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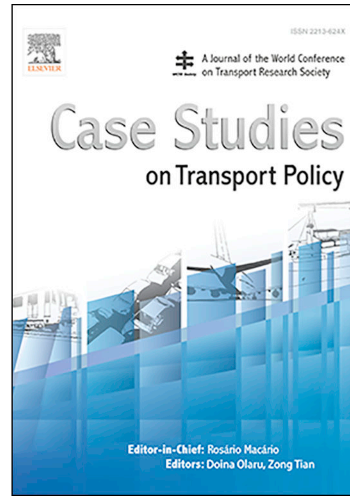

Car-Sharing Subscription Preferences and the Role of Incentives: The Case of Copenhagen, Munich, and Tel Aviv-Yafo

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PII: S2213-624X(23)00067-6
DOI: https://doi.org/10.1016/j.cstp.2023.101013
Reference: CSTP 101013

To appear in: *Case Studies on Transport Policy*

Received Date: 10 August 2022
Revised Date: 15 February 2023
Accepted Date: 1 May 2023

Please cite this article as: M. Moraes Monteiro, C.M. Lima de Azevedo, M. Kamargianni, G. Cantelmo, S. Shoshany Tavory, A. Gal-Tzur, C. Antoniou, Y. Shiftan, Car-Sharing Subscription Preferences and the Role of Incentives: The Case of Copenhagen, Munich, and Tel Aviv-Yafo, *Case Studies on Transport Policy* (2023), doi: https://doi.org/10.1016/j.cstp.2023.101013

Car-Sharing Subscription Preferences and the Role of Incentives: The Case of Copenhagen, Munich, and Tel Aviv-Yafo

Abstract

Car-sharing services provide short-term car access, contributing to sustainable urban mobility and generating positive societal and environmental impacts. Attraction and retention of members are essential for the profitability and survival of these services in cities. Yet, the relevance of a variety of possible business models' features for car-sharing subscriptions is still under-explored. This study examines individuals' preferences for subscribing to different car-sharing business models, focusing on the attractiveness of car-sharing-related features and incentives in different contexts. We designed a stated preference experiment and collected data from three different urban car-sharing settings: Copenhagen, Munich, and Tel Aviv-Yafo. A mixed logit model was estimated to uncover the determinants of each city's car-sharing plan subscription. The achieved insights pave the road for the actual design of car-sharing business models and attractive incentives by car-sharing companies in the studied or similar cities. Our findings reveal that although some car-sharing intrinsic features are likely to be relevant everywhere (e.g., pricing, parking conditions), the local context affects the preferences of others. In Munich, respondents prefer car-sharing services with fleets composed of electric vehicles and value high accessibility to shared cars, so marketing campaigns focusing on the positive environmental impacts of car-sharing and strategic distribution of shared cars (e.g., hubs) are expected to be very appealing there. As for Copenhagen, a high probability of finding a car, the opportunity to book a shared car in advance, and having plans including other modes are more appreciated, making hubs in high-demand areas and Mobility-as-a-Service (MaaS) plans very attractive. Finally, in Tel Aviv, our findings highlight the advantages of exploring different pricing schemes and offering dynamic incentives to users for fleet rebalancing to positively contribute to car-sharing subscriptions and ridership.

Keywords: Car-sharing preferences; Mobility incentives; Discrete choice models

1 Introduction

Accumulating more than 32 million members, distributed across 47 countries and six continents in 2018, car-sharing services have been providing short-term car access to their users (Shaheen, Cohen, and Jaffee 2020). Under the umbrella of sharing economy solutions, car-sharing aims at encouraging sustainable urban mobility, shifting the focus from personal ownership to demand-fulfillment shared use (Mi and Coffman 2019). Positive societal and environmental impacts derived from car-sharing solutions include an increase in mobility flexibility (Clewlow 2016) and in the use of some alternative transportation modes (Martin and Shaheen, 2011), as well as reductions in car ownership (fewer resources required for mobility)(Clewlow 2016)(Giesel and Nobis 2016), kilometers traveled (Clewlow 2016);(Martin and Shaheen, 2011), greenhouse gases and air pollutants emissions (Martin and Shaheen, 2011);(Chen and Kockelman 2016), congestion (Alisoltani, Leclercq, and Zargayouna 2021) and parking demand (Millard-Bal et al. 2005).

Today, car-sharing business models vary, among others, according to the level of flexibility both in regards to on pick-up and return locations and time (e.g., station-based,or free-floating services, peer-to-peer service – where one has to pick up and return the cars according to specific time windows), ownership of the service/cars (e.g., private entities, private citizens, cooperative co-ownership, peer-to-peer), the composition of car fleet (e.g., electric, combustion, hybrid, luxury, small city cars), pricing scheme (e.g., minutes, and daily packages) and parking opportunities (e.g., public, private reserved parking spaces)(Shaheen, Cohen, and Farrar 2019). Beyond the intrinsic features that can vary from one car-sharing service to another, i.e., those characteristics that are essential to the service (e.g., car types available, parking conditions), some incentives can also be offered to make services more attractive. Among other incentives, it is the possibility of collecting credits to redeem for goods every time one uses a car-sharing service and the possibility of having a plan including other modes for a seamless door-to-door trip. Although the appropriate combination of features can attract and retain users/members, which are essential for car-sharing services, the analysis of how car-sharing service features and the provision of incentives can affect car-sharing membership in different contexts is limited.

Most studies on car-sharing membership have focused on how sociodemographic characteristics (Prieto, Baltas, and Stan 2017);(Efthymiou and Antoniou 2016);(Becker, Ciari, and Axhausen 2017);(Dias et al. 2017);(Priya Uteng, Julsrud, and George 2019) and psycho-social factors (Jain, Rose, and Johnson 2021);(Chun et al. 2019) influence on the likelihood of becoming a member. The few studies that looked into the relevance of car-sharing services features (de Luca and Di Pace, 2015);(Yoon et al., 2017) highlight the importance of the local context in shaping individuals' preferences. Moreover, previous studies on car-sharing incentives have focused on fleet rebalancing (Lippoldt, Niels, and Bogenberger 2018);(Stokkink and Geroliminis 2021), when car-sharing users receive an incentive to finish their trips inside undersupplied areas (areas with high demand a few cars available), and to date, no study has explored whether and which incentives can increase the likelihood of subscribing to car-sharing services.

This study investigates the importance of service-related features and incentives in the decision to subscribe to car-sharing services and whether local context matters in these plays a role in individuals' preferences with regards to if and which service to enroll to. For this, we collected and analyzed data, including a Stated-Preference (SP) choice experiment conducted simultaneously in Copenhagen, Munich, and Tel Aviv-Yafo. The contribution of this paper is threefold: (i) to examine the impact of different car-sharing features on individuals' preferences for subscriptions; (ii) to contribute to the literature on mobility incentives by examining their relevance in keeping and attracting car-sharing members; and (iii) to help car-sharing providers to increase their appeal by aiding the design of services and incentives in different contexts. This work complements the findings presented and discussed in Cantelmo et al. (2022), which consists of an analysis of qualitative results derived from interviews and focus groups conducted in Copenhagen, Tel Aviv, and Munich. They found that solving issues related to regulatory barriers, providing car-sharing services well integrated with other mobility services, and promoting social equity and sustainable mobility through car-sharing are the most important elements to consider for implementing successful car-sharing services. These results were used to design the survey adopted in this study, as discussed in Section 3 (Data and Methods).

