding variables or spatial dependencies. This choice, however, was guided by data constraints such as the lack of individual-level socioeconomic indicators. These data availability constraints therefore underscore the exploratory character of the study.

Regarding the measurement of social status, the social status index aggregated multiple indicators, preventing the analysis of specific dimensions of social status. Some relevant factors, such as migration background, were not included in the index. Moreover, although the index featured a high level of spatial detail, it consisted of only four categories; however, these categories were distinct and offered an initial indication of spatial equity.

Finally, the distinctive survey design, with invitations sent after each booking over a period of several years, allowed for a reduction in self-selection biases. At the same time, however, this increases the risk of bias due to multiple responses. A closer analysis revealed, nevertheless, that over 96 % of participants responded a maximum of three times.

Future research

In light of the promising findings of this study and its stated limitations, several avenues for future research emerge. Building on this study's exploratory approach, future research should employ more advanced statistical techniques to better understand the drivers of transport equity outcomes. Access to more comprehensive spatial and public datasets as well as individual-level socioeconomic data would also enable a more nuanced analysis of how different factors interact in shaping shared mobility usage patterns. Additionally, research should examine the key barriers to shared mobility adoption that community-led initiatives address and how factors such as the absence of credit card requirements influence adoption. Further investigation is needed into additional barriers preventing individuals from using Commons Cargo Bikes, including psychological factors (Sands et al., 2020) and differences between cargo bike-sharing operators (S. Becker & Rudolf, 2018b). More generally, in accordance with Henriksson and Wallsten (2020) as well as Henriksson and Göransson Scalzotto (2023), this study further stresses the need for a deeper understanding of the organizational aspects of different bike-sharing models in light of more sustainable and just mobility futures, including questions concerning how and by whom in this case civil-society led innovations should be supported. For instance, the suggestions provided by Zimmermann & Palgan (2024) on how municipalities can support civil-society led cargo bike sharing initiatives could provide a promising starting point for future research in this direction.

Practical implications

With regard to practical implications, funding and supporting initiatives such as Commons Cargo Bikes present an opportunity for governments and municipal actors to promote bottom-up grassroots innovation (Carracedo & Mostofi, 2022; Zimmermann & Palgan, 2024). This offers a complement to top-down policy measures for fostering equitable transport. Thus, despite increasing austerity policies in urban (mobility) planning, policymakers could support socially-innovative initiatives through stable funding, reduced administrative burdens, and integration into climate action and low-emission zone plans. superblocks, also referred to as Kiezblocks in Berlin, could serve as promising starting points for integration of community-led initiatives into low-emission zones highlighting both livability and equity benefits of active mobility. Furthermore, partnerships with social, cultural, and educational institutions can extend outreach and embed services within even more communities, providing a cost-effective opportunity to spread mobility innovations.

Solely extending partnerships, however, is unlikely to be sufficient to reach diverse communities. Strengthening cycling skills and infrastructure themselves is essential, as is promoting a shift in the public image of cycling. Tailoring promotion to local needs - such as emphasizing child transport safety in family-dense areas or bulky-goods capacity in lower-income neighborhoods - can enhance equity benefits. Given the substantial share of car trips replaced, investing in cargo bike infrastructure and supporting hosts could yield both environmental and social gains.

Conclusion

This study examined the challenge of equitable shared mobility, focusing on community-led cargo bike sharing. Using multiple large-scale datasets, this study assessed the contribution of the Commons Cargo Bikes initiative in Berlin in terms of spatial distribution and user structure. The findings suggest that community-led shared mobility initiatives may serve as valuable complements to commercial providers, particularly as they are associated with use in areas typically underserved by traditional operators. Therefore, other cities currently facing inequitable distributions of cargo bikes and shared mobility options could also benefit from a community-led sharing approach. While fLotte Berlin is characterized by the considerable amount and variety of Berlin's social and cultural institutions, community-led approaches in other cities could be tailored to the respective local assets at hand. This highlights the potential of supporting and funding social innovation as one approach that may align with bottom-up policymaking goals. However, further user-level research is needed to gain deeper insights into user profiles, motivations, and barriers to adoption.

Declaration of generative AI use

During the writing process of this work the authors used DeepL Write in order to simplify sentences and improve readability. After using this tool, the authors reviewed and edited the content as needed and take full responsibility for the content of the publication.

Ethics declaration

Ethical approval for this study was waived by Faculty I of Technische Universität Berlin because it falls into a category of studies that are exempt from individual review.

CRediT authorship contribution statement

Michael Bissel: Conceptualization, Data curation, Formal analysis, Visualization, Writing – original draft, Writing – review & editing. **Anke Kläver:** Conceptualization, Writing – original draft, Writing – review & editing.

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Declaration of competing interest

The authors declare no competing interests.

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Data availability

Data will be made available on request.

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