2 Background

Previous studies have focused on sociodemographic characteristics to examine car-sharing subscription' and usage' determinants. Several papers have highlighted how employed young men with university-level education living in highly dense areas are more likely to become a member of car-sharing services (Efthymiou and Antoniou 2016);(Becker, Ciari, and Axhausen 2017);(Prieto, Baltas, and Stan 2017);(Dias et al. 2017);(Caulfield and Kehoe 2021). Prieto et al. (2017) hypothesize that older people are less likely to use car-sharing due to stronger habits, while Dias et al. (2017) speculate that they are rather less adept at technology and less likely to try new services than younger individuals. As for the lower adoption among women, stronger safety concerns are conjectured as a possible explanation (Prieto, Baltas, and Stan 2017), while those living in denser areas, such as the larger group in Caulfield and Kehoe (2021) cluster analysis, are hypothesized to be more prone to use car-sharing because they face higher parking costs (Dias et al. 2017).

The lower propensity of those with low income to use car-sharing services in the United States of America is assumed to be a consequence of budget constraints (Dias et al. 2017), but the low-income group in Greece was found to be more likely to subscribe to car-sharing services. There is no clear agreement in the literature about whether having a high-income increases (Giesel and Nobis 2016);(Yoon, Cherry, and Jones 2017);(Dias et al. 2017) or decreases the likelihood of subscribing to or using car-sharing (Efthymiou and Antoniou 2016);(Zhou and Kockelman 2011).

Moreover, those living in households with children were found to be less prone to use car-sharing due to their tendency to undertake relatively more complex tours and their need to set up more features (e.g., child seat) before using the service (Dias et al. 2017);(Jain, Rose, and Johnson 2021). Others, however, argue that when individuals experience the birth of a child (life event), they become more likely to become car-sharing members (Priya Uteng, Julsrud, and George 2019). In general, living in a car-free household increases the chances of subscribing to car-sharing (Becker, Ciari, and Axhausen 2017). Nonetheless, Dias et al. (2017) claim car owners living in high-density areas are more prone to use car-sharing than those living in low-density areas, while Caulfield and Kehoe (2021) found a substantial group of suburban car owners who use the service, suggesting that the interaction between the built environment and car ownership may explain car-sharing usage but tend to be contextually dependent.

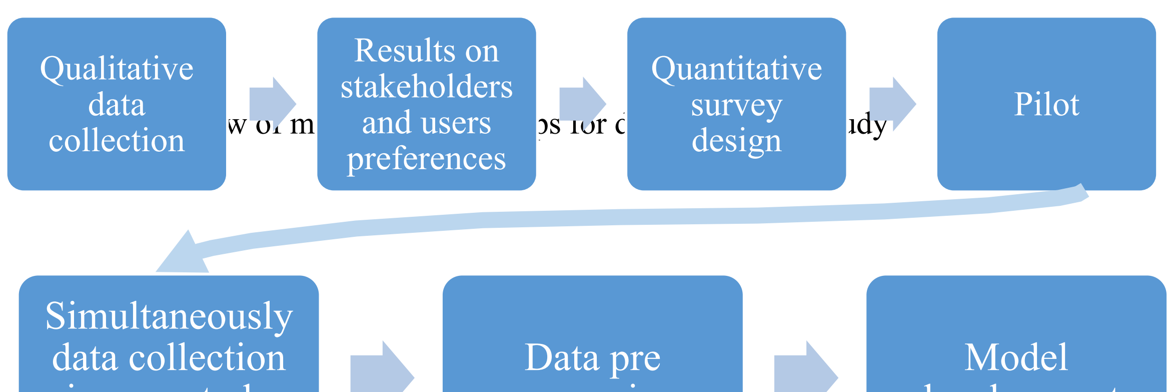
As for psycho-social factors, those who self-report as highly environmental conscious (Efthymiou, Antoniou, and Waddell 2013);(Yoon, Cherry, and Jones 2017);(Jain, Rose, and Johnson 2021) and those who have a more minimalistic lifestyle (reduced material possessions)(Jain, Rose, and Johnson 2021) are more likely to adopt car-sharing. Individuals that associate a positive social status with car ownership are less likely to join car-sharing (Chun et al. 2019), as they do not attach any status to car-sharing (Yoon, Cherry, and Jones 2017).

When examining the relevance of car-sharing service features, Kent and Dowling (2016) argue that providing fixed and reserved parking spaces is essential for car-sharing business success, as it is particularly suitable for highly dense areas with limited parking spaces. Furthermore, they claim such ~~incentives~~ service features contribute to delineating the car-sharing structure, sending a message of public support while raising awareness about this mobility service (Kent and

Dowling 2016). Reserved parking spaces for shared cars across the city (especially where parking restrictions generate stress for car owners) have the potential to encourage car-sharing usage (Priya Uteng, Julsrud, and George 2019). Additionally, de Luca and Di Pace (2015) observed that car-sharing travel cost and access time, together with car availability at home, are essential for promoting a switch to car-sharing in Italy. Yoon et al. (2017) found that monetary travel costs concerning other transport alternatives are important for car-sharing usage in Beijing (China), but access time and vehicle fuel type are irrelevant. These findings highlight the relevance of local context in shaping preferences for different car-sharing business models, also impacting individuals' predisposition to consider different incentives. Analyzing the importance of incentives for car-sharing usage, Yoon et al. (2017) found that access to priority lanes did not impact it (although reducing travel time). Fleet composition (car models available) can increase attractiveness to car-sharing adoption (for specific user segments), as it provides the opportunity to access car models they could not buy (Priya Uteng, Julsrud, and George 2019).

3 Data and Methods

For examining individuals' preferences for subscribing to car-sharing services and the impacts of incentives on that, we initially performed a literature review on car-sharing subscription and usage, and the impacts of individuals' sociodemographic characteristics and car-sharing services' features on it. This phase was followed by qualitative information gathering in the cities selected as case studies through interviews with public and private stakeholders, as well as focus groups with car-sharing users and non-users. Based on the discussions and analysis of results, we started designing a survey to collect quantitative data to be able to model individuals' behavior and preferences. While the quantitative survey focuses on the users, the proposed solutions are also based on the suggestions of the stakeholders. Before starting the data collection, we did a pilot to test the clarity and understanding of the questions. Then, we started collecting data simultaneously in the three cities chosen as case studies. After that, we pre-processed the data to remove inconsistent and incomplete answers before start developing the model. The next sub-sections will provide more details about these steps, which are illustrated in Figure 1.



3.1 Case studies

The same survey was used to collect data in Copenhagen, Munich, and Tel Aviv-Yafo, allowing preferences to be compared across the three cities. While they are densely populated and served by public transport and car-sharing services, the cities chosen have diverse transport systems, norms, and mobility cultures: Copenhagen has a particularly stronger bike culture (Københavns Kommune 2020), Munich has a comprehensive rail public transport network (Landeshauptstadt München 2017), and Tel Aviv-Yafo's mobility relies on private cars and public buses (Nir Sharav, Szeinuk, and Shiftan 2018). Table 1 summarizes information on Cities' socioeconomic characteristics and transport systems.

Copenhagen is the capital of Denmark and has a population of more than 1.8 million living in the Metropolitan area (Statistics Denmark 2021). Its public transport framework encompasses buses, harbor buses, driverless metro, intercity, and long-distance trains. The metro covers the city center, while the urban-suburban rail (S-trains) serves the Greater Copenhagen Area. All public transport modes use a common fare zone system for tickets (Din Offentlige Transport 2021). The City of Copenhagen has invested in making cycling the easiest and fastest option to move around, which can be seen in the comprehensive network of dedicated bicycle infrastructure with 390 kilometers of cycle tracks and in the coordination of the traffic lights during rush hour to favor cyclists (Visit Copenhagen 2020). The first car-sharing service was offered in 1998 at the request of the City of Copenhagen and, in 2020, free-floating, station-based, and peer-to-peer car-sharing services operate in the GCA. To support it, around 200 parking spaces are reserved for station-based schemes in Copenhagen, 7% of those destined for electric cars (Københavns Kommune 2019). Concerning private car ownership, the required registration tax in Denmark varies between 85%-150% of the vehicle's taxable value. Electric and hybrid cars currently have a discount (Skat 2020).

Table 1 Cities' socioeconomic characteristics and transport systems

		Copenhagen	**Munich**	**Tel Aviv-Yafo**
City's characteristics				
Population	City	737,153*	1,484,226	451,500
	Metropolitan area	1,846,023	2,606,021	3,984,900
Area (km^2)	City	98.8	310	52
	Metropolitan area	2,563	5,500	1,516

Population density (inhabitants/km²)	City	7461	4,800	8,718
	Metropolitan area	720.31	460	2,361
Median disposable income (US-$ at PPP)**	Country	34,235.81	33,060.83	23,386.67
Human Development Index (HDI)	Country	0.947	0.944	0.917
Transport system				
Mode share	Public transport	19%***	24%	12%
	Private motorized	32%***	34%	52%
	Active modes	49%***	42%	36%
Public transport	Modes available	Metro, train, bus, harbor bus	Metro, light rail, train, bus	Train and bus
Cycling network (km)	City	390****	1,200	160
Motorized private modes	Car ownership per 1000 inhabitants	438	550	394
	Taxation on purchasing a private car	Registration tax: 85% (up to 185,100 kr.) or 150% (above 185,100 kr.) of the car value	-	Import tax: 83% (there is no local manufacturing)

Number of car-sharing operators	Station-based	5	4	1
	Free-floating	2	3	1
	Peer-to-peer	1	NA	NA

* Including 104,118 residents of Frederiksberg municipality, which is located inside the borders of Copenhagen (Statistics Denmark 2021)

** OECD, 2022

*** Data from 2018 (City of Copenhagen 2019)

**** OpenStreetMap - multiple contributors, 2015

Munich is the capital of the state of Bavaria and Germany's third-largest city. Its metropolitan area has about 2.6 million inhabitants, with about 50% living in the city and the other 50% living in suburban districts. The transportation system includes trams (72 km), buses (94 routes, 2083 stops), and a subway (U-Bahn, 100km, 08 lines, 96 stations), and it is fully integrated with the regional light railway (S-Bahn), which connect Munich with other cities in Bavaria (MGV 2021). Munich's U-Bahn (metro) alone is used daily by more than a million people (MVG 2022). A special "Bicycle Traffic Development Plan" coordinates Munich's inner city planning of bicycle routes with surrounding communities. With more than 20% of the mode share (Follmer and Belz 2019) and 6000 paths (Landeshauptstadt München 2021), cycling is a popular travel option. In addition, public and private operators offer bike-sharing, and several electrical scooter services are available. As for car-sharing, it was introduced in 1992 in Munich, and in 2020, seven operators co-existed, offering free-floating and station-based services, with pricing based on minutes traveled and discounts offered for travels longer than 1 hour. Some services offer rather free registration and slightly more expensive usage costs. Car-sharing users can park their shared car for free in any legal public parking space in Munich, even if there is controlled parking, as long as they are within the service area. However, when there is time limit, this also applies to shared cars. In Germany there is no extra taxation on car purchase, only the annual motor vehicle tax obligation (Kraftfahrzeugsteuergesetz) for traffic on public roads.

Tel Aviv-Yafo, in short, Tel Aviv, has a population of over 450,000 people, and is the second-largest city in Israel, and is the core of Israel's largest metropolis (~4,000,000 inhabitants). Tel Aviv's transportation system includes rail and buses, as well as 160 km of cycle lanes (Municipality of Tel Aviv-Yafo 2022). According to the latest metropolitan travel habits survey, it is estimated that 52% of the trips in Tel Aviv Yafo are done by private cars, 12% are done by public transport and 36% are done by pedestrians and cyclists (including micro-mobility) (N.

Sharav et al. 2021). Since 2008, car-sharing services have been offered and currently operate within the Tel Aviv metro area: Tel Aviv, Ramat Gan, Givatayim, Herzeliya, and Raanana, providing customers with free-floating and station-based alternatives and with plans to be expanded to additional cities. AutoTel (free-floating service) users, can park shared vehicles, free of charge, in any legal on-street parking spot or in one of the over 300 free dedicated parking spots available, as the service consists of a joint venture initiated by the Tel Aviv-Yafo Municipality and the Tel Aviv-Yafo Economic Development Authority. According to Israel's Central Bureau of Statistics (2018), in 2017, residents living in Tel Aviv owned over 232,000 private cars (i.e., on average, 50% of Tel Aviv residents). Import taxation (no local manufacturing) on most cars in Israel reaches 83%. Hybrid cars were taxed at 30% and electric cars at 10%, but this favorable taxation is being phased out. Gas in Israel is also heavily taxed, about 65% of its value.

3.2 Survey design

The data used in this study was collected through a tailor-made online survey designed based on the literature [text removed for blind peer-review]. The survey was implemented by combining the choice-based conjoint modeling tool - Sawtooth Software (2021) and the statistical software platform - SPSS (IBM 2021). It was made available online in both web and mobile versions, in English and Danish for Copenhagen respondents, German and English for Munich participants, and Hebrew and Arabic for Tel Aviv respondents. In addition, a small pilot was conducted, which led to improvements to the survey design, structure, and language.

Questions to assess the eligibility of individuals (further described in the next section) were posed at the beginning of the survey to screen out ineligible respondents. The survey consisted of six parts. The first part included a brief introduction to the survey, its objectives, and information about data privacy and protection. It was followed by the second part, which had questions on sociodemographic details. In the third part, respondents were asked about their travel behavior and attitudes toward private cars and car-sharing services. The fourth part consisted of questions to examine car-sharing incentives preferences where we provided a list of incentives, but respondents could also suggest incentives not listed. The fifth part consisted of a Stated Preference (SP) experiment to reveal respondents' preferences for subscribing to different car-sharing plans. We included both car-sharing features and incentives in the design (see Table 2). Finally, as the survey was conducted during the outbreak of COVID-19, the sixth part consisted of questions to examine the effects of the COVID-19 pandemic on respondents' mobility behavior [text removed for blind peer-review]. For the analysis presented in this paper, we used the survey data from parts 2, 4, and 5.

Specifying the SP experiment attributes and levels was made through an iterative process with representatives of all cities, considering existing services in each city, and their current features, prices, and packages. We also explored different ways of presenting the cost (per minute, per hour, and per day) to verify whether this would play a role in preferences. The incentives offered were: (i) guaranteed child car seat availability, (ii) a family/friends account with discounted rates, (iii) a business account with discounted rates, (iv) the possibility of booking in advance, (v) a plan including other modes for a seamless door to door trip, and (vi) the possibility of collecting credits to redeem for goods (e.g., clothing and grocery discounts).

Table 2 SP Attributes and levels

ATTRIBUTES												
One-time subscription cost*												
Usage cost*	1kr/min	1kr/min	1kr/min	150kr/day	0.19€/min	0.19€/min	0.19€/min	20€/day	0.25₪/min	0.25₪/min	0.25₪/min	40₪/day
	4kr/min	4kr/min	4kr/min	200kr/day	0.25€/min	0.25€/min	0.25€/min	25€/day	1₪/min	1₪/min	1₪/min	52₪/day
	6kr/min	6kr/min	6kr/min	300kr/day	0.39€/min	0.39€/min	0.39€/min	30€/day	1.6₪/min	1.6₪/min	1.6₪/min	80₪/day
	200kr/6h	200kr/6h	300kr/6h	400kr/day	1.5€/h	1.5€/h	35€/6h	35€/day	52₪/6h	52₪/6h	80₪/6h	100₪/day
	350kr/6h	350kr/6h	400kr/6h	500kr/day	2.5€/h	2.5€/h	13€/2h	40€/day	90₪/6h	90₪/6h	100₪/6h	130₪/day
	500kr/6h	500kr/6h	550kr/6h	600kr/day	6€/h	6€/h	18€/2h	45€/day	130₪/6h	130₪/6h	145₪/6h	155₪/day
	300kr/day	300kr/day	450kr/day	800kr/day	23€/day	23€/day	35€/day	55€/day	80₪/day	80₪/day	120₪/day	210₪/day
	500kr/day	500kr/day	650kr/day	900kr/day	35€/day	35€/day	49€/day	70€/day	130₪/day	130₪/day	170₪/day	235₪/day

	800kr/day	800kr/ day	850kr/ day	1000kr/ day	48€/day	48€/day	79€/day	80€/day	210₪/ day	210₪/ day	220₪/ day	260₪/ day
Walking time to access the vehicle												
Probability to get a shared vehicle												
Car-sharing vehicle types												
Car-sharing vehicle engine type												
Walking time from the parking location	11 to 15 min											
Incentives ~~Extra features~~												

RT: Round trip; OWST: One-way Station-based; OWFF: One-way free-floating; P2P: Peer-to-peer

* Exchange rate (01st of September of 2020): 1.1987 USD = 1 EUR = 7.4434 DKK = 4.0183 ILS(₪).

The tasks were designed on Ngene (Choice Metrics 2010): an orthogonal design with 108 scenarios grouped in 36 blocks of 3 tasks. As shown in Figure 2, each task presented four different car-sharing alternative plans: (i) Round-trip or RT, (ii) One-way Station-based or OWST, (iii) One-way Free-floating or OWFF, (iv) Peer-to-peer or P2P, and an opt-out alternative. The same design was presented in the three cities, except for the cost levels, which were defined according to local currencies and current prices. The car-sharing services were described the same way for respondents in all cities to assure comparability of preferences across cities. In addition, the order of appearance of the attributes was random for each individual (but the same across the tasks of the same individual) to minimize response bias.

Below are presented several car sharing products with different service characteristics. Which one of these would you choose to **subscribe**? Consider that you are inside the coverage area of all services and that there are no fees other than the ones presented.

	One-way car sharing (free-floating)	**Roundtrip car sharing**	**One-way car sharing (station-based)**	**Peer-to-peer car sharing**	
One-time subscription cost	Free	200 kr.	200 kr.	Free	
Probability to get a shared vehicle	10 out of 10 requests	9 out of 10 trip requests	10 out of 10 requests	9 out of 10 trip requests	
Extra features	Family/friends account with discounted rates	Collect credits to redeem for goods (e.g.: clothing and grocery discounts)	Guaranteed child car seat availability	Plan including other modes for a seamless door to door trip	
Walking time from parking location to destination	6 to 10 min	up to 5 min	6 to 10 min	up to 5 min	**None of the alternatives**
Car sharing vehicle engine type	Electric	Electric	Electric	Electric	
Usage cost	850kr./day	500kr./day	300kr./day	800kr./day	
Car sharing vehicle types	Small, sedan and SUV cars	Small, sedan and SUV cars	One model of small city cars	Small, sedan and SUV cars	
Walking time to access the vehicle	up to 5 min	up to 5 min	6 to 10 min	up to 5 min	
	○	○	○	○	○

Figure 2 Example of choice task presented to respondents

3.3 Data collection

The data was collected from mid-July to the end of August 2020, simultaneously in Copenhagen, Munich, and Tel Aviv. An additional data collection was performed in Munich from 11th to 29th of September 2020, as we had the opportunity to increase the sample size there. At the time of the data collection, none of the cities was facing lockdown due to the COVID-19 pandemic. For each city, a minimum sample size of 200 individuals was defined. The general eligibility criteria were being 18 years or older and having a driver's license, except for Tel Aviv, where the minimum age for using car-sharing services at the time of the survey was 21 years. The sampling strategy focused on having a balanced sample in each city regarding gender, age (young vs. old), and car-sharing membership status of those living either in areas already covered by car-sharing services or in adjacent areas where car-sharing operators were considering expanding. While Copenhagen's and Munich's respondents were recruited through panels, in Tel Aviv, respondents were contacted by the Tel Aviv-Yafo municipality and local car-sharing companies through different mailing lists. The completion rate in Copenhagen was 80%, while in Munich, it was 77%, and in Tel Aviv, it was 39%. The relatively low completion rate in Tel Aviv is believed to be associated with the different recruitment and, consequently, willingness to answer the survey.

3.4 Sample characteristics

After removing respondents that provided inconsistent answers and those who answered the survey in fewer minutes than the 40% median, we ended up with a sample of 1276 valid respondents: 542 from Copenhagen, 490 from Munich, and 244 from Tel Aviv. Inconsistent respondents were those who stated being aware of car-sharing services in one question but later answered that their lack of awareness about car-sharing was the reason why they do not use the service. Those who answered in less than 40% median time were removed because their short response times suggest a lack of attention and low data quality (Greszki, Meyer, and Schoen 2015). Table 3 presents the sample's characteristics grouped by city.

As a possible consequence of targeting a sample balanced by car-membership status (i.e., partially trying to target car-sharing members), Munich's and Tel-Aviv's samples ended up with more men than women. Similarly, Munich and Tel Aviv samples also have more adults between 31 and 50 years old, and respondents from all cities have a high level of education. It is worth mentioning that, in Munich, official statistics show high levels of education, suggesting that the distortion in the distribution of the education level in Munich's sample is limited.

In all three cities, most of the respondents live in the main city. Still, Munich's sample has almost no respondents living in other cities due to the lack of plans to expand the service there and, thus, the low interest in targeting and studying the preferences of those living there. Additionally, most households have 1 or 2 residents and up to one car available, and almost half of Tel Aviv's sample respondents are from car-free households. Finally, most respondents in all cities earn around the average or above. Still, Munich's sample has fewer respondents in the lower category, which is likely related to respondents' overall high level of education.

Given the limitations discussed, our results should be interpreted with caution. Although they can reveal trends of preferences for specific car-sharing service attributes and incentives in each city and, thus, help in their design, they cannot be generalized to the entire population of the cities. Our results for Munich mainly reflect the preferences of those living in the city and cannot be generalized to its metropolitan region; in Copenhagen, they primarily indicate the preferences of younger and older non-car-sharing members, and in Tel Aviv, they mainly reflect the preferences of car-sharing members.

Table 3 Sample characteristics

	Copenhagen (n=542)		**Munich (n=490)**		**Tel Aviv (n=244)**	
	Total	**%**	**Total**	**%**	**Total**	**%**
Gender						
Man	266	49.08	284	57.96	134	54.92

Woman	275	50.74	203	41.43	108	44.26
Prefer not to answer	1	0.18	3	0.61	2	0.82
Age						
18-30	145	26.75	58	11.84	36	14.75
31-40	88	16.24	158	32.24	88	36.07
41-50	97	17.89	147	30.00	63	25.82
51-60	88	16.24	71	14.49	36	14.75
More than 60	124	22.88	56	11.43	21	8.61
Place of residence						
City center	235	43.36	303	61.84	117	47.95
Suburbs	189	34.87	185	37.75	84	34.42
Another city in the metropolitan region	71	13.10	2	0.41	16	6.56
Outside the metropolitan region	47	8.67	0	0.00	27	11.07
Level of education						
Less Than High School	39	7.20	22	4.49	2	0.82
High school diploma or equivalent	150	27.67	96	19.59	12	4.92
Bachelor’s degree	169	31.18	52	10.61	97	39.75
Master’s degree	134	24.72	181	36.94	77	31.56

Doctoral degree	8	1.48	57	11.63	12	4.92
Other	17	3.14	56	11.43	10	4.10
Did not answer	25	4.61	26	5.31	34	13.93
Number of cars in the household						
0 car	139	25.65	162	33.06	112	45.90
1 car	303	55.90	244	49.80	86	35.25
2 cars	91	16.79	71	14.49	37	15.16
>2 cars	9	1.66	13	2.65	9	3.69
Car-sharing membership status						
Car-sharing member	95	17.53	225	45.92	156	63.93
Past car-sharing member	64	11.81	32	6.53	20	8.20
Non-car-sharing member	383	70.66	233	47.55	68	27.87
*Income (before taxes and other deductions)**						
Low	82	15.13	32	6.53	56	22.95
Medium	140	25.83	219	44.69	46	18.85
High	221	40.77	146	29.80	96	39.35
Did not answer	99	18.27	93	18.98	46	18.85

* Exchange rate (01st of September of 2020): 1.1987 USD = 1 EUR = 7.4434 DKK = 4.0183 ILS. Low income: Copenhagen = Up to 250.000 kr./year; Munich = Up to €29,999/year; Tel Aviv= Below 11,000 ₪/month; Medium income: Copenhagen = 251-500.000 kr./year; Munich = €30,000 - €94,999/year; Tel Aviv= About 11,000 ₪/month; High income: Copenhagen = Over 500.000 kr./year; Munich = €95,000 or more/year; Tel Aviv= Above 11,000 ₪/month.

3.5 Model specification

To examine individuals' preferences for car-sharing plans and incentives, we have estimated a joint mixed logit model with data from the three cities, accounting for correlation among choices of the same individual over the SP experiment (panel effect)(Train 2003). As the variance of the error term (unobserved factors) vary among the three datasets (different cities)(Train 2003), we have set the overall scale of utility by normalizing Copenhagen and included scale parameters (Θ^c) to allow for estimating the variances of Munich and Tel Aviv relative to Copenhagen. By accounting for scale differences, we can compare the parameters from different datasets (Swait and Louviere 1993). The utility specification is defined in Equations 1 and 2:

$$U_{int}^{c} = \Theta^{c}(ASC_{i}^{c} + \beta_{ix}^{c} X_{int} + \beta_{Z}^{c} Z_{n} + \alpha_{in}^{c} + \sigma_{CSplans}^{c} + \varepsilon_{int}^{c}) \quad (1)$$

$$U_{0nt}^{c} = \Theta^{c}(\varepsilon_{0nt}^{c}) \quad (2)$$

where U_{int}^{c} is the utility that each individual *n* from city *c* associate to alternative *i* in the choice situation *t* and ASC_{i}^{c} is the alternative specific constant, which captures the average effect on the utility of all factors not included in the model. β_{ix}^{c} and β_{Z}^{c} are the vectors of the coefficients associated with the impact of the service-related attributes and incentives included in the choice experiment (X_{int}) and the socioeconomic variables (Z_n) on the utility. Respectively, α_{in}^{c} are error components normally distributed across individuals, which capture the correlation among choices for the same individual (panel effect), $\sigma_{CSplans}^{c}$ is an independently normally distributed error component with zero mean that captures the magnitude of the correlation between the alternative car-sharing plans in each city and $\varepsilon_{int}^{c}$is the i.i.d. extreme value error component. To perform the joint estimation of the models from each city, we defined fifteen alternatives (five for each city, namely: Roundtrip, One-way Station-based, One-way Free-floating, Peer-to-peer, and None of the alternatives), and each observation was associated with five of these alternatives, according to their respective city.

All socioeconomic variables tested were dummy variables, except for "age", which entered the model as a continuous variable, and "number of cars", which entered with the following levels: "0", "1 car", "2 or more cars". We tested alternative specific car-sharing membership variables to see whether being a member of the specific car-sharing service would impact the choice for that and alternative specific car access at home variables to examine whether those who have access to a car perceived the alternatives differently. We also tested interacting the variables related to incentives with the car-sharing membership variable to assess whether there was a difference in the preferences of members and non-members regarding the incentives proposed.

As for the variables related to service features and incentives, all the attributes and levels included in the model are presented in table 2. All the variables related to service features were included as continuous variables, except for the variables car-sharing vehicle types and car-sharing vehicle engine type, which were included as dummy variables representing the different possibilities presented. The reference level for the service features variables was "one model of small city cars", while a mix of combustion and electric engine cars was the base level relative to car-sharing vehicle engine type. As the category small, sedan, and SUV car includes the category only small and sedan cars, we have tested interactions between them to try to isolate the effects of providing sedans in addition to small cars (reference) and the effects of providing SUV cars in addition to small and sedan cars. However, these interactions were not able to isolate the impacts of the addition of each type of car (no significant coefficients) and, thus, were removed from the final model (the original variables without interactions were kept). The variables related to incentives entered the model as dummy variables (reference level: Business account with discounted rates). The interaction between the incentive Guaranteed child car seat availability and the dummy variable "at least one kid less than 12 years old" in the household was tested.

4. Results

To estimate the model, we tested the coefficients across the three cities for significant differences using the likelihood ratio test and t-test. When a model with restricted coefficients could not be rejected (in comparison with its unrestricted version), and the coefficients were not significantly different across cities at a 5% level, the coefficients of the cities were constrained to be the same (generic). One-time cost subscription was included as a generic coefficient across the three cities as the common preference parameter required for joint estimation. The joint model was estimated using PandasBiogeme (Bierlaire 2020) and is presented in Table 4.

The final model includes all service attributes' and incentives' coefficients, but only the coefficients of the sociodemographic variables or their interactions that were found significant in at least one of the cities, namely age, children up to 12 years in the household, car-sharing membership, and income. The significant error components show that the model captures the correlation between each city's alternative plans, and the scales indicate that the variance of unobserved factors is lower in Munich than in Copenhagen and greater in Tel Aviv than in Copenhagen. Significant panel effects show that the model captures the inherent correlations among the choices of the same respondent (three choice tasks). The alternative specific constants reveal a slight preference for peer-to-peer car-sharing in Copenhagen, while for one-way free-floating car-sharing in Munich and for one-way car-sharing in Tel Aviv, everything else being equal. Peer-to-peer services were only offered in Copenhagen at the time of the survey, which may explain relatively lower preferences for it in Munich and Tel Aviv.

Table 4 Model results

	Copenhagen		Munich		Tel Aviv	
Variable	**Estimate**	**Rob. Std err**	**Estimate**	**Rob. Std err**	**Estimate**	**Rob. Std err**
ASC - OWFF	4.83***	1.02	6.43***	1.22	1.62**	0.644
ASC - OWST	4.8***	1.02	5.86***	1.21	1.62***	0.627
ASC - P2P	5.3***	1.01	4.95***	1.19	1.29**	0.609
ASC - RT	4.95***	1.02	5.31***	1.2	1.43**	0.601
$\alpha_{\text{panel effect}}$ - OWFF	1.03***	0.188	1.84***	0.419	-0.1850	0.206
$\alpha_{\text{panel effect}}$ - OWST	1.07***	0.208	1.1*	0.652	0.1480	0.251
$\alpha_{\text{panel effect}}$ - P2P	0.604**	0.26	1.69***	0.469	0.542***	0.19
$\alpha_{\text{panel effect}}$ - RT	0.65**	0.255	2.77***	0.548	0.912***	0.25
$\beta_{\text{One time subscription cost (100 €)}}$	-0.856***	0.0996	-0.856***	0.0996	-0.856***	0.0996
$\beta_{\text{Usage cost (0.1€)}}$	-0.111***	0.0255	-0.647***	0.105	-0.111***	0.0255
$\beta_{\text{Usage cost per day (dummy)}}$	-0.997***	0.146	-0.997***	0.146	-0.383***	0.103
$\beta_{\text{Usage cost per hour (dummy)}}$	-0.462***	0.146	-0.244***	0.0814	-0.244***	0.0814
$\beta_{\text{Only combustion cars}}$	-0.25***	0.0756	-1.07***	0.241	-0.25***	0.0756
$\beta_{\text{Only electric cars}}$	-0.002940	0.0972	-0.09890	0.192	-0.07240	0.0615
$\beta_{\text{Only small and sedan cars}}$	-0.02760	0.104	0.484**	0.21	0.07920	0.07

$\beta_{\text{Small, sedan and SUV cars}}$	0.1360	0.1	0.2010	0.203	0.121*	0.0733
$\beta_{\text{Probability of finding a shared car}}$	0.909**	0.372	1.95***	0.692	0.392*	0.225
$\beta_{\text{Walking time to access the vehicle}}$	-0.01080	0.0103	-0.0324***	0.0113	-0.0324***	0.0113
$\beta_{\text{Walking time from parking location to destination}}$	-0.0185***	0.00676	-0.0689***	0.0212	-0.0185***	0.00676
$\beta_{\text{Incentive: Booking in advance}}$	0.331**	0.13	0.659***	0.25	0.02380	0.0786
$\beta_{\text{Incentive: Guaranteed child car seat availability}}$	0.3570	0.269	1.04**	0.476	0.07230	0.136
$\beta_{\text{Incentive: Collect credits to redeem for goods (e.g., clothing and grocery discounts)}}$	0.1150	0.13	0.01820	0.256	-0.07610	0.0866
$\beta_{\text{Incentive: Family/friends account with discounted rates}}$	0.24*	0.133	0.768***	0.262	0.0260	0.0858
$\mu_{\text{Incentive: Plan including other modes for a seamless door to door trip}}$	0.234*	0.13	0.3620	0.25	0.01430	0.0927
$\sigma_{\text{Incentive: Plan including other modes for a seamless door-to-door trip}}$					0.403*	0.227

*** Significant at 1% level

** Significant at 5% level

* Significant at 10% level

Table 4 Model results (cont.)

	Copenhagen		Munich		Tel Aviv	

Variable	**Estimate**	**Rob. Std err**	**Estimate**	**Rob. Std err**	**Estimate**	**Rob. Std err**
β_{Age}	-0.996***	0.159	-0.996***	0.159	-0.1180	0.076
$\beta_{Car\text{-}sharing\ membership}$	1.23*	0.665	2.12***	0.758	0.853***	0.307
$\beta_{High\ income – household}$	-0.4020	0.642	-1.170	0.805	-0.586*	0.313
$\beta_{Low\ income – household}$	0.4770	0.827	0.8830	1.51	-0.785**	0.375
$\beta_{Missing\ income\ -\ household}$	-0.1460	0.782	-2.23**	0.96	-0.841**	0.383
$\beta_{Household\ with\ children\ up\ to\ 12\ years}$	1.64***	0.542	1.64***	0.542	-0.1960	0.197
$\sigma_{CSplans – error\ components}$	4.69***	0.43	5.51***	0.884	0.914***	0.274
Scale (Θ) [a]			0.565***	0.0788	2.32**	0.607
Number of observations			3737			
Number of individuals			1276			
Number of draws			5000			
Number of estimated parameters			86			
Log-likelihood			-4870.409			
Null log-likelihood			-6014.469			
Rho-square			0.190			
Adjusted rho-square			0.176			

*** Significant at 1% level

** Significant at 5% level

* Significant at 10% level

[a] T-test against 1

4.1 Impact of car-sharing service features on subscription

All cost variables were converted to Euro (the exchange rate used can be found in Table 3's footnote). We tested whether there were differences in choices because prices were presented in different units across alternatives and tasks (i.e., pricing per minute, per hour, or per day). All the cost coefficients were significant and negative, indicating that it negatively affects the likelihood of subscribing to a car-sharing plan, which is consistent with the behavioral theory. Results indicate that the payment per minute (reference level) is preferred in all cities, followed by hourly, and thereafter daily rates. In all cities, more than 30% of members and past members of car-sharing services reported using a shared car for up to 30 min, around 50% of them used it for up to 1h, and less than 9% used it for more than 24h, which may have affected these preferences.

As for shared cars' fuel type preferences, the results indicate no significant difference in individuals' preference for a service with a fleet composed of a "mix of combustion and electric engine cars" (reference level) and a fleet composed only "of electric vehicles". However, individuals are less likely to subscribe to services offering only "combustion cars", especially in Munich, showing a strong environmental mindset.

Regarding car-sharing vehicle types, the results indicate that respondents from Munich prefer services with fleets composed of small and sedan cars rather than the reference level (one model of small city cars), while those from Tel Aviv prefer a more varied fleet, including small, sedan, and SUV shared cars. No significant effect of vehicle type was found for respondents from Copenhagen.

As expected, the probability of finding a shared car, which is connected to service availability, positively affects the likelihood of respondents from all cities subscribing to a car-sharing plan. Moreover, the results show that for Munich and Tel Aviv respondents, the higher the walking time to access the shared car, the lower the probability of subscribing to a car-sharing plan~~.~~ Respondents from Copenhagen, however, do not attach significant relevance to that. Furthermore, the attribute "walking time from the parking location to destination" was included as a proxy for parking conditions at the destination. As expected, it had a ~~significant~~ negative effect that was statistically significant in all cities, indicating that the further an individual anticipates having to walk after using a car-sharing service, the less likely they are to subscribe to it. Overall, our results suggest that Munich's respondents are the most sensitive to walking times, which may be due to the sample representing particularly the preferences of those living in Munich's city center or its suburbs.

4.2 Impact of car-sharing incentives on subscription

Regarding the incentives offered for car-sharing subscriptions, the reference level adopted was "business account with discounted rates," which concerns lower prices for business-related trips. We tested the interaction of the incentives' variables with the sociodemographic car-sharing membership variable to assess whether there was a difference in the preferences of members and non-members regarding the incentives proposed, but no significant difference was found. The incentive "booking in advance" is significantly preferred over the reference in Copenhagen and Munich, while in Tel Aviv, the preference for booking in advance is not significantly different from the reference. The incentive "guaranteed child car seat availability" was included in the model interacted with a dummy variable that took 1 if the respondent lives in a household with at least one kid less than 12 years old and 0 otherwise. This incentive positively affects car-sharing subscriptions only in Munich. As for the "Family/friends account with discounted rates" incentive, it was preferred (over the reference) only for those living in Munich and in Copenhagen, while the preference for the incentive related to "credits to redeem for goods" was not found to be significantly different from the reference none of the three cities analyzed. Finally, the incentive "plan including other modes for a seamless door-to-door trip" is preferred over the reference for respondents in Copenhagen, and most respondents from Tel Aviv, suggesting that integrating mobility services into a single mobility payment plan can increase car-sharing subscriptions in these cities.

4.3 Impact of sociodemographic characteristics on car-sharing subscription

Concerning the influence of sociodemographic characteristics, we have tested sociodemographic variables' interaction with alternative-specific constants and with some attributes (e.g., income and cost). The sociodemographic variables measured were: gender, education, occupation, age, car-sharing membership, number of children up to 6 and 12 years in the household, car access, car ownership, number of cars, income, and bike access.

Dummy variables for high- and low-income levels were tested (see levels in table 3) to examine whether individuals from different income groups would display diverse prospects of subscribing to CS services. ~~and t~~The results indicate that, in Tel Aviv, individuals with high and low household incomes have a lower probability of subscribing than those with medium incomes (reference level). Such effects of household i~~I~~ncome ~~effects~~ on car-sharing subscriptions were not found in Copenhagen or Munich. In some cities, other contextual variables may play a role in how individuals with different economic profiles perceive car-sharing services as, for example, residential locations, which may be highly correlated with income. As some respondents did not report their household income level, we have also included a variable related to those with missing income, which was interacted with the constants to adjust the alternative specific constant of those individuals that did not answer the question on income. However, although it came out significant in Munich and Tel Aviv, we are not able to draw further conclusions about respondents who chose to not report their income.

As expected, age negatively affects car-sharing subscriptions in Copenhagen and Munich. This finding is in line with (Prieto, Baltas, and Stan 2017), who argue that possible explanations are long-term private car use habits and/or generation effects. Interestingly, in Tel Aviv, age does not significantly affect car-sharing subscriptions. In Copenhagen and Munich, individuals living in households with children up to 12 years are more likely to subscribe to a car-sharing plan, which is in line with Priya Uteng et al. (2019).

Unsurprisingly, those already car-sharing members were more likely to choose one of the plans offered, as opposed to the opt-out alternative (not subscribing). This was expected because car-sharing membership indicates a predisposition and underlying preference for it. Finally, the variables gender, education, occupation, car access, car ownership, car leasing, number of cars, and bike access, were found to not significantly impact car-sharing subscriptions.

5 Discussion

As high costs negatively impact car-sharing subscriptions, offering different pricing packages and some discounts can attract more users. Offering discounts during off-peak hours, for example, can be a good alternative for operators since, at the same time that they are attracting users, they are incentivizing the use of shared cars when they are more likely to be idle and contributing to nudge users to travel outside peak-hours and thus, to reduce congestion (Millard-Bal et al. 2005). However, such discounts must not make the cost of using the service excessively low as it can lead to the cannibalization of traditional public transport.

Our results suggest that issues commonly associated with electric vehicle usage (e.g., battery level) are deemed less relevant when users perceive that the service consists of a sustainable mobility solution. Additionally, environmental concerns lead to services with combustion-only cars being negatively perceived by participants, remarkably in Munich. Thus, the popularity of services with combustion-only cars is limited in the studied cities, while all-electric fleet services are more likely to succeed. This finding is in line with Cartenì et al. (2016), whose results highlighted the greater potential of electric fleet car-sharing services to prosper compared to those services offering traditional cars. However, although exhibiting more sustainable mobility behavior, Caulfield and Kehoe (2021) found that only a few of the users have subscribed to car-sharing because they believe it is a more environmentally-friendly mobility alternative. Regardless, a greener configuration of the service, however, is more challenging for providers, since the vehicles take longer to be recharged (compared with traditional combustion cars) and vehicle availability will also depend on the quality of the charging infrastructure available in the city. To support and stimulate such schemes, public authorities can, for example, (i) invest in charging infrastructure, which also contributes to green transition more broadly (e.g., can make electric vehicles more attractive even for car owners); (ii) give tax incentives to private stakeholders that invest in charging infrastructure for electric vehicles in their parking garages/ spaces (e.g., shopping malls, airports, workplaces); (iii) reduce taxation for the acquisition of electric cars by registered car-sharing services or car-sharing associations, (iv) provide some dedicated parking spaces for electric cars close to charging infrastructure, especially if they are shared cars, since they are less likely to be parked for long hours, thus contributing to better use of spatial resources, and (v) marketing campaigns focusing on the positive environmental impacts of car-sharing, if possible, supported by data about the actual impacts it has had in the city. To reduce the burden of charging shared vehicles, car-sharing providers can implement policies for providing discounts to those users that place the shared car on charge after usage, so they take advantage of the idle parked time.

As for the importance given to vehicle type variety in Tel Aviv and Munich, this is likely to be a consequence of car-sharing intended usage for utilitarian purposes (e.g., for moving big goods), the existence of symbolic-affective motives related to car usage (e.g., excitement about trying different car models, the perceived status associated with car usage)(Haustein 2021) and/or desire for increased comfort. More flexibility is added to a car-sharing service when it offers different car types, which are suitable for several purposes and can fulfill different user needs. Marketing campaigns presenting alternative uses for different models of shared cars are likely to attract more subscribers. Note that, in Cantelmo et al. (2022), results highlighted the opposite trend for Tel Aviv. When asked about vehicle type variety, respondents mentioned that a fleet of small vehicles (Hyundai i10) was sufficient to satisfy all users' needs. The larger sample, however, clearly suggests that a high variety of vehicle types would make car-sharing more appealing in Tel Aviv.

The probability of finding a shared car also increases the chances of subscribing to such a service. Other than increasing the supply of shared cars, car-sharing operators can define hubs for picking up and delivering/parking the shared cars in coordination with public authorities, thus making it more likely that individuals will find a shared car in these zones. Such a solution is especially beneficial for car-sharing operators when a high-demand area is identified outside the main continuous coverage area of a car-sharing service, or when there is the possibility of providing good connectivity between big cities. However, in the case of areas where it is desirable to offer such services because the connectivity through public transport is low, public authorities may be interested in providing tax incentives for car-sharing operators (reduce operational costs) to serve such areas, which otherwise would be not interesting from a business point of view, at least initially.

In Munich and Tel Aviv, we found that the impact of walking time to access the shared car in subscribing to a car-sharing service is in line with de Luca and Di Pace (2015) study, whose results also pointed out that higher expected walking times for reaching a shared car decreases the probability of subscribing to a car-sharing plan. However, respondents from Copenhagen do not attach significant relevance to that, which may be associated with a relatively stronger active mode culture in Denmark (Haustein and Nielsen 2016). In cities where reduced walking times are considered important, strategic distribution of shared cars becomes imperative. For solving that, operators can increase their supply or invest in fleet rebalancing policies focusing on highly attractive areas, especially during times of high demand for shared cars should be put in place. An example of that is offering dynamic incentives to users for finishing trips inside undersupplied areas (e.g., parking the shared car in high-demand areas after using it).

Our results also highlight the importance of providing good parking conditions close to strategic city destinations, as high walking times from the parking location to destination affect car-sharing subscription likelihood negatively. Policies that target special concession of parking spaces for shared cars in areas with high demand for this service can contribute to decreasing walking times at the destination. Moreover, the provision of information about parking availability at the destination area beforehand can help users to plan their trip and make better-informed decisions about where to park, which can potentially help them to save some walking.

Among incentives to increase car-sharing subscriptions, the possibility of booking a shared car in advance is mainly desired in Copenhagen and Munich, suggesting that respondents from Tel Aviv may use car-sharing services more spontaneously and/or that the current car-sharing services already provide a satisfactory availability to shared cars. The same is true for providing family/friends accounts with discounted rates in Copenhagen and Munich, suggesting that their peers also use such shared services. As for guaranteeing child car seat availability, this incentive is most relevant only in Munich, indicating an intended usage for traveling with children. Lastly, offering plans that include other transport modes and allow for a seamless door-to-door trip is especially desirable in Copenhagen and Tel Aviv. Such an incentive is very interesting, and this integration should be supported by the relevant public authorities. It has the potential to improve car-sharing access and egress times, as other modes can be used for the first and last miles of car-sharing trips (e.g., electric scooters) and to increase public transport access (e.g., park-and-ride).

Table 5 summarizes the policy recommendations and actions discussed in this section. Although these policies can be implemented in any city, we highlight where, among our case studies, they are more likely to positively contribute to car-sharing subscriptions through asterisks (*). The more asterisks associated with a policy one city has, the more impact a policy or action should have there. The asterisks were derived from the coefficients in Table 4. For example, Copenhagen has already implemented strong policies to promote electric vehicles in the past five years. As a consequence, charging infrastructure is widely available. Therefore, new policies – such as the creation of mobility hubs – are perceived by the user as a more effective way to promote car-sharing when compared to the further implementation of charging stations.

Table 5 Summary of policies and actions recommendations according to stakeholder and city

Policies and actions	**Stakeholder**	**Copenhagen**	**Munich**	**Tel Aviv-Yafo**

Offer different pricing packages	CS operators	*	**	**
Discounts for traveling during off-peak hours	CS operators	*	**	**
Investments in charging infrastructure	Public authorities	*	***	*
Provision of dedicated parking spaces for electric shared cars close to charging infrastructure	Public authorities	*	***	*
Reduced taxation for the acquisition of electric cars by registered car-sharing services or car-sharing associations	Public authorities	*	***	*
Tax incentives to private stakeholders that invest in charging infrastructure.	Public authorities	*	***	*
Marketing campaigns focusing on the positive environmental impacts of car-sharing (supported by data)	Public authorities / CS operators	*	***	*
Discount for users who place the	CS operators	*	***	*

shared car on charge after usage				
Provide a diverse fleet that can fulfill different purposes	CS operators		*	*
Marketing campaigns presenting alternative uses for different models of shared cars	CS operators		*	*
Define hubs for picking up and delivering/ parking the shared cars in coordination with public authorities	CS operators	**	***	*
Providing tax incentives for car-sharing operators (reduce operational costs) to serve relatively low-demand areas poorly served by public transport	Public authorities	**	***	*
Offering dynamic incentives to users for finishing trips inside undersupplied areas for fleet rebalancing	CS operators		*	*
Concession of parking spaces for shared cars in	Public authorities	*	*	*

high-demand areas				
Foment the integration between car-sharing and other transport modes	Public authorities	*		*
Booking of a shared car in advance	CS operators	*	**	
Offer family/friends account with discounted rates	CS operators	*	**	
Guaranteed child car seat availability	CS operators		***	
Offer plans including other transport modes for integration of mobility resources	CS operators	*		*

6 Conclusions

We examined individuals' preferences towards different features and incentives associated with car-sharing services in Copenhagen, Munich, and Tel Aviv. Overall, our results improve the understanding of how these can help maintain and attract members to the system and highlight that different contexts demand diverse solutions. The achieved insights pave the road for the actual design of business models and incentives to be offered by existing and future car-sharing services in the studied or similar cities. Our findings also indicate the market segments with a higher likelihood of joining car-sharing services in each city, which local car-sharing operators can explore.

The model reveals that the local context indeed affects individuals' perceptions and preferences. Although some car-sharing intrinsic features are likely to be relevant everywhere (e.g., pricing, parking conditions), the local context affects the preferences of others. In general, offering reasonable pricing, good availability of shared cars (increased probability of finding a shared car), and good parking conditions are essential for both members and potential members when deciding whether to subscribe to a car-sharing service. Relevant authorities can help car-sharing operators to contribute to lowering car ownership levels in cities by employing parking management strategies such as converting parking spaces into reserved car-sharing spaces (Haustein 2021). As for pricing packages that could also contribute to congestion management in cities, car-sharing operators could explore offering off-peak discounts for the usage of shared cars (Millard-Bal et al. 2005).

In Munich, the results indicate that car-sharing fleet composition in terms of vehicle and fuel types is highly relevant. Marketing campaigns focusing on the positive environmental impacts of car-sharing are expected to be highly appealing, especially if supported by data about the actual impacts it has in Munich. Additionally, as age negatively impacts individuals' likelihood of subscribing to car-sharing services in Munich, promotion strategies targeting young individuals are more prone to succeed. Moreover, the high accessibility of shared cars (low walking times) is highly appreciated in Munich, revealing that the municipality can help by strategically coordinating reserved parking spaces and charging infrastructure. However, as Munich's sample mainly comprises respondents living in the city, their preference for shorter walking times may be a consequence of particularly high public transport accessibility. Anyway, the definition of hubs for picking up and delivering/parking shared cars is another measure that can increase the likelihood of individuals finding shared cars in high-demand areas. Regarding incentives, local operators should explore providing: booking in advance, guaranteed child car seats available, and family/friends accounts with discounts. These incentives highlight the need for more convenience and anticipation of users' needs while using the service.

In Copenhagen's market, car-sharing services that do not have electric cars in their fleet are less likely to thrive, and offering different car models is less relevant. It is worth mentioning that an all-electric car-sharing company has operated in the Greater Copenhagen Area (GCA) since 2016 (GreenMobility 2022). Furthermore, a high probability of finding a car (availability) is imperative in this market, which may be connected to their preference for booking a shared car in advance (incentive) and a more substantial need for service reliability. However, these preferences may also result from inexperience with car-sharing services (as most respondents are not car-sharing members) and, thus, higher uncertainty about expected service reliability. By defining hubs outside the continuous coverage area of car-sharing services, operators can help in fulfilling the users' needs for higher probabilities to find a shared car in strategic areas and public authorities can plug this solution together with tax incentives to offer this service where public transport is not well-served. Moreover, offering plans including other modes is appreciated and would provide more opportunities for multimodal trips. Marketing campaigns targeting young individuals with children are likely to be successful since both being young and having children increase the likelihood of car-sharing subscriptions in this marketplace.

In Tel Aviv, providing a varied fleet of shared cars such as small, sedan, and SUV cars is highly appreciated when deciding on subscribing to a car-sharing service. Their marked preference for bigger cars can be related to the anticipated need for a shared car (e.g., moving big goods), symbolic-affective motives (e.g., trying luxury models), and/or different perceptions regarding comfort. Marketing campaigns presenting alternative uses of different models of shared cars and targeting mid-income individuals are likely to attract more subscribers. The possibility of having a plan including other modes for a seamless door-to-door trip is the only incentive that came out as relevant to most respondents in Tel Aviv, highlighting the potential of car-sharing as a complementary mobility service there. The results reveal the need to explore different pricing schemes as pricing may be a barrier for low-income individuals there. Offering dynamic incentives to users for fleet rebalancing is likely to positively contribute to car-sharing subscriptions and ridership.

This paper has limitations, as our samples do not allow for the generalization of our results. Munich's sample is mainly composed of respondents living in the city, and their marked preference for shorter walking times may result from relatively better public transport accessibility there (compared to metropolitan areas). Moreover, Tel Aviv and Copenhagen samples are not balanced regarding car-sharing membership status, where the former reflects car-sharing members' preferences and the latter reflects the preferences of younger and older non-members of car-sharing. Additionally, as most respondents from all cities are highly educated, they are likely to display higher acceptance of car-sharing plans than other population segments. Further research is needed to check the stability of preferences across different areas and groups. Finally, we collected data in three cities, enriching our understanding of contextual differences; however, replicating the study in other cities (and continents) would expand our perspective on the differences and similarities of car-sharing markets worldwide.

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Highlights:

- Individuals' preferences for different car-sharing plans and incentives are examined

- Data comes from a Stated Preference experiment conducted in Copenhagen, Munich, and Tel Aviv-Yafo

- Findings reveal that the local context affects individuals' preferences for plans and incentives
- Policies and actions to increase car-sharing subscriptions are recommended for each context

Car-Sharing Subscription Preferences and the Role of Incentives: The Case of Copenhagen, Munich, and Tel Aviv-Yafo

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Acknowledgments

This work was supported by the EIT Urban Mobility through the research project Shared Mobility Rewards (ID: 20045). We would like to thank Epinion, Car2Go, AutoTel, and the municipalities of Munich, Tel Aviv, and Copenhagen for the help with the data collection.